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

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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.

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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
Bernhard Url, EFSA, 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 on 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 for 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
Eugenio Doglioni, Istituto Superiore di Sanità, Department of Environment and Health, Italy

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” technologies such as whole genome sequencing, epigenetic profiling, transcriptomics, proteomics and metabolomics have provided a snapshot of 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 cyanobacteria 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 environment 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 (PNEC). 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 PNEC 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

In order to develop a more complete understanding of spray drift to improve the regulatory basis for representation in risk assessments, a series 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 enhanced 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. Background to 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 further research efforts. Modelling Options for developing an expanded role for modelling of drift profiles have focussed upon evaluation 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. Bärnthaler, BASF SE; Z. Gunso, Bayer AG Crop Science Division; M. Lamshoef, Bayer CropScience AG / R&D; M. Reitz, H. Resseler, 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 organisations within 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. Afterwards, 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: TSCF values calculated from the uptake parameter using 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 EurePGUF 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 Regulator 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 Genotechnology; J. Agert, Bayer CropScience AG / Environmental Safety; N. Baran, BRCM; A. Botta, BASF SE / Crop Protection; F. Ferrari, AEIFORIA; P. Volz, BASF SE / Crop Protection; L. Hammond, Health and Safety Executive / Environmental Fate; F. Hegler, Dr. Knoell Consult; W. Koenig, UBA Umweltbundesamt; J. Kreuger, Swedish University of Agricultural Science / Centre for Chemical Pesticides; T. Van der Linden, RIVM / ENVIRONMENTAL QUALITY; D. Liss, SGS Institut Fresenius GmbH / Agro, L. Lotseau, Syngenta; A. Massey, Health and Safety Executive; B. Miles, BASF SE / Crop Protection, Environmental Fate Modelling; L. Monozor, Société CEC; A. Newcombe, ARCADIS US Inc; L. Padovani, European Food Safety Authority (EFSA); A. Poot, Cgbl, G.L. Reeves, Dow AgroSciences Ltd; S. Reichenberger, DR. KNOELL CONSULT GmbH; A.E. Rosenbom, Geological Survey of Denmark and Greenland / Geochemical; H. Staudenmaier, BASF SE / Crop Protection, Environmental Fate; R. Sur, Bayer AG - Crop Science Division / Environmental Safety; A. Schwen, AGES; M. Stemmer, Austrian Agency for Health and Food Safety / Institute for Plant Protection Products; W. Tütting, German Federal Office of Consumer Protection and Food Safety; U. Ulrich, University of Kiel

Groundwater monitoring is considered a higher tier assessment in the regulatory groundwater assessment of crop protection products in Europe, but little guidance is currently available to data in study designs. The SETAC EMAG-Pest GW group (a mixture of regulatory, academic, and industry scientists) in 2015 began developing the scientific basis for guidance for use by regulators and industry scientists. Rigid study designs are not appropriate since the study design needs to be tailored to the specific study objectives and should consider environmental conditions, the properties affecting environmental behaviour of the substance being studied, and site and use conditions. To illustrate how study design can vary, the group has proposed general study designs for seven hypothetical exposure assessment options, ranging from protecting all zones of saturation below the soil surface to only groundwater used to supply drinking water. Designs include recommendations on in-field and edge of field studies, as well as studies focused on catchments and aquifer. Examples of parameters and recommendations on the use of publicly available monitoring data have also been included. Also general recommendations on well installation and sampling procedures have been provided. Methodology has also been developed for assessing the relative vulnerability of agricultural regions and the vulnerability of specific sites for use in study design and site selection. The work of SETAC EMAG-Pest GW is still in progress but the goal is to finish by mid-2018.

4 Effect of the Freundlich exponent on the finite penetration depth in a homogeneous Freundlich-SFO leaching system
J. Boesten, Wageningen Environmental Research

Although the regulatory groundwater assessment since 2000 (PELMO, PEARL, PRZM and MACRO) are based on a Freundlich isotherm combined with a single 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 submolecular 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 homogeneous 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 will every pass. Simulations of an exponential pulse of mass N for a few 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 only occurs 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.
5 Bespoke monitoring to support Tier 4 FOCUS groundwater assessment
S.L. McManns, Syngenta; S. Payvandi, Syngenta Ltd; P. Sweeney, Syngenta; L. Fish, Syngenta Crop Protection, LLC / Environmental Safety; R.J. Andrews, D. Schofield, Ramboll Environ; J. White, ARCADIS UK; N. Jones, Syngenta Ltd; G. Langridge, CEM Analytical Services Limited; T. Oteyza, Syngenta Crop Protection AG; M. Greener, Syngenta Ltd

Data generated from this bespoke groundwater monitoring programme will offer a solution to address the non-relevance case of pinoxaden metabolites from an exposure side. Median modelled mass flux was determined using GeoPEARL 3.3.3 simulations over 20 years which represent vulnerability to leaching across the EU27 under standard conditions. These data were aggregated to a 10km² level and combined with a shallow groundwater dataset and a cereal land use dataset based on wheat in CAPRI. Those grid cells in the upper 50th percentile for each spatial layer (mass flux, shallow groundwater, and wheat) were considered for the site selection process. Sites identified by modelling were assessed during site walkover surveys. To justify inclusion in the programme, sites had to have a history of pinoxaden use, groundwater less than 10m bgl, no confining layers, and no influential features which may act as preferential flow pathways. In 2015, 70 sites were installed across France, Germany, Italy, Lithuania and the United Kingdom. Each site consisted of three shallow wells installed around the field perimeter. The 70 sites represent all EU FOCUS groundwater scenarios except Jokioinen. The sites have all had a minimum of two pinoxaden applications before 2016 with groundwater levels an average of 2.9m below ground level. Sampling began in 2015 from 84 down hydraulic gradient wells. Of the 871 samples collected between June 2015 and July 2017 from these 70 vulnerable sites, the average for each site never exceeded 0.1µg/L. Only minor residues of metabolites have been detected since sampling began. Monitoring is to continue until Q1 2019 to ensure a thorough assessment of groundwater vulnerability is made. The modelling approach should allow extrapolation of the modelled vulnerability to be extended to member states outside of those where the wells were installed.

6 Long-Term Trend of Aquatic Pesticide Risk
A. Paulus, UFZ - Helmholtz Centre for Environmental Research / System-Ectotoxicology; S. Kullmann, K. Foit, Helmholtz Centre for Environmental Research UFZ / System-Ectotoxicology; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; M. Liess, UFZ Centre for Environmental Research / System-Ectotoxicology

European Union member states aim at reducing ecological risks exerted by pesticides. For this, reliable trend indicators of pesticide exposure and risk are inevitable. Based on this demand we designed a long-term trend indicator of aquatic pesticide risk for Germany. It uses pesticide sales statistics, toxicity data and chemical properties as input variables. The trend indicator was designed by combining the most reliable exposure and effect models. (i) We selected the most promising exposure model by evaluating several established exposure models. For this we tested their performance with peak concentration data monitored in small agricultural streams in central Germany. These field data comprised of event-driven samples of 46 active substances from field-campaigns performed in 1998, 1999, 2000, and 2013. The highest agreement of measured and modeled peak concentration was yielded by the risk indicator EXPONIT/TEVA (R²: 0.38), followed by the more complex models FOCUS STEP 2 (R²: 0.36), SYNOPS-TREND (R²: 0.24), and GERDA (R²: 0.24). (ii) The translation from toxic potency to pesticide risk was implemented by applying the field based and validated exposure – response relationship SPEAR_fugacity. Based on these information and models, we calculated the trend of toxic potency and pesticide risk in Germany from 1996 to 2016 for the 500 substances authorized in this period. The method presented here requires only few input data, is based on validated models and can be adapted to regional conditions around the world.

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

7 The hydrophobicity delay: symptoms and solutions
A. Celsie, Queens University; D. Mackay, Trent University / Chemistry; D. Powell, DMER Ltd.; J. Parnis, Trent University / Cemetry

The objective of this presentation is to set out the conditions under which chemicals of high hydrophobicity experience significant delays in approaching equilibrium conditions. We suggest that this delay may be misinterpreted as being caused by a change in partitioning behaviour or mechanism resulting in development of non-linear regression models describing inter-media partitioning. In reality, the partitioning is fundamentally linear but is distorted by a kinetic delay. The rate constant format commonly applied to fish bioaccumulation from water of concentration C ultimately describes time delays in approaching equilibrium C = k possibility. The characteristic time for uptake and loss is t = L/kBCF. Slower uptake and loss will occur if the partition ratio KBCF is large, and the fish must contact KBCF-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 bioaetate model for fish. Due to the very high hydrophobicity (log KBCF=10³ for D5) and very low water solubilities C0 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=2 mol/m³ 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/aerial partitioning data in which the onset of a hydrophobic delay (HD) is apparent when log KBCF⩾7 [4] develops a model for the 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 KBCF=10⁵. 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?
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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 complicate their aquatic toxicity testing. In this work, we validate the use of passive dosing for the study of the partitioning behavior of CP technical mixtures between silicone, water and organic carbon. We used 5 different technical mixtures from the three 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 (KOC_water). Immobilization of D. magna was observed after 48 hours under different exposure concentrations. APC1-QTOM-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 MCCP, had a similar silicone-water partitioning coefficient as a restricted SCCP – Huelz 70C. We demonstrate that increasing average chlorine content of each CP mixture significantly increases the Log KOC_water and Log KOC_water. These results could have implications on the study of environmental fate of CPs: in-use CPs (MCCPs and LCCPs) might be equally or more bioaccumulative as restricted SCCCPs. KOC_water is particularly helpful at predicting bioaccumulation of chemicals into biota. The next step is to quantify the bioaccumulation potential of CPs. With the use of the passive dosing approach, we are producing laboratory experimental data that can be used to help in the on-going regulatory discussion on MCCPs and aid their risk assessment.

9 Trophic magnification of cyclic volatile siloxane materials (D4, D5, and D6) in a freshwater lake: A Monte-Carlo analysis

The trophic transfer of cyclic methylsiloxane (cVMS) materials in aquatic ecosystems is an important criterion for assessing bioaccumulation and ecological risk. These compounds are frequently found in the environment and include 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, 2,2′,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/carbon 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 highest trophic levels. TMFs measured for the three cVMS materials were all 99.5% 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 that the values exceeded 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, School of Environment, Civil, and Resources Engineering; A. 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 ecosystem. 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-, 1,3,6,8-tetrabromo-, 1-bromo-3,6-dichloro-, and 1,8-dibromo-3,6-dichlorocarbazole were screened. Halogenated carbazoles were detected in 98.7% of the sediment samples, with concentrations ranging from below method limits of quantification to 51.5 ng/g dry weight. In most of these sediment samples, PHCZ concentrations exceeded those of polybrominated flame retardants (PBDEs). The latter group of chemicals has been demonstrated 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/g 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) to 2,3,7,8-TCDD and their use in the CoEF scheme for biomagnification. The modern approach of our studies is an application of our previous research and supports the hypothesis that PHCZs can be transferred along food webs and can bioaccumulate in different biotopes. The results suggest that PHCZs are a potential threat to marine and freshwater ecosystems and warrant further investigation.

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

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Essential oils are fragrance materials that are registered as natural complex substances (NCS) under the European REACH legislation. One of the functions of information required in a REACH registration is information about the potential for bioaccumulation of NCS by fish. Determining the bioconcentration factor (BCF) of essential oils in fish can provide details on the potential for uptake and distribution of these compounds. The present study aimed to determine the BCFs of essential oils in fish and to assess the potential for bioaccumulation of these compounds in aquatic environments.

12 ROLE OF ADIPOSE TISSUE RESPONSIBLE FOR ECHOLOCATION IN THE BIOACCUMULATION PROCESS OF LIPOLYSIS COMPONDS IN HARBOUR PORPOISES

S. Schnurr, Utrecht University; L. Gross, The University of Queensland / School of Environment and Engineering; M. Wolter, University of Antwerp; U. Nilsson, Toxicological Center / Toxicological Centre Dep of Pharmaceutical Sciences; T. Bouweroux, OCEAMM; F. Demaret, University of La Rochelle / Observatoire Pélagis; R. Blust, University of Antwerp / Department of Biology (SPHERE Research Group); M. van den Berg, Utrecht University / Institute for Risk Assessment Sciences; L. Weis, 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 melon and mandibular fat are inert lipid bodies in odontocotes 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, melon and mandibular fat, and 2) Physiologically based toxico-kineti (PBTK) modelling of PCB 153 and PBDE 153 to compare bioaccumulation of lipophilic compounds in lipophilic 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 melon with increasing age. Nevertheless, the model showed the highest levels of PCB 153 in mandibular fat, followed by melon 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 Beltrán, Leiden University; P. Henriëns, Stockholm University / Stockholm Resilience Centre; E. Groen, Aretò 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 ‘correlations: 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 process data for 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 process output 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’ h...
framework in the daily practice of LCA practitioners needs further work, including implementation in LCA software programs and particularly data.

14 Drivers of variability and uncertainty in the chemical footprint of personal care products

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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 (ChFs) 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 ChFs for personal care products and quantify the variability and uncertainty in the different parameters used to derive these individual ChFs. 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, and 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 ChFs. The ChFs derived by this approach spanned nearly 4 orders of magnitude (95% Confidence Interval (CI)). The wide span of the ChF’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 ecotoxicity values. These preliminary results question the use of absolute values when communicating product’s 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.

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

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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 values for the LCA model (or parametrical uncertainty) and its modelling choices (or epistemic uncertainty). Parametrical uncertainty can be systematically addressed with parametrical uncertainty analysis, while epistemic uncertainty can be addressed with scenario analysis. However, the communicability and usefulness of LCI regionalization can be hindered by the fact that these 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. Parametrical uncertainty analysis was necessary for carrying out discernibility analyses across background conditions, allowing obtaining useful insights on the changes in sensitive parameters induced by the change in background conditions. The discernibility analysis results allowed obtaining a clear quantification of the probability measure of each waste management option to provide a better environmental performance than another, for each of the assessed impact categories and investigated background conditions, and in a manner simply conveyable to the users and final receivers of the LCA.

Which impact categories are relevant for LCA results interpretation?

A. Esonou, Institut National de la Recherche Agronomique, Narbonne-France / UR Laboratoire de Biotechnologie de l'Environnement; E. Latrille, J. Steyer, INRA LBE; A. Hélia, Montpellier SupAgro / LBE ELSA

LCA is intrinsically a multi-criteria approach comparing (almost) all the potential environmental impacts of human activities. However, multi-criteria decisions pose challenges as a wide range of environmental impacts results may lead to unclear conclusions. Based on their relevance, a choice amongst the impact categories may be necessary. It can be carried out by examining how the information given in the Life Cycle Inventories (LCIs) is used by the impact categories. The Representativeness Index (RI) proposed by Esonou et al. was initially used to compare the adequacy of Life Cycle Impact Assessment (LCIA) methods regarding LCIs. Here, the RI is used to explore the impact categories belonging to a given LCIA method. Thus, the present study focuses on how the interpretation of the LCA results can be undertaken given the choice of relevant impact categories. With a geometrical standpoint, LCIs of the ecoinvent database and impact categories of the ILCD method are standardized and localized within the same R² vector space. This vector space is generated by all the dimensions (i.e. elementary flows) from which the LCIs of the database are derived. 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 elementary flows from an LCI based on how they are represented by the impact categories of an LCIA method. Two inventories referred variability. Life Cycle Inventories (LCIs) regionalization deals with increasing 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 variability 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 sectoral recommendations regarding the impact categories (IC) and LCA phases (LCI or LCIA) that should be regionalized in priority. Those recommendations can mean to help 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 continues 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.

18 Poster spotlight: M0387, M0388, M0389

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

19 Unravelling longitudinal pollution patterns in freshwaters by non-target screening and cluster analysis

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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; 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 Höltemence 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 Ultima 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 (WWT), B: EOCs specific for first WWT 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 EOCs (e.g., first WWT). 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 applied to study other longitudinal data such as temporal dynamics in pollution at hotspots and comparison of treatment and transformation processes.

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

P. Zeller, M. de Koning, University of Cadiz / 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 Chemical Engineering; J. Hollander, Eawag / Environmental Chemistry

The open ocean is 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 (WWT) 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 WWT 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, Spain), and surface water from one of the biggest local WWTPs in the area (Jerez de la Frontera, Spain), and surface water from 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, Spain), and surface water from one of the biggest local WWTPs in the area (Jerez de la Frontera, Spain), and surface water from 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, Spain), and surface water from 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, Spain), and surface water from 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, Spain), and surface water from 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, Spain), and surface water from 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 the possible TPs from treated wastewater input of the two wastewater treatment plants (WWT), B: EOCs specific for first WWT 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 EOCs (e.g., first WWT). 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 applied to study other longitudinal data such as temporal dynamics in pollution at hotspots and comparison of treatment and transformation processes.

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

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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, cyclamate and sacralose. 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 can be degraded when present in water; however, 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.

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

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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 transferases (GST) which are present in the human liver at high concentration. Due to biological and/or abiotic processes that the contaminants undergo from 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 until the compounds have been targeted and 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 the quantification of these compounds in wastewater and surface water. This work was possible due to support from EU-IP7 programme (Solutions project), Merck (LC columns) and Biotage (SPE cartridges).

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


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, sulfamethoxazole (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 considerable frame reactivity to CBZ-10,11-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 a 1 × 10−6 M buffer solution and gold-ionized by ESI-Q-TOF 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 ELISAgarm. Careful analysis of the fractions led to the identification of N4-acetyl-sulfamethoxazole, a SMX metabolite which is present in the samples. With estrone, interferences 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

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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 inorganic 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 states 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 tripled in the last decade. The water utility aims to prioritize their measured chemicals and develop a tailored risk-based monitoring program. We presented here is the first step of this risk-based monitoring program for all 13 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 vivo as well as in vitro 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. Welge, 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 amphibian life stages is used (regulatory) fish data will be presented. By combining existing concepts, including interspecies correlation estimation (ICE), allometric relations, lethal body burden (LBB) and bioconcentration modelling, an equation was derived that predicts the amphibian median lethal dermal dose (LD₅₀) from standard acute toxicity values (96-h LC₅₀) for fish and bioconcentration factors (BCF) in fish. Where possible, fish BCF values were correlated to a parent compound. Then, BCF values were adjusted to an exposure duration of 96 h, in case steady state took longer to be achieved. The derived correlation equation is based on 32 LD₅₀ values from acute 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.I. Adriaanse, Alterra Wageningen University and Research Centre; A. Albroch, Agroscope / Ecotoxicology; C. Berg, Upsala universitet, 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; F. Stresl, EPSA / 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. EPSA Journal 2017: 329 pp. doi:10.2903/jsf.e2017.0222 [ECF. 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 39/1]

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

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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 biological endocent potential biomarkers of pollution on C. caretta. 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 non-invasive way in Mediterranean Sea Rescue Center 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), 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 CYPIA, 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 ecotoxicological stress. This study contributed to expand 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
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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 to date investigating effects 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 muscle were positively related to δ15N, a tracer for HPLC lipophilic 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 and thyroid tumours were not observed. Their eggs are a useful tool to monitor the levels of genetic damage and pollutant exposure. 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
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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 2015. Likewise, potentials of 2,4-D and tebuconazole on embryonic development and post-hatching survival of a common farmland bird, the red-legged partridge (Alectoris rufa). The first experiment simulated egg overspray with pesticides and the second one the incubation of eggs upon 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 of 20 chicks 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 30 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 nesting 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 might affect reproductive output. Likewise, potentials of 2,4-D and tebuconazole between 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
C. 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 members 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). Each of these 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 around developing improved guidance for the assessment of risks from aquaculture and
medicines and the role of veterinary medicines in driving AMR in the environment and its potential consequences and mitigation. The session will feature successes, current issues and developments in improving the guidance on the assessment of veterinary medicines in the environment; and will reflect on the future challenges and difficulties faced by the regulators and industry alike. This paper will acknowledge the significant continuing contribution made by the Environmental Risk Assessment Working Party (ERA-WP) of the CVMP.

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. Cortís Ruiz, C. Rubío 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 and Plant Protection Products ( "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 a new approach and used for exposure assessments at field-, field- 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 17α-TB, 17β-TB, 17α-E2, 17β-E2.

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 (17β-TB), 17α-trenbolone (17α-TB), tendrone (TBO), 17β-E2, 17α-estradiol (17α-E2), and estrene (E1). The similarity in chemical structures and metabolism 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-, field- 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 17α-TB, 17β-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 US.

34 How can mesocosm studies increase realism in risk assessment of biocides and veterinary medicines? L. Dören, ERK / Product Stewardship; U. Hommen, Fraunhofer IME; P. Ebke, Revalor-GmbH Institut für Gewässerschutz; R. Dürring, 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 complex web systems 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 mesocosms from the Guidance R10 (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 a new approach and used for exposure assessments at field-, field- 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 17α-TB, 17β-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 US.

35 Innovative environmental assessment of a veterinary medicinal product: watershed-level impacts of trenbolone acetate and 17β-estradiol J.P. Staveley, Q. Ma, J. Ma, Exponent; C. Celly, Intervet Inc. 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 (17β-TB), 17α-trenbolone (17α-TB), tendrone (TBO), 17β-E2, 17α-estradiol (17α-E2), and estrene (E1). The similarity in chemical structures and metabolism 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-, field- 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 17α-TB, 17β-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 US.

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. Olsøn, 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 sources include households, e.g. garbage disposal sites. Sophisticated methods for the identification of biocidal active substances in 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 included an LC-MS/MS method were BIT, C12-benzalkonium chloride, carbendazim, CMI, DCOIT, DEET, diuron, icaridine, OT, piperoxyl butoxide (PBO), triclosan, tucbonazole, 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 CMI and DCOIT, PBO and tetramethrin, 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, DEET and icaridine were measured in all samples. The results show that...
that washing and cleaning agents are important sources for preservatives such as BHT 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 captan 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 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 Comparitive 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. Louche, University of Siegen; N. Clark, Department of Chemistry and Biology; R. Louch, University of Manchester; R. Zeumer, Fraunhofer IME / Department 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 produced 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 NPs 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 µg/L, 2.5 µg/L, 5.0 µg/L and 10.0 µg/L), to solvent control (NM100K DI), or to three concentrations of TiO₂-NPs (nominal: 2.5 µg/L, 50 µg/L, 100 µg/L) 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 treated groups, the body length of daphnia was significantly larger at 5 µg/L in generation F2 and at 2.5 µg/L in generation F3 compared to the control. In the wastewater-borne Ag-NP treatment the adults’ body length was significantly larger at 2.5 µg/L. Thus, adult’s body length showed no consistent pattern towards 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, agglomeration and sedimentation, the likely exposure route to higher trophic organisms (e.g., fish) is through the diet. However, the address the availability of an ex vivo gut sac technique to test 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 AgS NP. Following a 4 h exposure, tissues were cut open and the mucosa was separated from the underlying muscularis, 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 AgS 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, gallbladder, kidney, spleen, gallbladder, liver and muscles were dissected. Tissues from both experiments were analyzed 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 Ag₂S NP compared to AgNO₃, but no difference between ENM treatments. The in vivo experiment demonstrated significantly more Ag in the mid and hind intestine of Ag NP and Ag₂O₃-NPs compared to Ag₂S NPs. Silver 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 Ag₂S 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

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Manufactured nanomaterials (MNMs) are widely used in various applications and commercial products, e.g. textiles, sunscreens, paints, cosmetics. Even though MNMs are mostly removed during wastewater treatment, the remaining and mostly transformed MNMs in the effluents 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 303A. 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 [lipid peroxidation; activities of acetylcholinesterase (AChE), 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 TiO₂ or AgNPs in water, the animals showed a decreasing offspring production and increasing 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.
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 TiO2 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 temporal behavior. Some samples of activated sludge from the reactor 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 (RTgill-W1 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 microbial exposure experiments, giving information about 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)

R. Kenworthy, Norwegian Institute of Bioeconomy Research NIBIO / Dpt for Soil Quality and Physical Transformations of Engineered Silver Nanomaterials (AgENMs) are mediated, in part, by proteins and other biomolecules. The high affinity of thiolate ligands for silver, metalloproteins are key targets to evaluate the role of biomolecules in AgENM transformations. In turn, metalloprotein interactions with AgENMs are also central in mechanistic studies of cellular impacts of AgENMs, including toxicity, antimicrobial, and resistance mechanisms. Despite the shared preference of both silver and zinc for thiolate and amine coordination, the interactions of zinc finger domains with AgENMs is not well studied. Zinc fingers constitute a large class of metalloproteins, ubiquitous in eukaryotes, that use a combination of cysteine and histidine residues that bind Zn(II) as a structural element. Zinc finger domains within proteins typically serve as interactors and can binding DNA, RNA, proteins or small molecules to mediate cell signaling and transcription. The small and labile nature of metalloproteins (Ag-ENMs) has made it difficult to study their interactions in a cellular context. In this study, we investigated the interaction of Ag(I) with zinc finger domains, which may play a role in regulating cellular responses to Ag(I) exposure. The study used a combination of fluorescence spectroscopy, affinity chromatography, and mass spectrometry to investigate the binding of Ag(I) to a range of zinc finger domains. The results indicate that Ag(I) binding to zinc fingers is not only mediated by the metal-coordinating residues, but also by the secondary structure of the protein. These findings highlight the potential role of zinc fingers in regulating cellular responses to Ag(I) exposure and suggest that understanding the binding of metalloproteins to Ag(I) is crucial for developing strategies to mitigate the effects of Ag(I) exposure. Additionally, the study provides new insights into the role of zinc fingers in cellular responses to Ag(I) exposure, which may have implications for the development of strategies to mitigate the effects of Ag(I) exposure.

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Fate and effects of transformed Ag and TiO2 nanoparticles aged through a lab-scale wastewater treatment system

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The increase in production and use of Ag and TiO2 nanoparticles has led to their release in wastewater streams and subsequently in the environment. Nanoparticles (NPs) can undergo transformations in environmental media such as wastewaters leading to an alteration in behavior, bioavailability and toxicity that may differ from their pristine counterparts and make predictions challenging. In this context, the overall goal of the study was to elucidate (i) the behavior and transformation of Ag and TiO2 NPs in realistic matrices such as wastewater effluents and activated sludge and (ii) the subsequent effects of transformed particles in comparison to their pristine counterparts. In this study, a laboratory-scale wastewater treatment system was designed and tested to investigate the fate and effects of Ag and TiO2 NPs in aqueous media. 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 TiO2 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 temporal behavior. Some samples of activated sludge from the reactor 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 (RTgill-W1 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 microbial exposure experiments, giving information about 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.

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Transformation of silver nanomaterials by ubiquitous zinc finger peptides


In biological systems, chemical and physicochemical transformations of engineered silver nanoparticles (AgENMs) are mediated, in part, by proteins and other biomolecules. The high affinity of thiolate ligands for silver, metalloproteins are key targets to evaluate the role of biomolecules in AgENM transformations. In turn, metalloprotein interactions with AgENMs are also central in mechanistic studies of cellular impacts of AgENMs, including toxicity, antimicrobial, and resistance mechanisms. Despite the shared preference of both silver and zinc for thiolate and amine coordination, the interactions of zinc finger domains with AgENMs is not well studied. Zinc fingers constitute a large class of metalloproteins, ubiquitous in eukaryotes, that use a combination of cysteine and histidine residues that bind Zn(II) as a structural element. Zinc finger domains within proteins typically serve as interactors and can binding DNA, RNA, proteins or small molecules to mediate cell signaling and transcription. The small and labile nature of metalloproteins (Ag-ENMs) has made it difficult to study their interactions in a cellular context. In this study, we investigated the interaction of Ag(I) with zinc finger domains, which may play a role in regulating cellular responses to Ag(I) exposure. The study used a combination of fluorescence spectroscopy, affinity chromatography, and mass spectrometry to investigate the binding of Ag(I) to a range of zinc finger domains. The results indicate that Ag(I) binding to zinc fingers is not only mediated by the metal-coordinating residues, but also by the secondary structure of the protein. These findings highlight the potential role of zinc fingers in regulating cellular responses to Ag(I) exposure and suggest that understanding the binding of metalloproteins to Ag(I) is crucial for developing strategies to mitigate the effects of Ag(I) exposure. Additionally, the study provides new insights into the role of zinc fingers in cellular responses to Ag(I) exposure, which may have implications for the development of strategies to mitigate the effects of Ag(I) exposure.

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Adapting the SIMA Process to Assess Offshore Decommissioning Options

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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 management programs. This paper describes a spill impact mitigation assessment framework using recent examples of OSR 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, while ensuring a transparent review of engineering studies and available decommissioning datasets 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

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In the field of oil and gas production, there is a constant challenge in developing new techniques of oil detection for prospection (natural seeps) and environmental monitoring purposes. (Catalina oil fields, 2001-2003) The technology used to monitor changes in marine ecosystems due to oil contamination is based on visual checks or chemical analyses. These methods are costly and time consuming. A prospective alternative would be the use of remote sensing, especially hyperspectral spectroscopy, which has provided promising results for the detection of oil in vegetated areas. It is achieved by extracting information from the spectral signature of vegetation, which corresponds to its reflectance measured by a sensor over multiple, narrow and contiguous wavelengths. Vegetation reflectance is driven by leaf structure, pigments and water content, which can be affected by oil. As a result, the spectral signature of vegetation is modified so it is possible to detect and quantify oil exposure.

The final objective of this rapid and non-destructive approach is to be applied on airborne hyperspectral images at high spatial resolution (Rubus fruticosus L.) exposed for 32 days to 6 to 25 g.kg⁻¹ total petroleum hydrocarbons (TPH) from crude oil and mud pits under controlled conditions. Spectral signatures were measured at different scales (leaf, plant and canopy) with a portable spectroradiometer, using a leaf-clip or fixing the sensor above the plant. After 18 days, the signature of TPH-exposed plants was strongly modified. Compared to controls, their reflectance increased in all wavelengths at leaf scale, up to 0.15 greater. The low ground coverage of TPH-exposed plants induced an opposite response in the near- and short-wave infrared (750-2500 nm) at plant and canopy scales.

Vegetation indices (VI), computed by reflectance ratio at different wavelengths, were able to discriminate among treatments, and remained robust from leaf to canopy scale. Plant pigments, chlorophyll fluorescence and stomatal conductance were also affected by TPH. The following step was to study the spectral response of the species in situ, in an oil and gas brownfield with the same characteristics as the former test. Results indicated that the same VI were highly correlated to TPH (r > 0.7). Finally, VI allowed identifying the brownfield from an airborne hyperspectral image at high spatial resolution, and thus confirmed the potential of this technique for assessing environmental risks deriving from oil and gas production in vegetated areas.

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. Tramm, T. Bakke, Norwegian Institute for Water Research; P.V. Hodson, Queens University / School of Environmental Studies; T.K. Collier, Delta Independent Science Board North Sea Suite, sleeps for oil

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 concerning the effects of the DWHOS have been published each year since 2011. Key issues investigated include the behaviour and fate of oil in deep spills, the effects of dispersed, dissolved, microbial oil degradation, oil-associated marine snow formation, oil impacts on deep water corals, seafood quality and safety, oil contaminants effects on fish, birds and marine mammals, effects of combined stressors on species and habitats, and habitat and ecosystem recovery processes. To keep order in this flow of new knowledge is an important albeit challenging task. It is essential that the lessons of DWHOS are applied globally to the next big marine oil spill, wherever it may happen.

In this presentation, we demonstrate a convenient tool for keeping track of the large amount of ecotoxicological data and knowledge that typically emerges from research and monitoring after marine pollution disasters, using the DWHOS as a case study. In addition, we provide a summary of the new insights about oil spill effects on marine ecosystems that have been gained from the DWHOS research, and identify some key knowledge gaps still remaining. The presentation will update a comprehensive review about the environmental effects of DWHOS that we recently published in Marine Pollution Bulletin.

47 Oil spill combat and effects in the Arctic coastal environment; self-clearing potential and in situ burning

S. Wegeberg, Aarhus University / Department of Bioscience; J. Frit-Marrusen, Aarhus University / Department of Bioscience - Arctic Environment; O. Goehr-Hansen, M.B. Larsen, Greenland Institute of Natural Resources; K. Gustavson, Aarhus University / Department of Bioscience - Arctic Environment

What is the environmental effects of a beaches oil spill in the Arctic, how well will the shoreline potentially be able to self-clean and will combating 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-clearing potential of a coast 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-clearing 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 test was performed by sanding the oil from rocky substrate and 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 coast 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.

48 How stable are our indices? - differentiating between sources in a weathering environment

S.M. Mudec, NILU - Norwegian Institute for Air Research / IMPACT

Oil crude contains many hundreds of compounds and some of these are widely used to differentiate between different oils and products, especially in spill scenarios. Traditionally, we have developed chemical fingerprints based on a suite of compounds such as the steranes and terpanes although the concept of a “fingerprint” suggests this is static in time. However, it is also well known that the degradation rates of compounds depend on the environmental conditions and the pattern changes with period of exposure. It would be more appropriate to use a “signature” analogy when comparing oils by this approach. The weathering processes change the chemical signature and old oil may have a different chemical composition to the original source oil. When we analyses such samples, we may need to ask if this is the same oil as the proposed source, or a different oil with a different signature that it is also present. The steranes and terpanes contain several homologues and analysis of the chemical signature during the Deepwater Horizon Response clearly indicated that several of these compounds were not behaving conservatively and were degrading at a faster rate than anticipated given the exposure time. Comparisons with the actual oil released clearly identifies the compounds most likely to alter the environments where they degrade. In this case, the Louisiana marshes were clearly a site where biodegradation was significantly faster than expected. This was also true of the alkylated PAHs which had been used as source identifiers in previous spills such as the Exxon Valdez. The triaromatic steranes were also degrading at a significant rate while the oil was at sea and the exposure to UV light may have led to a relatively rapid abiotic transformation. When it comes to distinguishing between sources, less may be more! We need to select the compounds we include in our analyses with care since each question may need a different approach: if we want to know if the oil is weathering, we use a suite of compounds with differential properties appropriate to the environment of the spill. If we want to conduct source apportionment, we may need to choose the most recalcitrant of the compounds rather than all of them.

Fish model species in human and environmental toxicology (I)

49 Exposure to bisphenol S alters microRNA expression in male zebrafish (Danio rerio)

J. Lee, J. Ji, Yongin University

In response to the restriction of bisphenol A (BPA), bisphenol 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 RT-PCR was used to validate the expression of several miRNAs in the microarray data. The GO term analysis revealed that miRNAs significantly affected by BPS exposure were involved in hematopoiesis, lymphoid organ development, and immune system development. Among 14 miRNAs that were significantly regulated after exposure to 5 and 50 μg/L, six may have a role in the 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

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A variety of alkaloid-like 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 (selenium as selenite) at 50 μg/L selenium (dry mass) and environmentally relevant sphyrophysiological levels (3.4 – 28.8 μg/g) for 90 days. Swimming performance, O2 consumption and metabolic rates were determined using a swim tunnel respirometer. Cardiac function was assessed using high resolution (30 μm) ultrasound biomicroscopy. Whole-body energy stores (triglycerides and glycogen) and mRNA transcript abundance of selected genes of interest 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 transcript 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 miRNA expression of the collagenase, MMP2. These results suggest significant ecophysiologiical effects that may impair the fitness of fishes exposed to elevated dietary Se in contaminated ecosystems. From a comparative biomedical viewpoint, the use 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. Massai, Helmholtz Centre for Environmental Research - UFZ; H. Hollert, 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 / UFZ Efzo...
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. Our data that later embryonic stages may exhibit advanced biotransformation capacity.

54 Differing PM2.5 Filter Extraction Methods: Impact on Chemical and Toxicological Analyses
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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. Zebrashift (n=32treatment) 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 constituents 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. Sabbioni, 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 change on the vulnerability of cultural heritage at European level. Recommendations on the inclusion of cultural heritage in the national adaptation strategies and plans to climate change will also be discussed.

56 Nanotechnologies 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 challenges of our group related to conservation of historic concrete in the framework of the Horizon 2020 project “InnovoConcrete”.

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

The European Research Infrastructure for Heritage Science (E-RIHS) entered the European strategic roadmap for new Research Infrastructures (ESFRI Roadmap) in 2016, as one of the six new projects. E-RIHS support research on heritage interpretation, preservation, documentation and management. Both cultural and natural heritage are addressed: museums, buildings, archaeological sites, digital and intangible heritage. E-RIHS is a distributed research infrastructure with a multi-level star-structure: facilities from many Countries will be organized in national networks, coordinated by separate National Hubs and the RIHS headquarters will provide the unique exit point to all E-RIHS services, by coordinating the net of National Hubs.

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 Ecfae Modelling; J. Kleimann, WSC Scientific GmbH; T. Schad, Bayer AG / Environmental Modelling; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; G. Ernst, Bayer AG / Ecotoxicology; G. Goeritz, 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 different major exposure routes. EFSA indicates the worst-case character of its scenario "In the absence of appropriate off-field exposure scenarios...", and hence, emphasizes 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-field 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 easily be 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 address SPGs.

60 Biogenic residues formation from pesticides - an overview
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Anthropogenic organic chemicals are deliberately (e.g. pesticides) released in major amounts to nearly all compartments of the environment. Soils and sediments 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, or volatilised 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 compounds, 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 isotope tracer allows an estimation of microbial activity in the transformation of pesticide. We investigated the turnover of various pesticides (2,4-D, glyphosate, metamitron, bentazon, bromoxynil and clodinafo-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 the 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 metamitron 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. Wollmann, Dr Knoell Consult GmbH; G. Reinken, 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, PELOM, 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 EFSA, which results in more exhaustive wash-off from the plant surface. Generally, the extent of rainfall-induced dispersed substance depends on several factors. An EFSA working group recommended a harmonized experimental approach to derive wash-off factors in the greenhouse: a 24h time interval between pesticide spraying and 10 to 20 mm of artificial rain, followed by an extraction of the plant material with an acetonitrile/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 pertinent literature was reviewed for the availability of data suited for the calculation of a 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
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In a regulatory setting, the potential for bioaccumulation and biomagnification of plant protection product active substance 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 parent compound or biodegradation 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 logKow 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 models and time-varying weather data to account for seasonality and variability 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
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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 small mountain watersheds, where runoff fluxes are particularly rapid due to side slopes, exposure peaks can be sharper 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 surface water. In this work, the project SMARTCROP (funded by the Research Council of Norway, was started to address the challenges of developing and providing farmers with the necessary IPP 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 PRZM and VFSMDO 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, 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 weather data. Data are also derived and carried out for specific field and application scenarios. Another important new feature is the implementation of various mitigation measures such as vegetated filter strips, hedges, tillage/mulch, 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.
Acute Toxicity of Pyrene Associated with Dissolved Organic Matter of Various Molecular Weights to Daphnia magna

H. Liu, 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 bioactivity-dissolved compounds (C_{bio}) was measured 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, 5-10K Da) > higher molecular weight (HMW, >100K Da) > middle molecular weight (MMW, < 1K Da) > 1-3K Da and 3-5K Da DOM. Furthermore, the superoxide dismutase (SOD), catalase (CAT), and peroxidase (POD) activity of Daphnia magna decreased gradually with the increasing C_{bio} in the systems of MMW and HMW DOM, whereas increased when C_{bio} was at a low level and then decreased when C_{bio} was at a higher level in the control group with pyrene only and the system of LMW DOM. The influencing dosing forms of silicone rod has been successfully 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.

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

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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 silicone rods has successfully been used in biodegradation and toxicity testing of hydrophobic chemicals covering a broad chemical space in terms of K_{ow} and K_{oc}. 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 linearily 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.

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 309. 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 Dibenz[a,b]anthracene was conducted on soils with different texture, organic carbon and microbial activity. At sampling dates the gashead space 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.

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

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Persistence assessment using standardized (e.g., OECD) tests is one of the main challenges for hydrophobic organic chemicals (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 for HOCs to predict persistence of a single HOC exposed to different test scenarios. This was achieved by 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.

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

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Polychlorinated biphenyl (PCB) deposition to the north polar regions has long been recognized. Here we investigate quantitative and qualitative PCB inputs to the southern 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
LCA. Biochar production from biomass residues and its use as soil conditioner in implications of spatial differentiation on the interpretation phase of a comparative case study, it did not necessarily contribute to more correct decisions. 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 substantial differences with respect to the environmental impacts 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 Kom 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 has been found in flue gas.

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, Germany

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 direct 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 standards. The cells were extracted using dichloromethane for three 15 min-cycles at 100 °C. The extracts were solvent-changed to methanol, reduced in volume to 150 μL and the extraction procedure was performed on a LC-MS/MS system (1290 Infinity coupled to 6490 triple quadrupole LC/MS, Agilent Technologies, Germany) equipped with an API-sonne 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)

Implications of spatial differentiation on LCA-based decision-making: a case study of biochar systems in Indonesia M. Owssianiak, Technical University of Denmark; G. Cornelissen, S. Hale, Norwegian Geotechnical Institute; H. Lindhjem, Menon Economics; M. Sparerik, NTNU

The development of spatially differentiated life cycle impact assessment (LCIA) 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 LCIA results. The aim of this work was to therefore to assess the implications of spatial differentiation on the interpretation phase of a comparative LCA. Biochar production from biomass residues and its use as soil conditioner in 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 (iii) irrespective of the geographic locations, regionalization of impacts led to a total damages to human health.

70 Considering space debris related impacts within the LCIA 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 more and more relevant. 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-mission disposal 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 LCIA 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 different missions. Volume occupied by debris and dead spacecraft 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.

71 Implementing ozone formation effects due to poplar plantations for biomass production in Europe under climate change impacts 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 bioenergy instead of fossil fuels as a source of electricity. The goal of this research was to determine country specific characterization factors (CFs) for ecosystem damage due to ozone formation from isoprene emissions caused by poplar tree plantations in Europe. CFs were defined as the change in potentially affected fraction of plant species (PAF) due to a change in the country-specific poplar plantation area (in km²/year/km²) and consists of a fate factor and an effect factor. To determine the fate factor, changes in Accumulated Ozone over a Threshold of 40 ppb (AOT40) in all grid cells connected to isoprene emissions resulting from additional poplar plantations on 1% of agricultural land in each country were estimated with chemistry transport model
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. Toressi, Kruger A/S; H. EI-taliawy, 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. Christenson, 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 micropolllutants 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 readily biodegraded in sludge systems, while it can be degraded with half-lives of 2-3 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 degradations. 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 micropolllutants. On the other hand the biomass related reaction rate constants are considerably higher with low 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 unknown stable metabolites. On the other hand compounds that are neither believed 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. Caraene, Curtin University / chemical department; C. Joll, Curtin University / chemical department; K. Ling, Y. Gruchlik, Curtin University; A. Paparini, Murdoch University

Due to improvements in analytical screening methods, a large number of emerging organic contaminants (pharmacologically 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 fungus 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 anaerobic 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 can be performed assessing the possible health and environmental risks associated with the reuse of treated wastewater, for applications such as irrigation and groundwater replenishment.

97 Evaluation of macroalgae as biotechnological transformation in model biodegradation and ozonation experiments using target and non-target analyses and ecotoxicological bioassays

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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 kinetic constants 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 parent compounds as well as the formation of transformation products (TPs) were followed by ultra-performance liquid chromatography/tripule-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 very low. The capability of the biotransformation 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 very low. The capability of the biotransformation 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 very low. The capability of the biotransformation 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 very low. The capability of the biotransformation 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.

81 Abatement of amoxicillin, ampicillin and chloramphenicol from aqueous solutions using activated carbons prepared from grape slurry

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There has been an increase in the use of pharmaceutical compounds for promotion of human and animal health, and the prevention of diseases over the past few decades. The sources of water and environmental contamination from these compounds include effluent discharges from household and several industrial activities. The capabilites of surface water and organic micropollutants in African countries is also not fully known. There is scarcity of information concerning the utilization of grape slurry waste as a precursor of carbon based adsorbents, as well as its application for the removal of amoxicillin (AMX), ampicillin (AMP) or chloramphenicol (CHL). This study therefore aimed at monitoring of the three antibiotic residues in selected surface waters. Activated carbons from grape slurry were synthesized and explored for abatement of the antibiotics’ residues from aqueous solutions. An UHPLC-UV-DAD was optimized for the separation, detection and quantification of antibiotics in aqueous matrix. Solid Phase Extraction (SPE) procedure was optimized for recovery studies. Surface water samples were collected along the mainstream and downstream branches of the Diep River at different sampling points over two seasons. The removal of antibiotics from aqueous solutions using activated carbons produced from grape slurry was also studied. Activated carbons were characterized using FTIR, SEM and EDX in order to understand the removal mechanisms of the contaminants by activated carbons. The three antibiotics studied were detected in environmental water samples. Attempts were made to remediate the antibiotic compounds using activated carbons produced from grape slurry waste. The sorption data indicated that all the operating conditions employed in this study were crucial for the control of antibiotics adsorption. The percentage sorption was enhanced with increasing adsorbent dose, contact time and pH, while increasing initial antibiotic concentration and temperature did not favour the sorption of the antibiotics. The equilibrium data fitted satisfactorily into the three isotherms studied. The biotransformation and ozonation experiments resulted in nearly full elimination of the antibiotics onto activated carbons used. Thermodynamic evaluation showed that the sorption was exothermic, feasible but non-spontaneous with increased in temperature.

82 Biodegradation of organic micropollutants in constructed wetlands: comparison of design and operational parameters

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Wastewater has been considered a major source of contaminants of emerging concern to the environment, as conventional treatment systems do not completely remove all of these compounds. Constructed wetlands (CWs) have been shown to be able to degrade some of these emerging contaminants, namely organic micropollutants. But the processes at the core of the removal of these compounds in CWs are yet unknown. Research being developed at Aarhus University aims at understanding the removal processes and fate of organic micropollutants in different types of CW systems. Five different experiments have been conducted in biofilter microbial community function. The plants Typha latifolia and Phragmites australis were the most efficient plant species in removing ibuprofen and isoxeol. Pragamites was the most efficient species to remove the pesticides tebuconazole and imazalil. Uptake, translocation and degradation of chiral pesticides inside the
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 density, 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.

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

83 Effects of PAH exposure on fuelling ability in a long distance migratory shorebird
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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 PAHs). We found that PAH exposure and pre-migratory fuelling activity were 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.

84 PFAAs levels, oxidative status and reproductive success in great tits (Parus major) inhabited a contamination hot-spot
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Perfluorooalkyl acids (PFAAs) are substances which have been produced for more than 50 years in the decade. Their unique properties of repellent 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 on their effects on mammals. 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 fluorochromalian 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 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 CRJ, Jönsson P, Jenson A, Kannan K, Mabury S, Van Leeuwen SP (2011). Perfluorooalkyl and polyfluorooalkyl substances in the environment: terminology, classification, and origins. Integ Environ Asses 7: 513-531. [2] Giesy JP and Kannan K (2001). Global distribution of perfluoroocicante sulfonate in wildfire. Environ Sci Technol 35: 1339-1342. [3] Giesy JP and Kannan K (2002), Peer-reviewed: perfluorochemical surfactants in the environment. Environ Sci Technol 36: 146-152.

85 Active and passive monitoring of lead poisoning in birds of prey in Spain
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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-known. The objective of the present study is to improve our knowledge on the exposure to Pb in birds of prey in Spain by means of passive and active sampling. We will perform the 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 several species that were trapped alive in centres of lead poisoning in Spain. The effects on the blood parameters, such as the activity of lead metabolism (PCEA), 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 elevated blood Pb exposure levels (>200 µg/ml). Passive monitoring revealed that the species with lead levels in liver associated with clinical poisoning (18-30 µg/g dw) were cirencious vulture (1/3), Eurasian griffon vulture (2/22) and western marsh-harrier (1/32); and the species with clinical severe poisoning (>30 µg/g dw. 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 Pb exposure in blood concentration and the activity of antioxidant enzymes. Acute effects of lead on the plumage biosynthesis, PCEA metabolism, oxidative stress and immune function were also evaluated in the active monitoring by means non-destructive biomarkers. The integration of active and passive monitoring permits to have a more complete view of the risk for raptors to be exposed to Pb and to 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 dw.) in Eurasian griffons and golden eagles with the passive monitoring.

86 Persistence of elevated p,p'-DDE levels and HCB-related protoporphyrin IX decrease in eggs of common kestrels from Tenerife (Canary Islands, Spain)
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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 Islands 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 2000 and 2002 in the studied area 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 kestrel from Tenerife Island collected between 2009 and 2016. We have also monitored the hatching success of the parasitized eggs, which was衡量的 by means of OBM (in percentage of chicks hatched per 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 acetone/HCl 3N (2:1) and then
analysed by HPLC-DAD. Egg content showed the following OC levels (mean ± SE; µg/g dw): p,p'-DDE, 15.2 ± 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 cropland 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. Proteoporphyrin IX was the only pigment in eggshells and its content was negatively affected by HCB levels in egg content.

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Long-term increase in secondary exposure to anticoagulant rodenticides in European polecats in Britain
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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 liver from polecats found dead (mostly road casualties) from 2013-2016 for residues of five SGARs. We related variation in residues to polecat 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 polecat died. We found a positive association between occurrence of liver SGAR residues and δ13N 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.

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Poster spotlight: MO035, MO036, MO083
Environmental risk assessment in time and space - new approaches to deal with ecological complexity

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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

Landscapes provide a multitude of ecosystem services, but the relationships between the populations of the organisms providing them, stressors and the delivered 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.

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Understanding risk - a better approach to reduce uncertainty
M. Wanga, WSC Scientific Gmbh / Dept E fate Modelling; M. Foudoulakis, 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 and to answer questions on the relevance of effects to ecosystem 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.

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Developing spatio-temporally realistic representations of agricultural landscapes for assessing the impacts of pesticides on non-target organisms
E. Ziólkowska, 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 during 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 in agricultural landscapes. 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, grassland, forest). The landscape heterogeneity refers to both crop management throughout a year, described through individually tailored management plans for each crop, and the cropping system understood as a perenni crop rotation. Crop management plans consist of combinations of farm activities (including pesticide treatments), as well as the length and number of carrying out activities. The temporal component also includes weathet conditions and vegetation growth models for all vegetation types and crops. Such approach aims to provide a realistic, updated on a daily basis, dynamic landscape with vegetation growth in response to the weather, and the pattern of farming activities related to each specific crop, farm, and field. Our methodological framework, supported with semi-automated procedures for spatial data management, makes creation of highly realistic representations of agricultural landscapes feasible and usable for landscape-scale 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/NZ7/01939).

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Where are the Springtails? A vertical distribution model for C harpoxysta spiculata
H. Mörth, 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 modelling offers a powerful tool to lock exposure and effect. 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: 0-1 cm, 1-2.5 cm, 2.5-5 cm, 5-10 cm, 10-15 cm and 15-20 cm. The location of feeding was varied by four different regimes while all other parameters were kept constant (28°C, 70% relative humidity). The dispersal data were recorded and simulation results of the vertical dispersal of *Folsomia* 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

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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 for the incorporation of individual variations in response and specific behaviours. 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 pertaining to species traits obtained from literature. Modelled 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

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An ongoing dilemma in risk assessment is the perceived difficulty in successfully integrating scales that range from the molecular to ecological, timeframes from days to decades, and endpoints that can be species specific to a host of ecosystem services. Starting In the late 2000s to now there has been an interest in defining ecosystem services and in the calculation of risk to these properties. It has been suggested that ecosystem services are a method to encourage a systems approach to sustainability. Human well-being has become part of the lexicon to included endpoints such as a sense of place, education, employment, public safety and traditional activities. In a recent publication (Harris et al. 2017) it was demonstrated that it is possible to estimate risk in a contaminated site to ecological endpoints, human health and ecosystem services using a clearly defined causal pathway and Bayesian networks. Now we are extending the integration of ecological endpoints, ecosystem services and human well-being from the scale of a contaminated site to that of the Salish Sea. The Salish Sea is a term applied to both the Puget Sound and its watersheds in the United States and the Straits of Georgia in Canada. Vancouver, Seattle, Tacoma, major ports, numerous refineries, paper mills, and high tech industries. The same area is also noted for intense agricultural use, outdoor recreation and the harvest of marine resources. The region is also home to more than 30 recognized Tribes in the U. S. segment and First Nations in Canada. We will use three watersheds in this region, the Skagit, the Nooksack and the Cedar as case studies. Time frames will be from current conditions to 2070 and will include climate change projections in terms of temperature and precipitation. We will demonstrate the application of the Bayesian-network relative risk model to integrate pesticide effects at the molecular level and the alteration of watersheds to calculate risk to the ecological endpoint Chinook Salmon, the specific economic ecosystem services provide by the endpoint and the watersheds, and finally demonstrate the risks to human well-being as defined from a variety of cultural perspectives.

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

95 Mobilisation of silver sulphide nanoparticles in soil column by earthworms’ bioturbation

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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 the 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±0.20 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 Lumbricus rubellus and with and without Ag2S-NPs. Every week for 28 days earthworms and four different layers of the soil column (0-2, 2-4, 6-8, 10-12 cm depth) were sampled. In the same way a second experiment was performed with daily application 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 the environment

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 (RefSoi 01A). Additionally, a medium clayey silt (Luvisol) was used for the column experiments. The column remobilization of the Ag concentration after digestion (Ag_{stored}) 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 1% of the Ag_{stored} concentrations in the soil columns. The correlation between remobilized Ag_{stored} and Ag_{stored} 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 remobilization. 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_{stored} in the lysimeter experiments was low and very likely related to soil tillage as well as bioturbation. A low Ag_{stored} release to the percolate water (t= 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 water induced a retardation of Ag ENP concentrations detected in the lysimeter with the lower Ag ENP concentration. All roots (wheat, canola, barley) showed a low uptake of Ag_{stored}. All approaches showed a more or less high retention of Ag ENP in soils why soils are a sink for Ag ENP. However, the demobilization in the lysimeter was incomplete because of root uptake and inhibition of the soil microflora. Thus, the impact of a repeated sludge application to the soil microecosystem and the root uptake (e.g. beet) needs further long-term investigations.

97 Determination of attachment efficiency (α) for ENPs in different types of soils by saturated column experiments

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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 composition 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 (AgS ENPs) may affect the resulting α values between the different soils sampled in the UK. Artificial rainwater was used as the eluant. 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 relative fraction 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 minimize the proportionality 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

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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 sewage sludge from the same municipal wastewater treatment plant in four different combustion 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 – Zn and 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 sulfides, the remaining fraction was best described by a ZnO reference spectrum. For sludge spiked with ZnO-NP, a lower degree of sulfidation (~83% ZnS) with a constantly high fraction of ZnO (17%) was calculated. After combustion, EXAFS spectra of Zn were best described by a spectrum of ZnS 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. Comparably, Cu nanoparticles were retained by the sludge and the ashes were a sink for Ag ENP. However, the demobilization in the lysimeter was incomplete because of root uptake and inhibition of the soil microflora. Thus, the impact of a repeated sludge application to the soil microecosystem and the root uptake (e.g. beet) needs further long-term investigations.

99 Soil ecotoxicity and dissolution of a marketed nanosilver product - a direct comparison with ionic silver

J. Mertens, Precious Metals and Rhenium Consortium c/o EPMF; K. Arijs, ARCHE; E. 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 nanoflours. Therefore, the soil ecotoxicity and dissolution of ionic silver vs nanosilver were tested. The smallest silver nanoflour with the highest specific surface area registered under REACH was used for testing (aqueous suspension containing approximately 37% nanoparticles, degree of sulfidation (~93% ZnS) with a constantly high fraction of ZnO (17%) was calculated. After combustion, EXAFS spectra of Zn were best described by a spectrum of ZnS 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. Comparably, Cu nanoparticles were retained by the sludge and the ashes were a sink for Ag ENP. However, the demobilization in the lysimeter was incomplete because of root uptake and inhibition of the soil microflora. Thus, the impact of a repeated sludge application to the soil microecosystem and the root uptake (e.g. beet) needs further long-term investigations.

100 Tackling nanoparticle fate assessment in surface waters - heteroaggregation as a key process

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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 which, unless soluble, is determined by aggregation, including homo- 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 homoaaggregation. 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 homoaggregation. 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 homoggregation is the complexity added to the system by SPM in the case of heteroggregation. In this contribution we therefore propose an approach to develop a heteroggregation testing protocol based on the OECD TG 318, with a focus on tackling SPM analogue selection. The development of such a protocol requires (1) selecting SPM analogues and how to ensure that they represent relevant environmental characteristics, and simple enough for routine testing, (2) an easy-to-handle experimental setup to estimate a heteroggregation parameter, and (3) an accurate experimental method to validate the latter. Point (1) requires informed simplifications based on a profound understanding of the system. Recent hydrochemical testing conditions have been established for homoggregation in the OECD TG 318 and will also apply for heteroggregation. 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 heteroggregation.

**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. 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 heteroggregation.

**102 Downregulation of hsp90 expression and increased intermolt duration in the blue crab, Callinectes sapidus, in response to oil exposure**  
S. Chiasson, Loyola University / EEB; S.M. Giltz, C.M. Taylor, Tulane University / Ecology & Evolutionary Biology

The 2010 Deepwater Horizon (DWH) oil spill in the northern Gulf of Mexico (NGOM) resulted in over 780 million liters of crude oil spilling into Gulf waters. In an effort to disperse the oil, nearly 7.6 million liters of dispersant was applied. Many commercially and recreationally important species reside in or near the area of the spill. The blue crab, Callinectes sapidus, is common in the NGOM and is both economically and ecologically important in this region. In this study, after exposing juvenile Blue crabs to weathered crude oil, we tested the relative expression of heat shock protein 90 (hsp90) by measuring the corresponding mRNA expression. Expression of hsp90 is normally upregulated in response to thermal or environmental stress, and it also plays an important role in the regulation of estrogen dependent cell signaling. We also monitored crabs over two molts to test for effects on growth after exposing crabs to oil. Expression of hsp90 was significantly downregulated in juvenile crabs exposed to dispersed oil but not oil alone. This suggests that dispersed oil interferes with either the pre-mRNA transcription of hsp90 or potentially causes alternative splicing of pre-mRNA.

**103 Physiological and molecular impacts of crude oil and/or dispersant-contaminated seawater and sediments on the sponge Halichondria panicea (phyllum Porifera).**  
J. Vág, Heriot-Watt University / School of Energy, Geosciences, Infrastructure and Society; J.M. Roberts, The University of Edinburgh / Grant Institute; T.B. Henry, Heriot-Watt University / The School of Energy, Geosience, Infrastructure and Society

Sponges (phyllum Porifera) are a diverse group of filter-feeder organisms present in most aquatic environments. In the marine environment, sponges perform a wide range of ecological functions including cycling of nutrients such as carbon, nitrogen and silica; and, in areas where they are present at high densities (sponge grounds), they provide a habitat for a diverse range of benthic organisms. Because of their importance within marine ecosystems, the impacts of anthropogenic activities such as hydrocarbon exploration and production on marine sponges must be assessed. The objectives of this study were to: (1) determine the physiological impact of crude oil and/or dispersant contaminated seawater and sediments in model sponge Halichondria panicea; and (2) characterise the effects of crude oil and/or dispersant contaminated seawater exposure on the transcriptome of H. panicea. A series of 48-hr cyclical aromatic hydrocarbons (PAHs) are a class of oil exposure to seawater or sediments contaminated with Schiehallion crude oil and/or Sligcogne NS dispersant in H. panacea. Sponge respiration rate and filtration rate (by clearance rate) were measured throughout exposures, and tissue samples were collected for evaluation of the transcriptome. Throughout the exposure experiments, respiration rate displayed a high inter-individual variability, consistent with scientific literature. A decreasing trend in respiration rate was observed when sponges were exposed to contaminated seawater or sediments. Filtration rate was significantly decreased in sponges exposed to contaminated seawater or sediments, and filtration rate did not recover for 48h 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 understanding 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. Venable, University of North Texas / Advanced Environmental Research Institute; M.O. Krasnek, Abt Associates; M.L. Gielazyn, NOAA / co USEPA Region IV

Polycyclic aromatic hydrocarbons (PAHs) are a class of organic contaminants present in the vast majority of the sampled sediments, indicated that the PAH contamination in the current study was not from the Deepwater Horizon oil spill event. Exposure to ultraviolet radiation (UV) can exponentially increase the toxicity of photodynamic PAHs to biota, leading to adverse outcomes well below the threshold of other mechanisms of toxicity. This phenomenon is known as photo-induced toxicity and is well documented in a wide range of aquatic organisms. Consequently, laboratory tests investigating effects of PAH on aquatic biota which fail to account for phototransformation by UV may significantly underestimate toxicity. The intensity of UV exposure to biota is highly variable within aquatic ecosystems, due to a number of factors intrinsic to the water column, and extrinsic factors (e.g. cloud cover, time of day, seasonal variations). Tissue repair mechanisms may be sufficient to counteract some effects of photo-induced toxicity during periods of relief from UV exposure. Here, we report the results of experiments in which larval red drum (Sciaenops ocellatus) and zooplankton (Daphnia magna) were exposed to either a single PAH (fluoranthene) or a complex PAH mixture prepared from weathered crude oil with varying PAH and UV exposure scenarios. Red drum tests were conducted as a single pulse exposure, and daphnia tests were conducted as static renewals. Toxicity (LC50) was UV and PAH dependent in both species. In red drum tests, shorter PAH pre-exposure times resulted in LC50 that were considerably lower than LC50 associated with longer pre-exposure periods. This is likely due to lag time in the initiation of physiological metabolism/clearance mechanisms in the organism and loss of PAH from the test chamber. A similar pattern was observed in photoperiod testing for both species. Significant latent mortality was observed in daphnia at a general daily dose rate that approached the conclusion of the UV and PAH exposures. We also report the effects of various UV-modified products on marine fishes. Taken together, these data suggest that even short-term, transient exposure to low concentrations of PAHs (common during a spill event) results in acute toxicity in aquatic organisms, and those effects may be manifested outside of standard bioassay testing durations.

**105 Photoenhanced Toxicity of Petroleum to Aquatic Invertebrates and Fish: Review of the Science**  

Photoenhanced toxicity is a distinct mechanism of petroleum toxicity that is mediated by the interaction of solar radiation with specific polycyclic aromatic compounds (PACs) in oil. Photoxotoxicity 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 (UVR). A recent study assessing the effects of oil and weathered oil on experimental species identified that the mid-waters of the 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. Orhel, Queens University; B. Hollebone, Environment Canada / Emergencies Science & Technology; V. Palace, M. Paterson, ISBD-Experimental Lakes Area; J. Rodriguez Gil, University of Ottawa / Department of Biology

107 Life-stage, and species-specific effects of dietary methylmercury exposure

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Mercury is a globally distributed contaminant, found even in remote aquatic ecosystems. Once deposition occurs, it can be microbiologically 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 MeHg in the 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 teleosts 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 brain 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

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109 Transgenerational effects of early life stage exposure to endocrine disruptors across biological scales in a euryhaline model fish

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Emerging research demonstrates that EDCs, which agonize, antagonize, and/or synergize the effects of endogenous hormones, can cause deleterious effects in adults as a result of early-life exposure as well as transgenerational effects. A majority 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 hpft) until 21 dhp to environmentally relevant of an androgenic or estrogenic EDC of emerging concern: levonorgestrel (Levo) (10 ng/L), bifenazin (Bi) (5 ng/L), respectively, and coupled this exposure with testing of an established androgenic or estrogenic EDC: trenbolone (TB) (10 ng/L), and ethinylestradiol (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 dhp) 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 bifenithrin and levonorgestrel, and this pattern is stronger in F1 adults, with significantly greater T-cell proliferation in bifenithrin-exposed individuals relative to controls. Bifenithrin-exposed parental females have increased atritic follicles, and developmental defects are more prevalent 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

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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. Rainbow trout (Oncorhyncus 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 CYP1A 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 mixed exposure 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

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The BioBio River (Central Chile) is the third most important basin in Chile and is 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.

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

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

E. Giovanni, ASviS

113 How the SDGs are being addressed in Horizon 2020

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119 Mercury Biogeoosciences - Fate, Effects and Policy

Mercury Biogeoosciences - Fate, Effects and Policy

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(I) or Hg(II) compounds), and that bound 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 subtle neurotoxin and is bio-accumulated in ecosystems. Recent work using cation exchange membranes in the University of Nevada Reno –Reactive Mercury Active System (UNR- RMS), 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.

Mercury Biogeoosciences - Fate, Effects and Policy

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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 in modern nutrition; 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 effects of Se against Hg have been shown in laboratory experiments and in the seabird diet. The protective effect of Se against Hg has been suggested in the literature, but the exact role of Se in regulating Hg bioavailability in the marine ecosystem remains unclear. In this study, we evaluated the effect of Se on the biogeochemistry of Hg in marine ecosystems by using a multimedia model for mercury, and we assessed the role of Se in regulating Hg bioavailability in marine ecosystems. Our results suggest that Se inhibition of MeHg accumulation might occur both at the microbial and macroinvertebrate levels of

Constraining Uncertainties in the Global Mass Balance of Mercury Using Observations and a Bayesian approach S. Mustala, 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, Uncertainty. Reducing uncertainty helps in estimating mercury concentrations and mass balances with greater confidence. Ten key input parameters that were identified to be significantly contributing to the output uncertainties in previous studies. These included: emissions of mercury to the atmosphere, reduction and oxidation of mercury in surface and sub-surface oceans, and partition coefficients of mercury species groups (Hg(0), Hg(II), Hg-p) in surface and sub-surface oceans. Then, a survey of literature on observations of mercury in the global environment is made. As these observations (for example, concentration of total mercury in air) are also key model outputs, we can update model inputs by comparing model simulated outputs to the actual observations. For this updating, a Markov chain Monte Carlo (MCMC) technique called Metropolis Hastings which is based on the Bayes rule is adopted. The observed concentrations of Hg(0) in atmosphere, dissolved gaseous mercury (Hg-g) and total mercury in surface ocean are collected from published literature and used to obtain a likelihood function. Input parameters and their confidence range are revised. A revised mass balance is obtained through a forward Monte Carlo analysis using updated inputs. It is found that the uncertainties in key input parameters (such as partitioning of reducible divalent mercury between suspended solids and water in surface oceans) have been constrained to a considerable extent, through a process called (20% limitation). In addition, the biogeochemical conditions that promote this pathway of mercury bioavailability are revised. In fact, only a limited effort must be made in understanding mercury process in oceans rather than in conducting emission inventory exercises.

123 Effects of probable nutrient limitation on the relationship between mercury and marine microorganisms in seawater I. Zivkovic, V. Fajon, J. Kotnik, Jozef Stefan Institute; M. Solc, J. Lusic, G. Kupsic, Institute of Oceanography and Fisheries; M. Orduz, University of Split; F. Matic, B. Grbec, N. Bojanic, Z. Nincevic Gladan, Institute of Oceanography and Fisheries; M. Horvat, Jozef Stefan Institute; M. Petric, V. Fajon, J. Kotnik, Jozef Stefan Institute

Microbial transformations of monomethylmercury (MMHg) and dissolved gaseous mercury (DGM) at the lowest trophic levels are not well understood. This is especially important in oligotrophic and nutrient-limited seas, where microbial food web and microbial loop dominate over classical (herbivorous) food web. Our research focused on the examination of the effects of probable nutrient limitation (P-limitation) on the relationship between different mercury fractions (total methylated mercury – MeHg, and DGM) and autotrophic and heterotrophic microorganisms. We determined total mercury (THg), MeHg and DGM, alongside with relevant microbiological and chemical parameters in the Central Adriatic Sea. Using statistical analysis (non-metric multi-dimensional scaling, principal component analysis, Pearson’s product-moment correlations), we assessed the microbial effects on Hg transformations and bioaccumulation. Only in the absence of P-limitation conditions (49% P-limitation), we found that MeHg was significantly related to total chemical and microbial parameters, which is an indication of metabolism-dependent Hg transformations. The activity of heterotrophic low nuclear acid bacteria seems responsible for most of Hg methylation in seawater under P-limitation. Under P-limitation conditions, DGM shows strong correlation with microbial fractions and chlorophyll a, which confirms previous research about biological DGM production. Contrary to MeHg, DGM transformations are probably not metabolically dependent, as most of these correlations can also be observed under P-limitation. MeHg biomagnification from microeston to mesozooplankton was observed through an increased biomagnification factor. Hg contributions from DGM to uptake and MeHg biomagnification and uptake are probably enhanced under P-limitation, which emphasizes its impact on Hg transfer to higher trophic levels. In order to test our nutrient-limitation hypothesis, we have performed statistical analysis on previously published data from the Southern Atlantic Ocean. We found similar correlations between MeHg (DGM) and physico-chemical characteristics of seawater under probable nitrogen limitation compared to those found under P-limitation in our study. These results indicate that mercury methylation is impaired in seawater under probable nutrient limitations.

124 Poster spotlight: MO333, MO334, MO335

Bioavailability and realistic risk assessment of organic
125 Anisotropic exchange kinetics of organic contaminants with passive samplers in stagnant 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 method for the assessment of toxic risk due to nonpolycyclic aromatic hydrocarbons (PAHs) and other 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 equilibration 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 spiked 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-particomponent model (release). The results showed that both in-situ and ex-situ 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 in a series of studies to our group on whole-sediment-equilibrated silicon rubber (ESR) could 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 4d ESR passive dosing test using first instar larvae of the midge Chironomus riparius. Additional sampling with polycarbonate 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/l. 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 insecticidaequilibrated 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 developments 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 contamion concentrations 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 (HCs) such as PAHs is the desorption extraction with Tenax during 20 h (ISO 17402) (Environ. Toxicol. Chem. 20:706–711, 2001; Integ. Environ Assess. Manag. 11:208–220, 2015). Understanding the role of bioavailability in the biodegradation of chemicals is relevant not only for retrofit 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 carrying out desorption extraction measurements with Tenax in a greenhouse experiment in which different strategies (use of spiked or non-spiked PAHs) were monitoring PAH depletion and PAH recovery of contaminated soils. 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 and 2) slow degradation in the following 6 years and 3) very slow degradation in the following 6 years at least until 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 200°C gives the fast desorbing fraction of 1-3% and all fractions are the same and the same 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 desorptions (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 using biosays 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


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 soils, showing 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 200°C gives the fast desorbing fraction at 60°C and all fractions are the same and the same 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 desorptions (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 using biosays 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.

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130 Impact of Biochar Additions to Soil on Contaminant Sorption and Plant Bioavailability

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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. But its biological activity and efficiency depend on many factors including the biochar type, process conditions, the organic content of the biochar and the form of the contaminant (e.g. dissolved vs. particulate material). The main objective of this study is to investigate the impact of wood biochar on the crop bioavailability of selected PPCPs often found in reclaimed water. A secondary objective is to quantify the contaminant sorption-desorption characteristics in the amended soils and to determine if there is a relationship with plant bioavailability. Target PPCPs were selected based on chemical properties, widespread use, frequent detection in WWTP effluent, and potential risk to the environment. The target PPCPs represent a range of therapeutic uses including antibiotics linked to antibiotic resistance in bacteria (sulfamethoxazole (SMZ) and trimethoprim (TR)), an anti-inflammatory that prevents seizures and relieves nerve pain (carbamazepine), an antidepressant (fluoxetine (FLX)), and an antihtyerpilipidemic (gemfibrozil (GBZ)). Atrazine (ATZ) was also selected because it is an herbicide commonly used on corn and has been used in a number of sorption studies with biochar. Pinyon Juniper, Russian Olive, and Lodgepole Pine derived biochars were chosen because they were produced from tree species that often require removal because they are too invasive or due to insect infestations. Corn was used as the test plant because of its commercial value and has been grown with reclaimed water in the past. After the 28 day growing period, it was found that there was no negative impact of the biochars on corn growth. Once the plant tissue analysis and sorption studies are completed, the impact of biochars on contaminant uptake will be evaluated along with the potential to remove PPCPs from soil. Extraction and analysis of the plant tissue is being conducted along with the sorption/desorption experiments. Final results expected by December 2017.

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

131 A novel framework for a new generation of water consumption indicators in LCA and footprint studies

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Several life cycle impact assessment (LCIA) models have been proposed 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 model. Such a model is described with the dynamic version of the USEtox® model. This provides the time-integrated pollutant mass remaining in the freshwater compartment (at continental scale) after 100 years n=100 (in kg/day). Then, the quantification of the effect factor is based on the concept of adsorption processes with activated carbon. This allows for an indicator based on physical properties of the pollutant which is (i) substance specific, (ii) dependent on the level of pollution (i.e. chemical mass in freshwater), and (iii) proportional (although not covering energy requirements) to the effort necessary to fully remediate the persistent pollution. Therefore, the substance-specific characterization factor has a unit of mass equivalent of activated carbon per kg emitted kg_{eq,act,kg_{emitted}} and represents a midpoint. It does not describe the effects of a specific behaviour of future generations when facing water pollution, but rather indicate the potential effort required to recover the pristine freshwater resources depending on the persistence of the pollution and its difficulty in being remedied. Thus, this approach provides a new perspective allowing more transparent results for the differentiation of safe, short-term water supply issues (AoP natural resources) and potential (short-term) toxicity effects (AoP human health).

Towards global regionalized characterization factors for water consumption impacts on instream freshwater ecosystems


Freshwater resource has been recognized as being a safeguard subject within the Aichi Target (AoP natural resources) (WULCA resource group framework). Besides depleting 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 model. Such a model is described with the dynamic version of the USEtox® model. This provides the time-integrated pollutant mass remaining in the freshwater compartment (at continental scale) after 100 years n=100 (in kg/day). Then, the quantification of the effect factor is based on the concept of adsorption processes with activated carbon. This allows for an indicator based on physical properties of the pollutant which is (i) substance specific, (ii) dependent on the level of pollution (i.e. chemical mass in freshwater), and (iii) proportional (although not covering energy requirements) to the effort necessary to fully remediate the persistent pollution. Therefore, the substance-specific characterization factor has a unit of mass equivalent of activated carbon per kg emitted kg_{eq,act,kg_{emitted}} and represents a midpoint. It does not describe the effects of a specific behaviour of future generations when facing water pollution, but rather indicate the potential effort required to recover the pristine freshwater resources depending on the persistence of the pollution and its difficulty in being remedied. Thus, this approach provides a new perspective allowing more transparent results for the differentiation of safe, short-term water supply issues (AoP natural resources) and potential (short-term) toxicity effects (AoP human health).
Environmental fate of emerging contaminants in the water cycle: analytical challenges and engineered solutions (III)

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Poster spotlight: MO093, MO094, MO106

S. Perez, E. Hidalgo, M. Pujalte, CSIC / Environmental Chemistry; D. Barcelo, CIBER-enB / Environmental Chemistry; T. Galle, Montpellier SupAgro / LBE ELSA; J. Langlois, Université Paul-Valéry Montpellier 3 / CEPE UMR CNRS Université de Montpellier Université Paul Valéry Montpellier EPHÉ Université PaulValéry Montpellier Montpellier cedex France; P. Fréon, IRD, emritus scientist, PaulValéry Montpellier / EPHE Université PaulValéry Montpellier, France. This paper is devoted to the water cycle and the impact of emerging contaminants in this environmental transition. Several emerging contaminants are treated such as pharmaceuticals, hormones, and personal care products. The paper focuses on the analytical challenges and engineered solutions to control these emerging contaminants in the water cycle. The analytical challenges include the determination of emerging contaminants in various matrices such as surface and groundwaters, sediments, and sewage sludge. Engineered solutions include the use of advanced treatment technologies such as membrane filtration, activated carbon, and ozone. The paper highlights the importance of interdisciplinary approaches to address the emerging contaminants in the water cycle.

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Screening of wastewater-borne pharmaceuticals and their phototransformation products in rivers

S. Page, W. N. Montemurro, IDAEA-CSIC / Environmental Chemistry; D. Barcelo, IJQAR-CSIC / Department of Environmental Chemistry. Pharmaceuticals are continuously discharged into the rivers from wastewater treatment plants. Hundreds of wastewater-borne pharmaceuticals have been detected in river samples but their concentrations along the river change constantly due to additional inputs and natural attenuation processes. Apart from biodegradation, drugs can undergo phototransformation reactions by either direct or indirect photolysis including redox reactions with oxygen (O2), photoreduction with hydroxyl radical (·OH), peroxyl radicals (HO2), photo-excited organic matter, and other reactive species. To evaluate these processes in a river, usually laboratory studies are conducted to understand the fate and behavior of pharmaceuticals in natural aquatic environments. However, field studies are essential to validate laboratory findings and to understand the complex interactions between pharmaceuticals and environmental factors such as sunlight, temperature, and flow regime. The paper focuses on the screening and phototransformation of pharmaceuticals in rivers, including the identification of phototransformation products and the assessment of their ecological impacts.
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 TP s was created and used to screen them in SPE-concentrated river water samples. For the generation of photo-TPs, reconstructed 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–HR–MS–MS and UPLC–Q–Exactive–MS/MS were used to identity photo-TPs. Several photo-TPs of our database were detected in the extracts of the surface water samples. Thus this approach highlights that UPLC–HR–MS 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. Quevedo, CSIC - Spanish National Research Council / Environmental Chemistry; M. Vila-Costa, B. Zonja, IDAEA-CSIC / Environmental Chemistry; N. Montemurro, IDAEA CSIC Barcelona / Dipartimento di scienze agro-ambientali e territoriali; S. Pérez, A. Martínez-Varela, IDAEA CSIC / Environmental Chemistry; D. Rivas, IDAEA CSIC / Environmental Chemistry; D. Barceló, 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 tank (ER) and in the effluent (ER). Anaerobic and aerobic samples were collected from the WWTP. The nucleic acids were extracted by phenolchloroform process. One microtitre of the extracted DNA was used to amplify the bacterial 16S rDNA by PCR. In general, composition of free-living bacteria was significantly different than polymer-attached microbial. Bacteriodia, Spirochaetes and unclassified bacteria co-dominated the free-living communities in AER and ANA, although metabolisms under oxic and anoxic/nitrifying conditions differ quite dramatically. Polymer-attached in the same waters were dominated by delta proteobacteria, a class of proteobacteria characterized by sulfate-reducing bacteria although also harbors aerobic phytophylotypes. Free-living microbial communities in IN were dominated by Bacteriodia, belonging to the phylum Bacteroidetes whereas their potential attached was dominated by Spirochaetes (a class of Bacteriodetes). Results suggest that polymers select specific microbial groups that benefit from consumption of PCLD that can be used as carbon and energy source.

140 Optimization of Laccase Catalyzed Iodine Synthesis as Enzyme Based Disinfectant

g. yuksel, Universite de Sherbrooke / Civil Engineering

In addition to traditional and new generation water pollutants, microbial contamination is still one of the major problems which has affected the potential recycle and reuse of wastewater for domestic or industrial use. Selection appropriate treatment approach has played an important role not just to reach discharge limits, it is also important to decrease human footprint in the environment. Some hydrolytic and oxidative enzymes (i.e., Laccase) is capable of oxidizing unreactive iodide to reactive iodine, when they can play roles to degrade recalcitrant pollutants in wastewater. The resulting iodine represents a powerful antimicrobial compound. The aim of this study is investigating the potential of actophenone and phenolic organic contaminant acetylampheno as mediator in a laccase mediator system to generate disinfectant iodine. The stability of reaction can be changed depending on the pH, temperature and multiple compound existence and system optimization is required to stabilize iodine synthesis. In this study, two different free laccases and insolubilized as cross-linked enzyme aggregates have been tested. Iodine synthesis is investigated with different KI (0.5, 1.0, 5.0, 10.0 mM) concentrations and different KPS activities (5, 10, 30 and 40 Unit/L) for 5 hours. Compounds were injected in distilled water as well as in the influent and effluent samples of wastewater treatment plants to see synthesis of iodine while the micropolllutants have been removed in Laccase Mediator System. In the experimental sets, removal of persistent compounds were determined by UPLC–HR–MS–MS and UPLC–Q–Exactive–MS/MS. Laccase-catalyzed disinfection effect of iodine measured by fecal coliform tests. 0.35 maximum mM/L iodine concentration could be synthesized during experiments. During iodine production, while phenolic compounds' concentrations were decreased (50% acetylampheno removal in real effluent wastewater treatment plant), removal of non-phenolic compounds such as naproxen were also observed (50%). The results have shown that the biocatalytic generation of I2 was possible using laccase-mediator system. Iodine production was affected by the initial laccase activity and mediator concentration. Laccase catalyzed bacterical activity in municipal wastewater was also assayed without the addition of any mediator assuming that wastewater already contains mediators such as acetylampheno. Using this system, non-fecal coliforms present in the tested wastewater were removed.

141 Halogenated methanesulfonic acids in drinking water - Identification, standard synthesis, and analysis

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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. Halogenated methanesulfonic acids (MSAs) are one of the most prevalent contaminants to be in the 100 ng/L range for some drinking water samples. Accurate quantification however, was hindered by the lack of commercially available reference materials. Thus, we synthesised chloromethanesulfonic acid, dichloromethanesulfonic acid, bromomethanesulfonic acid and bromochloromethanesulfonic acid as well as O-Trifluoromethanesulfonic acid (as internal standard) and included these analytes in a sample pre-treatment and hydrophilic interaction liquid chromatography – tandem mass spectrometry (HILIC-MS/MS) method dedicated to the analysis of very polar water samples. With this method, we monitored chlorinated and brominated MSAs throughout four drinking water treatment plants and in several tap water samples taken from high population areas in different countries.

142 Poster spotlight: MO272, MO273, MO274

Building of large-scale inventories of emissions and resources and applications for environmental footprints of territories, nations and sectors

A.S. Leidschendam, DTU / Management Engineering; S. Sala, M. Secchi, A. Cerutti,
European Commission Joint Research Centre / Bioeconomy unit; A. Laurens, 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 chemical substances are included in life cycle impact assessment (LCA) 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 increased availability 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, including both organic and inorganic 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 LCA 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. Beussier, INRA; E. Loiseau, 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 distributional outcomes in economic models and the two-way interactions in the input-output and environmental developments are required 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 (FFSM), 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 Life Cycle Inventories (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 value chains

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Keywords: 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 produce more regional and spatially representative life cycle assessments of biobased systems and bioeconomy regions. “RELCAs”, 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, illustrating 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 biodiesel 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 1.14-57.1 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 turbine’s life cycle impacts, including the manufacturing, transportation, installation, maintenance and dismantling of the plant, 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 product 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. Using LCA_WIND_DK, an up LCA model for Switzerland that is able to assess 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 LCA-model for Switzerland

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Besides governmental consumption, household consumption is the main driver of economy, and is thus ultimately responsible for the environmental impacts that occur throughout the whole life cycle of the product and services. 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
Mechanistic effect modelling 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
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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 ecosystem models with an initial 24 hour exposure period followed by six hour recovery in co-exposure and co-resistance. In this approach, TKTD model framework 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. 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. Furthermore, in other regions temperatures than 20°C, increased toxic effects on organisms are to be expected. We hypothesise that toxicodynamics of chemicals can be described and modelled by adding a synergy parameter α to the biotransformation rate constant for α-cypermethrin and that the value of this "synergy parameter α" will depend on the 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 than 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 predict survival of aquatic invertebrates as previously observed in D. magna.

150 Robust implementation of TKTD models with Bayesian inference
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The application of toxicokinetic-toxidynamic (TKTD) modelling 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 toxidynamics 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. Infor survival analysis of organisms in response to a chemical stress factor, the Generalized Unified Threshold model of Survival (GUTS) is today recognized as a suitable and powerful TKTD framework incorporating two complimentary death mechanisms: Stochastic Death (GUTS-SD) and Individual Tolerance (GUTS-IT), from which a large range of existing models can be derived. International governmental institutions as the OECD have acknowledged the necessity of TKTD models for ERA improvement, but while an integrative mechanistical 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 posteriors. nTo ease the access of Bayesian fitting of GUTS models based on ordinary differential equations, we compared several implementation of GUTS models. To do so, tools for the computational simulation have been developed, such as the widespread statistical language R (JAGS and Stan). Then, we embedded those 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 toxidynamics.
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 Pythreoid in rainbow trout

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Ecotoxicology

The study investigates effects of beta-cyfluthrin on juvenile rainbow trout (Oncorhynchus mykiss) using TK-7D 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 supports the investigation of the effects of a sublethal toxicity 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 is rapidly removed from the body and the fry have sufficient reserves 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

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To improve environmental risk assessment, mechanistic models predicting the impacts of toxicants on populations such as individual-based models (IBM) was suggested as relevant tools. Furthermore, IBM 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 on the organism’s physiology and how they relate to body size. To this aim, data from mesocosm experiments can be of great interest for developing and calibrating DEB-IBMs. One of the species that can be used in mesocosm experiments is the three-spined stickleback (Gasterosteus aculeatus). Furthermore, the ecology and biology of this telesiost fish is relatively well-known and a DEB model for this organism has already been developed. In this study, we used data from several mesocosm experiments to describe stickleback populations under control conditions, and exposed to three concentrations of an endocrine disruptor, the Bisphenol A (BPA, 1, 10 and 100 μg/L). First, using two set of experiments in control conditions, different ways of integrated temperature and food data was tested in order to assess the relevance of the DEB model calibrated with laboratory data for sticklebacks in mesocosms. Then, the DEB-IBM was developed and calibrated and simulated endpoints of the population dynamics in control conditions were compared to the observed endpoints of the population dynamics in control conditions or exposed to BPA. We showed that the DEB model successfully predicted the growth of male and female sticklebacks for two set of experiments in control conditions. Furthermore, the calibrated DEB-IBM successfully predicted endpoints of stickleback populations during mesocosm experiments in control conditions. Indeed, the different descriptive variables of the populations (population size, male, female and 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 Atmospheric Microplastics: A novel method for the identification of microplastics in the inhalable size range.

L. Xu in size range; MRC-Environ Centre &; E. Zimmer, INERIS / INERIS UMRI SEBIO ECOT; R. Beaudouin, INERIS / Models for Ecotoxicology and the internal METEO

Atmospheric Microplastics: Microplastics (μP) are a class of persistent omnipresent contaminants found in aquatic, atmospheric and terrestrial environments. Current investigations focusing on atmospheric microplastics (μP) have identified microplastics >6 μm in size. For atmospheric microplastics, it has been shown to have the potential to directly impact human health, research must now focus on the presence of μP in the inhalable size range (<10 μm). We present a novel analytical method compatible with the Multi-vial cyclone sampler (MVCS), for assessing whether microplastics down to an inhalable size range are airborne. An automated Raman Spectral Imaging (RSI) protocol has been developed for chemical analysis of bulk samples. This approach removes operator bias while allowing for the chemical identification of all microplastics (>3 μm in size in a sample. To validate RSI for the identification of microplastics (RSI analysis was conducted using an in-house protocol developed by Dr. Frederic Festy (KCL). Pre-identified features unique to polystyrene (1000.9 cm⁻¹; 1030.7 cm⁻¹ and 1602.1 cm⁻¹) were fit to the dataset using a Pearson-based cluster analysis to indicate spatial feature intensity (Imaged). The identification of 4 and 10μm beads was successful and an operator based particle count detected 163 particles per 100 μL; this resulted in an 85% recovery rate. However, 2μm polystyrene beads were not identified as they were found to be below the limit of detection. This automated RSI protocol facilitates the identification of microplastics >3 μm in size and inhalable size range. An improved identification rate could be achieved by eliminating the dilution step. This RSI protocol will be utilised for the analysis of samples collected from a month-long monitoring campaign at an urban background site in London, UK.

156 Analysis of polystyrene based microplastics in the environment

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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 fractions 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 methods for the quantitative and qualitative analysis of MPLs and 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) quantitative and qualitative information by techniques based on direct mass spectrometric as high resolution mass spectrometry with Electrospray Ionization (ESI), Atmospheric Pressure Chemical Ionization (APCI), 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-APPI-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

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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 mussel. Once ingested, MP may be excreted through defecation,
retained 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 vessel close to two nominal concentrations (2 and 4 mg 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 egested around 80% of the MP ingested. The highest volume of MP (Low and High MP dose, respectively) of microalgae (MA) (Isochrysis galbana, clone t-ISO) and MP (high-density polyethylene, HDPE) of similar size was collected after 24 hours of the exposure. Then, lower volume of MP was recorded in feces 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 pseudofaeces. 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 feces of larger MP particles and the retention of smaller ones in the digestive system.

159 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. Beyhan, TU Berlin / Department of Water Quality Control; U. Braun, BAM - Federal Institute Material Research and Testing / 5.3 Mechanics of Polymers Tire and road wear particles (TRWP) as environmental contaminants have received interest since the 1960s[1]. TRWP have adverse effects on human health[2]. Multiple cities in the EU are violating legal threshold values for atmospheric pollution to which TRWP contribute. Therefore, financial penalties as well as consequences like vehicle bans in metropolitan regions are discussed. TRWP can be regarded as microplastics, because the rubber component of TRWP is mainly polymer (natural and synthetic). With regional differences, the contribution of TRWP to the microplastics emissions to the environment can reach up to 60%[3]. Analysis of TRWP is challenging because of the high variance in compositions of the TRWP. Published analytical methods suffer from unspecific marker compounds, disadvantages of a definition. Further we will discuss our ideas on relevant definitions 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 providing a common language is valuable, any definition should be well-justified as it will ultimately shape 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 definitions and share our thoughts rather than providing definitive answers. In our presentation, we will use the advantages and disadvantages of a definition. Further we will discuss our ideas on relevant definitions and share our thoughts rather than providing definitive answers.

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; 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 providing a common language is valuable, any definition should be well-justified as it will ultimately shape 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 definitions and share 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 definitions and share 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 definitions and share 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 definitions and share our thoughts rather than providing definitive answers.

161 Behavioral and physiological responses of bicolor damselfish and mahi-mahi to offshore oil spills and fish offal lures J.D. L. Schlenker, RSMAS, University of Miami / Marine Biology and Ecology; J.W. Welch, James Cook University; M.J. Benetti, RSMAS University of Miami / Marine Biology and Ecology; M. Grosell, RSMAS University of Miami / Marine Biology and Ecology In fishes, flavor cues provide information about predators, prey, and conspecifics that is crucial to survival; however, olfactory sensory neurons are directly exposed to the environment and are susceptible to damage from aquatic contaminants. The 2010 Gulf of Mexico oil spill overlapped with the habitat of
pelagic and reef fishes, including mahi-mahi (*Coryphaena hippurus*) and bicolour damselshark (*Stegus 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 fluorescent system. Observations demonstrated that both LEWAF and CEWAF sample exposed mahi-mahi spent a greater proportion of time in crude oil than the control fish. It was observed that both LEWAF and CEWAF exposure resulted in higher micronucleus formation compared to the control exposed control. The CEWAF exposure led to the highest micronucleus induction occurring already at much lower exposure concentrations than used for LEWAF exposure. In general, it can be concluded that the mechanism-specific mode of actions estrogenic activity and genotoxicity can contribute to crude oil toxicity. Further investigations will include additional endpoints to generate a more comprehensive toxicity profile of the selected crude oil.

164 Impacts of Oil Exposure on Mahi Embryos

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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 maintenance of embryo buoyancy is crucial to survival, and aids in promoting dispersal by facilitating drift through ocean currents and positioning newly hatched larvae in the upper water columns where planktonic food is plentiful. We found that co-exposure to oil and additional environmentally relevant stressors, such as high temperature and UV-radiation, affect the timing and duration of negative buoyancy in mahi-mahi embryos. Furthermore, we have shown that the growth rate and buoyancy of mahi-mahi embryos are 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).

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

R.T. Heger, 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 in the Gulf of Mexico. Mahi exposed to environmentally-relevant crude oil concentrations have shown compromised intact animal performance, including reductions to maximal swimming speed and maximal metabolic rate. In addition, premature death has been observed in mahi-mahi embryos. Further, prolonged negative buoyancy was coupled with a ~40% reduction in cardiac output following oil exposure in mahi. Although cardioactive effects have been widely reported, the mechanisms underlying these responses remain poorly understood. In the present study, we examined the impacts of crude oil on isolated mahi heart cells to better understand these mechanisms. Contractility of mahi ventricular heart cells was measured via sarcomere shortening using an IonOptix cell recording system. The first objective was to examine contractility in isolated cardiac myocytes from mahi-mahi embryos. In previous studies, we have measured that the negative impact of crude oil exposure on intact animal performance results from a decrease in contractility. In the present study, we measured that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. In the present study, we measured that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility. Therefore, we hypothesized that the negative impact of crude oil exposure on isolated heart cells also results from a decrease in contractility.
166 microRNA and messenger RNA networks in early life stages of pelagic and nearshore fish species exposed to Deepwater Horizon oil
D. Schlenk, University of California-Riverside / Department of Environmental Sciences and Management; G. Xu, UC Riverside / Department of Environmental Sciences - Developmental cardiac phenotype is a common trait 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 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. miRNAs and mRNA were sequenced from the same pooled animals and expression compared using advanced bioinformatics with subsequent target organ predictions based on their comparisons. 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-15b (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-15b 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
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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 and indirect 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 4MBC, Carbendazim, Linuron and Triclosan, which have potential endocrine disrupting activity. High-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. Reports still show that there is still unclear whether in vitro assays and computational 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 (Onchorhyncus 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 excess toxicity and to accurately predict in vivo toxicity for most of the chemical MoA in the panel. Our results support the view that cell line has the potential to replace zebrafish embryo in toxicity testing.

168 Predicting in vivo toxicity from in vitro transcriptional responses following chemical exposure
D. Basili, University of Liverpool / Institute of Integrative Biology; M. Knobel, Eawag / UTOX; A. Sawle, Cancer Research UK Cambridge Institute / Department of Systems Biology; J. Hulbert, P. Anagnostidou, 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 (Onchorhyncus 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 excess toxicity and to accurately predict in vivo toxicity for most of the chemical MoA in the panel. Our results support the view that 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 this project, we propose that the chemical effects on cell population growth, measured over few days, can be used as proxy for chemical impact on fish growth, which needs weeks to occur. In particular, we linked information on the proliferation and survival of a fish gill cell line (in vitro) to the effect of chemicals on fish growth (in vivo). Research was divided into two phases. In the first phase, we have tested in vitro several chemical concentrations that correspond to those used in toxicological tests. In the second phase an in vivo approach was adopted: 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 stringent 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 Thresholds for Toxicological Concern (eco-TTC) - Applications for Environmental Risk Assessment in Various Contexts
M.R. Emby, 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. Beijer, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; M.A. Bonnell, Environmental and Climate Change Canada / Ecological Assessment Division; D.T. Chang, United States Environmental Protection Agency / National Exposure Research Laboratory; K.A. Connors, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization; D. De Zwart, DdZ Ecocentre for Sustainability 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.
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 the PNEC for exposed ecosystems based on depth and breadth of data. Several mode 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 dataset was transitioned from Microsoft Excel and Access into a modern MySQL format, 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 ecoTTC 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 of screening, chemical risk MoAs, site-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.

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

The identification 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 QSARs, 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 (e.g., chemical risk MoAs). For specific risk assessment, the detection of MoA-related endpoints has been discussed to improve its predictive capacity for acute and chronic fish toxicity, and for human developmental toxicity. We hypothesized that using a battery of endpoints in the zebrafish embryo test would allow to differentiate between baseline toxicity, formation of methemoglobin, neurotoxicity, heart rate inhibition, and developmental toxicity. Therefore, we compared the toxic ratios and endpoint-specific effect concentrations (EC50) of 12 compounds representing 5 broad MoA groups with 2, respectively 4 (neurotoxicity) compounds per MoA. In order to compensate for differences in the toxicokinetics and mortality, the effect concentrations were normalized by the LC50 of each compound. It was shown that the toxic ratio and effect concentrations for behavior, heart rate inhibition and chorda malformations were able to differentiate the selected compounds according to their anticipated MoA. Using a threshold for the normalized effect concentration a decision tree was developed that allowed to assign a MoA to a compound. A major bias of the selected approach could be the variability associated with visual phenotype assessment – which may depend on the experience and accuracy of the observer. Therefore, a software named FishInspector that enables a more unbiased assessment of malformation using images of zebrafish embryo. Using the software and a system for automated positioning of zebrafish embryos we compared the phenotypes of 25 compounds with known developmental toxicity outcome in rats and/or rabbits. In contrast to the previous analysis, we applied a different normalization approach based on the most sensitive endpoints. The analysis indicated that the developmental toxicity observed for inhibitors of cyclooxygenase may not be related to the pharmacological MoA, given the diverse phenotype patterns observed for this class of compounds.

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. Croning, 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 sufficient local food production, with an 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 measurable concepts allowing an economic assessment of the costs and benefits. 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. Ecotaxonomological 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.

183 Identifying ecosystem services-based protection goals.
L. 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, where and when they should be protected. But how do we go about identifying the services that we want to protect and how do we determine what level of protection is required? 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.

184 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 on 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: ie 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 there is a logarithmic relationship 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 to be based, it is recommended an expert judgement 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 species) of species potentially affected, and the frequency of occurrence.

185 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 state of the science on the risk assessment of plant protection products for non-target terrestrial plants (NTPPs) was published in 2014. The Opinion defines 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 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. However, options for achieving the in-field protection levels were identified as the wider use of non-selective pesticides. 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 well being. The issues outlined in this presentation will illustrate that the feasibility of protecting weeds in-field requires investigation of complex species definitions and agronomic consequences while the discovery and availability of new herbicides with the required selectivity is considered unlikely, particularly under the current regulatory framework in the EU.

186 Specific Protection Goals and the Assessment of Key Drivers in the Aquatic Environment: Are we doing the right thing?
R. Benstead, Fera Science Ltd., Centre for Chemical Safety and Stewardship; D. Phillips, Fera Science Ltd / Environmental Sciences; P. Gilbertson, Fera Science Ltd; J. Chinn, Centre for Crop Health and Protection (CHAP)

When designing High Tier Assessments, the underlying concept is a progression from simple and conservative laboratory exposures, towards those that more closely resemble the ‘Final Reference’ (the actual ecosystem), so that the risk assessment can be refined by reducing the Assessment Factor that accounts for uncertainty. In the aquatic environment, the focus of High Tier Assessments should not be on ‘specific Protection Goals’ (sPGs) defined for surface waters alone, but Ecosystem Services. Biodiversity is a common and important General Protection Goal, and Ecosystem Services, as they pertain to human health and welfare, are comprised of ‘provisioning services’ (e.g. drinking water), ‘regulating services’ (e.g. water purifying microbial communities), ‘supporting services’ (e.g. organisms contributing to nutrient cycling) and ‘cultural services’ (aspects of the water landscape that conserve species and promote well being). To this end, the EPA Guidance requires that a surrogate system for the Final Reference (termed 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 ecotoxicological and protecctive ecological data that are more directly relatable 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 risk assessment currently 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 biodevise aquatic communities that support the relevant ecosystem services. Perhaps in this context, the most important assessment end points are those that reflect the direct and round based effects, and those that preserve the biodiversity of aquatic communities that ultimately present the ‘target image’ and therefore closer relevance to the Final Reference.

187 Is “biodiversity” a measurable study endpoint?
E.M. Bakker, Eurofins-ILSI, Brussels

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 protection of pest control capacity outweighs the preservation of aesthetic value? Biodiversity is a concept with many facets and the quantification of biodiversity is rather 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 of biodiversity in experimental designs. With this contribution we explore different approaches to quantifying effects of biodiversity 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 microbiota for the setup of a site-tailored 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. Terzaghi, 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. Uhlík, University of Chemistry and Technology Prague; E. Zaccarelli, R. Morosini, University of Insubria / DSAF; A. Di Guardo, University of Insubria / Department of Science and High Technology; S. Borin, University of Milan / DeFENS

The Site of National Priority (SIN) 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 bioremediative potential of soil plant species, and to 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 assemblages. 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 autotrophic 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. Molecular fingerprinting showed that, with the 18-month biostimulated soil was incubated with 14C-labelled 4-chlorobiphenyl, the production of 14C02 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. Esposito, Università La Sapienza / Department of Earth Sciences; M. Carbone, P. Goria, J. Birstring, Regenesis Ltd; S. Rossetti, B. Matturro, Water Research Institute Italian National Research Council IRSACNR; M. Bacchi, P. Foglietto, Renato-Ferronieri Institute of Soil Science; and a Sapienza University 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 and characterized by a long-term historical activity (PCE, TCE and cis- and trans-DCE - concentrations ranged between 10-100 µg/L). The Italian environmental legislation is among the most restrictive in Europe with some of the most stringent target levels especially concerning the CAHs. A thorough investigation of the site has been carried out (geological, chemical and biological) and integrated with a microcosm study. Based on the results, biological reductive dechlorination was recognized as a potential approach for the site remediation but the extremely low CAHs concentration and the consequent kinetic limitation made it unfeasible for the site.

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 significant and differential reduction of target compounds 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.

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

A major share of world energy production, derives from fossil fuels, such as oil. According to OPEC (Organization of the Petroleum Exporting Countries), world oil demand growth is expected to rise by 1.53 mmb/d in 2017. The large-scale use and countless applications of petroleum compounds, frequently lead to environmental contamination, as a result of oil spills, accidents. Groundwater contamination by petroleum hydrocarbons is a serious problem, with nearly 50% of groundwater contamination being due to petroleum-derived products such as mineral oil, chlorinated hydrocarbons, monoaromatics (e.g., BTX) and polycyclic aromatic hydrocarbons (i.e., PAH). Accidental petroleum spills may result in severe environmental problems, thus requiring the development and implementation of suitable remediation strategies. In recent years, microbial electrochemical technologies (MET) have attracted considerable attention as an effective and sustainable remediation technique. In MET the microorganisms catalyze oxidation or reduction reactions by using solid-state electrodes as terminal electron acceptors or donors. The discovery that carbon-based electrodes can be used as terminal electron acceptors in the anaerobic oxidation of a variety of organic substrates has raised the possibility that they could be employed in-situ to accelerate the anaerobic oxidation of environmental contaminants, such as petroleum hydrocarbons in soils and groundwater. Here we describe a novel bioelectrochemical reactor configuration, named the “bioelectrochemical well”, that is suitable for in-situ treatment of contaminated groundwater. A lab-scale prototype of the bioelectrochemical well [1]” has been realized and operated in a continuous-flow regime using first toluene and then a mixture of BTX as model contaminants. The performance of the bioelectrochemical 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. This study was financially supported by Fondazione Cariplo in the framework of the project BE ERAGE - Biol-ElectroChemical RemediaTion of Groundwater plumes (2015-0195). [1] Palma E., Daglio M., Franzetti A., Petrangeli Papini M., Aulenta F. The bioelectric well: a novel approach for in situ treatment of hydrocarbon-contaminated groundwater. Micro Biotechnol., 2017: doi: 10.1111/1751-7915.12760.

191 Identification of major HMW-PAH degrading communities during active bioremediation of a PAH-contaminated J. Vila, Instituto de Recursos Naturales y Agrobiología; M. Grillot, Universitat de Barcelona / Dept. Genètica, Microbiologia i Estadística; M. A. Aitken, University of North Carolina / Environmental Sciences and Engineering; J. Ortega-Calvo, Instituto de Recursos Naturales y Agrobiología / Agroquímica y Conservacion del Suelo

Biodegradation of polycyclic aromatic hydrocarbons (PAHs) in soils is generally constrained by their low availability to microbial communities. As a result, a remarkable unproductive potential of PAH degradation at the lab scale is revealed, with a major composition in high molecular weight (HMW) compounds (four or more rings). We analyzed the active microbial processes associated with the dissipation of PAHs during a lab-scale bioremediation of a creosote-contaminated soil. Treatment under stimulated conditions resulted in an extensive reduction (93%) of the total PAH concentration. Low molecular weight (LMW) compounds (2 3 rings) were mostly depleted during the first month of incubation. In contrast, degradation of HMW-PAHs started thereafter following biphasic kinetics. Despite the 16S rRNA gene copy numbers (bacterial abundance) remained constant throughout the 5-month treatment period, the number of 16S rRNA gene transcripts (bacterial activity) dramatically increased (from 107 to 109 copies/g dry soil) during the initial 45 days, associated with major PAH removal. 16S rRNA gene pyrosequencing revealed distinctive profiles for total and active communities that evolved with time. Gene expression analysis of ring hydroxylating dioxygenases, together with changes in pyrosequencing libraries, identified members of Pseudomonas as the main LMW-PAH degraders. In contrast, dioxygenases of
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 Immobilesinosiibacterales and members of Sphingobium as the main active populations. Their role on HMW-PAH removal was confirmed by DNA-SIP. Members of Sphingobium formed major phylotypes associated with the activity, whereas members of Immobilesinosiibacterales were only detected in incubations with 13C-pyrene and 13C-benzo[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, when degradation kinetics were drastically attenuated, suggested their partial action on the residual fraction of contaminant.

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Stable Isotope Raman Microspectroscopy and Surface-Enhanced Raman Scattering: Analysis of Microorganisms at Single Cell Level
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Microorganisms play a vital role in most ecosystems. They are essential for global biogeochemical cycles and for biodegradation of soil and water pollutants. Therefore, it is crucial to develop reliable and sensitive methods for the detection, discrimination and identification of microorganisms as well as for analysis of their activity. Raman microscopy (RM) and Raman analysis (SIMS) in combination with a stable isotope approach (SIRM) is an emerging tool for the nondestructive characterization of the molecular and isotopic composition (due to a shift in Raman spectra for heavier stable isotopes) of microorganisms at the single cell level.1-3 SIRM allows for instudies investigations of ecophysiology and metabolic functions of microbial communities. Furthermore, the sensitivity of RM and SIRM analysis can be significantly improved (in the range of 105 – 106 max., up to 107) due to surface-enhanced Raman scattering (SERS), e.g. by using of Ag nanoparticles synthesized in situ. In contrast to RM and SIRM (where whole-organism fingerprints for bacteria are obtained), SERS is more selective and provides information on cellar surface substances. We applied SIRM and SERS for analysis of unlabeled, 13C- and 15N-labeled single bacterial cells.4-6 Single cell SIRM analysis was carried out for the Delagregatoebacterium sp. strain N47, a strictly anaerobic sulfur-reducer, degrading the recalcitrant environmental pollutant naphthalene. For the 13C-labeled N47 cells peak pattern from isopentanoids of phenylalanine with 0, 2, 4 and 6 13C atoms was found even though this strain is a strict anaerobe growing on 13C-naphthalene. Additionally, our results suggest an incorporation of hydrogen carbonate from the medium into biomass during growth of strain N47 on naphthalene. Furthermore, SERS analysis of E. coli revealed that the SERS signal intensity and the major peaks depend on different factors (storage time, presence of D-0) and can reflect the metabolic activity of cells. Our findings can open new possibilities for the application of SERS (in combination with a stable isotope approach) to probe for the activity of pollutant degrading microorganisms at the single cell level.1,2,6 Berry B, et al. 2015. Proc Natl Acad Sci USA 112: E194-E203. [2] Wang Y, et al. 2016. Curr Opin Biotechnol 41: 34-42. [3] Iwai A, et al. 2015. Anal Chem 87: 10336-10343. [4] Kubryk P, et al. 2015. Analyul Chem 87: 6622-6630. [5] Kubryk P et al. 2016. Analyst 141: 2874-2878. [6] Weiss R, et al. in prep.

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Flux chambers data for the estimation of the biodegradation rate in the subsurface at hydrocarbon contaminated sites
I. Verginelli, University of Rome Tor Vergata / Department of Civil Engineering and Computer Science Engineering; R. Pecoraro, Versalis; R. Bacigochi, University of Rome Tor Vergata

The occurrence of aerobic biodegradation in the subsurface by ubiquitous soil microbes has been observed in many cases eliminate the degradation of petroleum hydrocarbon vapours from contaminated soil or groundwater on outdoor and indoor air quality. The occurrence of natural attenuation in the subsurface is generally evaluated by employing multi-parameter approaches, which include the monitoring of contaminant concentrations in the source (soil and/or groundwater) and the effective emission rate of the contaminants measured using dynamic flux chambers installed at ground level. The reliability of this approach was tested in a versalis site characterized by the presence of BTEX in soil and groundwater, using dynamic flux chambers. The site is characterised by the presence in the subsurface (mainly in groundwater) of BTEX and light petroleum hydrocarbons. The flux of volatile organic compounds (VOCs) from the subsurface was estimated using 14 “dynamic” chambers, by measuring with a canister the concentration of vapours collected over a period of approximately 6 hours. Before starting the measurement, the achievement of steady-state conditions inside the chamber was assured by purging at least 4 chamber volumes of an inert gas. The measurement of sampling points were repeated for 4 seasonal campaigns. The obtained results highlighted that the traditional methods based on the application of a non-reactive diffusive model with the concentrations measured in the soil and/or groundwater can lead to an overestimation of the emission rates of BTEX from the subsurface in some cases up to 4 orders of magnitude. Furthermore, the BTEX loss rates for the investigated site were found to be up to almost 0.5 kg/year/m2. These rates are in line with the values reported in the recent literature for natural source zone depletion.

New frontiers in Life Cycle Inventory data collection and modelling

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The end of an era: is data and model exchange across LCA software tools finally possible?
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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 (EFPCRs) 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, RangleLCA, 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 suggestions to improve the models will be discussed. 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.
temporarily 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 (lUC) modelling in LCA since 2011 as part of a crowdfunding project. Recently, the model has been integrating into the multimodal 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 production plant, which are linked to the land use trends. The agricultural and land use module in EXIOBASE make use of FAOSTAT data, which provide time series on area and production per crop. The data allow modelling the global supply of land to the global market for land, distinguishing between land expansion (land transformation) and land intensifications (increased production per unit of land). The land transformation and intensification LCA activities are populated with data on carbon stocks of different land use types in all countries, and time series of fertiliser use in all countries. The current version of the model (version 4.3) includes the following elementary flows: emissions of CO2, N2O, NOx, NO3, NH3 and resource inputs of accelerated denaturation caused by transformation of land. The iLUC model can be combined with any life cycle impact assessment (LCA) 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.

197 WSmix: a globally regionalised Water Supply mix framework with current and prospective databases for use in LCA
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Water 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 objective of this work is to develop a WSmix framework for modelling current and prospective LCI (WSmix) and an inventory database for direct use in LCA. To demonstrate the relevance of including WSmix and P-WSmix in LCI databases, case studies have been conducted. To develop the WSmix framework, system boundaries have been defined and variabilities in classification and terminology of water sources and users have been harmonized. A global inventory database for various water-related users has been developed and a technological matrix has been established to link water sources to water production technologies and energy use. To develop the P-WSmix, a methodology based on algorithms enabling to obtain prospective WSmix (P-WSmix) is proposed. Data on water demand and water availability projections for different scenarios and time horizons have been used. The WSmix includes a framework, a WSmix database and technological matrix. The P-WSmix includes also a framework, a P-WSmix database and electricity mix and technology evolutions. The WSmix database covers 93 countries at different spatial scales for various users. The P-WSmix covers 73 countries at national scale for two users under different scenarios and time horizons. It has been shown that the environmental impacts of supply public water are highly dependent on the country and change over time. The inclusion of WSmix and P-WSmix in LCI databases is relevant for a more consistent water-use related impact assessment and for the LCA of infrastructures or products with a long life span.

198 The evolution of database- and tool development for Agri-footprint
B. Durlinger, L. Kuling, Blonk 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 Blonk 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: TU979, TU998

Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment
M. McCallum, Umea University; A. Sundelin, J. Fick, Umea University / Department of Chemistry; A. Alarain, 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 Sciences
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 ibesartan) commonly detected in the environment at two doses (80 ng/L, 1500 ng/L, 200 ng/L, 20000 ng/L for temazepam and ibesartan, respectively). We then assessed how exposure affected fish behaviour in the laboratory (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 assay. In contrast, fish exposed to ibesartan dispersed further downstream when compared to control fish. Ibesartan exposure did not affect fish behaviour in the field. Across all treatments, we also found that activity in the laboratory correlated with migration speed, indicating that fish that were more active in the laboratory also moved faster downstream in the wild. We discuss our findings in relation to differences in tissue bioconcentration for both pharmaceutical compounds in the marine tissue of fish in the field. We also report the first results on measuring how pollutants affect ecologically relevant behaviours in the field alongside standard and efficient laboratory assays.

200 Do laboratory assays predict behaviour in the wild? A study with pharmaceutical pollutants
M. McCallum, Umea University; A. Sundelin, J. Fick, Umea University / Department of Chemistry; A. Alarain, 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 Sciences
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201 Exposure to the widespread androgenic steroid 17β-trenbolone alters behaviour in fish
M.G. Bertram, Monash University / Biological Sciences; M. Saaristio, J.M. Martin, T.E. Ecker, C.P. Johnstone, B.B. Wong, Monash University / School of Biological Sciences
As a consequence, increasing amounts of pharmaceuticals are released into freshwater environments via runoff and leaching. 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 pharmaceutically 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.

204 Can personality influence the response to fish environmental contaminants?
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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 stressors? In this research, we aimed to determine how personality traits (i.e. shy-bold) could induce differences in the way individuals explore a novel environment and how such exploration of a novel environment into shy and bold individuals, and subsequently exposed during 90h to carbamazepine, a human pharmaceutical, suggested as a marker of anthropogenic pollution. Assessed responses included behaviour (distance swan, position in the tank and time spent swimming) and biochemical markers associated with oxidative stress, neurotransmission and energy metabolism. Overall, our results showed significant differences between control shy and bold organism with behaviour endpoints demonstrating to be very sensitive to stressor conditions. Although carbamazepine alone did not show considerable effects in the assessed endpoints, strong interactions were found between personality and pharmaceuticals, supporting further studies.

205 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 (WWTs), representing an exposure route to a range of contaminants including pharmaceuticals. The selective serotonin reuptake inhibitor (SSRI) fluoxetine is heavily prescribed and could induce indirect effects on WWTs. 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 to investigate the effects of fluoxetine exposure on 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 of 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.
indicating increased lethargy in the flouetine birds relative to controls. There was no clear effect of treatment on exploratory tendency. Finally, infrared thermography showed that flouetine-treated birds had significantly colder legs compared with controls. This indicated that, as observed in humans, flouetine 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 subtle 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?

206 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 largely 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 Dutch Environment Agency (EEA). For the more than 600 mostly industrial substances, including many detergent ingredients such as benzotriazol, 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 in the EU and the German environmental specimen bank (ESB). For the more than 600 substances. The monitoring programs considered in this study often include only a subset 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 rather 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 macroinvertebrate 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.

207 Threshold trends in wildlife taxa: challenging and evaluating our chemical- and environmental risk assessments of chemicals and their mixtures
L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; D. De Zwart, DiD 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 contextualising chemical and environmental risk assessments, as they enable relating predicted risks to observed 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 0EB, UK ajo@ceh.ac.uk Keywords: macroinvertebrates, biodiversity, wastewater, GAC Track 7, Session 7.2 Preference Platform

208 How much do improvements in wastewater treatment benefit downstream macroinvertebrate populations?
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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 winter 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 a correlation between parameters and this improvement in environmental quality. Based on time series of 20 years of biometric data of bream from multiple sampling sites of the German environmental specimen bank (ESB), we assessed which biometric parameters and indices of bream are suitable indicators for long-term changes in fish health and environmental quality. The length and weight of individuals of a defined age, hematocrit index and weight restriction the condition factor and lipid content of bream are reliable indicators for long-term changes of fish health and hence hint at long-term changes of environmental quality. We show examples for current trends of these indicators in German river systems. Our results confirm the high value of biometric parameters for monitoring of long-term changes in state and quality of aquatic ecosystems.

210 The burden of being a slow-life cycle species: freshwater fish population dynamics in France, correlations to species life traits and implications in ecotoxicology
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PoEcology, Environment and Health; D. De Zwart, DiD Ecotoc / Centre for Sustainability Environment and Health; J. Postma, Ecofide; M.C. Zijp, RIVM / Centre for Sustainability, Environment and Health
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 decrease observed. 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 pressures, which could 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 Center / Toxicological Centre Dep of Pharmaceutical Sciences; B. Hjort, Norwegian Monitoring; G. Malarvannan, University of Antwerp / Toxicological Center; J. Sondergaard, Aarhus University / Arctic Research Centre; K. Thorup, A. Tøttrup, 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 patterns here observed, present and future health risks. We have established a retrospective examination of Mercury (Hg) and several organohalogen 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 isotope ratios. 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 = 3.293 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. Stubblefield, 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 designated metals. The overall aim of this workshop was to evaluate the 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 expanded incorporation 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 specific models can be used to assess bioavailability. In toxicity and to which 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 seawa

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 Environment Limited; D. Smith, Wilfrid Laurier University / Department of Chemistry Nickel (Ni) toxicity in seawa is of increasing concern because of coastal Ni smelting and rising atmospheric Ni deposition. For Ni to be available to aquatic organisms, it should be in a form that can be taken up by cells. For Ni toxicity to be observed, the source of this protective effect (2) how geoichiometrically wide-spread protective saltwater sources are, and (3) to be able to predict Ni speciation and toxicity, are the objectives of this project. As a test of Ni toxicity protection by ligand complexation in saltwater media, defined solutions of artificial seawater (ASW) containing different model compounds (i.e. citric acid, EDTA, L-tryptophan, glutamic acid, and tryptophan) were titrated with ligands to determine the conditions for speciation. In all instances Ni speciation was determined in real saltwater 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 Ni⁺⁺ values were compared with model predictions (i.e. Visual Minteq) for evaluating the feasibility and applicability of the IET method for Ni in seawa. For the most part IET-masured [Ni⁺⁺] agreed very closely with model predictions. In the same 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 ([Ni⁺⁺]). If the Ni toxicity is explained by [Ni⁺⁺], all the toxicity response curves of different model ligands will overlap and this was in 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. Vercaigne, ARCHE; A. Peters, wca; C. Van der Veeken, NiPERA; E. Van den Aarde, NiPERA 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 the most relevant acute Ni toxicity data for predicting acute Ni toxicity for both model and non-model species and to demonstrate how they can be applied to derive 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 physio-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 pH effects on acute Ni toxicity to crustaceans very well, an “average crustacean” model was developed. The parameters for the 3 crustacean models were used 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 performed similarly. 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. Descoste, AREVA Mines / R&D; V. Lagneau, Mines ParisTech PSL Research University, Geoscience; W.J. Adams, Red Cap Consulting; R. Gensemer, GEI Consultants. 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 bioavailability of uranium in the larval of the non-biting midge Chironomus riparius exposed to specific mineralogical phases (pure Quartz (Q), 10% Kaolin/90% Q, 10% Smeectite/90% Q, 10% Ferrihydrite (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 larva Sediment to porewater partition coefficients (Kpw) range from 10 L/Kg for quartz to 60000 L/Kg for FOH. After ten days exposure, the highest Biota Sediment Quotient (BSQ) was found for magnesium (Mg), followed by (HR) Environmental regulations are becoming more and more ecosystems-oriented. These results are compared with the proposed regulations by IRSN on uranium sorption behaviour and chemical speciation in the aqueous phase. The irreversibility effects that the environment has suffered due to anthropogenic activity has reduced the availability of water for living beings, both in terms of quantity and quality. Industrial, agricultural, mining and urban development activities have in many cases led to the generation of pollutant discharges that threaten the health of our ecosystem. 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. cyanidation, cyanamidation, 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 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 to simulate the toxicity of the aquatic pressure of the activities carried out in the basin, which is predominantly dedicated to the extraction of gold. Artificial 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 flow. Through the ecological predictive model it was possible to determine the permissible levels of calcium in the rivers to improve the environmental condition of 30% 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

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Detecting nanoparticles 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 nanoparticles 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 crossflow ultrafiltration reduces the determined detection limits, and enables the identification of polystyrene for an original concentration of 20 μg L⁻¹ in an aqueous samples. Finally, we propose an approach to estimate polymer masses based on the two-dimensional microparticle fingerprinting and their distribution in the environment has intensified in recent years; but truly quantitative analytical, even at the bench scale, has remained elusive in part due to the analytical difficulties in detection. Synthesizing plastic particles with a metallic core, 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, polyethylene, polycarbonate, polyurethane and polyethylene terephthalate (PET) using GC-MS) can be combined and compared.

219 Trace particulate plastic analysis in environmental systems: synthesis and utilisation of metallic cores and micro-particles and microplastics in wastewater
F. Schmidt, M. Schmiederber, Eawag Swiss Federal Institute of Aquatic Science and Technology; D.M. Mitran, 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 analytical, even at the bench scale, has remained elusive in part due to the analytical difficulties in detection. Synthesizing plastic particles with a metallic core, 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, polyethylene, polycarbonate, polyurethane and polyethylene terephthalate (PET) using GC-MS) can be combined and compared.

220 Detection of polymers in treated wastewater using TED-GC-MS
C. Goedecke, C. Altman, Bundesanstalt für Materialforschung und Prüfung; C. Bannick, Umweltbundesamt; E. Köber, Technische Universität Berlin; M. Rieck, UBA Umweltbundesamt; T. Schmitt, Berliner Wasserbetriebe; U. Braun, BAM- Forschungszentrum, Institute for Testing / 5.3 Mechanics of Polymers
The presence of large quantities of plastic waste and its fragmentation in various environments 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 concentration 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 liquors 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 plastics, even at the bench scale, have remained elusive in part due to the analytical difficulties in detection. Synthesizing plastic particles with a metallic core, 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, polyethylene, polycarbonate, polyurethane and polyethylene terephthalate (PET) using GC-MS) can be combined and compared.

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
The very little existing work on the analysis 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 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 tests protocols; 2. Efficacy of reagents in reducing organic matter content in soil and sludge; and 3. Extractions of reagents in reducing organic matter content in soil and sludge. By using these materials, bench scale and pilot scale studies can be used as a bridge to understand the environmental processes that dominate (particulate) plastic fate, transport and interactions with biota until analytical techniques to measure native particulate plastics of small sizes and in trace concentrations have matured.

222 Mapping microplastics in sludge during a country-wide investigation of domestic wastewater treatment plants
A. Lusher, NIVA Norwegian Institute of Water Research / Marine and Freshwater Research Centre; R. Hurley, Nowegian 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 waste water and sludge 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 removal 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 – 9 837) or 1 176 889 particles m⁻³ (470 270 – 3 394 274). 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 low density (1 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 technologies. Based on this study and details on the application of sewage sludge in Norway, it can be estimated that approximately 446 billion 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.
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 experiment data to microplastic, covering different shapes (spheres, fibres, and irregular), microplastic classes into 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 waters 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

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We present the results of the first part of an experimental study carried out in an number of academic environments, ranging from small laboratories to very wide classrooms. The study was aimed to evaluate the mass concentration and the chemical composition of indoor atmospheric particulate matter (PM$\text{$_{2.5}$}$ and PM$\text{$_{10}$}$) and its relationship with a number of parameters. These include: concentration and chemical composition of outdoor particles, mixing properties of the lower outdoor atmosphere, volume and floor of the classroom, distance from the street, 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$\text{$_{2.5}$}$ samplings 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 sampling was performed during the winter SOP and during the winter part of the Long-Term Sampling. The composition of PM in the indoor environments was dominated by the organic fraction, with a relevant contribution of the bioaerosol, mainly in the coarse fraction. The infiltration of particles from outside constituted a significant source of inorganic species. A vertical gradient was observed for soil components. A relationship of the concentration and composition of indoor PM with the volume of the classroom, height from the ground, presence/absence of the students and distance from the street has been highlighted.

225 Source apportionment of major species and metals in PM$\text{$_{2.5}$}$ in urban sites under industrial influences in northern France

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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 territory of France 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 Giggit@ DAA80 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 (SiO, inland urban and industrial site). PM$_{2.5}$ composition was analyzed for major elements, trace elements and polycyclic aromatic hydrocarbons. 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$_x$, SO$_2$, NH$_3$ and TC were found as the major contributors of PM$_{2.5}$ (between 95% and 99%) and a wide range of differences were evidenced. Trace elements (Cr, Zn, Ni, As, Ag, Cd, Cu, Mn, Pb, V, Sn, Rh, Sr, Bi, Ba, Co, Si 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 their contribution to PM$_{2.5}$ levels. 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

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Partitioning of PAHs between the particulate and the gaseous phases strongly influences their fate and transport in the atmosphere 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 crops was modelled using an uptake model representing leafy vegetables, fruits and grains, 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). In case of exceedance, the deposition rates were iteratively adjusted until the calculated exposure equaled the TDI. Simulations were run for 16 priority EPA - PAHs + benzo[j]fluoranthene. For only 4 PAHs sufficient measurement data are available in the EFSA database to perform a reality check. Of these 4 carcinogenic PAHs, only the calculated exposure to benzo(a)pyrene exceeded the TDI with a factor 4, implying that current deposition rates might be too high. More deposition measurement data for B[a]P are required to confirm these results. (The authors thank the Flemish Agency for Health and Care for their support)

227 A bioassay-directed analysis as a biomonitoring tool to assess the endocrine-disrupting air microcontaminants

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Air quality is currently assessed by monitoring a few pollutants involved in the causation of several known health effects. It remains difficult to identify with any certainty the molecule responsible for a given biological effect, owing to human co-exposure to many bioactive micropollutants, which can also interact with each other. In this way, in vitro bioassays might be relevant biomonitoring tools to assess the air quality, as they integrate these “cocktail” effects. Furthermore, the pulmonary exposure to semi-volatiles endocrine-disrupting compounds (EDCs) may cause hormonal disruptions observed in humans, especially indoors where they spend 80% of their time. By using cellular bioassays, we have previously shown that bioactive EDCs tend to concentrate indoors, especially in the gaseous phase. The concomitant chemical analysis of a wide range...
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 building 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 initial organic 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 (estrogendicity measured by transactivation cellular assay). After applying various selection criteria for the quantified target EDCs in the separated 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.

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The Modifying Effects of Ambient Air Pollution on Indoor Air Quality, Impacts on Human Health
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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 expenditure, adverse health impacts (i.e., indoor air quality) can result from 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 represented the full spectrum of indoor air pollution imbalances, which is situated downstream of major industrial point sources. Indoor and ambient measurements of particulate matter (PM$_2.5$, PM$_10$), black carbon, ozone (O$_3$), total volatile organic compounds (TVOC), carbon monoxide, carbon dioxide (CO$_2$), relative humidity, and formaldehyde (HCHO) were collected on a seasonal basis. The heterogeneity in ventilation type along with the negative effects of deficiencies in heating and ventilation systems had on indoor air quality are distinct; however, the counterintuitive findings implied that green and naturally ventilated buildings underperform when compared to some of the conventional buildings within our study. The CO$_2$ sensors used in most green buildings respond to the number of occupants within a space but do not consider ambient concentrations of criteria air pollutants (i.e., PM$_2.5$, O$_3$, NO$_2$) before increasing outdoor air volume. Natural ventilation systems effectively supply 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 (overnight). To this end, with our limited sample size, our focus is on the concentration of PM$_2.5$, mass, ions, 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$_2.5$ mass concentration and its main chemical components in the area of Teramo, a urban/industrial hot spot situated in an intramountain depression of Central Italy. Lichen transplants have been exposed at the same sites of the samplers in order to evaluate the potential of lichens as biomonitor 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)
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Transgenerational effects of a parental exposure in the sentinel species Gammarus fossarum
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Since the 80's, 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 scare (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 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 outcomes 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 is currently in progress. References (1) Forbes VE, Calow P. Silby RM, 2008. The extrapolation problem and how population modeling can help. Environmental Toxicology & Chemistry 27:1987-1994, (2) Lacaze E, Geflard O, Goyet 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

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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 Chemistry; C. Vignet, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; D. Fedrizzi, Eawag, Swiss federal Institute of Aquatic Science and Technology; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences; J. Hollender, Eawag / Environmental Chemistry
Numerous micropollutants have been detected concurrently in aquatic systems, but little is known about the mixture effects of micropollutants in aquatic ecosystems. Due to their low bioavailability, the inhibition strength (IC$_{50}$) of azoxystrobin in the presence and absence of prochlozor, the inhibition strength (IC$_{50}$) of prochlozor, and its effect on the locomotory behavior of the two species. Bioaccumulation of azoxystrobin were similar in both species with bioaccumulation factors (BAFs) approximately 5 L kg$^{-1}$, while bioaccumulation of prochlozor was different in two species, with BAFs 57 and 110 L kg$^{-1}$ in G. pulex and H. azteca, respectively. Many biotransformation products were found for azoxystrobin in both species, of which curarine and azole conjugates were surgically identified in H. azteca. Most BTPs result from oxidation and conjugation reactions, which occurred at the (E)-methyl $\beta$-methoxyacrylate group of azoxystrobin and imidazole ring of prochlozor. Prochlozor 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 prochlozor IC$_{50}$, R. azteca was 0.1 and 0.02 µM in G. pulex

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The LC50 of azoxystrobin alone were 157 and 200 μg L−1 in G. pulex and H. azteca, respectively. Prochloraz significantly decreased the LC50 of azoxystrobin in both species. Video-tracking of the locomotory behavior suggested that prochloraz induced hyperactivity in G. pulex, but not in H. azteca. Overall, results suggests H. azteca comprise more diverse biotransformation reactions and G. pulex tended to be more sensitive than H. azteca toward prochloraz effects.

### 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, Université Lyon 1; **G. Ungherese**, Irstea Lyon / Laboratory Ecotoxicology; **N. Delorme**, K. PIavlaki, University of Aveiro / Department of Biology; **S. Lourei**, University of Aveiro / Biology Department; **R. Martins**, University of Aveiro / Biology Department; **A. Robinson**, 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 2 Widespread interspecific variation is observed in the sensitivity of soil invertebrates to chemical pollutants (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, Dendrobaena octaedra, Apporectodea caliginosa and Aminthys 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 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, biochemical 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.

### 233 Adaptation of Gammarus pulex to agricultural insecticide contamination in streams

- **N. Shahid**, Helmholtz Centre for Environmental Research UFZ; **J.M. Becker**, Helmholtz Centre for Environmental Research UFZ / System-Ecotoxicology; **M. Krauss**, W. Brack, Helmholtz 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 effects of contamination and may provide a first line of defense against future changes in chemical quality status assessment in European freshwater ecosystems. The use of bioassay approaches to monitor the effects of contamination has been proposed as a rapid method to assess stress caused by multiple stressors in natural ecosystems. Here, we show that Gammarus pulex, a dominant macroinvertebrate species in many agricultural streams, acquires increased tolerance to pesticides when re-colonization from non-contaminated recovery area is low. Populations in the field that were exposed to pesticides at concentrations several orders of magnitude below field-relevant concentrations showed almost 3-fold higher tolerance to the neonicotinoid insecticide clothianidin (mean EC50 = 218 μg L−1) compared with non-exposed populations (mean EC50 = 81 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 predicted to be safe by risk assessment models. Prochloraz induced hyperactivity in G. pulex -1. A. robinson1, (alorub@ceh.ac.uk), S. Short1, E. Laive, K. Pille1, K. Delorme1, J. Becker1, 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 2 Widespread interspecific variation is observed in the sensitivity of soil invertebrates to chemical pollutants (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, Dendrobaena octaedra, Apporectodea caliginosa and Aminthys 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, biochemical 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)

- **M. Santen**, 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. Their value to people is critical for system for water security. In the past decades Greenpeace did several investigations on persistent chemicals like pesticides and industrial chemicals polluting waterbodies. Producing our food within an agricultural system highly dependent on synthetic–chemical pesticides doesn’t come without consequences. The impacts of industrial agriculture like Apple and fruit production are widespread, ranging from contaminated soil and water, to impacts on bees and other beneficial insects, as well as on farmers, their families and consumers. Starting in 2011 investigations in the
context of Greenpeace’s detox campaign have 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 PFASs have been subject to increasing regulation. In 2015 Greenpeace conducted an unexpected survey in remote 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 wastewater, analysis revealed PFASs presence in all tested samples of rivers and drinking water collected in schools and public fountain. It is not too late to act – but new rules and regulations are needed. 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 is the go ahead 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. [1] https://gain.fas.usda.gov/Recent%20GAIN%20Publications/Fresh%20Deciduous%20Fruit%20Annual_Vienna_EU_27_10-28-2011.pdf [1] http://www.greenpeace.org/international/Global/International/publications/Toxics/Water/200101/dirty-laundry-12-pages.pdf [1] https://www.greenpeace.de/sites/www.greenpeace.de/files/2012/03-Toxic-Threats-China-engl.pdf [1] http://detox-toolbox.org/assets/uploads/Report%2028%20AR/RAE_report_08_2015_en.pdf [1] http://www.greenpeace.org/italy/Global/italy/report/2017/Inquinamento/PFAS-in-veneto.pdf [1] http://www.greenpeace.org/italy/Global/italy/report/2017/Inquinamento/Report_Non_ce_la_beviamo.pdf [1] 237 Benefits of international Science & Policy cooperation to promote a paradigm shift in water quality and safety assessment framework A. Fleischhauer, Institute for Environmental Research, 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. Meekor, Water Environment & Recovery 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 inclusion of individual components alone fail to achieve their contribution to contribute to surge 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 Austria, Europe and US recommend to incorporate predictive tools to regular framework. 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 cycle by targeting Water effect-based guidelines. Complementary tasks could be to discuss for example Science 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 characteristics 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 environmental status of waters. At the same time, the environmental authorities need to be continuously developed and supplemented in order to reflect new knowledge and best available technology regarding micro-pollutants. This also includes more holistic approaches for the assessment, monitoring and screening of chemicals. The review of the Water Framework Directive can provide a suitable window of opportunity in this regard as agreed by the European Water Directors in 2016. However, there are challenges regarding the inclusion of new approaches to a regulatory context. 239 Non-target Screening for Holistic Chemical Monitoring and Compound Discovery: Open Science, Real-time and Retroactive Approaches E. Schymanski, University of Luxembourg / Luxembourg Centre for Systems Biomedience (LCSB); R. Aalizadeh, National and Kapodistrian University of Athens / Department of Chemistry; N. Alygizakis, Environmental Institute; J. Hollender, Eawag / Environmental Chemistry; M. Krauss, T. Schulze, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; J. Slobodnik, Environmental Institute; N.S. Thomaidis, National and Kapodistrian University of Athens / Department of Chemistry; A.J. Williams, US EPA / ORDNCC Non-target screening (NTS) with high resolution mass spectrometry (HR-MS) provides unprecedented opportunities to detect new chemical hazards and effects on the environment 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 European OMAM Suspect and Fragmentation Database (http://www.norman-network.com/?q=node/236) and NORMAN Digital Sample 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-undefined 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 intractable 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 Biobanalical Ecotoxicology; S. Alt-Aissa, Institut National de l'Environnement Industriel et des Risques (INERIS); P.A. Behnisch, Biodeetection 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 / Biobanalical Ecotoxicology; S.E. Crawford, RWTH Aachen University / Institute for Environmental Research,
Anthropogenic and natural sources of environmental contaminants highlight the impacts of opposing and conflicting regulations.

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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; H. 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. Its use for crop protection industry (Targeted Metabolite 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 R53. 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 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 study 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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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. Chappelle, Bayer Crop Science; F. Teltesch, Bayer AG Division CropScience/Environmental Fate / Development Environmental Safety; O. Heinemann, Bayer AG Crop Science Division 1H-1,2,4-triazole (124T) is an ubiquitous occurring 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, replicate 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 top soils. This shows that analogous 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.
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. Kanne, Bayer AG Crop Science Division; D. Liss, SGS Institut Fresenius GmbH / Agrar; E. M. M. Blank, Bayer AG Crop Science Division / Environmental Safety; H. Borchers, Modelling; H. Resseler, Syngenta Agro GmbH; M. Schneider, SGS Institut Fresenius GmbH; H. Staudenmaier, BASF SE / Crop Protection, Environmental Fate

The triazole story: Differentiation between different 1,2,4-triazole fungicides, it was not possible to fully relate the detections to the specific fungicide before application of these fungicides, the known applied fungicides and fertilizer 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

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

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Relevant amounts of trifluoroacetic acid (TFAA) are formed in the atmosphere by photochemical transformation of several refrigerants and subsequently introduced into the aquatic environment by wet deposition. TFAA 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, especially by the European Union. Furthermore, TFA is a by-product of the biodegradation 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 Rhine tributary. Extended monitoring demonstrated that this contribution still implies 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.

Persistencia & Biodegradation Assessment

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

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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 Texan or passive sampling, methods also subject of standardization and 2) specific methods suitable to deeply characterize phase exchange with liquid mixtures and 1C-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. 48:10669-10677, 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 radiorespirometry and dual 1Cresidue analysis (Environ. Pollut. 159:3692-3699, 2011). In spite of these advancements, significant gaps of knowledge exist between bioavailability 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

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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 bioremediation systems necessitates a better understanding of how plant performances are affected by operational and environmental parameters, such as temperature fluctuations (e.g. daily and seasonal). Currently, environmental exposure assessment uses Arthenius-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 validity of such models, by exploring the effect of short-term temperature variation on micropollutant biotransformation in an aerobic sludge community. Laboratory batch reactors were seeded with activated sludge from a Swiss full-scale treatment plant and the biotransformation of 93 target micropolllutants (65g/L) was monitored over time at five different temperatures (4-4°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 rates. Inhibited compounds included very hydrophobic compounds. 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 Arthenius-behaviour over the 4-40°C range, the biotransformation rates may be linked to basic living cell function and less sensitive to temperature fluctuations. Our study highlights limitations in the applicability of Arthenius-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

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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, whereby 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 centrifugal 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 (sediment-degradable, a negative reference compound (pentachlorophenol) and three compounds with variable reported degradation (4-nitrophenol, triethanolamine and hydrolysed polycyclic) 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, in 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. Hennecke, Fraunhofer IOME - Institute for Molecular Biology and Applied Ecology / Ecological chemistry; M. Kruse, Fraunhofer IOME - 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 water like direct and indirect photolysis are not addressed. Since biodegradation is limited in the OECD 309 study, the consequences are critical for substances which are hydroxylactably stable but sensitive to light. Within pesticide regulation direct photolysis studies are mandatory, indirect photolysis studies optional. In natural waters, which have to be used for OECD 309, both processes are relevant for photolytically instable compounds. Hence, beside direct photolysis in the upper layer of a water column, it is interesting to know until which water depth indirect photolysis might contribute to degradation since the light intensity decreases with increasing water depth. A simulation approach has been performed considering the major conditions required in OECD 309 but at a much larger scale. Stainless steel containers of 900 litre volume are filled with surface water taken from a natural lake and maintained at 20°C. The geometry of the water column is 140 cm and a surface area of 0.70 m2. In contrast to OECD 309 the system is exposed to simulated sunlight and the water is not mixed by stirring or shaking. Sampling is performed in 5 different water depths using permanently installed steel tubes of different length in order to avoid mechanical mixing of the water body by the sampling procedure. A second container with same test setup but equipped with a lid of stainless steel served as dark control. The test is conducted as both pelagic and suspended-sediment setup. Test substance was 14C-pendimethalin, which is known to degrade rapidly in aqueous systems under the influence of light. The purpose of the test was to determine if photolysis is a relevant process in natural water bodies under OECD 309 test conditions and up to which water depth this can be applied.

253 Poster spotlight: TU267, TU268, TU269

54 SETAC Europe 28th Annual Meeting Abstract Book
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

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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 detect shortcomings and underlying indicators. 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

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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 Recycling Utilization Score (MRS), included in the Cradle to Cradle® certification program; ii) the Material Circularity Indicator (MCI) developed by the Ellen Mac Arthur Foundation and Grant 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) method is applied. 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 MCDA 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) are 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 MCDA 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

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Identifying a suitable allocation procedure is always a challenge in the modelling of the system boundaries. This fundamental choice is often minorised when focusing on 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 the LCA study goal, several LCA types and combinations 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 and criteria 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 visible. The production phase of the laptop is modified to reflect a closed loop for recovered materials. 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 at the highest level possible. The laptops are then processed in a demanufacturing line followed by depollution step followed by mechanical treatment. The end-processing is modelled assuming remelting in an average European electro furnace, aluminium production site and subsequent smelting and refining. In the third scenario, a second life of 3 years is assumed for the repaired laptop. The main environmental impact of the repair activity is the replacement of components. It is assumed the laptop requires a new hard disk drive and a new battery. No additional transport is assumed for self-repair. At end of life the laptop is assumed to be recycled, as described above. The case study presented in this paper indicates that repair of laptop’s should be considered before discarding for material recycling. The potential benefits of material recycling for high-end or closed loop applications remain limited. If the extended life is at least 2 years, the number of components to be replaced considered in this case study does not impact the decision making. The results also show that increased energy efficiency of new products has a limited impact on the overall results.

257 Sustainability assessment of product lifetime extension through increased repair and reuse

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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 at the highest level possible. The laptops are then processed in a demanufacturing line followed by depollution step followed by mechanical treatment. The end-processing is modelled assuming remelting in an average European electro furnace, aluminium production site and subsequent smelting and refining. In the third scenario, a second life of 3 years is assumed for the repaired laptop. The main environmental impact of the repair activity is the replacement of components. It is assumed the laptop requires a new hard disk drive and a new battery. No additional transport is assumed for self-repair. At end of life the laptop is assumed to be recycled, as described above. The case study presented in this paper indicates that repair of laptop’s should be considered before discarding for material recycling. The potential benefits of material recycling for high-end or closed loop applications remain limited. If the extended life is at least 2 years, the number of components to be replaced considered in this case study does not impact the decision making. The results also show that increased energy efficiency of new products has a limited impact on the overall results.
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 automatized 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 dirt 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 nutrient sources need to be optimized. In this sense, different literature entries show that half of the currently economic 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 pellets (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

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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. 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. The presented method is used to evaluate chemical recycling technologies for polyethylene terephthalate (PET). In this case study, we show the 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 eq. 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

260 Substitution of PFOS under the Stockholm Convention


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 delay in the evaluation process of new principles in order to facilitate a total phasing 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 insect bait 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 new applications will be added in the near future. 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 baits to deliver data on production and use and monitoring data on emissions at the points 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"

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Within the research project SUPFES (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 identify feasible alternatives solutions. The SUPFES SIP model includes 1) characterisation of PFAS in use and efficiency assessment of selected consumer products 2) initial alternative selection based on matching function criteria and toxicity and exposure assessment and 3) final selection of alternatives underlying environmental impact and technical performance assessment for specific scenarios. The SUPFES 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 and chemical alternatives assessment complement our previous hazard assessment, we have conducted an LCA to evaluate chemical alternatives assessment - the case of per- an polyfluoroalkyl substances in textile applications

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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 improved in recent years, and life cycle assessment (LCA) and life cycle thinking are part of the more comprehensive CAA methods available. 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 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
functional basis. Based on this case we were also able to further elaborate on the inclusion of the life cycle perspective in a CAA framework by identifying both possibilities and challenges. We conclude that the inclusion of a life cycle perspective in CAA is crucial for an informed and sustainable substitution, as lack of life cycle thinking can lead to problem shifting. We show that LCA, with its focus on function, is a tool that can identify such problem shifting as well as the key chemical properties to be considered. These toxicological effects in such cases can however turn out to be difficult, especially for substances such as the PFAS as they are outside the domain of the LCIA model. In the case under study here we conclude that the DWR should be selected with three main considerations: (i) the intrinsic hazard properties of the chemistry, selecting the DWR associated with the lowest hazard but, (ii) providing the functionality as needed and, (iii) giving the garment the longest life length.

263 How much function do we need in textiles? Strategies for replacing PFAFs based on end-user requirements

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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 (PFAAs), a variety of new DWRs have been developed including biodegradable materials that are based on renewable resources and their unique properties to provide substantive 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 outline the different requirements in case studies for functional outdoor clothing and occupational 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 properties provided through established method 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 reduces the surface repellency, but also 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

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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 common alternative; others 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 more deciding 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

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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 in 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 heath 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 applications is challenging. Case studies will be used to help illustrate 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

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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 30000 sites, an 14000 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 ecotoxicology database (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.
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 for human and cancer and non-cancer endpoints. For PEF these 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 (305'068 test results) and human toxicity data (41'381 test results) available in the IUCCLID 5.5 database (as of May 2020). To implement the USEtox model, we had to build code in step wise manner until we obtained the desired selection without impacting the structure of the original file. 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 IUCCLID database contained about 7'500 substances covering both 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
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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 yet to be critically evaluated. We 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 IUCCLID database contained about 7'500 substances covering both 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
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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 chronic 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 (used within 48 h of hatching) or nauplii (less than 24 h old) from Daphnia magna or D. longispina, or even Acartia tonsa naupli. 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 analysis of the dataset. 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 eusensitive to Daphnia and should fulfill invertebrate regulatory toxicity requirements
K.A. Connors, S.E. Belanger, The Procter & Gamble Company / Environmental Stewardship and Sustainability Organization;
The OECD 202 Acute Daphnia Immobilization Toxicity 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 studies. Then, simply present the battery of exposures (mixed species or single) to the 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 this device in bioassays do 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.

271 Poster spotlight: TU001, TU002, TU003
Environmental effects of metals: Improvements to risk assessment by considering speciation and bioavailability (II)

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environmental realism of laboratory toxicity studies.

274 To leach or not to leach: Soil enzymatic responses to metal mixture species

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University of Saskatchewan / Department of Soil Science; B.A. Hale,
University of Guelph / School of Environmental Sciences

Presentation Type: Presentation preferred Abstract Title: To leach or not to leach: Soil enzymatic responses to metal mixture species Authors: F. K. Awuah, B. Hale and S. Siciliano, University of Saskatchewan, Toxolgy Centre.

University of Guelph, School of Environmental Sciences. Abstract: In soil laboratory experiments, metal mixture studies are usually carried out with metals dosed as salts, followed by leaching with artificial rainwater to remove excess salts. In the leaching process, metals are lost unequally, which affects the ratio of the mixtures in the soil. An efficient way of carrying out metal mixture experiments is by using the fixed ratio ray design. This design reduces the amount of experimental effort and allows the estimation of both additivity and interactions. In using this design, metal concentrations should be fixed in specific ratios, but this is compromised when soils are leached. Hence, an alternative method of dosing that allowed fixed ratio testing had to be determined. Two proposed alternatives were metal oxides and spinel minerals which were both abundantly found in aged salt spiked soils and field metal contaminated soils. The toxicity of the oxides and minerals to soil enzymes were tested and compared to the salts. The experiment was conducted with three Canadian soils (pH: 3.5-7), three metal species, five fixed metal mixture rays, and five metals (Pb, Cu, Co, Ni, Zn) at one dose. The activity of the soil enzymes ammonia monooxygenases, beta-glucoisidases, acid-phosphatases and arylsulphatases were determined colorimetrically. Results showed that leaching alone significantly inhibits the enzyme amniota monooxygenases in all three soils. The response of acid phosphatases to the metal mixture rays followed known paradigms of bioaccessible concentrations defining toxicity. However, the response of ammonia monooxygenases followed a pH-dependent hormetic toxicity across the three soils. Here, ray toxicity was highest in the soil with a pH value of 5 and vice versa for pH 3 and 7. Generally, metal salts were the most toxic form, and the spinel minerals were the least toxic. Metal oxides were chosen as a replacement for carrying out metal mixture studies in soils because no leaching was required and it was more toxic than the minerals. Keywords: Fixed ratio ray, metal oxides, spinel minerals.

275 Soil moisture influences the avoidance behaviour of Folsomia candida and Enchytraeus crypticus in metal(loid)-contaminated soils

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This study aimed to assess the effects of soil moisture content on the avoidance behaviour of the soil invertebrate species Folsomia candida (arthropod) and Enchytraeus crypticus (soft-bodied oligochaete) in metal(loid)-contaminated soils. Two metal(loid)-contaminated soils from Central Portugal were selected as test soils (mining soil with pH=5.9; agricultural soil with pH=4.8). Avoidance behaviour was evaluated in two-section vessels for 48 h at 20 °C. F. candida did not avoid both metal(loid)-contaminated soils when tests were performed at the same soil moisture content (expressed as soil water holding capacity, WHC): 50% (standard conditions), 75% (to simulate floods) and 25% (to simulate droughts). Different soil moisture content combinations were tested (test soil WHC vs. control soil WHC): 1) 50% vs. 50%, 2) 75% vs. 75%, 3) 25% vs. 25%, 4) 50% vs. 75%, 5) 50% vs. 25%, 6) 75% vs. 50%, 7) 25% vs. 50%. Porewater metal(loid) concentrations were analysed by ICP-MS in soils incubated at 50%, 75% and 25% WHC for 48 h at 20 °C. Soils incubated at 75% WHC had higher porewater metal(loid) concentrations than those moistened at 50% and 25% WHC. This was more pronounced in the agricultural soil (e.g. 2-50 fold higher Mn, Ni and Pb concentrations at 75% soil WHC). F. candida did not avoid both metal(loid)-contaminated soils when tests were performed at the same soil moisture content in test and control soils while E. crypticus did, but only at 50% soil WHC (low avoidance). Vanaja et al. (2012) showed that when test and control soils the behaviour of both invertebrate species was mainly controlled by soil moisture content. F. candida had a preference for soils moistened at 50% WHC, regardless the soils were contaminated or not. E. crypticus avoided both metal(loid)-contaminated soils in all the soil moisture combinations tested (~10-100% avoidance), except when the control soil was at drier conditions than the test soils. The present study showed that, pH-porewater metal(loid) concentrations increased with increasing soil moisture content, especially in soils with higher acidity; 2) F. candida and E. crypticus differed in their capacity to avoid metal(loid)-contaminated soils; 3) F. candida preferred soils moistened at 50% WHC, regardless soils were contaminated or not; 4) E. crypticus could avoid metal(loid)-contaminated soils but its capacity was highly dependent on soil moisture conditions.

276 Manganese bioavailability in legacy contaminated soils by medieval
metallurgical wastes
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In this study, deposits of the slag were contaminated 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 Bibracte. Preliminary analyses highlighted anomalous manganous (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 interdisciplinarity and complementary approaches: i) mineralogical characterisation of slags (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 toxicokinetics (28 days in Cantuares aspernas 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 ranges 4.5% to 6% MnO. With time, slag weathering, as testified by the formation of brown smelting ash, lead Rodrigo, Universidade de Aveiro / CESAM & Departamento de Química; L.A. Tarelho, Universidade de Aveiro / Department of Chemistry; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; N. Abrantes, University of Aveiro / CESAM/DAO; A.M. Goulavles, MARE, Dep. of Life Sciences, University of Coimbra/ 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 microplastics (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 Antua 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 143 ± 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 contaminated 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 Aguincheira, 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 lower medium high oxidation ratio for the MP particles were 54.38% and 38.39% 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 Aguincheira and Estarreja in water and sediment samples, respectively. Since Portugal is the 12th country in Europe with the highest plastics demand (~1 nt) 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 carriers of MPs within environment. Further studies should be performed to identify point sources in order to mitigate the MP contamination in aquatic systems.
279 Microplastics in German rivers - first monitoring results
M. Hess, LANUV NRW / Water management, water protection; C. Latorsch, University of Bayreuth; P. Diehl, State Environment Agency Rhineland-Palatinate; H. Imhof, University of Bayreuth / Animal Ecology I; M. Loeder, University of Bayreuth; J. Mayer, Hessian Agency for Nature Conservation, Environment and Geology; H. Rahm, North Rhine-Westphalia State Agency for Nature, Environment and Consumer Protection; W. Reichenhäuser, Bavarian Environment Agency, Wielenbach; I. Schrank, University of Bayreuth; J. Stark, State Institute for Environment, Measurements and Nature Conservation Baden-Württemberg; J. Schwaiger, Bavarian Environment Agency / Aquatic Toxicology and Pathology Plastics 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 degradation. 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 harmonized in terms of sampling and processing and analytical procedures. 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. Material extracted in terms of mass (% of MPs) and chemical properties 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 fluviatile systems regarding the number of sample sites and the analytical accuracy. Excepts of the study, focussing 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.

280 Exploring the relation between plastic concentration and river discharge in an urban river
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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) upstream (P1) and downstream (P2) of an inflow from two different 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.

281 Microplastic pollution in upstream river catchments
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Microplastic particles (< 5 mm) are known to pollute large lakes and river systems globally. However, there is a dearth of data associated with wastewater treatment plants and centres of population and industry. However, the extent to which they pervade upstream catchments is comparatively underrepresented in the study of freshwater microplastic pollution. Results presented here form part of a year-long project that aims to quantify the spatial and temporal variation of microplastic pollution in rural headwaters and urban rivers that do not receive wastewater treatment effluent according to England’s Midlands, as well as in atmospheric fallout. FTIR analysis of three months’ samples identified microplastic particles in 30 litre water samples taken from the headwaters of the River Trent and its tributaries. It has also been used to identify non-fibrous microplastic fragments in rural and (sub)urban atmospheric fallout. Moreover, spherical particles that resemble those used in cosmetic / personal care products have been identified in rivers that do not receive wastewater treatment effluent, some of which have proven not to be polymer following FTIR analysis. This brings into question the source, and chemical composition, of spherical particles that have previously been visually identified as plastic spheres likely derived from cosmetic particles. The findings of this study have identified the need for the more extensive consideration of upstream catchments and reaches of rivers not in the receive wastewater treatment effluent in the study of freshwater microplastic pollution. The work conducted here suggests that, though wastewater treatment facilities and large centres of population and industry are suitable predictors of microplastic pollution, the cumulative contribution of headwaters and tributaries are likely to influe a river’s microplastic load.

282 Microplastics in stormwater ponds
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Stormwater runoff contains pollutants from land surfaces. As the majority of production and consumption of synthetic polymers is happened on land, microplastic (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 steel filter. Sediment samples were collected using an Ekman bottom grab sampler. The filters from the water samplings were pre-oxidized by 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 hydrolysis. Inorganic materials were reduced 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 final presentation. Nevertheless, the water samples have shown that stormwater pond do not detain all MPs, particularly for low-density polymers. With the high mobility, discharges from stormwater ponds will potentially affect adjacent environmental compartments.

283 Towards a more realistic assessment of microplastics as pollutant transporter: a combined experimental and modelling study
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Freshwater environments are contaminated with various compounds. In such systems, hydrophobic organic contaminants are often associated with particles such as microplastics (MP) which are ubiquitously detected and have raised concern. The release of pollutants from such particles is a combination of two different diffusive fluxes. External mass transfer governed by diffusion through an aqueous boundary layer on the one hand and internal mass transfer limited by the interparticle diffusion coefficients on the other hand. Both mechanisms control the kinetics depends on various factors, such as partition coefficients, particle properties, boundary conditions, and time. The aim of this study was to identify if and how observations of pollutant release from MP under laboratory conditions can be transferred to field conditions. We formulated a coupled mass-transfer model to consider both, external and internal mass transfer, and tested it against an analytical solution via Laplace transformation. For model evaluation, we performed batch experiments with different wastewater contaminants with varying hydrophobicity and at different amounts of dissolved organic matter, which changes the overall partitioning between the MP and the water phase. We measured equilibrium partition coefficients and release kinetics over 240 hours. Based on experimental data and the analytical solution of the model, characteristic times of mass transfer were calculated. These are proxies for the equilibration time and can be used to assess the relative importance of the two mass-transfer processes. Results show that, mass transfer for hydrophilic compounds usually is limited by intraparticle diffusion whereas for hydrophobic compounds it is externally limited. For intermediate compounds, a shift from internal to external dominance was observed. Calculated characteristic times show that under lab conditions the overall equilibration time decreased with increasing partition coefficient while under field conditions the opposite is the case. Thus, a simple first-order approximation of mass transfer would not be enough to transfer experimental results to field conditions adequately. Rather, it is necessary to consider true intraparticle diffusion. Application of our model to different particle sizes, shapes, materials and for varying particle concentrations underlines the fundamental differences between lab and field and allows the transferability between these different boundary conditions.

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284 Analysis of the contribution of a coal-fired power plant to PM10 concentrations in four sites in Southern Italy
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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 SSO 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 (CL), Torcariello (TR) and Lecce (LE). The Lecce site is also included in the Observatori CNAO of the Global Atmosphere Watch (GAW-WMO) program. Daily PM_{2.5} samples were collected at 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, CL, TR) and on 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\textsuperscript{-}, NO\textsubscript{2}\textsuperscript{-}, SO\textsubscript{4}\textsuperscript{2-}, Na\textsuperscript{+}, NH\textsubscript{4}\textsuperscript{+}, K\textsuperscript{+}, Mg\textsuperscript{2+}, Ca\textsuperscript{2+}; the elements Al, Si, Ti, V, Mn, Fe, Ni, Cu and Zn. Measured data was used for source apportionment of PM\textsubscript{2.5} based on a receptor-oriented model approach that integrates the results obtained using positive matrix factorization (PMF) via Meva (300-10187 Rome, Italy); E. Cordelli, G. Rasciutti, ENEA; positive matrix factorization (PMF) via Anguillassiere, 301, 00123, Rome, Italy; A. Malaguti, E. Petralia, ENEA; positive matrix factorization (PMF) via Met-INAT Via Martiri di Monte Sole 4, 40129 Bologna, Italy; T. L. Torretta, M. Raccugliasan, ENEA; M. Manigrasso, INAIL / Department of Technological Innovations, Via Novembre 144, 00108 Rome, Italy; A. Wiedensohler, Leibniz Institute for Tropospheric Research / Permoserstrasse 15, 04318 Leipzig, Germany; G. Cremona, ENEA; K. Weinhold, Leibniz Institute for Tropospheric Research / Permoserstrasse 15, 04318 Leipzig, Germany; M. L. Di Liberto, CNR / ISAC - Italian National Research Council, Institute of Atmospheric Science and Climate, Rome, Italy; C. Consales, ENEA; positive matrix factorization (PMF) via Anguillassiere, 301, 00123, Rome, Italy; M. Berico, ENEA; positive matrix factorization (PMF) via Met-INAT Via Martiri di Monte Sole 4, 40129 Bologna, Italy; M. Aufderheide, CULTEX LABORATORIES GmbH / Feodor-Lynen-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 500,000 premature deaths mainly due to non-communicable diseases and disabilities. The epidemiological associations have already evidenced significant relationship between increases in risk factors for selected human diseases and air pollutants concentration. Finally IARC has classified outdoor air pollution as carcinogenic to humans (Group 1).

Air pollution and health: early biological effects in children exposed to air pollutants and genotoxic effect of PM_{0.5} in different Italian towns

S. Bonet, 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 Medicine and Surgical Specialties Radiological Sciences and Public Health; F. Alliot, EPHE / UMR Metis; E. Escat, N. Dufour, B. Rocq, INAT Via Martiri di Monte Sole 4, 40129 Bologna, Italy. The atmosphere is the main environment with which humans have the most important exchanges. However, human activities (industrial, road traffic) are a primary matter but also a necessary condition for a human population. The atmospheric conditions are made this experimental set up feasible. The aim of the project was to assess the genotoxic effect of PM_{0.5} on human cells in vitro (2.5, 0.5) and to obtain an estimation of its contribution to secondary sulphate. Therefore, few data exist on air contamination by endocrine disruptor compounds (EDCs) in France. With the experience acquiring in Paris region in a previous research, 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 (10 EDCs were analysed by LC-MS/MS. GC-MS/MS in gasous and particulate phases separately. Whatever the site, in outdoor air as well as in indoor air, EDCs were detected and concentrations range from 33 553 to 0.001 ng/m\textsuperscript{3}. 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. Therewith, two different health impacts can be considered, i.e., potential alterations on health and potential genotoxic impacts. The most of the studies reported on potential sources of emission, on activities inside the building and urban density. For example, phthalates concentrations are linked to consumer products, building materials, furnishing… PAHs are coming from residential and tertiary heating and from road transport; alkylphenols and musks from detergents. Excepted few specific sites, the EDCs concentrations in air in the North part of France are in the same order than those in Paris region. In conclusion, the air contamination by EDCs is becoming a sanitary concern because French people spend 80% of time in indoor environment and young children, a particularly sensitive population, are the most exposed.
implementing policies of public health protection.

288 Source apportionment of PM near steel plant by electron microscopy
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Source apportionment based on bulk chemical analysis often uses advanced statistical tools for a detailed source categorization. In contrast, in this study the source apportionment is based on properties of individual particles determined by scanning electron microscopy with energy-dispersed spectrometry (SEM-EDS).

The receptor site is located near a steel plant in the Apulia Region, South Italy. A total of 5000 particles were analyzed by SEM-EDS and based on the morphology and chemical composition they have been classified into the following main groups: Aluminosilicate particles; Silicium reach particles; Ca-rich particles; Biological particles; Carbonaceous particles; Soot; Kish flakes; Salts of Sodium Chloride (sea salt); Calcium sulfate; Metal particles; Secondary particles; Fe reach particles (Fe mixture and Fe oxides). All particles, which could not be classified into one of these groups, were listed as other particles. The particle groups observed in the present investigation can be assigned to different emission sources. Beside the chemical composition, information on the morphology and mixing state of the particles is helpful for discrimination of industrial emissions originating from high temperature processes from a natural soil component, for both iron-rich particles as well as silicates. In the present study, the following source categories have been distinguished: soil, industrial, secondary, biological, soot, Ca-rich particles. In industrial, soil and secondary, particles of different groups are merged. The source apportionment analysis performed with the single particle analysis let to investigate the dimensional and mass distribution of the sources in PM10-2.5, PM2.5-1, PM1 fractions, showing that the antropic sources are mainly present in the fine and ultrafine particles, while the natural sources are characterized by coarse dimension.

289 Oxidized transformation products of polycyclic aromatic hydrocarbons in secondary organic aerosols particles
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Long-range atmospheric transport of polycyclic aromatic hydrocarbons (PAHs) in fine and ultrafine particle matter (PM1) remains a global health concern as transport models continue to fall short of accurate predictions. To improve modeling accuracy the determination of chemical speciation of PAHs within PM1 is necessary. Secondary organic aerosols (SOA) particles sorb PAHs during formation and transport them as a large fraction of global atmospheric PM1, and the presence of PAH vapor has been demonstrated to increase the mass loading of atmospheric SOA. The oxidation of four PAHs were studied in laboratory generated α-pinene SOA experiments. Dibenzoathioephene (DBT), phenanthrene (PHE), pyrene (PYR), and benz(a)anthracene (BaA) were measured along with their oxidation products in freshly formed α-pinene ozonolysis SOA grown in the presence of vapor phase PAH (PSOA). Ratios of oxidized transformation products was measured and changes in those ratios was observed during the aging of the SOA, as well as after exposure to ozone. In freshly formed PSOA, the sum of measured oxidized products was found to be equal to the measured amount of parent compound in all four systems. Characterization of aged particles provides evidence of continuing chemical reactions in PHE and PYR PSOA. DBT and PHE PSOA showed evidence that ozone exposure, performed in a flow-tube reactor, results in further oxidation. Data suggests the environment inside SOA particles are complex and dynamic, and need to be further explored. Implications of the presence of oxidized PAHs in long-range transport modeling will be discussed.

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

290 The role of the p38-activated protein kinase signaling pathway-mediated autophagy in cadmium-exposed monogonont rotifer Brachionus koreanus
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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 437.47μg/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 antioxidant enzymatic activities were determined in response to TCS exposure. Furthermore, mRNA expression of detoxification (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 copepod.

291 The protective role of multixenobiotic resistance (MXR)-mediated ATP-binding cassette (ABC) transporters in biocides-exposed rotifer Brachionus koreanus
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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, and one of the most important efflux transporters that function in the removal of defense to xenobiotics is the nitroreduction-resistant multixenobiotic resistance (MXR) transporter, P-glycoprotein (P-gp) and multidrug resistance-associated protein (MRP) are ATP-binding cassette (ABC) transporters that 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 role of P-gp and MRP in the rotifer Brachionus koreanus were examined in response to four biocides (alachlor, chloryprufos, 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 in response to biocide exposure. 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, these results demonstrate that the 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.
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- and tri-allelic del TRH mutations 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 iVermic 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

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295 Poster spotlight: TU108, TU109, TU110

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?

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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, Rhone 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 anti-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.

297 Toxic mixtures in time-the sequence makes the poison

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It is generally agreed that “the dose makes the poison” – that chemicals can be toxic or non-toxic depending on their dose. This principle assumes that once a chemical is cleared out of the organism (toxicokinetic recovery), it no longer has any effect. However, it is now evident that many mixtures act in a more complex manner than this, resulting in toxicodynamic recovery, which can be fast or slow. We tested four combinations of substances and found a clear difference in toxicity when the exposure order of two toxicants was reversed, while maintaining the same dose. When toxicodynamic recovery of the organism was slow relative to the interval between exposures it resulted in carry-over toxicity and so caused this sequence effect. We provide evidence 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?

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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 challenges. The SOLUTIONS project (Altenburger et al. 2015, STOTEN 512:540) built on these questions and there are options for utilising the advanced scientific knowledge for answers by either amending existing regulatory procedures of the EU water framework directive or by establishing novel assessment approaches. Priority mixtures can be conceived as a means to reduce the complexity of all real world situations into simplified archetypical scenarios. This might be achieved through modelling of typical emerging mixtures from different contamination sources and from chemical suspect pattern analysis. Identifying drivers of mixture risk can be tackled by various approaches all of which rely on a combination of chemical and biological information. Methods range from effect-directed analysis to compound class grouping by effect categories. To determine the impact of mixtures, multiple lines of evidence are emerging. They comprise of translating contamination information into expected adverse effect, effect-based monitoring using panel of bioassays and utilising trait-based parameters for analysing ecological monitoring data. In conjunction, they can be used to strengthen causal links between chemical and ecological status assessment. All these approaches were exemplarily tested within the SOLUTIONS project and should pave the way for improved water resource management.

299 A mixture risk assessment for pollutants that reach humans via the water – fish exposure route

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An important route for human exposures to substances present in freshwater is through the consumption of fish. To protect humans against this route of exposure, the WFD defines specific quality standards for priority substances. In general, combined exposures are not considered, with the exception of quality standards for mixtures of specific contaminant groups, such as poly-chlorinated dioxins (PCDD) or polybrominated diphenyl ethers (PBDE). However, the possibility of combination effects across these pollutant groups is not currently considered. We present an advanced tiered mixture risk assessment for these groups of pollutants, first by using Water Framework Directive Quality Standards defined for PCDD and
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.

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An Advanced Methodological Framework for the Identification of Priority Pollutants and Priority Mixtures of Pollutants in European Freshwaters
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We present a proposal for an advanced methodological framework for identifying priority pollutants and priority mixtures of pollutants in European freshwaters. 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). Although data are available, they are prioritised for further research without a conclusive risk assessment 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) ecological 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, there may be a need 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 interest must be 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).

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A diagnostic toolbox for ecological effects of pollutant mixtures: a case study application using in situ experiments with microbial communities
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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 pinpoint 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 photautotrophic 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 ecotoxicological effects using predictive mixture toxicity 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 (PICT). In the end, the study allowed us to demonstrate that (i) the STP effluent actually caused ecologically 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.

Derivation, Validation and Implementation of Environmental Quality Benchmarks

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Questioning annual average concentrations for plant protection products - TKT modelling of real exposure profiles
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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 use of annual average concentration gives a sense of the toxicity of a substance, the AA-EQS is based on chronic toxicity 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 eco-toxicity tests and Habel’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 modeled 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 of water fowl and development growth in daphnia. The results also show that comparing quality criteria for protection against acute effects (MAC-EQS) to time proportional 3-day mixed samples is appropriate.

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Revision of 62 Environmental Quality Standards - lessons learned
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Environmental Quality Standards (EQS) are ecotoxicologically based threshold values that aim to prevent or reduce a toxic effects of pollutants on ecosystems. Similar values exist in Switzerland and the Federal Office for the Environment recently commissioned the revision of existing EQSs 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 EQSs and to highlight knowledge gaps. As for the original EQS derivation, relevant data were retrieved from databases, the public literature and Toxification studies, 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) and decreased in 18 cases (fold change -0.05/50). MAC-EQSs increased in 2 cases (50/61.8) and decreased in 9 cases (22/72.4). 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, AFs were reduced in 12 cases and increased in only 6 cases. For the MAC-EQS derivation, AFs 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 required to be associated with the derived EQSs, as evident from applications 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, crustaceans, and invertebrates. An issue that on the mode of 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. Bothamley, INERIS; S. Andres, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances TIA; M. S. Warne, Coventry University / Centre for Supervising Scientist / Department of the Environment and Energy; A. Proctor, Australian Energy; C. L. Humphrey, Environmental Research Institute of the Supervising Scientist / Dept. of the Environment and Marine Science; D. Fox, Environmetrics Australia; A. J. Harfor

The recent revision of the Water Framework Directive from the adverse effects of toxicants. As such, numerous countries, 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 best, whether particular features are “unwanted” and how 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.


The most common method for deriving water quality benchmarks (WQBs) for toxicants is the use of a species sensitivity distribution (SSD) to estimate a median effective concentration in 5% of species. Although various exist in the specifications 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. bimodality). 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 variety of questions associated with WQB derivation methods and their application. 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 status and to set discharge and setting effluent discharge limits. 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 for the derivation is a major factor as is the inadequate lack of resource allocation 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 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 best, whether particular features are “unwanted” and how 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.

66 SETAC Europe 28th Annual Meeting Abstract Book
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. Tsiola; P. Pitta, Hellenic Centre for Marine Research Crete / Institute of Oceanography and Environment; S. Fodeleianakis, 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; I. Karakasis, University of Crete / Department of Biology; G. Kotoulas, Hellenic Centre for Marine Research; D. Daffonchio, 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 Echinodermata and Patrakos Gulf. 16S rRNA patterns resembled abiotic variables, and especially the patterns of heavy metals Cd, C, Cu and Pb. The highest concentrations of NO$_3^-$, NO$_2^-$, NH$_4^+$, PO$_4^{3-}$, SiO$_4^{4-}$ and chlorophyll were found in stations influenced by extensive industrial, agricultural and maricultural activities. The 3 stations of Anvrakikos 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 integrase 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: 156-166.

309 Impacts of stormwater on microbial community structure and function in estuarine sediments

K. Huffman, 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. Sim, University of New South Wales; T. Lachnit, University of Kiel; S. Swapat, 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 water-flushed channels. Sediments were collected monthly during base rainfall (<5mm/day) for 4 months from 5 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 investigate the chemical process 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-Doval, F. Romero, V. Acuña, S. Sabater, ICRA Catalan Institute for Water Research

Climate change will affect agriculture practices and productivity because increased incidence of drought events and changes in precipitation and temperature will threaten to stress and decrease the yields, reduce the quality of the product and, consequently, the income of consumers. It is predicted that the frequency and intensity of droughts will increase in future with potential consequences in terms of production and 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.

311 Linking pesticide pollution with periphyton quality in agricultural streams: a fatty-acids approach

N. Correll, University of Gothenburg, Sweden / Biological and Environmental Sciences and Engineering Division; Hålånskogen / Department of Biological and Environmental Sciences; A. Nilsson, University of Gothenburg / Section of Ophthalmology, Dept. Clinical Neuroscience, Institute of Neuroscience and Psychology, Sahlgrenska Academy; K. Johansson, University of Tartu / Institute of Technology; H. Spångfors, Halmstad University; M. Kahler, SLU Swedish University of Agricultural Sciences / Department of Aquatic Sciences and Assessment; J. Kruuger, Swedish University 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 polyunsaturated 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, Skivarpså 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 Skivarpså and M42 than in Höje å. Ecotoxicity testing using the passive sampler extracts demonstrated that the pesticide mixture occurring at Skivarpså 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 of pesticide polluted streams (Skivarpså 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 more abundant in pesticide polluted streams (Skivarpså 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 Estrorene and trielosan 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 is of major concern as effects of such an extended persistence of PPCP is poorly understood. Estrorene and trielosan 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 estrorene and trielosan mixture, their potential to persist and disrupt soil microbial community composition and function. Soil was spiked with estrorene, trielosan, and a 1:1 mixture of estrorene: trielosan, 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 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. Estrorene and trielosan as single compound treatments exhibited half-lives of 6.8 days (estrorene) and 26.7 days (trielosan). The rate of degradation of the binary estrorene:trielosan 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 dominant in all the day 90 treatments. Soil microbial communities are adept at degrading estrorene and trielosan 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. Hischier, EMPA / Technology and Society Lab

Tailings, a waste material produced during mineral concentration (beneficiation), contain significant quantities of mobile toxic metals and are typically produced in large quantities. To manage these wastes, tailings are commonly stored and managed. Tailings ponds pose a significant environmental burden, the ecoinvent database contains a global average life cycle inventory (LCI) dataset for sulphidic tailings disposal, developed using a decision-analytic approach. The LCI dataset was set to take different tailings management and processing approaches into account. The approach and data were used to model the production of tailings according to the regional tailings management system. Metagenomic analyses indicate the effects of different tailings disposal strategies on the composition of the microbial community and the potential for phosphorous or nitrogen fixation. The results show that the microbial community composition is highly dependent on the specific tailings management approach. The study highlights the importance of considering regional and site-specific characteristics in tailings management practices.

315 Closing the copper cycle in the EU-28: scenario analysis and potentials for GHG emissions reduction L. Bruxelles, Alma Mater Studiorum - University of Bologna; F. Passarini, 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 material 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 the context of such extended import reliance 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, as 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 economic function for copper recycling is not sufficient to close the copper cycle. Fundamental constraints are likely to limit the implementation of a circular economy unless dramatic changes occur in the current pattern of copper production, consumption and recycling at end-of-life.

316 Multi-Objective Reverse Supply Chain Network Design of Fluorescent Lamps with Piecewise Linear Functions C. Lee, 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 associated with the recycling of lamps and the end-of-life operation. The examined networks comprise multi-echelons, including disposer markets, collection facilities, recycling plants and reuse markets connected by a transportation network. 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 not an economic indicator calculated to total cost excluding production 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 the 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 using a multi-objective mixed-integer programming. 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 ecological objective function is based upon the 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 using a multi-objective mixed-integer programming. 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 ecological objective function is based upon the 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 using a multi-objective mixed-integer programming.
Safe by Design: responsible and innovative research for safe and sustainable chemistry
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 safer and sustainable economy.

323 Emisions of PFAAs 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 / Environment 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, PFAAs have been used because their perfluoralkyl chains have the ability to repel liquids of a wide range of polarities (DWR compounds, and hydrophobic (DWR compounds, like PFASs and silicons are emitted to air, as well as to rain water and washing water. During the use phase of outdoor clothing, DWR chemicals are emitted to the environment.

324 Chemicals in plastic packaging: Prioritization of hazardous substances
K. Groth, 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. Geuweke, Food Packaging Forum Foundation; A. Lennquist, Chemsec; H. Leslie, VU University Amsterdam / Environment&Health; J. Lager, Food Packaging Forum Foundation; A. Votipkova, General Management Foundation.
Plastic packaging is increasingly used globally, causing rising concerns for the environment and human health from littering of microplastic and leakage of hazardous chemicals. Specifically, chemicals may migrate into foods or the environment during use, disposal, and recycling of the packaging material. Occupational exposure during plastic packaging manufacture is also relevant. One of the main obstacles to assessing the risks of chemicals originating from plastic packaging is the absence of information on the materials’ exact chemical composition. In order to provide an overview of the chemicals associated with plastic packaging, we compiled the Chemicals in Plastic Packaging Database (CPP-DB), which comprises unique substances with additional substance-specific information such as soil data, physico-chemical properties and uses. The CPP-DB includes plastic monomers, additives, and other substances used during plastics manufacturing, such as solvents and raw materials, and the main non-intentionally added substances (NIAS) such as impurities, reaction by-products or degradation products of e.g. polymers and stabilizers. We ranked the substances in the CPP-DB according to their hazard for human health and the environment, using Classification, Identification and Packaging of Chemicals (CIPIC) categories, and also including endocrine disrupting properties and PBT (persistence, bioaccumulative and toxic) characteristics. Due to the lack of empirical hazard data for many of the substances in the CPP-DB, we also used in-silico tools to bridge data gaps. In this presentation we will use the CPP-DB to present an overview of chemicals associated with plastic packaging, their hazards for human health and the environment, and we will highlight priority hazardous chemicals for substitution. Finally, we will discuss the research needed to allow for a more robust hazard characterization and ranking.

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; V. Cazzagon, University Ca Foscari of Venice / Department of Environmental Sciences Informatics and Statistics
Innovative nano-enabled products can overcome some issues 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 Cooper Stage Gate 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 up-scale 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 bioassays: (i) aquatic toxicology, (ii) a set of tests for cytotoxicity, DNA-damage and mutagenicity. In addition, specific testing leach 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 Applying the Margins: The confluence of Modern Agriculture and Aiculture
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 bees 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 extend beyond the urban back yard garden to the farm 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 Stastics, A. Votipkova, General Management Foundation.

Managing on the Margins: The confluence of Modern Agriculture and Aiculture
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. Including 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. Pollinating 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

Academic R. Sharp, C. Szentes, D. Auteri, EFSA - European Food Safety Authority / Pesticides Unit

In recent years, neonicotinoid 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. To 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 quantifiable way for a more comprehensive understanding of 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

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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 honey bees Using the existing scientific database on the impact of pesticides, the EFSA Guidance Tier 1 assessment showed the following: • Almost all substances and uses fail the screening step for chronic risk to larval and chronic risk to adult honey bees for both spray and solid application types. • For bumble and solitary bees very few substances pass the acute screening step and none pass for chronic risk assessments. • Even known low-bee-toxic substances fail the risk assessment and would need higher tier refinement. In order to pass the assessment, the required doses that would have to be tested would be so high that they would not be technically (solubility) or practically (consumption by the bee) achievable. Results of the Tier 1 assessment following an industry proposed approach will be presented, together with a comparison of existing honey bee and bumble bee data, proposals for protection goals and higher tier testing methodology In its present over-conservative form, the EFSA guidance will make it difficult to register 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 of Environmental Sciences, Centro de Estudos de Insetos Sociais; 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 Biológicas 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; A. Delerme, Unesp / Departamento de Ciências Biológicas Brazilia the greater diversity of native stingless bees of the world and makes intensive use of pesticides. Thus, forager workers may collect pollen and nectar contaminated and, subsequently, to offer the resources to the brood. Studies on larval phase focus on Apis mellifera, since for this species the rearing method is already standardized by the OECD®. However, while in A. mellifera the larval food is progressively offered to the brood, in stingless bees the food consists of a mass deposition. This scenario requires the development of techniques which enable to evaluate the exposure of native bees during larval phase to pesticides, and may be used for public authorities responsible for environmental safety for studies on risk assessments. Melipona scutellaris is an interesting species to be used as a model organism for risk assessment, since, besides composing the native Brazilian fauna, species from the same genus are recognized as effective pollinator of important crops as eggplant, tomato and sweet pepper. Thus, the present study aimed to propose an in vitro larval rearing method of M. scutellaris. We extracted the larval food from 20 brood cells per non-parental colony (n =3), for estimating the amount of food consumed by larvae. Before the experiments, the acrylic plates with the food cells were placed in an incubator at 30ºC and 75% of relative humidity, with a water to keep the humidity around 95% within the Petri dishes during the first five days of rearing. Each artificial cell received 130µL of larval food and, afterwards, 24-hour-old larvae were placed in the food. Then, the plates were kept in an incubator at 30% and 75% of relative humidity. After the total consumption of the food, the humidity within the Petri dishes was reduced to 75% in order to NaCl This technique was carried out five times sequentially, evaluating parameters as the defecation rate, pupation, emergence, and mortality and morphometry of newly emerged workers. For the morphometric analysis we also evaluated newly emerged work from natural brood combs. The survival rates increased gradually according to...
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.

331 Poster spotlight: TU038, TU048, TU052

Understanding human and environmental exposure to chemicals in urban systems

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

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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 two latter being most relevant, but also difficult and/or expensive to produce for a wide range of chemicals. In this study, we used 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.

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

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Building materials have important contribution to the chemical exposure 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^{13} 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.

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

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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 relevant to those in PCB and TPhP, respectively. The emissions factors of OPEs from indoor air to outdoor air estimated in this study were within the range estimated by Liagouridis 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 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-calculated from outdoor concentrations. Indoor rate is governed by partitioning between air and high sorptive-capacity materials such as PU 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.

335 Drivers of pharmaceutical exposure in urban river systems

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Pharmaceuticals are heavily used by society and urban environments are one of the main receptors for these molecules. Pharmaceuticals can be relevant to those in PCB and TPhP, respectively. The relevance of these emissions 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 sinusoidal 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 concentrations of clofibric acid, diclofenac and loradate, are temporarily 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.

336 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

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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

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Microplastic exposure is a burning topic in environmental research, but few large scale exposure studies have yet been performed in freshwater. 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 European rivers and 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), polyethylene terephthalate (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 consumptions. In a second step, every stage of the life cycle is analyzed and the voluntary or inadvertent emissions are assessed. The emission-specific 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

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Pollution with nano- 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 regeneration-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 regadenring of MPs from WWTP point sources in US waterbodies 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 nm to 10 mm, a range that incorporates the theoretical parabolic size-setting relationship reported by Besseling et al. (2017). Depth dependent 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 concentrations 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 (~30,000 km²). Emission capitalization and population measured 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

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Plastic contamination of freshwater sediments is well documented, and whilst quantitative measurements of plastic in sediments are becoming more capable, 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 as they are becoming aware 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

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an ecologically relevant system, using the freshwater aquatic worm Lumbriculus variegatus, representing an entry point for nanoparticles from abiotic compartments of sediments, into biota. The role of surface functionalisation of fluoroescently dyed nano-poly styrene (50 nm) 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 nanoparticles to the worm's surface are examined in waterborne exposures, whilst dietary uptake is tested using nanoparticles associated with an algae food source. The accumulation of nanoparticles directly from contaminated sediments is also investigated, alongside the fate of these particles in sediments to assess the relationship between nanoplastic mobility and accumulation. Results indicate that pristine nanoparticles and plasticized nanoparticles are retained in both waterborne and dietary exposures and from dietary uptake of a nanoplastic associated algal food source, with carboxylated andaminated 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 though strong associations of the nanoplastics to solid constituents of the sediment. Ongoing work addresses the potential for formation of an "ecocorona" 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
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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 (ACHe); 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
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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 of rigid and flexible polyvinyl chloride microplastics on the transcriptome of Daphnia magna are based on the polymer type alone, or if incorporated additives are regulated or downregulated 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 Daphnia magna reacts substantially different to the chronic (31 days) exposure to rigid PVC or flexible PVC (with diisononyl phthalate (DINP) as a plasticizer) with changes in gene expression. Rigid PVC caused a fivefold upregulation in a total of 19 genes (15 up-regulated and 4 down-regulated) related to stress responses, antioxidative defense, nucleotide, and enzyme activities, and atosine and endothiase inhibitor activity. Flexible PVC exposition lead to a fivefold change of a total of 267 genes (238 up-regulated and 29 down-regulated) related to the GO terms of proteolysis, carbohydrate and chitin metabolism, Vitellogenine membrane formation, yet most genes were related to immune response. Our attained results imply that flexible PVC had a more severe effect that might be attributed to the levels of DINP (induced by biofilm formation on these two different 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.

343 Poster spotlight: TU149, TU150, TU151

When ecotoxicology meets trophic ecology

344 Does stress propagate along aquatic food chains? An experimental approach with a tri-trophic brown food web
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Pollution is a major driver of ecosystem change resulting in alterations in food webs and ecosystem functioning. Some pollutants such as endocrine disruptors 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. Therefore, 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 glutinosa 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 mesocosm 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 untreated stream for 9 days after which predators' growth was analysed. Imidacloprid concentrations increased within the contaminated microcosms over time. The presence of imidacloprid in the water was associated with lower survival of decomposers and leaf decomposition in contaminated microcosms compared to the control. Furthermore, decomposer's biomass and length decreased in the contaminated but not in the control microcosms. Predators hunting decomposers from contaminated microcosms 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. For example, increased mortality and reduced growth of 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 leaks from plant material and may influence downstream food webs directly and indirectly.

345 Accounting for trophic relationships in fish bioconcentration models applied with emergent-pollutants risk-assessment tools
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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 (Aarnot & 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 contamination 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 catchment or over all catchments. 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

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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 K_{ow} 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 rates and diets for lake trout from 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 feeding on less lipid rich rainbow smelt.

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

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Riparian areas in Romania support diverse vegetation and fauna, ranging from freshwater to freshwater to terrestrial ecosystems. Large invertebrates are major prey for riparian predators and also important contributors to the energy budget of freshwater ecosystems. To investigate the potential effects of land use related stressors, we sampled spiders 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 orbweb 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 stream increasing productivity of primary producers and invertebrates 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 greese

D.J. Hitchcock, University of Oslo; M.J. Loenen, 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; . Varpe, University Centre in Svalbard; T. Andersen, University of Oslo / Department of Biosciences; K. Borge, Department of Biosciences; University of Oslo / Department of Biology; University of Oslo / Institute of Marine Research; Arctic breeding barnacle geese (Branta leucopsis) are a herbaceous 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 sample collections) was collected at different sites along the goosel s flyway. Resignments of ringed geese also took place in Northern Norway. Egg and vegetation samples were analysed for stable isotope of carbon (δ^{13}C) and nitrogen (δ^{15}N), as well as pollutants including protein-associated poly- and perfluoralkyl substances (PFASs), lipid soluble polychlorinated biphenyls, and hexachlorobenzene (PCBs and HCB). Stable isotope ratios in eggs could not be related to PCBs, but emerged to POPs like perfluorinated compounds due to overlapping signal, but 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. The TMFs 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 high 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. Dekker, SFU / Department of Biological Sciences; J.E. Elliott, Environment Canada / Science Technology Branch; F. Gosab, 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 DDTs, are eliminated from the food chain, while POPs like polychlorinated biphenyls (PCBs) and perfluorinated compounds are released from multiple sources into the ambient environment and are known to negatively impact endocrine and physiological functions within exposed wildlife. Protocols to assess bioaccumulation of these persistent chemicals within terrestrial systems are far less developed compared to aquatic systems. Presently, regulatory agencies in Canada, the USA, and the EU use only bioaccumulation information for fish to assess the bioaccumulation potential of POPs 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 high seasonal environments.

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

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SETAC Europe 28th Annual Meeting Abstract Book
Toxicokinetic-toxicodynamic models as new tools for environmental risk assessment

S. Charles, University Lyon 1 / Laboratory of Biometry and Evolutionary Biology; V. Baudoit, 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 typically 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, which makes it difficult to extrapolate the results to more realistic scenarios for example to effects under time-variable exposure profiles. To overcome this gap at the organism level, the use of the toxicokinetics-toxicodynamics (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 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 scant data to allow us to use and validate 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 ‘morse’ 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 and related parameters will then 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-pesticides 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. Vignardti, University of California Santa Barbara / Bren School of Environmental Science and Management; J. Jayne, Scripps Institution of Oceanography

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 intact agricultural systems, there are scant data to allow us to use and validate 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 ‘morse’ 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 and related parameters will then 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

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Assessing effects of a contamination on populations requires get 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 ecosystem 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 R. for different treatments: new hatched 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 toxicokinetics-toxicodynamics model for estimating impacts to coastal and marine environments. Advantages of nano formulations include better application control and slower release of copper, but the size and shape of nano formulation change the environmental behavior and to allow more users 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 ‘morse’ 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 and related parameters will then 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.

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

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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 ecological-level effects 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 adverse outcome is lethal are less relevant for a response-based risk assessment. 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 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 (Klanjesk 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 developmental stages, but minimal among the AHR positive chemicals. The mechanisms of toxicity are also poorly 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

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We are investigating best approaches to utilizing in vitro data to 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 ecological-level effects 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 adverse outcome is lethal are less relevant for a response-based risk assessment. 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.

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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 (bistomatized to 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 larvae 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 of these effects have recently been made in developing kinetic models for predicting metal accumulation in fish-parasite systems. Our present 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 organ-specific accumulation of pollutants. However, the capability of this model for simulating fish-parasite systems has not been investigated. We developed a PBPK model for simulating Ag accumulation in the host-parasite system: chub (Squalius cephalus) and the acanthocephalan Pomphorhynchus tereticollis. 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 constants for Sciothor 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 in 2012
J. van Gils, DELTARES; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; h. baveco, Wageningen Environmental Research; L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; I. Cousins, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); C. Lindegren, 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 it provides truly “emerging” chemicals 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 prediction of effects is 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 larvae 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.

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; e. 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 being sought to align chemical and biological monitoring results, based on 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.

358 Eco-epidemiology of aquatic ecosystems: aligning chemical and ecological status
L. Posthuma, RIVM / Centre for Sustainability, Environment and Health; S. Birk, University of Duisburg-Essen / Aquatic Ecology; A. Burton, University of Michigan / School of Natural Resources Environment; D. De Zwart, DAIzEcotex / 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.M. Holmes, K.E. Kapo, Waterborne Environmental, Inc.; D. van de Meent, Association of Retired Environmental Scientists ARES / Environmental Epidemiology of aquatic ecosystems: aligning chem...
Sustainability Environment and Health

This paper analyses water quality assessment and management specifically looking at the diagnosis of toxic effects of mixtures in field ecosystems. We apply various methods to liaise ecosystem responses to mixture toxic pressure under natural, variable and multi-stressed conditions. We collated vast amounts of monitoring data to explore those diagnostically, in line with the Father of Epidemiology, dr. Snow, who famously provided a solution to a cholera outbreak in Soho, London, 1854, by epidemiological reasoning. So, this 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 criteria such as VLE. 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 vast 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 process and system and source assessment. The future EU project MARS (Mixing Aquatic and early stress characterization of chemical mixtures up till a solution-focused approach related to ecosystem services management goals. We present specifically a body of evidence for the wide-spread occurrence of chemical mixture impacts in current water systems at the continental and national scale (Netherlands), corroborating recent findings of this kind based on chemical risk.

359 Unravelling the cocktail of stress: toxins 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. Direkt, D25, Ecotox / Centre for Sustainability Environment and Health; M.F. Sanchez, Management; A. Focks, Alterra Wageningen University and Research Centre / Environmental Risk Assessment Team; L. Globiekvi, 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; V. Panagopolous, 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 status and services. The future EU project MARS (Mixing Aquatic and early stress characterization of chemical mixtures up till a solution-focused approach related to ecosystem services management goals. We present specifically a body of evidence for the wide-spread occurrence of chemical mixture impacts in current water systems at the continental and national scale (Netherlands), corroborating recent findings of this kind based on chemical risk.

360 Mitigation options for chemicals of emerging concern in surface waters: 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 over the last two decades. To minimize or eliminate adverse effects, removal efficiencies of various (advanced) drinking water and wastewater treatment technologies has been studied. Advanced water treatment technologies are based on sorption, (advanced) oxidation and size separation. Removal efficiencies consisting of approximately 2000 entries, 93 compounds and 9 treatment technologies for wastewater (ozone, + H2O2, conventional WWTP, UV, UV + H2O2, PAC, GAC, NF, UF) and drinking water treatment (ozone, ozone + H2O2, UV, UV + H2O2, PAC, GAC, NF, UF).

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. Brotström-Lundén, IVL Swedish Environmental Research Institute; E. Krarup, D. De Zwart, DdZ ARS looked into multi- stressor effects on the toxic environment 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 criteria such as VLE. 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 vast 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 process and system and source assessment. The future EU project MARS (Mixing Aquatic and early stress characterization of chemical mixtures up till a solution-focused approach related to ecosystem services management goals. We present specifically a body of evidence for the wide-spread occurrence of chemical mixture impacts in current water systems at the continental and national scale (Netherlands), corroborating recent findings of this kind based on chemical risk.
Climate Change Canada; K. Dafforn, Macquarie University / Evolution and Ecology Research Centre; L.E. Johnston, University of New South Wales / Evolution and Ecology Research Centre; K. Korb, Macquarie University; D. Lapen, University of New South Wales; M. Mayer-Pinto, University of New South Wales / Evolution Ecology Research Centre School of Biological Earth and Environmental Sciences; W. Monk, Environment and Climate Change Canada; A. O'Brien, Environment and Climate Change Canada; N. Young, Environment and Climate Change Canada; K. Simons, R. Verdonck, Wageningen University; P. van den Brink, Alterra/Wageningen UR / Aquatic Ecology and Water Quality Management Group b Alterra

In the Anthropocene, ecosystems are exposed to a range of stressors that if not properly managed can lead to ecosystem state shifts and significant losses in ecosystem services. We held a workshop (September 2017, Wageningen, The Netherlands) to develop a conceptual framework to assess the effects of multiple stressors on the structure and functioning of aquatic ecosystems. This framework was subsequently applied to three ecosystem types (ditches, floodplains and harbours). The proposed framework consists of two parts: an environmental filter and a transmitting function to allow effects to propagate to higher levels of biological organisation. Applying the framework consists of the following steps: 1) Select an ecosystem of concern; 2) Identify stressors and potential interactions; 3) Identify receptors/sensitive groups for each stressor; 4) Identify stressor-response relationships and group stressors according to their mode of action; 5) Construct an ecological model that includes relevant functional groups and endpoints; 6) Predict the resultant impact of multiple stressors; 7) Confront the predictions with experimental and monitoring data has been obtained. The talk will present the details of the framework and will also briefly introduce the three case studies developed during the workshop and discuss the commonalities and differences in approaches between the three case studies which all used the framework as a starting point.

363 Predicting the response of ditch ecosystems to multiple stressors S. Bracq, Wageningen University & Research / Department of Aquatic Ecology and Water Quality Management; R. Verdonck, Wageningen University, Wageningen University Research (Alterra); R. Schaefer, University Koblenz Landau / Institute for Environmental Sciences; A. Bush, University of New Brunswick / Environment Canada; D. Lapen, Agriculture and Agri-Food Canada; K. Sumon, Wageningen University & Research Centre / Aquatic Ecology and Water Quality Management; P. van den Brink, Alterra/Wageningen UR / Aquatic Ecology and Water Quality Management Group, b Alterra

Until recently, our knowledge of the net effects of multiple stressors on freshwater ecosystems has been limited. We still lack a general framework that can integrate known effects of individual stressors on organisms and predict how these effects propagate through higher levels of biological organisation. In light of this, a workshop was held at Wageningen University and Research, the Netherlands, (September 2017) to determine the current state of knowledge of multiple stressor effects on aquatic ecosystems and to assess how these effects can be better predicted. The workshop was attended by experts from the Netherlands, Australia, Germany, and Canada and covered a range of ecosystem types considered to be at high risk from multiple stressors. The workshop resulted in a “best-approach” conceptual framework for assessing multiple stressor effects on aquatic ecosystems. The framework was subsequently applied to three case studies: harbours, agricultural drainage ditches, and floodplains. Here, we present the application of this framework to agricultural drainage ditches. Agricultural drainage ditches are an under-appreciated and undervalued habitat for a range of aquatic and terrestrial organisms. Although these man-made features can maintain high biodiversity in agriculture landscapes, they are often ignored for their habitat value and are not protected under the EC Water Framework Directive 2000/60/EC. Using the framework developed during the Wageningen workshop, we developed a conceptual food-web model using functional groups to assess known direct effects of stressors on ditch communities. We identified the most important stressors (nutrients, pesticides, dredging and mowing, salinisation, and sedimentation) and their impact on communities and conducted a literature search for each stressor-functional group combination to identify sensitive and non-sensitive subgroups. We also reviewed the literature on experiments using at least two of the identified stressors and identified potential interactions. The conceptual food-web model was updated using this knowledge to capture interactions. Finally, the conceptual model and its predictions regarding the response to multiple stressors was compared to large scale ditch biomonitoring data to assess the validity/predictive power of the model. The demonstration that the framework provides a useful conceptual template to assist and predict multiple stressor impacts as well as to unravel research gaps.

364 The combined effects of nutrients and thiacloprid on macrofauna invertebrate population and community responses H. Barmenli, 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 co-occur in the ditches, we aimed to study their combined effects on invertebrate population and community responses. To this end, we exposed caged organisms and naturally assembled invertebrate communities to environmentally realistic thiacloprid and nutrient concentrations at the Living Lab facility. The Living Lab facility consists of 36 naturally colonized ditches of 25 cm depth in which experiments can be conducted for up to 28 days. We found that the combined effects of thiacloprid on several population responses at concentrations that were comparable or far lower than laboratory derived LOECs as obtained from literature. These effects were less pronounced when organisms were exposed under nutrient enriched conditions. In addition, we observed significant dissimilarity between the naturally assembled communities under the influence of both thiacloprid and nutrients. These shifts were largely represented by a severe decrease in insect abundance under thiacloprid exposure. This decrease was not observed in ditches that received both thiacloprid and nutrient application. Thus, we showed the importance of nutrient enrichment (and the resulting increase in primary production) for coping with thiacloprid induced toxicity. This might explain the difficulties as often faced when extrapolating lab to field data and the other way around.

365 Macroinvertebrate communities across a gradient of multiple stressors from agricultural land use in Romanian streams V.C. Schneider, M. Link, S. Kanz, E. Stoeva, University of Koblenz Landau; B. Verdonck, Eawag, Swiss Federal Institute of Aquatic Science and Technology; K.P. Batten, M. Cimpean, Babes-Bolyai University E. Vermeiren, Ecotoxicology Centre Eawag-EFPL / Aquatic Ecotoxicology; H. Singer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; J. Hollander, Eawag / Environmental Chemistry; R. Schafer, University Koblenz Landau / Institute for Environmental Sciences; K.P. Battes, M. Cimpean, Babeș-Bolyai University; E. Vermeiren, Ecotoxicology Centre Eawag-EFPL / Aquatic Ecotoxicology; H. Singer, Eawag, Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; J. Hollander, Eawag / Environmental Chemistry; R. Schafer, University Koblenz Landau / Institute for Environmental Sciences.

Pesticides from agricultural usage are one of the major drivers of biodiversity loss in freshwater ecosystems. Their entry pathways are mainly related to pesticide use in agriculture. To differentiate pesticide toxicity and other agricultural stressors, we conducted a field study in a small Eastern European (Romania), where agricultural intensity varies, ranging from high to low intensity (extensive) agriculture relying largely on chemical inputs (e.g., horse-powder). We assessed that, in contrast to pesticide toxicity, excessive nutrient and sediment input would be unrelated to agricultural intensity. Consequently, this would allow distinguishing effects from pesticides and these other stressors. We analysed the relationships between pesticide toxicity and other agricultural stressors. Additionally, we analysed combined and individual effects of these variables on the biodiversity, as well as on the composition of stream macroinvertebrate communities. We examined 19 low-order streams across a gradient of agricultural intensity in terms of average field sizes. Pesticide concentrations were investigated using two different passive sampling methods. Firstly, we used styrene-divinylbenzene (SDB) disks to sample hydrophilic compounds, which enabled the determination of approximate time-weighted pesticide concentrations in streams during heavy rainfall events. Secondly, we used polyethylene films and corian sheets (both hydrophobic) for the determination of lipophilic pyrethroids and organophosphates. The toxicity of the 88 detected pesticides was assessed using the sum toxic unit (sumTU). Stream macroinvertebrate communities were sampled twice, using a quantitative multi-habitat-sampling. This allowed the analysis of relationships between the community composition and diversity with a gradient of pesticide toxicity in interaction with additional agricultural stressors. The toxicity gradient originated from pesticides and nutrients (NH4+) showed no relationship to the intensity of agriculture expressed as the average size of the adjacent fields. This indicates that pesticides and nutrients co-occur independently of agricultural intensity. How and to which extent, in terms of effect size, the communities are affected by the pesticide gradient and the additional presence of other stressors originating from agricultural land use will be presented during the conference.

366 Daily temperature variation determines the toxicity of a pesticide mixture V. Delnát, T.T. Tran, L. Janssens, KU Leuven / Biology; R. Stoks, University of Leuven / Department of Aquatic Ecology and Water Quality Management, b Alterra

Synergistic interactions between pesticides in mixtures and between pesticides and warming may improve the efficacy of vector control. Particularly, synergistic interactions between biopesticides and chemical pesticides would be promising as these could potentially result in the combination of efficacy of control, slowdown of resistance build-up and lower ecological damage. One understudied aspect of global warming is the increase in daily temperature variation (DTV). While DTV may increase the toxicity of chemical pesticides, it is unknown whether it also interacts synergistically with biopesticides, and magnifies the toxicity of pesticide mixtures. We tested whether DTV influences the toxicity of pesticides with a
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 examined the effects of DTV 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 enhanced 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 that may not only decrease the pestici"
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 MPs displayed less than 5% passage, except benzoazoline, tolyltriazole and phenylurea, which displayed a passage of 25%, 17% and 10%, respectively. The data showed that removal of neutral polar MPHs is mainly governed by size exclusion. For neutral and moderate polar MPs the inverse was the case. Tighter membrane and multi-stage RO will be investigated to improve the removal of small neutral MPs for drinking water applications.

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

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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 (POMCs) against microbiological and chemical degradation, their removal during wastewater treatment and drinking water purification may prove difficult. Toxic POMCs can be classified as PMTs (persistent, mobile, and toxic) substances. Since the most frequently used trace analytical method for the quantification of organic pollutants in aqueous matrices, reversed-phase high performance liquid chromatography - tandem mass spectrometry (RP-HPLC-MS/MS), is only of limited use for the analysis of very polar substances, little is known about POMCs in the water cycle and only few (e.g. acesulfame, glyphosate) have been extensively studied and monitored. POMCs may be, among others, industrial chemicals, or transformation products thereof. Most transformation processes usually result in the formation of transformation products (TPs) with increasing polarity until either mineralization is achieved or a dead end TP is formed, thus potentially resulting in persistent and highly polar water pollutants. Many POMCs 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 function as markers for regulatory and study specific environmental behaviour during hydrolysis, biotransformation, oxidation with MnO₄⁻, 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 were detected. A more comprehensive 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

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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 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 (the framework was written 20 years ago with a more modest level of ambition), and we are doing this with 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 (PFAAs) 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 PFAAs 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/compartment. 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?

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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 (VMMP/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/PvB 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 pvPvB 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 all legislations.

Product benefits and positive outcomes: valuation and beyond

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

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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 fulfil 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 product use 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.

Second, the respective product benefits have not 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. Third, 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 develop a holistic sustainability system that is not simply assessing if 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 unsatisfied (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
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Diet is 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 μDALY/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 nutrient range between -8 avoided μDALY/y for sodium, up to 57 avoided μDALY/y for omega-3 from seafood. HENI score typically ranges from -80 avoided μDALY/serving for Frankfurter sandwiches to 50 avoided μDALY/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 nutrient-related CFs define 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
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Food production and security has been highlighted as one of the most threatened sectors worldwide due to the consequences of climate change. However, food production is also responsible for an important fraction of GHG emissions. In Peru, up to 50% 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 costs, the model included all the 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 CO2eq 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® was used as the programming platform, and CPLEX® 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 CO2eq 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 people eat. 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 CO2 in Life Cycle Assessment
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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 CO2 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 reduced emission visions. Our study looks into the monetary values of GHG, represented by CO2 (or CO2-equivalent), and their underlying cause-effect chains in three Life Cycle Impact Assessment (LCIA) methods LIME2, EPS2015 and ReCiPe2016. The damage cost for CO2 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 CO2 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 CO2 cost evaluated by LCA, especially in studies where social and economic consequences are the major concerns. The CO2 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

The assessment of Human Health Benefits and Risks of Contaminated Sediment Remediation
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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 alter the chemical composition and condition of dredged sediments. 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 accidents. 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 D ha/day for human and aquatic organisms (Lin et al., 2011; Qin et al., 2015). A broad range of pharmaceuticals has been increasingly used worldwide to prevent or treat human and animal diseases and continuously released into the environment (Nikolaou et al., 2014). 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 layer of contaminated sediment from adjacent layers, and animal diseases and continuously released into the environment (Nikolaou et al., 2014). 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 layer of contaminated sediment from adjacent layers. Therefore, the potential health impacts of the selected remedial options are similar to the combined benefits of MNA and the selected remedial scenario. Impacts associated with chemical inhalation exposures are less substantial, albeit not negligible. The quantitative framework of this study, when supplemented with adequate monitoring data, can provide valuable insight into the overall effectiveness of a given remediation in light of alternatives.

381 Six 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 fate of particulate 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. In this study, the method was retroactively, i.e., after 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 layer of contaminated 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 site. 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 1 - 40 cm). Endpoints were the growth and PCB bioaccumulation in Laminulara variegata 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
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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 an 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 assess ecological soundness of engineered systems. Environmental remediation is a complex problem, involving various stakeholders and a multitude of factors (including social, legal, technical, and economic). This paper presents a novel approach to comprehensively evaluate the potential for a long term remediation success of AC caps even under 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 accidents. 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 D ha/day for human and aquatic organisms (Lin et al., 2011; Qin et al., 2015). A broad range of pharmaceuticals has been increasingly used worldwide to prevent or treat human and animal diseases and continuously released into the environment (Nikolaou et al., 2014). 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 layer of contaminated sediment from adjacent layers.
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 and pesticides 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 not been decisive role for the environmental behavior 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 dissocation degree of molecule in soil have been published so far (Droge and Goss, 2013; Franco and Trapp, 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 matrix characteristics on the sorption behaviors of compounds in the soil environment. First, sorption behaviors of nineteen pharmaceuticals across four groups (neutral, 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 components 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. In vitro and in vivo assays to evaluate chlordane transfer to animals: interest of soil amendment

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Chlordane (Kepon) (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. Four matrices were tested by dietary routes 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 with relative bioavailability was found lower than 3% for both tissues. Finally, a positive correlation was found between environmental availability, bioaccessibility and bioavailability 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

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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 biochemistry. In the present research we used examples of the dumps of the provincial landfills and agro-technical enterprises and water basins near some settlements of the Armenia. 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, 189. Quantitative determination was carried out 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 η ± 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, a 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 is the fact that at one of the soil sampling sites (Dilijan Town, Tavush Province of Armenia) along with 3.5-fold exceeding the standard, almost all 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

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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), diclophenac(DP), salicylic acid (SA), tetracycline(TC), chloramphenicol(CHR), ciprofloxacin(CP), bisphenol A(BPA), α-terpinene(E2), estradiol(E1), estrone(E3), and ivermectin(V) from agricultural wastewater using the hydrophilic-lipophilic balance(HLB)-SPE column. Recoveries of the pharmaceuticals from standard aqueous solutions containing 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 high estrogenic 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

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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 preoccupant micropolutants 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 receptor for micropolutants in general. It is thus necessary to consider pesticide impact on water downstream. Theories of pesticides can be quite expensive and inputs may not be clearly identified or collated, and reduction at source can be 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 of excreta
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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, bioaccumulation 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 than in comparison to the rest of tissues/biids. Since BP-3 is hydrophobic and non-ionizable compound, the lowest concentrations of BP-3 were found in plasma. Although liver tissue (highly lipidic) could be an appropriate reservoir of BP-3, the low concentration of non-metabolized BP-3 found in this tissue could indicate a high metabolism 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 tissues/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 CTM2014-56623-C3-1-R and CTM2014-56623-C3-2-R, Xunta de Galicia (ED431C2017/36) and FEDER/ERDF. H. Ziarrusta is grateful to the Spanish Ministry of Science; 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. V. Pico, University of Valencia / Medicine Preventive; R. Alvarez-Ruiz, University of Valencia; L. Wijaya, A.H. Alfarhan, A. Malayemi, King Saudi University; D. Barcelo, IQAB-C5IC / 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 Gizan area of Saudi Arabia, were germinated in Petri "plates or sown in rice or soybean soil for 5 days. In the first two cases, the control of 100 mg L\(^{-1}\) of ibuprofen. Seeds and plants were incubated in a growth chamber in the dark at 26 °C 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.

391 Prioritisation and Intelligent Testing of Pharmaceuticals in the Environment (l)

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

The environmental risk assessment of active pharmaceutical ingredients (APIs) in 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 substitution 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 predicted environmentally significant concentration (PESC)) and analysed the variability in the risk quotients (RQs) for each API across Europe and (iv) looked at the impact of country-specific dilution factors applying the 5th percentile and 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 hydroponic 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.
Estimation and prioritization of hospital API emissions

A.M. Ragas, Radboud University / Department of Environmental Science; C. van Laren, M. Galen, K. Tipater, Radboud University; R. Oldenkamp, Radboud University / Department of Environmental Science; C. Zwiener, Analytical Laboratory 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-site 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. Diclofenac 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 imipenem also ranked relatively high, but only limited toxicity data were available for these substances, resulting in large safety margins.

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

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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 potency. 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 prediction of API concentrations in surface waters based on country-specific per capita consumption data. The starting point for modeling the environmental fate of APIs is country-specific per capita consumption data. Subsequently, the modeling chain follows the steps of excretion into the sewerage system, transport to and fate in WWTPs, emission into surface waters and, finally, environmental transport, partitioning and degradation. Unique features of the model include 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.
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. Coussot, Eurofins Agroscience Services Ecotox GmbH
When results of standard laboratory tests show an unavoidable 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 used for the selection of the species for non-standard species. Most tests were performed based on the L. variegata OECD 237, the ASTM E1913 and the OECD 238 and OECD 239, the ASTM E1913-04(2012) for Myriophyllum spicatum guidelines OECD 238 and OECD 239, the ASTM E1913-04(2012) for Myriophyllum spicatum, Sediment contact test with Myriophyllum aquaticum (ISO/DIS 16191) and the principles of the method proposed by the AMRAP (Aquatic Macrophyte Risk Assessment Procedures) group (Myriophyllum spicatum), Myriophyllum Sibiricum and Myriophyllum aquaticum. 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 NTPP: Testing non-crop species and the reproductive capability of selected species under greenhouse conditions
Agriculture is the dominating land-use of the EU member states by covering nearly half of the surface area. Using herbicides to reduce weed competition in agricultural areas can adversely affect non-target terrestrial plants growing at field margins. According to the recent EFSA Opinion for non-target terrestrial plants (2014) one important goal is maintaining the biodiversity of plant species in the agricultural area. It is therefore recommended to include also non-crop species in the testing scheme from the list provided in OECD guidelines 208 and 208b to assess the life-cycle with flowering and seed production. The objective of this study was to assess the viability of generative traits of non-crop species for risk assessment. For this purpose generative traits were evaluated if they provide more relevant information for the risk assessment. For this purpose they were compared with the vegetative traits, such as mortality and biomass production, which are currently assessed in OECD guidelines 208 and 227. The selected non-crop species are included in commercially available seed mixtures for flowering strips. Our experimental design consists of one control and four different herbicide application rates, with 6 replicates. The field rate was defined as the highest. The field rate was defined as the highest. The number of flowers and plant height were assessed for selected species to evaluate differences in development and flowering. In addition, seeds were sampled to evaluate differences in seed quantity and quality. Furthermore, the results will be compared to a non-target terrestrial plants pilot field study (Knaebe et al. 2017). Presentation of SETAC Europe 2017. References: EFSA PPR Panel (2014). Scientific Opinion addressing the state of the science on risk assessment of plant protection products for non-target terrestrial plants. EFSA Journal 2014;12(7):3800, 163 pp, OECD (2006). Test No. 208: Terrestrial Plant Test: Seedling Emergence and Seedling Growth Test. OECD Publishing, Paris. OECD (2006). Test No. 227: Terrestrial Plant Test: Vegetative Vigour Test. OECD Publishing, Paris.

400 Predicting plant community level effects of herbicides based on monolute dose-responses: Testing the plant community model IBC-grass with experimental data
L. G. Leenen, University of Potsdam / Plant Ecology and Nature Conservation; S. Hein, Bayer Ag / Effect modelling; C. Mihan, Bayer CropScience AG / Ecotoxicology; T. Preuss, Bayer Ag / Environmental Safety; F. Jeltsch, University of Potsdam
Ecological models are rarely found in terrestrial plant ecology. Ecological models are rarely found in terrestrial plant ecology. Plants: predicting and assessing direct, indirect e...
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, lemma, and myriophylum 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. Duquesnè, UBA, Federal Environment agency; L. H. nemann, S. Matezki, M. Solé, K. Swarowski, 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 (ErEC50) or as reduction in biomass, calculated from yield (EyEC50) or as the integral under the growth curve (EbEC50). The lowest available EP among ErEC50, EbEC50 or EyEC50 used to be selected to derive safe concentrations of pesticides in surface water bodies. It is now recommended [1] to use ErEC50 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 ErEC50) 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 EC3, (ECIn cr, EC 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 biomonitors

404 Persistent Organic Pollutants in Germany: Results from the 2015/2016 moss and Co2C2 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 dioxins and furans (PCDD/F), 18 polychlorinated biphenyls (PCB), 16 polycyclic aromatic hydrocarbons (PAH), 17 perfluoralkyl substances (PFAS), 3 isomers of hexabromocyclododecane (HBCD), 7 polychlorinated biphenyls (PCB), 24 polybrominated diphenyl ethers (PBDE), and 21 alternative halogenated flame retardants (HFR) such as Dechlorane Plus were determined. Except for PCBs 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 magnitude as those observed in coniferous shoots or deciduous tree leaves from nearby located areas. Highest levels of PCDD/F, dioxins, HBCD and PAH in moss were observed at sites close to the Belau 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 Söding (forestry) and Scheven (agriculture) 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, sampling devices and bioaccumulators such as moss. Within the European moss survey programme, since 1990 every five years moss samples have been collected at 7580 sites in Europe. This work presents a first tier assessment of chemical determination 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, Sb 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, Sb and Zn will be focused in this paper together with Cd, 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 monitoring. References [1] Nickel S, Völksen B, Dreyer A (2017) "Reorganisation of a long-term monitoring network using moss as biomonitor for atmospheric deposition in Germany. Ecological Indicators 76:194-206. [2] Schröder W, Nickel S, Völksen B, Dreyer A (2017) "Utilising moss for the determination of nutrient concentrations in agricultural sites." J. Zwaal, K. Swarowsky, German Environment Agency UBA; J. Wogram, German Environment Agency UBA / 2

406 Heavy metal and nutrient concentrations in different age classes of holm oak leaves and pine needles - a reference for biomonitoring and geochronology J. Franzaring, 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 / Dept. of Life Sciences; S. Nickel, University of Hohenheim / Core Facility Hohenheim; E. Menauj, 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. forest and agricultural ecosystems and their effect on wood and soil chemistry. In the present work, 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 Pinus pinaster Ait.), i.e. evergreen deciduous conifer and two evergreen conifer species. Holm oak leaves and pine 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 of samples 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, Zn, Cd, Hg, P, Ni, Fe, Hg, Pb, Mg, As, Pd, Cd, Zn, N and S. Apart 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 element concentrations between different age classes which relate to the availability, transformation, accumulation or growth dilution 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 exceedance 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 for agriculture and recommendations.

407 Examining historical trends in diet and contaminant exposure in bats using butyrate deposits from Jamaica L. Gallant, University of Ottawa / Department of Biology; C. Grooms, Queens University; L.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 useful environmental archives as the cave environment preserves stable isotope data and records which allows 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 exploitation or exploration. The objective of this study is to reconstruct historical changes in diet and contaminant exposure to bats in order to better understand how anthropogenic activity affects these high trophic level mammals. We constructed the 31Pb, 73Cs, 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 δ26Si, δ34S, and δ35S 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 sugarcane. We also examined the sterol profiles in the bat guano deposits for the purpose of determining more specific dietary information. Recent peaks in cholestrol and stigmastan, for example, could be evidence of fluctuations in farming habits (e.g. barley or corn) over the past 3,000 years. We also present the long-term increase in metals such as Cd, Hg, Pb, and Zn within the bat guano deposits associated with contaminant exposure in relation to the onset of the Industrial Revolution, a period characterized by an increase in atmospheric emissions of metals owing to increased mining and production. Lastly, we present the decrease in 39Pb/206Pb within the bat guano deposits in association with the introduction of leaded gasoline.

408 Perfluoroalkyl substances and metallic elements in South African dragonflies
H. Boldman, North-West University / Unit for Environmental Science and Management; V. Lesch, North-West University; Y. Shibata, National Institute for Environmental Studies / Fellow; A. Kinoshita, National Institute for Environmental Studies
Adult dragonflies are aerial predatory arthropods that occur globally. However, no research on adult dragonflies as potential indicators of environmental metallic eutrophication has been done previously. PFAS and elevated concentrations of environmental metallic elements are toxic to organisms and can cause disruption of biological processes. Adult dragonflies were collected and analysed for PFASs and metallic elements. The results indicated that dragonflies from farmed areas had significantly lower ZPFPAS concentrations than sites located closer to industrial areas (median 2PFPASs of 0.32 ng/g wet mass for Non-hubs vs 0.3 ng/g for South). Adult dragonflies can incorporate perfluorooctanesulfonic acid (PFOS) occurred at similar concentrations at all six sites, when quantifiable, but PFOS dominated in the Southern sites. The highest median concentration was from Bloemhof Dam (ZPFPASs = 21 ng/g), 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 metallic elements. 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 isolated water sources, showed lower metallic element concentrations when compared with other sites. Based on these results we conclude that dragonflies would be excellent indicators of environmental metallic elements and PFAs.

409 Bioavailability of Arsenic and Antimony co-contamination to vegetable crops in agricultural soils
L.P. Fereodawans, University of Wollongong / School of Chemistry; A. Holland, La Trobe University / School of Engineering; A. Zhucht, University of Wollongong / School of Environmental Science
Antimony (Sb) is an emerging contaminant that is known to behave in a similar way to arsenic (As). Sb and As often co-occur 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 (safety and nutrition), and elevated concentrations of environmental metallic elements or perfluorinated substances (PFASs) pollution have been documented worldwide. The freshwater pearl mussel Margaritifera margaritifera is one of the most threatened freshwater bivalves worldwide. In this study, we aimed to (i) 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 report on the toxicology of these animals was assembled and gene transcription determined by RNA-seq. Correlations between transcription levels of each single transcript and the bioaccumulation of 9 trace metals, age (estimated by sclerochrono) 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 retrotansposons-related genes. To investigate this effect, dragonflies from farming areas had significantly lower 2PFPAS concentrations than sites located closer to industrial areas (median 2PFPASs of 0.32 ng/g wet mass for Non-hubs vs 0.3 ng/g for South). Adult dragonflies can incorporate perfluorooctanesulfonic acid (PFOS) occurred at similar concentrations at all six sites, when quantifiable, but PFOS dominated in the Southern sites. The highest median concentration was from Bloemhof Dam (ZPFPASs = 21 ng/g), 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 metallic elements. 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 isolated water sources, showed lower metallic element concentrations when compared with other sites. Based on these results we conclude that dragonflies would be excellent indicators of environmental metallic elements and PFAs.

410 Transcriptomic responses of the endangered freshwater mussel Margaritifera margaritifera to trace metal contamination
A. Ceriotti, F. Perzon, University of Bordeaux / UMR EPOC CNRS 5805; J. Thébault, Université de Breté / LEMAR UMRS 6539 CNRS/UBO/IRD/Iffrer; O. Koppel, INRA Institut National de la Recherche Agronomique / Plate-forme bio-informatique Genotoul, Mathématiques et Informatique Appliquées de Toulouse; J. Béllec, Université de Breté / LEMAR UMRS 6539 CNRS/UBO/IRD/Iffrer; 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 to (i) 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 report on the toxicology of these animals was assembled and gene transcription determined by RNA-seq. Correlations between transcription levels of each single transcript and the bioaccumulation of 9 trace metals, age (estimated by sclerochrono) 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 retrotansposons-related genes. To investigate this effect, dragonflies from farming areas had significantly lower 2PFPAS concentrations than sites located closer to industrial areas (median 2PFPASs of 0.32 ng/g wet mass for Non-hubs vs 0.3 ng/g for South). Adult dragonflies can incorporate perfluorooctanesulfonic acid (PFOS) occurred at similar concentrations at all six sites, when quantifiable, but PFOS dominated in the Southern sites. The highest median concentration was from Bloemhof Dam (ZPFPASs = 21 ng/g), 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 metallic elements. 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 isolated water sources, showed lower metallic element concentrations when compared with other sites. Based on these results we conclude that dragonflies would be excellent indicators of environmental metallic elements and PFAs.
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. Aetoclemimines and serotonin are involved in osmoregulation, and in gamete 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].

Studies on the effects of polychlorinated biphenyls (PCBs), dichlorodiphenyldichloroethylene (DDE) and some ortho-polychlorinated biphenyls (PCBs) were greater in the SHB bears and changes in the metabolic concentrations had some consistency (PBDEs), bears, and Spearman correlation analyses were used to establish significantly different or impacted physiological pathways were identified that may multivariate and univariate statistical analyses. Correlated compounds and 14) and Western Hudson Bay (WHB; 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. Roelofs, Vrije Universiteit / Department of Ecological Science; N. van Straalen, Association of Rare Environmental Scientists (ARES), Department of Ecological Sciences; M. Lemos, Instituto Politecnico 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 and responsive of its taxa and 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, CHT was selected for this study because it is toxic to many terrestrial organisms and it is widely used on agriculture soils. To find the reproduction EC50, several dilutions of the formulation were spiked according to nominal concentrations of the active ingredient. For the mechanistic assessment of effects, and to better understand the correlations between omics information through time, organisms were then exposed to the estimated EC50 of the formulation (plus control) and sampled at consecutive time points (2, 4, 7, and 10 days). Four replicates per treatment and time point were used (32 in total). CHT exerts its toxic effects primarily through binding to thiol-rich molecules (ex. glutathione), exhibiting often a multi-site activity and the results with the formulation were very indicative of these mechanism of toxic activity. Also in this study, results point for similar effects of the fungicide formulation on the functional mechanisms 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 omics results. Our results indicate the potential of using functional genomics to provide useful insights, exhibiting their relevance in toxicological studies and proving the importance of a time-series analysis in correlations between these datasets.

Using functional genomics to find mechanisms of herbicide toxicity in *Chlamydomonas reinhardtii* A. Cupani, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; A. Betz, Eawag / UTOX

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 not every 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 one of the highest priorities of the (eco)toxicological research community. One of the best method for gene function discovery is functional genomics based on high throughput screening of whole-genome mutants. This allows the analysis of many single-gene mutants in parallel and permits the identification of unknown gene functions (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 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 (compared 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 defense 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.

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**Impact of marine litter in the Mediterranean Sea: monitoring and specific reduction measures within MSFD**

F. Giliani, FPREMER

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 quantities of marine litter do not cause harm to the coastal and marine environment”. In 2016, the Revised Commission Decision identified four indicators for Descriptor 10, of which two are focusing on harm considering (i) The amount of litter and micro-litter ingested by marine animals is at a level that does not adversely affect the health of the species concerned (indicator 10DC3), and (ii) The number of individuals of each species which are adversely affected due to litter, such as by entanglement, other types of injury or mortality, or health effects (indicator 10DC4). For these two indicators, Member States shall establish that list of species to be assessed and thresholds values for these levels through regional or sub-regional cooperation. In the context of the Mediterranean Sea, we discuss the ongoing work that is focusing on the implementation of monitoring and reduction measures, defining constraints, protocols, better defining harm and research needs to support monitoring efforts and reduction measures. The analysis of existing data will reveal (i) the suitability of some approaches for better monitoring the adverse effects of litter, and (ii) the potential of visual observations of the sea floor for the measurement of interactions between litter and invertebrates as an approach for evaluating entanglement. Strategies for the implementation of monitoring are discussed, as well as risk assessment and the possible associated measures within MSFD.

**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 action 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 enhanced 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 broad extent of involvement and interventions required for the protection of the marine and coastal environment. 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 inconstant truth that if the world had 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 at high risk of dispersion**

F. Deoli Innocenti, Novamont SpA

The problem of plastic marine debris is caused by inadequate waste management and improper disposal. The measures taken to prevent spreading, such as recycling programs, do not address the problem of biodegradability of the plastic waste. Bioplastics can be the right solution for specific products, if properly applied. For example, in mussels farming (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 this depositional environment is microbiologically 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. 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 where accidental release is certain or very probable, biodegradability decreases the environmental risk. Materials that show full and relatively fast biodegradation may be suitable for plastic products known to wear down or become stranded (for example, fishing gear) and scatter into the sea. Bioplastics hold promise for aquaculture professional applications (e.g. nets for mussel 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/RPML 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 the cooperation with 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 a 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

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 Biology, Ecology and Environmental Sciences; E. Leu, Akvaplanniva AS; F. Poertner, Max Planck Institute of Aquatic Sciences; E. Kaloijanni, I. Karouzas, A. Vourka, E. Stroli, L. Vardakas, Hellenic Centre for Marine Research, Institute of Marine Biological Resources & Inland Waters (HCMR); M. Paunovic, University of Belgrade, Institute for Biological Research Siniša Stanković; 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. Lurz, Henholz Centre for Environmental Research UFZ; A. Bellin, E. Stella, University of Trento / Department of Civil, Environmental and Mechanical Engineering 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 loss 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 bacteria, algae, macrophytes, macroinvertebrate and fish communities related to environmental pressures. The data obtained from the field work conducted in three of the Globqua case study basins (Adige, Sava and Evrots) 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. Håk, N. Wichman, C. Lewis, K. Smith, A. Wilson McNiel, 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 keystone 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 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. Endpoint 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 modulating the 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. API 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.
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 metrological 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 compounds). This 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 30 days experiment. Overall, stressors contamination and environmentally relevant concentrations have a drastic persistent impact on the different levels of organisation of the phytoplankton community. At community level, contaminant decreased the photosynthetic yield. At higher concentration levels these effects persisted throughout the duration of the experiment, resulting in lower productivity and communities with contrasting. This suggests that diffuse chemical pollution can disrupt the capacity of natural communities to handle environmental changes.

427 The role of multiple stressors in an Alpine river and the response of the macroinvertebrate community

M. Trettin, I. Carbognin, E. Cer Donato, Università Cattolica del Sacro Cuore / Institute of Agricultural and Environmental Chemistry; E. Stella, University of Trento / Department of Civil, Environmental and Mechanical Engineering; E. Capri, Università Cattolica del Sacro Cuore / Institute of Agricultural and Environmental Chemistry; I. Muñoz, University of Barcelona / Department of Evolutionary Biology, Ecology and Environmental Sciences; A. Bellin, University of Trento / Department of Civil, Environmental and Mechanical Engineering

In this study the combined effects of hydrological and chemical stressors on benthic macroinvertebrates are evaluated in order to explore the response of the biological community in relation multiple pressure factors. The Adige River, located in the South-eastern Alps, was selected as a case study because representative of a variety of stressors characterising the Alpine region. As expected, streamflow showed a seasonal pattern, with higher values in the spring-summer period; however, in some sites the natural hydrological regime was altered by the presence of hydropower plants, which management affected most low values of streamflow. Statistical analysis showed a clear seasonal and spatial pattern in both chemical and hydrological parameters; in detail higher concentrations of nitrate, Personal Care and Pharmaceutical products were found in winter season associated with lower streamflow. Changes in richness, diversity and composition of macroinvertebrate community are related with inputs of urban pollution along the river, and with hydrology, chiefly downstream hydropower plants. Pollution (nitrates and other compounds such as PhACs and FCP) favor higher invertebrate densities but lower diversity, changes in thermal natural regime affects Plecoptera, and Gomphus sp dense population was observed with flow velocity. This study lies in giving a comprehensive and general explanation of the response of biological communities to multiple stressors investigated in an Alpine environment; in particular the analyses performed allow to distinguish the main pressures that impact macroinvertebrates in the Adige river.

428 Coping with antidepressants in a changing ocean: tissue bioaccumulation and behavioural implications in juvenile Argyrosomus regius exposed to venlafaxine

A. Maulvault, Instituto Portugués do Mar e da Atmosfera / Division of Aquaculture and Seafood Upgrading; L. H. Salmo, Catalán Institute for Water Research ICRa; S. Rodríguez-Mozos, Institute for Water Research (ICRa) / Water Quality; P. Anacleto, Portuguese Institute for the Sea and Atmosphere / Division of Aquaculture and Upgrading; V. F. Barbosa, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Seafood Upgrading; R. Alves, IPMA, I.P.; J. R. Paula, Faculdade de Ciências da Universidade de Lisboa / MARE Marinha e Environomes Centre; L. Rosa, MARE Marinha e Environomes Centre / MARE Marinha e Environomes Centre; M. Diniz, UCIBIO, REQUIMTE / UCIBIO, REQUIMTE; P. Pousão, IPMA. Portuguese Institute for the Sea and Atmosphere; A. Marques, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Upgrading

Anthropogenic 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 conducted in order to fill the first-time, 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.

429 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. Assuncão, Celas Lowestoft Laboratory; P. E. Posen, Centre for Environment Fisheries and Aquaculture Science Cefas; M. G. Hutchins, Centre for Ecology and 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 scale and a baseline generated for the period 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, corresponded 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 residues (NER): Scientific strategies, Analytical challenges and Regulatory Issues (II)

430 Evaluation of PBt and PbB substances based on exposure dynamics, use-specific impacts and costs for emission reduction or abatement in the context of REACH

S. Rabbert, 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 specific use or end uses; 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/PvBs, 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.
target values (standards) by means of which it can be determined whether or not the costs of a control measure are excessive. This paper suggests an approach for the evaluation of PBT/vPvB substances by means of CEA that accounts for the complex environmental distribution patterns, and that allows balancing (long-term) impacts from PBT/vPvB use against costs for emission reduction and abatement. The approach proceeds along a sequence of steps and uses different analytic tools and data. Starting with a grouping and ranking of PBT/vPvB substances, exposure data are obtained by a multimedia model approach. Based on the assessment of exposure dynamics in different compartments, impacts arising from the stock can be evaluated via different routes. To assess the cost-effectiveness and proportionality of possible (policy-) measures for PBT/vPvB control, the routes to impact evaluation are linked to assessments of costs for restricting or stopping a specific use or a multitude of uses and to benchmarks, being standard values of a specific parameter to which the actual/estimated value of that parameter can be compared. As illustrative case study, the approach is applied to perfluorocarboxylate sulfonate (PFOS).

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 IITM / Chemical Risk Assessment; M. Klein, Fraunhofer Institute for Molecular Biology and Applied Ecology IME; F. Oosterhuis, Vrije Universiteit Amsterdam / Institute for Environmental Studies; U. Ostermann, Helmholtz Centre for Environmental Research – UFZ / Department of Environmental Biotechnology; J.R. Verbruggen, RIVM Expertise Centre for Substance / Centre for Safety of Environment; P. Bayer AG Division CropScience/Environmental Fate / Development Institute for Environmental Research RWTH Aachen University; M. Telscher, Evidence Director

The formation of non-extractable residues (NER) of chemicals in soils and sediments is a critical issue for the environmental risk assessment of these compounds, as they may potentially be remobilised as parent or transformation product. However, a standardised or commonly accepted methodology for the characterisation and evaluation of NER does not yet exist. In scientific literature different terms like soil Attached Pharmaceutical Residues (SAPRs) or Soil-Associated Pharmaceutical Residues (SAPRs) are used. However, a harmonised term is not defined yet. The aim of this study is 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 concept-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


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 (Possberg et al. 2016) a distinct analysis of NER has been reported. The method relies on the determination of natural amino acids as the main part of biogenic 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 major limitation of the method, 55% of the applied 14C-labeled 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 Estimation 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. Due to their inherent nature, analysis and further assessments of bound residues are challenging. In a recent publication (Possberg et al. 2016) a distinct analysis of NER has been reported. The method relies on the determination of natural amino acids as the main part of biogenic 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 major limitation of the method, 55% of the applied 14C-labeled 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.

435 A tool to establish the role of Non-Extractable Residues (NER) in soil on toxicity

J. Harmsen, Wageningen Environmental Research / CALM; D. Hennecke,
Developments in the Biopharmaceutical Acid (6-APA) Sustainability Assessment; LCA is integrated in their daily decision making work. We will share insights that LCA is relevant for their job at hand. This requires developing tools that can answer the questions that are relevant in a specific decision making situation. For this goal we need to develop tailor made LCA indicators that are tailored to the needs of decision makers. 

Results can have a different meaning in different context. Therefore, it’s 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. 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 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 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. 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 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 need to develop tailor made LCA indicators that are tailored to the needs of decision makers. We will show examples of how to develop assessment tools and criteria that can support the decision making process.

Keywords: fit for purpose, decision making, LCA, Sustainability Assessment; Presentation preference: platform presentation

Using Life Cycle Assessment (LCA) to Evaluate Global 6-Aminopenicillanic Acid (6-APA) Manufacture and Make Recommendations for Future Developments in the Biopharmaceutical 

Using Life Cycle Assessment (LCA) to Evaluate Global 6-Aminopenicillanic Acid (6-APA) Manufacture and Make Recommendations for Future Developments in the Biopharmaceutical

C. Chau, University College London / Department of Biochemical Engineering; N. Tichener-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 and many 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. 

The importance of sustainability in transportation infrastructure has raised in response to the link between anthropogenic activity and global challenges such as 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, at an early design phase of the infrastructure delivery process. That is a typical multi-criteria decision-making (MCDM) problem, in which the decision-makers need to measure the sustainability through a set of meaningful, representative and quantifiable criteria, balance the relative importance of those criteria and determine the sustainability sequence of multiple alternative technologies for fostering transportation sustainability. In order to help the decision-makers to efficiently and effectively carry out this challenging task, a decision support tool (DST) was developed in the scope of the training-through-research programme Sustainable Pavements & Railways Initial Training Network (www.superin.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 best pavement and railway 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.

Influence diagrams and scoping for Life Cycle and Sustainability Assessment, an example from sustainable mining 

D. Lo Presti, The University of Nottingham / Institute for Manufacturing Engineering; M. Calvo, Wageningen Environmental Research / ERA team; C. Chu, University College London / Department of Biochemical Engineering; N. Tichener-Hooker, University College London / Department of Biochemical Engineering; P. Lettieri, University College London / Chemical Engineering

Life Cycle Assessment is a technique typically intended to provide a holistic assessment of environmental and possibly also social impacts over the entire supply chain and life cycle. However, LCA has limitations, for a variety of reasons. In this situation, it is interesting to investigate, for a given issue, the ideal portfolio of tools...
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 United Nations 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 now acknowledged as the worthiest methodology to evaluate the life cycle impacts of space systems. As outlined in this paper, the integration of social and economic aspects with environmental LCA to evaluate the life cycle impacts of 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 approach and the potential of the environmental and social aspects with 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 LCSA 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.

How can Agent-based Modeling improve decision making in Life Cycle Assessment?

A. Micolier, A. Selleri, Autostrade per l'Italia / direzione tecnica; S. Frisiani, Spea Engineering S.p.A.

Evaluating biotests, limit values of some contaminants should be fixed to consider ESR as by-products, the allowed treatments 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 binders, 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.
The use of foaming agents and additives is one of the fundamental factors allowing the correct use of the EPB-TBM (Earth Pressure Balanced-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 of the environmental legislation. 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 following approval process. 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 need for an amount of conditioned soils to be disposed, is not only of environmental significance, but also of economic importance. 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.

**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. Gremi, National Research Council of Italy (CNR) / Water Research Institute; E. Beccaloni, National Health Research Institute / Health and Environment Department; L. Patroloce, 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 lauryl ethel 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 if 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 eco-toxicological 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**
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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 required for a licenced waste facility which 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 foam. The product can be used with existing equipment found on EPB TBMs. It was developed after specific studies together with ecotoxicological tests in order to meet the requirements for the current legislation, but also because the TBM is commissioned with an environmental consultancy, it was considered that excavated material from excavation processes can be re-used by-products if the chemical thresholds other additives. In accordance with the Italian legislation, spoil material from excavation processes can be re-used by-products if the chemical 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.

**448 Analysis and Fate of Emerging Contaminants in soils, water and plants under water scarcity (II)**

**449 Quantification of Carbon Nanotubes in Complex Matrices: Possibilities of Electron Microscopy**
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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 still lacking. Therefore, for a laboratory have demonstrated a 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. The new product will be attractive to those seeking to minimise the environmental impact of tunnelling projects.
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 emission 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 on the TEM grids. CNTs with a length of 30-100 nm and a diameter of 1-2 nm were counted. 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 µL⁻¹ to 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 mg CNTs/L) 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 CNTs/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

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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 97.1 - 135.0% for PFCs, 95.0 - 117.2% for Insecticides, and 72.5 - 86.4% for BFRs, with coefficients of variation of less than 15%. Method detection limit (MDL) for PFCs, insecticides, and BFRs were 0.3 - 7.1 ng/L, 3.0 - 3.7 ng/L, and 5.1 - 11.7 ng/L, respectively while limit of quantification (LOQs) were 0.9 - 21.1 ng/L for Insecticides and 1.5 - 35.0 ng/L for 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 PFOA, PFHxS, and dinofeturan (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

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Impacts of Contaminants of Emerging Concern on Terrestrial Organisms

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Reclaimed water is a historically underutilized resource. However, with increased population growth and global climate change placing increased pressure on fresh water resources, reclaimed water is evolving into a 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 resistance to biodegradation in the environment. Using mass spectrometry, 14C tracing, enzyme extraction and Illumnia sequencing techniques, we evaluated a wide range of biological effects in terrestrial organisms 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 raphanistrum sativus) 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


The concentration of perfluorinated compounds in surface waters 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 rapid screening of bile 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, Cadiar, and Mallorca. In total, 20 bile 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

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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 bioaccumulation 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 (diclofenac, trimethoprim, carbamazepine, oxcarbazepine, lamotrigine, cis-diltiazem, valsartan, midazolam, and methadone), an illegal drug (cocaïne) and two transformation products (acridone and valsartan 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 period, leaves, roots and soils were harvested. All metabolically 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 tissues (leaves and root system), whereas cis-diltiazem, midazolam, and methadone 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
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

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This study was focused on a root uptake of carbamazepine, atenolol and sulfamethoxazole from 3 soils: Haplic Chernozem, Haplic Cambisol and Arenosol Epifluvic. 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 (radish), probably due to its type as a pro-drug. Higher concentrations of 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 solute 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

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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. 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 (radish), probably due to its type as a pro-drug. Higher concentrations of 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 solute divided by a dry mass of soil).

455 Environmental effect assessment of human pharmaceuticals - the regulatory way forward

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Human pharmaceuticals are extensively studied and assessed before marketing approval. The EMA guideline for environmental risk assessment of human pharmaceuticals (EMEA/CHMP/SWP/4554/2002) 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 the multiple quality checked effect data of algae, aquatic invertebrates and fish provided within several European authorization procedures. Both, the effect of water pollution with pharmaceuticals and the exposure calculation with modeled data is 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 authorisation 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 mg/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 approaches for long-term effects, replace long-term by short-term for certain factors 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

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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 neccessity of risk assessment. To address this need, the following study was performed to estimate PPCP use in Nigerian households to prioritise the potential for PPCPs to enter source water. Using questionnaires as the survey instrument, we elicited information from 350 participants, concerning the most frequently used PPCPs, duration and amount of use in households. Drug usage was limited to over-the-counter(OTC) medicines and was estimated by application of statistical data. The National Health Organization (NHO) daily dosage values were used for the estimated consumption of personal care products (PCPs) was calculated by multiplying the quantity of products used by the frequency of use. To prioritise PPCPs, a risk index was developed to rank chemicals according to their potential to enter source water. Consumption of PPCPs varied considerably. Analgesics were the most commonly used OTC medicines and highest use was observed for anti-inflammatory drugs. Furthermore, the following analysis point will be the question whether there are specific factors as applied usually for chemicals without any specific mode of action will be analyzed.

fish. There was no significant correlation between plasma PG and plasma NSAID concentrations within exposure treatments; plasma NSAID concentrations exhibited much lower inter-individual variation, with blood plasma: water partition coefficients ranging from 1-3 for ibuprofen and 1-9 for diclofenac. To identify factors affecting PG levels in individual fish we measured plasma lipid content and plasma protein binding influencing partitioning and bioavailability, haematocrit and cytochrome-p450 c-reactive protein concentration quantifying baseline immune system status, and plasma corticosteroid 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.
ciprofloxacin, ampicillin, cloxicillin, sulfamethoxazole, trimethoprim and pseudoeperine) and 4 PCP ingredients (sodium laurel ether sulphate, alcohol ethoxylates, ammonium thio glycolate 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 pharmaceutical or secondary targets of human pharmaceuticals

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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 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 Raphidiocelis subcapitata. Acknowledgement - The research leading to these results has received support from the Innovative Medicines Initiative project PREDICT developed within iPIE grant agreement n° 115735, resources of which are composed of financial contribution from the European Union's Seventh Framework Programme (FP7/2007-2013) and EFPIA companies’ in kind contribution.

458 Neurotoxicity testing approach to investigate venlafaxine and oxazepam modulation of transcriptomics and behavioral profiles in zebrafish embryos and larvae

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459 Virtual fish tales: Liver, Intestinal and Gill Organoids as an in vitro alternative to live fish for prioritising pharmaceuticals and other compounds of highest concern in the environment.

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Pharmaceuticals enter the aquatic environment largely through patient use, and result in a pseudo-persistent background in the aquatic environment. The risk of those compounds is assessed for new products registered since 2007. 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—IP). Those 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 (BBBSC/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 spheroids 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.

Emergence and multidimensional interactions of engineered nanomaterials in toxicity

460 Effects of fullerene C60 increasing concentrations in Mytilus galloprovincialis: role of mTOR in cellular/tissue alterations

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Little is known about the effects at cellular, tissue and individual levels of emerging contaminants such as fullerene C60 or other nanomaterials. The mechanisms of action of C60 are poorly investigated. In this research, 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 a variety of cellular physiological and environmental signals to regulate cell growth, mTOR is found in two functionally distinct complexes, mTORC1 and mTORC2. In particular, the phosphorylated active form of mTORC1 mediates temporal control of cell growth by activating anabolic processes (such as transcription, ribosome biogenesis, protein synthesis), and by inhibiting catabolic processes (such as autophagy); mTORC2 is primarily involved in actin cytoskeleton reorganization. Mussels were exposed to C60 (0.01, 0.1 and 1 mg/L) for 72h. Tissue C60 accumulation was evaluated by immunofluorescence using a specific antibody as well as by LC-HRMS. qPCR analysis revealed the presence and cellular distribution of C60 in mussel tissues, already at the lowest concentration. Our data demonstrated that the changes of the phosphorylation of mTORC1 and mTORC2 may explain most of C60 effects studied at cellular and tissue level. Indeed, the C60 induced dephosphorylation of mTORC1 contributed to increase autophagy and to decrease protein synthesis as previously reported. The reduction of lysosomal membrane stability and the enhancement of lysosomal/cytosplasmic volume ratio of the digestive gland cells; and mTORC2 to affect cytoskeleton organisation as revealed by the changes of actin/tubulin structures. Transcriptomic data are important to understand the cellular adaptive responses to the chemical. For this purpose, a novel low density oligo microarray (470 genes, suitable to follow 15 stress response pathways) was used. Transcriptomic analysis identified a number of DEGs showing a bell-shape trend with a maximum in animals exposed to 0.1 mg/L C60. In terms of processes related to the DEGs depicted in all conditions, the most affected are associated to...
461 Protemic 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. Pascual, F. Cassio, University of Minho / Centre of Molecular and Environmental Biology CBMA Department of Biology. Enhanced use of Ag nanoparticles (AgNPs) has inevitably resulted in their release into freshwaters raising concern about the risk to non-target biota and related ecological functions. Functional proteomics 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 (effect concentration) were assessed based on the variations in the overall proteome in two aquatic fungal strains of Arthrobotryspora tetracculudia, one isolated from a non-polluted stream (ArT72) and the other from a metal-polluted stream (At61), and ii) the bacterial strain Pseudomonas sp. M1 (PsM1) isolated from a metal-polluted stream. ArT72 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 ArT72 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 biochemical pathways involved in Ag+ and AgNPs exposure were different. At61 had ~25% more proteins induced by both Ag forms (compared to ArT72), 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 ArT72, 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 proteomics 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. Boker, University of Natural Resources and Applied Life Sciences; J. Sturze, Goteborg University / Department of Biological and Environmental sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences. 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 of 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 destruents, 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 toxicity. 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. Biritragunta, 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 healthcare 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 in segment 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 chlorpyriphos and ZnO on oxidative stress and reproduction of the earthworm Dendrobaena veneta
D. Hackenberg, Department I Biology, University of Osijek / Department of Biology; J. Obbo, Birla Institute of Technology & Science, Hyderabad Campus / Biological Sciences; T.C. Telfer, University of Stirling / Institute for Water Research, NIVA; A. Rico, IMDEA Water Institute / Aquatic Sciences. The enhanced use of silver nanoparticles (AgNPs) has inevitably resulted in their release into freshwaters raising concern about the potential organisms to undergo the conditions 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 chlorpyriphos (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 toxic mixture 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 desorption, 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 ZnC/OHP/chlorpyriphos combination. The inhibition of AChE was present at all applied combinations. In natural soil the number of juveniles was reduced with ZnO, while it remained the same as control after bZnO exposure. The effects of combined exposure of CHP and ZnO were dependent on the concentration and 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.

465 Poster spotlight: WE305, WE323, WE324

Improving the environmental risk assessment of the aquaculture 'Blue Revolution'

466 Tools for Assessment and Planning of Aquaculture Sustainability (TAPAS) P. van den Brink, Alterra and Wageningen University; A. Lilliecrap, 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 must be used wisely if the development of the sector is to be sustainable. Appropriate environmental characteristics, good water quality, well-understood social interactions and use of inland and coastal resources are essential to maintaining in existing and future aquaculture systems. Consequently, suitable zoning, selection of sites and application of carrying capacity are among the most important issues for the future success of European aquaculture, and also predicte the need for sustainability, resilience and best practice guidelines, as provided by the Ecosystem Approach to Aquaculture. The four-year Horizon 2020 TAPAS research project, which started in March 2016, aims to consolidate the environmental sustainability of European
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. Li, N. N. Dinh, National University of Singapore; C. G. Lin, 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 targeting 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 saccharose, with concentration range of

468 Perspectives on Urbanization, Water Reuse, and Aquaculture Product Quality

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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, agriculture and chemical 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 other 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)

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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 teflubenzuron, emamectin, deltamethrin and azamethiphos. Due to the low solubility of teflubenzuron 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 teflubenzuron also indicated that in other mussels in brackish waters show different bioaccumulation dynamics. So far, the results have shown a clear uptake of teflubenzuron over 14 days, reaching maximum concentrations (~1500 ng/g) after 10 days. Depuration of teflubenzuron 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 teflubenzuron. In contrast, emamectin showed lower 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. Pouill, F. Oberhänsli, International Atomic Energy Agency / Environmental Laboratories; P. Bustamante, Universidad de La Rochelle / Littoral Environnement et Sociétés LIENs; P. Swarzennski, 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 to support powerful tools for assessing 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 aquaculture practices is essential. Such work will attempt to better understand the role the fish food or key 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 radiotracer 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 radiotracer permits 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 exposed 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

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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 increasing occurrence 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 vs. uncovered) with local fish feed 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 flumequin. 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 target antibiotics in the invertebrate community and evaluation of the antibiotic targets over the microbiome and resistome of the sediment bacteria is still ongoing. This is one of the first studies describing fish feed and antibiotic impacts produced by aquaculture under Mediterranean conditions.

**Systems ecotoxicology: application of OMICS data across multiple level of biological organization in research and risk assessment (II)**

**472 Systems toxicology approach for the assessment of zebrafish cardiac and neurotoxicity**

R. Li, M. Talikka, Philip Morris International; S. Madan, Fraunhofer Institute for Algorithms and Scientific Computing; J. Doerinqhaus, Fraunhofer Institute for Algorithms and Scientific Computing; A. Zupanic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Flueck, Fraunhofer Institute for Algorithms and Scientific Computing; C.M. vom Berg, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; J. Szostak, F. Martin, M. Peitsch, J. Hoeng, Philip Morris International 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 human effects 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 models 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 transcriptional analyses. Finally, we describe the utility of the network model in interpreting transcriptional 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**

J. Asselman, I. Semmoumi, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology, GhEnToxLab unit; K. De Schampaere, 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 timepoint to measure gene expression or log responses 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 timepoint, 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 microbial in risk assessment processing?**

E. Deligent-Muller, VetAgro Sup / Laboratory of Biometry and Evolutionnary Biology; M. Schmitt-Jansen, UFZ - Helmholtz Ctre Environm. Research / Department of Bioanalytical Ecotoxicology Microorganisms (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 microbial communities exposed to environmental conditions. 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 (i.e., metabolites/transcript) and used their concentration responses to assess each of them and we derived a sensitivity value from each curve (even the non-monotonic 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 functions and integrating two levels of OMICs responses. The next step consists to build such tool from the periphytic community level.

Sex, drugs and Daphnia magna. A multi-omics approach supports conserved mechanisms of interaction between metallohomones and endocrine disruptors

E. Caamaño-Gutiérrez, University of Liverpool / Computational Biology Facility; P. Atharctic communities in Liverpool / Institute of Integrative Biology; L. Senbrah, The University of Birmingham / School of Biosciences; K. Grzintalís, 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 risk assessment frameworks are mostly based on chemical hazard 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 10 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 or AChE inhibitors (Cd), whereas metals and estrogen 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 disruptors 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
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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 (alidcarb, chlorpyriphos, 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 in all stages of female stickleback. We also see that some chemicals for which predicted no-effect concentration (PNEC) is not known (such as PCB s 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 „cycotkin-cytokeine receptor interaction”). Conclusion. We have shown 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.
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Detection and evaluation of the impact of pollutants 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 a 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 can 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 Gasterosteus aculeatus. Shotgun proteomics was used to identify the molecular key players involved in different physiological states linked to reproduction and in case of exposure to insecticides 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. Vanhoenacker, 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 fed-expert – in which the 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 debates.

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 organisational 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.

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 organisational 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. Agran, 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). In 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. ’nThis 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 Vanhoutte, 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 487 The impact of chemical pollution on the resilience of soils under multiple stressors A. Haefiger, 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. Kandler, University of Hohenheim; J. Kruse, University of Bonn; A. Milner, Helmholtz Centre for Environmental Research UFZ / Department of Environmental Biotechnology; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research; H. Pegel, 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. Streck, University of Hohenheim; M. Rob-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 pollutions as a primary stressor will change the system reaction of soils, 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 desaturation and elongation of fatty acids in freshwater fish M. Fadhlaoui, INRS - Eau, Terre et Environnement / 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 dismutatase, 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 (fads2, degs2, 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, the 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 membrane fatty acid composition of both tissues, but was more pronounced than for yellow perch. We observed a mismatch between desaturation 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 impairment in juvenile rainbow trout (Oncorhynchus mykiss) S. Volz, 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 in a predictable manner, modelling approaches, such as the Biotic Ligand Model (BLM), are powerful tools to predict site-specific effect concentrations. To date, the BLM used in risk assessment for fish only predicts gill-based metal toxicity. However, metal-binding dynamics at the olfactory epithelium may be different than for gills. For this reason, the present study investigated the impact of water chemistry on cadmium induced olfactory impairment. 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 odorants were measured via electro-olfactography (EOG). To investigate the impact of water chemistry on Cd-induced olfactory impairment, fish were exposed to the EOG-bathed 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 chemistry had a significant impact on Cd (210 µg/L) chemosensory impairment increased with rising pH, which may be due to a difference in metal speciation. DOC had a protective effect against Cd induced olfactory impairment, i 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 parametrized 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 affinity 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 / Department of Biology; 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 density. We investigated the effects of changing salinity on the bioturbation capacity of the mud shrimp Upogebia pusilla, 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 neapolitana), behaviour (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 evenless TEC than remaining sediments, which seems that salinity changes may influence elements availability. TEC levels were higher at salinity 40 for H. diversicolor and A. marina, and at salinities 21 and 40 for D. neapolitana. 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 and to fine sediment at salinity 40 led to a decrease of burrowing kinetic and upogebia neapolitana 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. Clurat, P. Gonzalez, University of Bordeaux / UMR EPOC CNRS 5805; M. Baudrimont, 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 with bioturbators fitness and therefore modify their influence as 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 exposure. 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 predict 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 approaches to testing on multiple stressor effects. Moving forward, ecotoxicology 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.

493 Improving the Quality of Ecotoxicological Testing and Assessment

493.1 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 / Center for Veterinary Medicine; G. Stoddart, C. Fathbender, PETA International Science Consortium Ltd.; M. Halder, European Commission Joint Research Centre / DG Joint Research Centre IHCP EURL ECVAM; 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.

493.2 Calibrating Non-Target Arthropod (NTA) Lower Tier Assessment Factors

F.M. Bakker, Eurofins-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 Agrisciences / Regulatory Sciences; G. Weymann, ADAMA; P. Neumann, Bayer AG

Assessment factors for non-target arthropod (NTA) studies 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 were carried out for calibration of non-target arthropod (NTA) studies were included for. Each product a Hazard Quotient (HQ) was calculated based on the most sensitive lower tier test result, both lethal and sublethal (only tier 2), and the test rate applied in the field study against which the HQ was calculated. Thus, multi-rate studies could yield more than one HQ. Values obtained were related to the longest duration of adverse effect observed in the field. With this information we derived limit values 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 depicted 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's of 40, 375, 620 and 2500. Tier 2 studies could have lethal 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 no effect level. These HQ’s also correspond to 1 and 2 month recovery periods. For the in-field, using VDF=0.5, 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, MASSEB SE / Experimental Toxicology and Ecology; L. Welte, BASF SE / Crop Protection Ecotoxicology
The Medaka Extended Observation 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. However, it is not known whether data is available for the current and very 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 validation criteria 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. L. Realey, Exponent; J.W. Green, DuPont / Data Science and Informatics; J. Nuz, Exponent, Inc.; D.E. Edwards, BASF Corporation / Ecotoxicology; K. Henry, NovaSource / Tesserenderlo 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, FMC Corporation / Global Regulatory Sciences / Global Regulatory Sciences, Department of Biochemistry and Microbiology; F. Kee, FMC 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 pesticyde or chemical mixture data is part of the plan for these data for research assessment. Standardized NTTP testing protocols were initially designed to calculate the application rate causing a 25% effect (ER25, used in the U.S.) or a 50% effect (ER50, used in Europe) for various growth measures based on an observed dose-response relationship. The requirement to generate a no-observed-effect rate (NOER), or, in the absence of a NOER, the rate causing a 5% effect (ER05) in OECD Tier 2 studies was established in the MEOGRT. The ER05 endpoint is useful for comparing studies about the same chemical, enabling statistical variability in, and statistical detectability of, these tests. Statistically significant differences observed between test and control groups may be a product of inherent variability and may not represent biological relevance. Attempting to derive an ER05 and the associated risk assessment conclusions drawn from these values can overestimate risk. To address these concerns, we evaluated historical data from approximately 100 seedling emergence and vegetative vigor guideline studies on pesticides to assess the variability of control results across studies for each plant species, examine potential causes for the variation in control results, and define the percent effect that can be estimated or the minimum percent effect that can be reliably detected statistically. The results indicate that with current test design and implementation, the ER05 cannot be reliably estimated.

497 An avian reproduction study historical control database: A tool for data interpretation
J. Wheeler, Dow Agrosciences; P. Valverde-Garcia, Dow Agro Sciences LLC; T.A. Spence, 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. Here we present a historical database 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 existing 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 = β0 + β1 x, where βj is the expected mean response in the jth concentration, and the ε 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, µj. 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. Alvaranga, J. Delfuw, 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 downstream recycling and compliance with health and safety regulations. For instance, 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 factories who incinerate 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 Impression 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. Ernstoff, F. Sessa, V. Rossi, Quantis
This paper is dedicated to the identification of key “un-conventional” indicators that demonstrate the sustainability and circular characteristics of promising bio-based products, complementing conventional life cycle analysis. Some of the new LCA complementary indicators proposed as a part of this study emphasise on resource efficiency and material circularity of bio-based value chain and include (bio)restoration, in-use circularity, critical material circularity, land-use efficiency and output quality services. The proposed indicators were drawn out of a comprehensive evaluation of more than 45 certification labels, schemes and initiatives associated to bio-based products, relevant international and national standards and 80+ scientific articles encompassing bio-product life cycle assessment. A current need for a harmonised sustainability certification protocol, coupled with an aim to develop an indicator-led assessment framework lead to the identification of potential gaps in criteria and indicators. Adoption of bio-based products has been identified as the one of the pathways to reach a sustainable bioeconomy. Some of the many advantages conceived from adopting bio-based value chains include development of waste-management infrastructure, job creation, SME’s and other environmental opportunities, contributing directly to seven out of 17 UN Sustainable Development Goals. The benefits of such systems approach can be realised only via quantitative and qualitative evaluation of the embedded environmental, techno-economic and societal impacts, all of which are a function of a product’s variables like feedstock type, technology-route, product’s functionality and application [1]. Life cycle assessment, a robust impact-led sustainability analysis tool has the potential to improve these impacts via use of holistic indicator also has insufficiencies, mainly the limitations in addressing the circular product characteristics. This work is a part of the EU-H2020 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. Aarnoudse, DTU (Technical University of Denmark) / Division for Quantitative Sustainability Assessment DTU Management Engineering and DTU Biosustain; S. Sukumaran, DTU Technical University of Denmark / DTU Biosustain; P. Fanti, Technical University of Denmark / Quantitative Sustainability Assessment Division
Existing Life cycle assessment (LCA) studies of biochemicals reveal that there are choices that not only need to be made in order to reach 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 lignocellulos, or native algae. Macro-algae is one such potential source that given they grow without being farmed, while simultaneously being an important sink for CO2. The objective of this study is to identify trade-offs 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 ids highest 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 bio-based chemicals. This requires external application of nutrients and energy intensive of chemical pretreatment. Today decision making on bio-based chemicals 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 bio-based products
D. Majer, University of Bologna; S. Majer, DBFZ, Deutsches Biomasseforschungszentrum gemeinnützige GmbH / Bioenergy Systems; V. Rossi, Quantis; J. Golazowski, University of Szczecin / 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 bio-based products are ultimately obtained from land or sea, a specific attention has to be payed when considering additional exploitation. Changes of land/sea uses can rebound and cancel out environmental performances and economic benefits. Indirect land use change (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 gas emissions 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. Hirsch, EMPA / Technology and Society Lab; F. Piccinno, EMPA
The Multi-Perspective Material Selection (MPAS) method has been developed as a decision support tool to identify 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 to support materials innovation at the early development stage. 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 are 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/compatively. 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
the developers of the material. The new independent environmental assessment part in Step 3 overcomes the necessity of a comparison case while also reducing 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. Scchi, 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 allows assessing environmental impacts along the products life cycle (raw material extraction, production, use phase, re-use/recovery and recycling). 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 five BoP scenarios, there will be a MFA survey and a MFA and a MFA survey for identifying the environmental hotspots along the product lifecycle and within the consumption area of each specific BoP. The results of the hotspot analysis are then used as a basis for the selection of actions towards environmental burden reduction, covering either consumption pattern, behavioral changes, implementation of eco-solutions, or a combination of the previous. For each of the actions, a scenario has been developed, by acting on the baseline model and simulating the changes associated to the specific intervention. The LCA results of each scenario are then compared to the results of the baseline, to identify potential benefits or impacts coming from the implementation of the solution tested, as well as to unveil possible trade-offs.

### 505 Environmental Risk Assessment in Sediments

S. Heise, Hamburg University of Applied Sciences / Life Sciences; U. Rieth, Institut für Hygiene und Umwelt

The Elbe river has one of the largest catchment areas in Europe (150 000 km²) of which two thirds lie in Germany. While it was once considered to be among the most polluted rivers in terms of water quality, this has been 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 especially during flood events to downstream sites. The question, where they originate, what chemicals they carry and how much of it may still be around, has been in the focus of several previous studies (e.g. Heise et al. 2008, Hillebrand et al. 2015). Little attention, however, had been paid to long-term changes in the PbO content in those ca. 1000 backwaters and floodplain lakes along the Elbe with regard to their contamination, their ecotoxicity and their mobility in times of high water discharges and floodplain submergence. Two studies, carried out in 2013 and 2014, were dedicated to this kind of structures with the task of evaluating a potential risk from these sites. Over a stretch of 230 km along the Middle Elbe, sediments from 25 backwaters were sampled, analyzed for heavy metals and for Elbe-typical historic contaminants (HCH, HCB, PCB, PAHs, DDX). Additional lines of evidence in an assessment framework are important for identifying the environmental hotspots along the product lifecycle and within the consumption area of each specific BoP. The results of the hotspot analysis are then used as a basis for the selection of actions towards environmental burden reduction, covering either consumption pattern, behavioral changes, implementation of eco-solutions, or a combination of the previous. For each of the actions, a scenario has been developed, by acting on the baseline model and simulating the changes associated to the specific intervention. The LCA results of each scenario are then compared to the results of the baseline, to identify potential benefits or impacts coming from the implementation of the solution tested, as well as to unveil possible trade-offs.
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 testing of freshwater sediments with 3 freshwater species, Hyalella azteca (amphipod), Chironomus dilutus (midge) and Lumbriculus variegatus (oligochae) 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 met test 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. From 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 the test acceptability control survival, weight and other endpoints. Control waters needs to have a minimum level of chloride and species of a different taxonomic group, such as the midge Chironomus riparius or the amphipod 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 fluoroacetone-spiked field-collected and artificial sediment were performed with all sediment-dwelling invertebrate taxa measured. In a previous performed spiked field/sediment outdoor microcosm experiment with fluoroacetone the most sensitive sediment-dwelling organism was the oligochaete Dero diginta. The test systems used were 1.5L glass vessels containing approximately 2 cm sediment and 1 L aerated spring water. Tests were considered valid if control mortality did not exceed 20% or, in the case of the larvae of the midge C. riparius, if more than 70% emergence had occurred. Fluoroacetone concentrations were measured at the start and end of the testing. Endpoints for both worms comprised surviving animals and their weight, including yield and growth rate. For Hyalella both survival, weight and length were assessed, while for Chironomus emergence and total survival was monitored. All tests met the validity criteria of less than 20 percent control mortality or more than 70 percent emergence. With the exception of the C. riparius test on artificial sediment. Overall, tests with field-collected sediment agree with the toxicological findings of tests with spiked sediments. The main finding is that the Tier-1 test organisms for fungicides are readily adapted for waterborne exposures. For the oligochaete bioaccumulation test, the recommendation for the maximum loading rate is increased to 1 g dry tissue:100 g of sediment organic carbon (previously 1:50). Use of laboratory proficiency criteria is incorporated in addition to test acceptability criteria for individual tests for each species and method, laboratories would report their averages for the test endpoints/measures. These proficiency criteria would not be used to accept or reject individual tests, but serve as a broad indicator 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 AST methods. This abstract does not necessarily reflect the views or the policies of the USEPA.

Wastewater effluents: How research can improve risk assessment and regulation

Sediment-spiked toxicity tests with benthic macro-invertebrates and the fungicide fluoroacetone
Jason Cerda, 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 (e.g. the amphipod Hyalella azteca, or the bivalve Mytilus edulis), was proposed as the main test organisms for field and sediment toxicity testing included. While designed for sediment evaluations, the methods are readily adapted for waterborne exposures. For the oligochaete bioaccumulation test, the recommendation for the maximum loading rate is increased to 1 g dry tissue:100 g of sediment organic carbon (previously 1:50). Use of laboratory proficiency criteria is incorporated in addition to test acceptability criteria for individual tests for each species and method, laboratories would report their averages for the test endpoints/measures. These proficiency criteria would not be used to accept or reject individual tests, but serve as a broad indicator 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 AST methods. This abstract does not necessarily reflect the views or the policies of the USEPA.

510 Spatio-temporal exposure of Plant Protection Products in OECD 219 sediment test systems - Comparison of model results with measurements
K. Hambler, Bayer AG, Crop Science Division / Environmental Safety; A. Dorn, Hochschule Niederrhein / Department of Chemistry; P. Dalkmann, 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 assessment. In 2015, the European Food Safety Authority (EFSA) has published a scientific opinion on sediment toxicity testing of organism that live in and on soft sediments. According to the European Union’s Water Framework Directive, sites that show 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 spatial and temporal 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, DT50, water/sediment) 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 millimeters 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.

511 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 middle-income countries (LMICs) is of growing environmental concern owing to their possible ecotoxicological effects. This is related to the practice of direct discharge of untreated wastewater (DWW), 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 concentration (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 DWW. 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 area of research within ERA. The bioconcentration of set of APIs was studied in batch tests at several levels of dilution. Nevirapine shows persistence across the experimental period and only the dilution is controlling the observed concentrations. Acetabutol 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 behaviour consistent with the previously reported studies. As a consequence, the bioconcentration but the sorption alone is responsible for the 70% of the removal. The TOC analyses do not show significant concentration 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.

512 Active Pharmaceutical Ingredients Entering the Aquatic Environment From

SETAC Europe 28th Annual Meeting Abstract Book
This work reports on the ability for wastewater treatment plants (WWTPs) to remove active pharmaceutical ingredients (APIs), the variations within and between works, the effectiveness of trying to model removal and the risk of exceeding predicted no effect concentrations (PNEC) in the environment. The research is based on data generated from two large UK-wide WWTW monitoring programmes. Taking account of removal of parent compound from the aqueous phase during treatment in combination with estimates of dilution available it is possible to prioritise the APIs of greatest risk of exceeding estimates of their PNEC in receiving waters for all WWTW in the UK. The majority of substances studied were removed to a high degree, although with significant variation, both within and between WWTW. Poorer removal (between influent and effluent) was observed for ethynoestradiol, diclofenac, propranolol, the macrolide antibiotics, fluoxetine, tamoixin and carabamazepine. All except the last two of these substances were present in effluents at concentrations higher than their respective estimated PNEC (based on monitoring of effluents from 45 WWTW on 20 occasions). The application of models to predict removal efficiencies are reported. Based on available dilution data as many as 890 WWTW in the UK (approximately 13% of all WWTW) may cause exceedances of estimated riverine PNECs after mixing of their effluents with receiving waters. The overall degree of risk is driven by the toxicity value selected, which in itself is controlled by the availability of reliable and relevant toxicity data. Our data is part of the project focuses on assessing the health status of gammarids and the macrozoobenthos community in the Schussen ecosystem of the Schussen river, a major tributary of Lake Constance, Southern Germany. In this project, the efficiency of an additional wastewater treatment step based on powdered activated carbon for the ecosystem of the Schussen river, a major tributary of Lake Constance, Southern Germany, has been investigated. Our data is part of the project focuses on assessing the health status of gammarids and the macrozoobenthos community in the Schussen river. Samples were taken up- and downstream of the WWTP, as well as before and after the upgrading of the WWTP. Gammarid populations from all sites were investigated with respect to sex ratio and fecundity of breeding females. In addition, analyses of heat shock protein (hsp70) levels and lipid peroxides allowed us to draw conclusions on the resistance status of gammarids. Macrozoobenthos community integrity was determined by means of the srapibio index as well as the number of sensitive taxa (EPT index). Prior to the WWTP upgrade, the health status of gammarids as well as the integrity of the macrozoobenthos community was negatively influenced by the WWTPs effluent. After the upgrading of the WWTP, gammarids from the downstream site did not differ any longer from those collected upstream of the WWTP with respect to the investigated health parameters. Furthermore, the overall number of taxa and particulary the number of EPT taxa within the macrozoobenthos community downstream of the WWTP increased distinctly after the upgrade of the WWTP with the additional activated carbon step. We conclude that the efficiency of the activated carbon step to eliminate toxic and emerging water pollutants from the effluent can plausibly be related to the improved integration of macroinvertebrate health and community structure in the connected river Schussen.

This study provides information to assist in the future management of these types of chemicals.

513 Impact of a wastewater treatment plant upgrade on amphipods and other macroinvertebrates: individual and community responses K. Peschke, Tübingen University / Animal Physiological Ecology; S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; K. Wurm, GOL Water Ecology Laboratory Starzach; R. Triebkorn, University of Tuebingen / Animal Physiological Ecology

Conventional wastewater treatment plants (WWTPs) equipped with secondary and tertiary treatment steps do not or only partially remove micropollutants which makes them important point sources for the release of these substances in the water cycle. Micropollutants can cause short- or long-term adverse effects in aquatic organisms even at low concentration levels. One possibility to reduce the input of micropollutants into the water cycle is the upgrading of WWTPs as an additional purification stage using e.g. ozonation or powdered activated carbon. The current work is part of the joint research BMBF project “SchussenAktiv plus” funded by the German Federal Ministry of Education and Research (BMBF) and the Ministry of Environment, Baden-Württemberg, Germany. In this project, the efficiency of an additional wastewater treatment step based on powdered activated carbon for the ecosystem of the Schussen river, a major tributary of Lake Constance, Southern Germany, has been investigated. Our data is part of the project focuses on assessing the health status of gammarids and the macrozoobenthos community in the Schussen river. Samples were taken up- and downstream of the WWTP, as well as before and after the upgrading of the WWTP. Gammarid populations from all sites were investigated with respect to sex ratio and fecundity of breeding females. In addition, analyses of heat shock protein (hsp70) levels and lipid peroxides allowed us to draw conclusions on the resistance status of gammarids. Macrozoobenthos community integrity was determined by means of the srapibio index as well as the number of sensitive taxa (EPT index). Prior to the WWTP upgrade, the health status of gammarids as well as the integrity of the macrozoobenthos community was negatively influenced by the WWTPs effluent. After the upgrading of the WWTP, gammarids from the downstream site did not differ any longer from those collected upstream of the WWTP with respect to the investigated health parameters. Furthermore, the overall number of taxa and particularly the number of EPT taxa within the macrozoobenthos community downstream of the WWTP increased distinctly after the upgrade of the WWTP with the additional activated carbon step. We conclude that the efficiency of the activated carbon step to eliminate toxic and emerging water pollutants from the effluent can plausibly be related to the improved integration of macroinvertebrate health and community structure in the connected river Schussen.

This study provides information to assist in the future management of these types of chemicals.

514 Effects of full-scale ozonation of treated effluent - Environmental impact in a receiving river J. Fick, Umea University / Department of Chemistry; T. Brodin, Umea University / Department of Ecology and Environmental Science; J.D. larsson, University of Gothenburg, Sweden / Department of Infectious Diseases; L. Norgren, Swedish University of Agricultural Sciences / Department of Biomedical Sciences and Veterinary Public Health; B. Björnlienius, KTH Royal Institute of Technology / Industrial Biotechnology Division; S. Orr, Swedish University of Agricultural Sciences / Department of Biomedical Sciences and Veterinary Public Health; J. Pohl, Swedish University of Agricultural Sciences (SLU) / Department of Biomedical Sciences and Veterinary Public Health; J. Jutkina, C. Flach, A.

Karkman, C. Rutgersson, University of Gothenburg Sweden

Pharmaceuticals have been found in aquatic systems globally, due to a combination of worldwide usage and low removal efficiency in wastewater treatment plants (WWTPs), or a complete lack of WWTPs (1). In surface waters, concentrations of pharmaceuticals usually range from low μg l⁻¹ close to point sources to low ng l⁻¹, and are correlated to human population density in the drainage area, volume of the receiving water body and pharmaceutical use in WWTPs. One technique to increase the removal of pharmaceuticals in WWTPs is to add a tertiary treatment step based on the addition of ozone. Ozonation is a cost efficient way to degrade chemicals and several studies have shown that most pharmaceuticals are readily degraded in the presence of ozone (2). However, several oxidized degradation products are formed during ozonation and the environmental impact of these are largely unknown. The aim of the study was to investigate the effects of ozonation on 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 by an addition of 8 h o³ 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, during 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.

515 Dreissena polymorpha as purifier tool of protozoa in wastewater treatment plant effluent E. Karpin, University of Reims Champagne Ardenne / UMR SEBIO; D. Aubert, Laboratoire de Parasitologie-Mycologie / EA 3800; S. Betoule, URCA / UMR SEBIO; O. Dedouge-Geffard, University of Reims Champagne Ardenne / UMR SEBIO; D. RIOUT, UMR 02 INERIS-URCA-ULH SEBIO / MObICYTE 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-Clivio, University of Reims Champagne Ardenne / UMR SEBIO

Aerial 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 chemical and physical treatments. These protozoa are clearly identified as a public health priority since they are major parasites of waterborne outbreaks. Many studies underline the interest of using of freshwater bivalve Dreissena polymorpha for biomonitoring. Indeed, this bivalve has a huge filtration capacity leading to an accumulation of chemical and biological contaminants in its tissues. The DROPPE (The dreissene as purifier tool 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 is 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 channel (Charleville-Mézières, France) for 28 days. We studied morphometric parameters, filtration capacity, energetic reserves, enzymes related to oxidative stress (Superoxide dismutase, Catalase, Glutathione S-Transferase and Glutathione 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 bivalve could use these to bioaccumulate contamination Considering these results, Dreissena polymorpha seems to be a promising tool for protozoa depuration. Keys words: protozoa, wastewater treatment plant, bivalve, depuration

516 Aquatic 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. Pflugmacher, 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 result 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. Eugeria densa, Ceratophyllum demersum and Myriophyllum spicatum were exposed to concentrations of paracetamol, diclofenac 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 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
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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 and AMR is the need for cost-effective monitoring 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
C. Michael, M. 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, multi-contaminated soils. This study is near 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
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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 without previous treatment. Using the occupancy sampling methods, we screened the occurrence of 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 issued along 5 rivers receiving hospital effluents. They were analysed for the presence of clonality and the resistant level 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 genotype ST11, ST157 were carried by 1.3%, 5.4%, 2.7% and 6.8% of the strains. These results indicate the human and environmental potential risk of tropical urban rivers. Indeed, ESBL strains carried by urban rivers are associated to resistance against numerous antibiotic classes (i.e. inhibitors combination, 4th generation of β-lactams, monobactams, carbapenams, aminoglycosides, tetracyclin, quinolones and phenicol classes) and may also carry virulence genes factors. The proportion of multi-drug resistance E. coli are not only linked to untreated hospital wastewater discharge in urban receiving system and are widely distributed along the river, thus highlighting the risk of surface water use.

520 Methods 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 inich culture results in antibiotics and 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 determine the 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 method is available for selecting a method for selective endpoint determination is always protective of the other; though there is good agreement between PNEC’s (PNECs for resistance) published previously and PNEC’s 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 PNEC’s for environmental risk assessment of antimicrobials.

521 Determining the minimal selective concentrations of macrolides in a complex microbial community
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Antimicrobial resistance bacteria are widespread throughout hospitals. Continued 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 Guo et al. showed selection at low environmental concentrations using single species assays. The macrolide antibiotics, 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 aims of this study were 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 (ermA, ermB, ermC, msrA, msrD and mefA/mefE) and catD and catI 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. 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 ermA 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). Our 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, clarithromycin 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. intI1, sulI, 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 cassette amplification are selective in soil following repeated exposure to antibiotics.

Distribution, transformations and biological effects of incidental nanoparticles and nanomaterials 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
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Microplastics (MP) smaller than 500µm 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 May2014, May & Sept2015, May & Sept2016, 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 MP particles. There was no apparent pattern of spatial distribution. Although a spike in MP particle and 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.
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Nanoparticles are constantly used at world level leading to their presence in the aquatic environment and to possible interaction with living organisms. The potential impacts of nanoparticles on microalgae was observed in 2014 and 2015, and the concentration 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.

525 Ecotoxicological evaluation of high-generation cationic PAMAM dendrimers towards a representative organism of aquatic ecosystems
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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(amideimine) (PAMAM) dendrimers are polymeric nanomaterials which are radially symmetrical, homogeneous, and monodisperse structures that have a typically symmetric core, an inner shell, and an outer shell. Due to these characteristics, their use is being tested in the implementation of targeted therapies in biomedicine so that they might end up in the environment [2]. In this study, we have investigated the effect of high-generation cationic G5-NH₂ and G7-NH₂ PAMAM dendrimers in a prokaryotic primary producer of aquatic ecosystems, the filamentous cyanobacterium Anabaena sp. PPC7120 (Anabaenaceae). Dendrimers significantly decreased the growth of the cyanobacterium and both dendrimers induced morphological alterations of both filaments and individual cells. Furthermore, cyanobacteria exposure to dendrimers resulted in significant alteration of physiological parameters: increase in the formation of intracellular reactive oxygen species, damage in membrane integrity, membrane potential depolarization, increase in the production of intracellular pH and alteration of intracellular free Ca²⁺ homeostasis. Dendrimers also induced alterations in the photosynthetic responses of Anabaena. In conclusion, high-generation cationic dendrimers exhibited high toxicity towards

526 Interactive effects of carbon nanoparticles and benzo(a)pyrene on marine mussels, Mytilus galloprovincialis

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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), UK aims to test the hypothesis that environmentally relevant carbon based nanoparticles (CNPs) and polycyclic aromatic hydrocarbons (PAHs) can interact with each other to differentially modify their potential toxicity. To probe this hypothesis, marine mussels (M. galloprovincialis G) and algae (C. fluminea) were exposed for 3 days to benzo(a)pyrene with two different types of carbon nanoparticles, [C60 fullerene and multi-walled carbon nanotubes (MWNNTs)], both alone and in combination with BaP. Tissue specific distributions and concentrations of CNPs and BaP were determined in exposed mussels. To enhance the analytical traceability of these CNPs in biological systems, some nanoparticles were labelled with rare elements. CNP uptake was followed by ICP-MS and/or HPLC-UV, with the BaP uptake tracked by GC/MS. CNP uptake was also investigated by electron microscopy. The genotoxic effects were characterised by the level of DNA strand breaks (comet assay), micronuclei and DNA adduct analyses. Global gene expression profiles were analysed using microarray technologies targeting 15 stress response pathways. Contrasting results were obtained between G. Bankin and G. Banki. The fate of carbon nanoparticles used Co-School of mussels to MWNNTs and BaP seems to reduce the uptake and genotoxic effects of BaP in the digestive gland. Conversely, co-exposure to C60 and BaP does not 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 pathways). In order to have a better understanding of the effects of these CNPs, further biological analysis (e.g. DNA oxidation and proteomics) are currently in progress. This study opens new questions highlighting the importance of studying the potential interaction between nanomaterials and environmentally important pollutants.

527 Trophic transfer of CuO NPs and Aqueous Cu from worms to fish - a proof of concept study

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Nanoengineered nanoparticles (NPs) will settle out and accumulate in the sediment. Therefore benthic fauna is at an increased risk of exposure to ENPs. The fate of CuO NPs added to water (1000 ng/ml) to marine mussels (M. edulis) was followed over a period of 14 days. The mussels were then co-fed with the mussels and concentrations of CNPs and BaP were determined in exposed mussels. To enhance the analytical traceability of these CNPs in biological systems, some nanoparticles were labelled with rare elements. CNP uptake was followed by ICP-MS and/or HPLC-UV, with the BaP uptake tracked by GC/MS. CNP uptake was also investigated by electron microscopy. The genotoxic effects were characterised by the level of DNA strand breaks (comet assay), micronuclei and DNA adduct analyses. Global gene expression profiles were analysed using microarray technologies targeting 15 stress response pathways. Contrasting results were obtained between G. Bankin and G. Banki. The fate of carbon nanoparticles used Co-School of mussels to MWNNTs and BaP seems to reduce the uptake and genotoxic effects of BaP in the digestive gland. Conversely, co-exposure to C60 and BaP does not 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 pathways). In order to have a better understanding of the effects of these CNPs, further biological analysis (e.g. DNA oxidation and proteomics) are currently in progress. This study opens new questions highlighting the importance of studying the potential interaction between nanomaterials and environmentally important pollutants.

528 Corbicula fluminea exposure to copper oxide nanoparticles: an integrated mesocosm study

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Engineered nanoparticles (ENP) are now part of our daily life because of their introduction in a wide variety of products. Their concentrations in environment are not yet known but release during their life cycle is obvious. Copper oxide nanoparticles (CuO ENP) are well known for their antimicrobial properties allowing their use in numerous products as in wood-paints, textiles or food packaging. Since aquatic compartments are the ultimate sink of contamination, they should be impacted by release of ENP. Some studies highlighted the ability of CuO ENP to induce stress responses in several levels of biological organisation in aquatic organisms, indicating their toxic potential. Most studies were nonetheless made using simplified exposures, thus maximizing ENP dispersion and contact with the studied organisms. The fate and consequently the toxic potential of CuO NP differ depending on the complexity of the exposure media that can considerably modify ENP physico-chemical properties and consequently, their bioavailability to living organisms. Thereby, setting up more complex design of exposure may help to gain in environmental realism. The aim of this work was to evaluate the fate and effects of different CuO ENP on a widespread endobenthic freshwater bivalve Corbicula fluminea. In order to improve environmental realism, C. fluminea were exposed in indoor mesocosm containing sediment, water and food. A cumulative contamination was applied until reaching a final concentration of 50 µg CuO/L at the end of the exposure period (28 d). Behavioral, physiological, biochemical and molecular parameters were quantified in order to assess CuO ENP impacts on C. fluminea. Results of this study allow to conclude that CuO ENP affected C. fluminea both in terms of survival, growth, 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.

Luminescent biomonitoring via bioassays of different complexity - from cells trough enzyme reactions to proteins

529 Applications of Luminous Bacteria Enzymes in Toxicology and Ecology

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A new approach in developing bacterial bioluminescent enzymatic biosensors: application to toxicity bioassays, and the needed reagents has been developed. To solve the problem of how to quickly, identify, and measure the numerous chemical compounds in environmental monitoring, food product contamination, and medical diagnostics, bioluminescent enzymatic toxicity assays were proposed, wherein the bacterial coupled enzyme system NAD(P)H:FMN-oxidoreductase-luciferase substitutes for older methods using living organisms. The immobilized reagent Enzymoluminol was used to facilitate and accelerate the development of the bioluminescent enzymatic microbial biosensor for environmental and food toxicological assays. The reagent is easy to use and convenient to be applied not only in toxicity studies but also in education, mainly in ecological and enzymological practical courses. Prototype biosensors offer cost advantages, versatility, high sensitivity, rapid response, extended shelf-life and flexible storage conditions. This study was supported by the Russian Science Foundation (project no. 16-14-10115).

530 Toxic and adaptive effects via luminescent assay systems of different complexity - from cells trough enzyme reactions to proteins
Ecotoxicological Soil Analysis; M. Freidkin, Lomonosov Moscow State University / Department of General Physics; S. Patsaeva, Lomonosov Moscow State University / Depament of General Physics

The interest to functional and structural indicators of mycobacteria with a respective to use them in biogeosciences is currently rising because fungi represent as essential component among environmental decomposers of organic material in ecosystems. The complexity of utilization of fungi in biogeochemistry is explained by diversity of reactions to environmental stimuli, 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 fulminating fungi cultivated under different concentrations of source of bioavailable and not readily bioavailable carbon in the growth medium. The research objects were strains of Alternaria alternata, Chalcospomum chalcosporioides, and Trichoderma harzianum. The strains were kindly provided by O.E. Marfenina and A.E. Ivanova, Soil Science Faculty of MSU. The filamentous fungi Chalcospomum chalcosporioides and agar Crakep 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 exciting radiation (250, 308, 310, 350, and 450 nm). Fluorescence excitation spectra were registered for emission at 350, 440, and 460 nm. Typical fluorescence spectra of fungal samples (spores suspensions of each strain) registered in the range of 280-450 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 chrophores like NADH and or melanins. 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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Effect of surface functionality on Fe3O4 nanoparticles toxicity

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Surface characteristics stands out as one of the most important, if not the main, determinants of biological performance, as the nanoparticles (NPs) surface is the most prominent and earliest point of exposure. Complexity of this issue is that the coordination of ligands on the surface of NPs can significantly enhance subsequent cytotoxicity. The principal challenges that have to be addressed are a detailed understanding of how NPs’ original physicochemical surface chemistry influences subsequent NP interactions with biosystems. In this work results of a complex study of Fe3O4 functionalized by humic acids (HA) were described. We hypothesized that, along with the NPs size, the surface functionalization was a major factor contributing to sorbent toxicity mitigation. The average particle size calculated by the Scherrr equation tended to decrease from 8.4 nm for Fe3O4-HA20 to 4.5 nm for Fe3O4-HA80. Optical spectroscopy indicated that the fluorescence quantum yield depended on the HA content in the nanocomposite and confirmed that the humic component interacted with ferric ions. Biosafety of Fe3O4-HA NPs was investigated in laboratory biotest systems using algae, infusorians, and higher plants as test-cultures. Concentration limits for using the Fe3O4-HA NPs suspended in water under controlled artificial conditions were found experimentally by ecotoxicological tests. Experiments with this “battery” of three biotests showed that, in controlled chemical conditions, water suspensions of the preparation can be safely used for biota given a certain concentration limit. It was found that samples of bare Fe3O4 and the Fe3O4-HA80, 0.01 %, were remarkably more toxic than water suspensions Fe3O4-HA20 and Fe3O4-HA50 in this concentration in biotests with Scenedesmus quadricauda for Fe3O4, Fe3O4-HA50, and Fe3O4-HA20. Humic substances in natural conditions are likely to increase the permissible concentration limit and to mitigate harmful impact of the NPs. Obviously, before applying such remediation agent in specific biotope conditions, its biosafety should be additionally assessed by the biodiagnostic methods based on response of biotope inhabitants.

Poster spotlight: WE209, WE210, WE211

Obesogens and lipid disruptors
Lipidomics profiling of wild fish to identify patterns associated with pollution exposure

C. Porte, IDAEA-CSIC / Department of Environmental Chemistry; M. Blanco, IDAEA-CSIC; A. Maceda-Beiga, 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 lipidomic gene signalling pathways 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.

Lipidomics profiles distinguish fish from organochlorine pesticide contaminated lakes compared to control lakes

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The organochlorine pesticide (OCP) contamination of two like Apoka 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 Apoka 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 Apoka 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 Apoka compared to a relatively clean lake. Follow up experiments with fish exposed in the laboratory support the changes seen in the field. Cholesterol was decreased and diheptanoyl lecithin (DHL) was elevated in the livers of fish from Lake Apoka 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 Apoka fish was observed in short chain length free fatty acids, such as palmitic acid and in ceramides, phosphatidic acids and phosphatidylethanolamines. But decreases were observed in sphingomyelins, phosphatidyl-ethanolamines and other phospholipids. 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 OCP contamination.
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 nanoparticle 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 afterward. [1] Schwab, F. Bucchel TD, Lukhele 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 Umbmittelkasser ausgemacht. www.lifegem.de/news/ 1.2.2011-11-09-3109&pc=s02. 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. Oberg, 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 understood CNTs to be toxic. 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. Kotterman, 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 far away from the coast. Researchers were accused of fear-mongering. As a result, Dr. Schwab and her colleagues were seen as irresponsible, as most of the published articles did not have proper controls. And if they did, it 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 matter, 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 microplastics 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. Wagner, 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-scarcie 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 place for political negotiations, to 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, Azti-Tecnalia / Marine and Coastal Environmental Management
The H2020 project ResponSE Able (www.responsesable.eu) is trying to raise awareness among 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 communicate the risks of (micro)plastics in 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. Ajao, 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; H. van den Brink, Azte Wageningen UR / Azte Ecology and Water Quality Management Group; A. Focks, 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; D. De Zwart, DdZ Ecotox Weighting; T. Backhaus, University of Gothenburg / Department of Biology and Environmental Sciences

Wildlife is exposed to an infinite number of different combinations of chemicals. There is evidence that single substances that are present at levels that are toxicologically significant may 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 provided, and even if the concept is statistically supported, transparent and form

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Application of new statistical distribution approaches for mixture risk assessment
T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; R. Parmar, ARC Arnot Research Consulting; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

There is an increasing trend towards multi-targeted and non-target analysis (NTA) screening methods to increase the number of analytes monitored in biomonitoring and environmental samples. While the opportunities in advances in chemical analytical capabilities have shown substantive development over recent years, application of information related to data reported from NTA represents a challenge to the field of exposure modelling. For example, it is not possible to interpret any compound as a single exposure once its concentration has been reported from studies involving NTA to inform exposure and risk. The absence of guidance may consequently lead to difficulties in prioritizing risk assessment activities. In this study we examine the state of the science with respect to NTA, and present a summary of the merits and limitations for exposure assessment and risk assessment. These preliminary observations are then used to provide an initial framework for the appropriate use of NTA within exposure assessment. Recommendations include a number of suggestions regarding how these data can be better gathered and reported in order to strengthen their applications for chemical exposure and risk assessment, including emerging contaminants.

Towards the development of a framework for applying non-target chemical analysis data within exposure and risk assessment
T. Gouin, TG Environmental Research / Safety and Environmental Assurance Centre; R. Parmar, ARC Arnot Research Consulting; J.A. Arnot, ARC Arnot Research & Consulting / Adjunct Professor, Department of Physical & Environmental Science/Department of Pharmacology and Toxicology

There is an increasing trend towards multi-targeted and non-target analysis (NTA) screening methods to increase the number of analytes monitored in biomonitoring and environmental samples. While the opportunities in advances in chemical analytical capabilities have shown substantive development over recent years, application of information related to data reported from NTA represents a challenge to the field of exposure modelling. For example, it is not possible to interpret any compound as a single exposure once its concentration has been reported from studies involving NTA to inform exposure and risk. The absence of guidance may consequently lead to difficulties in prioritizing risk assessment activities. In this study we examine the state of the science with respect to NTA, and present a summary of the merits and limitations for exposure assessment and risk assessment. These preliminary observations are then used to provide an initial framework for the appropriate use of NTA within exposure assessment. Recommendations include a number of suggestions regarding how these data can be better gathered and reported in order to strengthen their applications for chemical exposure and risk assessment, including emerging contaminants.

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; D. De Zwart, DdZ Ecotox Weighting; T. Backhaus, University of Gothenburg / Department of Biology and Environmental Sciences

Experimental mixture studies have shown that the toxicity of a mixture is usually greater than that of the single chemical components. The fact that sub-mixture effects can occur even though all components in the mixture are present at levels that are individually without observable effects. These observations have lent urgency to the need of evaluating the risks from multiple pollutants both to humans and wildlife. Here, we present a common decision tree and tiered work flow scheme for performing human and ecological mixture risk assessments (MRA) in the context of the hierarchical risks of multiple pollutants in European freshwater systems on MRAs for humans and aquatic species groups. It uses measured concentrations of chemicals co-occurring in water and builds on the principle of a tiered approach, where unnecessary expenditure of resources is avoided by discontinuing the analysis when cumulative exposures are judged to be acceptable on the basis of crude and simple worst-case assumptions. The analysis is refined when previous tiers reveal clearly unacceptable exposures, with refinements based on best-case assumptions of minimum expectable risks. The workflow is divided into three main tiers in which the distorting influence of different assessment factors present in regulatory values is successively removed, and increasingly sophisticated
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 possible 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. Schulze-Stverak, RWTH Aachen University / Institute for Environmental Research / Institute for Environmental Research; S. Bar, 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. Roß-Nickoll, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Chair of Environmental Biology and Chemodynamics; A. Sybertz, RWTH Aachen University / Institute for Environmental Research; C. Ullich, 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 acreage and pesticide application rates from the years between 2007 and 2015. The data was used for classification of sprayer series by typical mixture patterns, sequences and toxic potentials. 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 (PDB, Lewis et al. 2016) and ECOTOX (US EPA 2017) and the mere application rates without consideration of exposure pathways. Only for focal sprayer series, 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). Mixture risk indices were calculated based on the concept of 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 fungicides and high-intensities. Risk exceedances became relevant if multiple individual TER-values (TERsingle) were already close to the critical TER trigger values. Our results emphasize the relevance of the nowadays largely non-regulated tank mixtures for the risk assessment of non-target organisms. In conclusion, we clearly see the necessity to consider realistic exposure assessments of typical treatment regimens as well as effect estimates from appropriate mixture toxicity models in order to describe the “total risk” of the common chemical plant protection practice.

556 Advances in Soil Ecotoxicology and Risk Assessment of Terrestrial Ecosystems (I)

557 Toxicity of imidacloprid and thiacloprid towards four Colembolan 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 Solfosmia candida has been used for assessing the toxicity towards non-target soil communities. The species was the target soil organism for an Ilyobacterium based test for calculating the factor safety index (FSI). We tested the utility of the Ilyobacterium based test for calculating the factor safety index (FSI). We tested the species suitability for assessing the toxicity of neonicotinoids. Imidacloprid was most toxic. F. fimetaria presenting around the same sensitivity as F. candida for survival (LC50 0.56 mg/kg dry Luffa 2.2 soil), and a slight difference in the sensitivity for reproduction, with EC50 for F. fimetaria of 0.10 mg/kg dry soil and for F. candida of 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. Thiacloprid was tested on S. curviseta, F. candida and H. nitidus, with a 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. Thiacloprid was more toxic to 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 species tested presented similar sensitivity patterns towards thiacloprid, with the exception of S. curviseta. The results suggest a specific mode of action of thiacloprid 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 mite movement responses to pesticide residues J. Wotton, 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. Wey, 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 – mites avoiding spraying applications or pesticide residues – 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 a natural predator found in fruit orchards in the UK. Using video analysis, we exposed individual adult mites to 3 insecticidal active ingredients (acetamiprid, deltamethrin, dimethoate), each at 3 concentrations, and evaluated mite 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 mL−1 deltamethrin, and that 54% of individuals exhibited a slight avoidance when exposed to the test arena for at least 50 s. We found a non-linear dose response pattern, with the concentration compared to 0% in the controls. When exposed to 18 μg mL−1 acetamiprid mean distance covered fell by 34%; however, when exposed to 0.45 μg mL−1 dimethoate the mean distance covered increased by 11%. No individuals
exhibited avoidance behaviour when exposed to acetamiprid 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 of NTAs 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.

559 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. Nutil-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. Amor, EFSA - European Food Safety Authority ; Pesticides; J. Sousa, University of Coimbra / Department of Life Sciences

The recent scientific opinion of EFSA addressing the state of the science on risk assessment of plant protection products (PPPs) for non-target arthropods highlighted the need for the inclusion of other relevant exposure routes, besides contaminated soil, in tests from lower tiers. The reproduction test with the predatory mite *Hypoaspis aculeifer* (OECD 226) is currently being calculated in the new EU data requirements for the ecological risk assessment (ERA) of PPPs. However, the low sensitivity often shown by this mite towards PPPs, when compared to other 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 food, mainly detrital food, bacteria, and microalgae. 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 evaluate the importance of oral exposure to 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 the following substances: CuS (1519, 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 that the route of exposure represents an important factor which needs to be taken into account in reproduction tests. The reproduction test 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.

560 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 (OECD and/or EFSA 2017). One possible 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 (DT50, DT90) 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.

561 PBT assessment of substances - Proposal of a trigger value for bioaccumulation in terrestrial oligochaetes


Assessment and regulation of PBT (Persistent, Bioaccumulative and Toxic) substances, are 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 bioaccumulation in terrestrial organisms. The objective of this project is to provide a suitable data base which will help to clarify how to address terrestrial 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 tiers, i.e.: 1) Literature research on available bioaccumulation factors (BAFs) both in open scientific literature and in regulatory data from several OECD 317 studies and performance of correlation analysis between soil-substance-properties, BCF and BAF values. 2) Performance of bioaccumulation studies according to OECD 317 with the earthworm *Eisenia fetida* using the four model substances endosulfan, methoxychlor, o-tolylphenol and PCB153. 3) Proposal of a trigger value for identification of bioaccumulative substances in terrestrial organisms based on the literature research and the performed experimental results. The results clearly showed that organic carbon content of the test matrix used in the tests influences the BAF, whereas no clear correlations between log KOW, log KOC or similar substance properties and the BAF were observed. Additionally it was observed that no correlation was found between substance-specific BCF from fish studies and BAF determined with earthworms. Therefore, lipid- and tissue-normalized BSAF should be used for the assessment of terrestrial BAF. Kinetic BSAF from both experimental studies and literature-derived values ranged from 0.21 to 14.8. Based on the data evaluated in the present work, a BSAF trigger value of 1.00 is proposed as a general trigger to include bioaccumulation in terrestrial organisms. Objectives like other non-degraded residues at the end of the elimination phase are discussed.

Challenges, methodological developments and practical solutions for Social Life Cycle Assessment in industry and policy

562 Developments and recommendations on the practical use of Social LCA

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S-LCA is a multi-criteria, multi-stakeholder and multi-step methodology 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; (2) to highlight the methodology to identify social hotspots along the whole life cycle, and in particular in theremote 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 many 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 data 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
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Global textile and leather industries facing constant discussions on social compliance mostly in relation to bad working environments and thus cause severe social impacts for different stakeholder groups along the supply chain due to e.g. unhealthy working conditions. 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 implementations have to consider indicators and impacts determining social hotspots along the supply chain and should in addition provide information on social challenges and chances 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 supply chain including social impacts considering negative as well as positive 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 chances of European leather production including the different stakeholder groups affected (e.g. workers) but also positive/negative directions of each social impact category defined (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 existing generic framework and critical topics along 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. The inclusion of positive impacts may function as an incentive for improvement and guide the way towards future developments within the European leather industry. The results may also be transferred to further product groups in the global textile and leather industry.

565 Integration of sustainability in industrial research and innovation: perspectives from ArcelorMittal's experience
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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 the importance and complexity of the iron and steel supply chain, to properly understand its sustainability development it 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. From the outset the company has invested in 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
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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. is an example of how the summation of social impact indicators can be both positive or negative. Thus, this study aims at providing a social footprint of an activity can be defined as $SF = IR + PL$. 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 for both systems 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 v3.3.10, 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 50% 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 research presented is an example of how the summation of social impact indicators can be both positive or negative. Thus, this study aims at providing a 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
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Toxicology 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 assays 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 (EPQ) 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 industrial 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 superior to the EQP model for safe and sustainable exposure concentrations 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.

569 Experimental exposure assessment in in vitro bioassays for organic acids
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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 the chemicals exposed to static exposure conditions to static concentration-dependent toxicology 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.

570 A versatile and low-cost open source pipetting robot for automation of toxicological and ecotoxicological bioassays
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The contrasting demands of performing bioassays in compliance with regulatory test requirements and the practical use of automated assay systems call for automation technology to assist with automated handling and analysis of multiwell plates. Such systems are typically highly sophisticated and thus costly. As a consequence, the availability of pipetting robots, liquid handlers, and stacking units in environmental monitoring is generally scarce. As a potential solution, we developed a simple and low-cost, versatile open-source pipetting robot that has a small footprint. The construction of the pipetting robot was realized mostly using readily available parts, and partly using open-source hardware. We tested its precision in automated 2-fold dilution series and used it for exposure of zebrafish embryos (Danio rerio) – a common model species in ecotoxicology - to cadmium (Cd) and permethrin. As expected, concentrations of permethrin rapidly decreased after initiation of static exposures and after each renewal in the semi-static exposure experiments. No such drastic differences were observed for exposures conducted using the pipetting robot. The accuracy of the pipetting steps was generally high. The apparent toxicity was not only greater in zebrafish embryos exposed to permethrin and cadmium using manual semi-static renewal (24 h interval) but also greater in embryos exposed using the automated semi-static exposure using the pipetting robot (1 h interval). Thus, we were able to confirm that any attempt to keep exposure concentrations as constant as possible will yield more realistic assessments of toxicity. In this respect, exposure using our pipetting robot can be hypothesized to be similar to flow-through exposure, which is, however, typically more labor- and cost-intensive. With minor modifications, this robot system can be used in a variety of different setups and environments. Because its construction and operation are very cost-effective and do not require any specialized personnel, provisioning of instructions to replicate this design has made automation technology accessible to a much higher number of laboratories around the world.

571 An intestinal fish cell barrier model to assess absorption of poorly soluble organic chemicals in vitro
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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 (logKOW = 5.8 to -2.2) and hydrophobicity (logKOW = 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 bioformation. The involvement of bioformation 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 model, which correlated with the logKOW. The chamber enabled stable exposure concentrations and close to full recovery at the basolateral compartment. All exposure times 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 bioformation.

572 A new paradigm in water sampling - how can we challenge the needs of effect-based monitoring?
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In vitro and in vitro bioassays (effect-based methods, EBM) are increasingly used for the water quality monitoring to complement chemical analysis. In a holistic point of view, sampling is the starting point and an integrated part of the whole analysis workflow. However, sampling for effect analysis is more challenging than for chemical analysis. Thus, the aim of this paper is to discuss (1) the requirements and challenges of sampling for EBM and (2) to present the recently developed large-volume solid phase extraction approach and apparatus (LVSP) as a
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 full recovery of extracted chemicals 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

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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 5th 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 5th 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 either based on exceedance of the threshold of Toxicological Concern. After confirmation of their identity, the prioritized suspects are candidates for a 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: advancements 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

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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 perfluoralkyl and polyfluoroalkyl substances (PFASs). Following the report of firefighting training activities or fire fighting 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 perfluorooalkyl acids (such as PFOS or PFOA) could, however, seriously 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 could not be compensated through simple dilution due to the lack of matching internal standards. If consistent and method recovery cannot be ensured in a set of environmental samples of variable physicochemical characteristics, any comparison drawn between samples (e.g., inter-site differences) could be questionable. Failure to obtain quantitative recoveries from soils/sediments could also preclude a reliable assessment of environmental fate properties (e.g., sorption, persistence, bioaccumulation factors). 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 28 industrial textiles have been investigated in-house with AFFFs and aged. The optimized method presented quantitative or near-quantitative PFAS recoveries from diverse soils and limited matrix effects were noted. The method was applied to a limited survey of firefighting training areas in eastern Canada, showing the prevalence of betaine-based (e.g., 6:2 FTAB, 9:1:2 FTB) and amine-based (e.g., PFHxSxMs) PFAS at such sites.

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

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Perfluoroalkyl 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 dealt 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, sulfonylamides and fluorotelomer alcohols. PFASs of diverse chain length (C4-C14) were detected in 31 of 51 investigated samples. Concentrations of perfluorooalkyl acids were up to 430 µg/kg for highly contaminated samples. FTOHs were even detected in 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 5th 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 either based on exceedance of the threshold of Toxicological Concern. After confirmation of their identity, the prioritized suspects are candidates for a 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).

The growing role of seafood consumption for exposures to legacy PFASs

576 Evident in Longitudinal Birth Cohorts from the Faroe Islands

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Rapid declines in legacy poly- and perfluorooalkyl 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 thus new important for mitigating future risks. Here, we report serum concentrations of 19 PFASs (SPFAs) measured in children between 1993 to 2012 from a North Atlantic fishing community (Faroe 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 (PFOAs) with nine or more carbons (C₉) were strongly associated with mercury in children’s hair, a well-established proxy for seafood consumption, especially perfluoroundecanoic acid (PfU11DA, r = 0.72). Toxicokinetic 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, declines in SPFAS exposure after 2000 were achieved by the rapid phase off of PFOS and its precursors in consumer products.

577
Membrane-water partition coefficients to aid PFAS risk assessment.
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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 ionicogenic, 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 ionicogenic 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 a 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 ionicogenic 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 experiments to be carried out to calculate charge densities to 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. GenX. Negative data points may even exert a great push on electrons of any ionizable group, thereby e.g. rendering perfluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a 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 Hygiene; E.M. Sunderland, Harvard University / Department of Environmental Science 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 released into the environment as it 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. GenX. Negative data points may even exert a great push on electrons of any ionizable group, thereby e.g. rendering perfluorooctane sulfonamide (PFOSA) to be a strong acid, whereas recent studies and reports suggested PFOSA to be a neutral PFAS.

PFAS in the ocean: Part 1
P. Kliver, Marine Bio zdję, University of Copenhagen / Centre for Marine Environmental Sciences

The release of PFASs into the environment has been extensive for several decades. PFASs are found ubiquitously in the environment due to their persistence, bioaccumulation potential and toxicity. The presence of PFASs in the marine environment has been documented in various studies reporting PFAS concentrations in marine organisms, sediments, water, and air. The widespread presence of PFASs in the marine environment is a concern due to their potential impact on marine ecosystems and human health.

PFASs in the ocean: Part 2
P. Kliver, Marine Bioすぎて, University of Copenhagen / Centre for Marine Environmental Sciences

PFASs are found ubiquitously in the environment due to their persistence, bioaccumulation potential and toxicity. The presence of PFASs in the marine environment has been documented in various studies reporting PFAS concentrations in marine organisms, sediments, water, and air. The widespread presence of PFASs in the marine environment is a concern due to their potential impact on marine ecosystems and human health.
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 2018. The expected outcome of the workshop is the identification and prioritization of relevant endpoints to be assessed (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
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Fertilizer studies 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 Fertilizer Europe and the FARM REACH consortium, the fertilizer sector 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 emissions (up to hydrogen) were considered to test and the framework proposed an exposure assessment. The scheme as serves a useful base to guide additional requirement and help regulators to take informed decisions without having to systematically perform a comprehensive new nano-specific assessment. One of the key conclusions is that an early and reliable measure of the durability of the AI-nanocarrier complex under relevant conditions is key to the assessment of nano-enabled pesticides. There is currently no standard protocols to measure the durability of the AI-nanocarrier complex and robust methods for its measurement are urgently needed. References: 1. K. Breivik et al., 2014. Environ. Int. 63:224–235. 2. Kookana RS et al. 2014. J. Agric. Food Chem. 62:4227–4240. 3. Walker GW et al. 2017. J. Agric. Food Chem. doi:10.1021/acs.jafc.7b02373.

583 Bioaccessibility of grease thickeners and the implications for REACH registration
R.J. Brown, wca consulting; R. Smith, wca; P. Whitehead, wca consulting; J. Dawick, G. Whale, Shell Health / Risk Science Team; A. Dodos, Eldons; T. Halmans, Shell Global Solutions International / Analytical Department
An intrinsic component of greases are the grease thickeners which include a diverse range of materials such as calcium soaps and metal-organic compounds. These are often used in the production of greases, and are mixed with the base oil and thickening agents. The bioaccessibility of these materials is important for the assessment of their environmental fate. 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. 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 carrier, i.e. the “durability” of the AI–nanocarrier complex (1). Kooiman 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 (pendulinin for mammalian spermatozoa) was used as case example to test and the framework proposed an exposure assessment. The scheme as serves a useful base to guide additional requirement and help regulators to take informed decisions without having to systematically perform a comprehensive new nano-specific assessment. One of the key conclusions is that an early and reliable measure of the durability of the AI-nanocarrier complex under relevant conditions is key to the assessment of nano-enabled pesticides. There is currently no standard protocols to measure the durability of the AI-nanocarrier complex and robust methods for its measurement are urgently needed. References: 1. K. Breivik et al., 2014. Environ. Int. 63:224–235. 2. Kookana RS et al. 2014. J. Agric. Food Chem. 62:4227–4240. 3. Walker GW et al. 2017. J. Agric. Food Chem. doi:10.1021/acs.jafc.7b02373.

584 The durability criteria: a pragmatic and sound approach to the exposure
M. Kooiman, K. Oorts, R.J. Brown, Fertilizers Europe; Department of Environmental Geosciences; P.S. Kookana, CSIRO / Land and Water
After 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 carrier, i.e. the “durability” of the AI–nanocarrier complex (1). Kooiman 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 (pendulinin for mammalian spermatozoa) was used as case example to test and the framework proposed an exposure assessment. The scheme as serves a useful base to guide additional requirement and help regulators to take informed decisions without having to systematically perform a comprehensive new nano-specific assessment. One of the key conclusions is that an early and reliable measure of the durability of the AI-nanocarrier complex under relevant conditions is key to the assessment of nano-enabled pesticides. There is currently no standard protocols to measure the durability of the AI-nanocarrier complex and robust methods for its measurement are urgently needed. References: 1. K. Breivik et al., 2014. Environ. Int. 63:224–235. 2. Kookana RS et al. 2014. J. Agric. Food Chem. 62:4227–4240. 3. Walker GW et al. 2017. J. Agric. Food Chem. doi:10.1021/acs.jafc.7b02373.

585 Can we model emissions, fate and exposure on a global scale? A case study of PCB 153 in human milk
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PCB 153 is a widely studied persistent, hydrophobic and semi-volatile pollutant was chosen as the test chemical. We used physical-chemical properties recommended by Schenker et al. and global historical estimates developed by Breivik and co-workers to drive the global multimedia fate and transport model BEITR Global. The fugacities of PCB 153 in air, water and soil, modeled at a spatial resolution of 3.75° × 3.75°, were re-gridded to give the historical fugacity records on the basis of individual countries. These were entered into the bioaccumulation and exposure model ACC-HUMAN, which modeled the concentrations of PCB 153 in fish, meat, dairy products and human milk. The human diet in ACC-HUMAN was parameterized for each country based on the WHO Global Environment Modeling System (GEMS) consumer diets. The modeled concentrations of PCB 153 in human milk were compared with the concentrations measured in the WHO/UNEP global monitoring program for POPs. The predicted and observed concentrations were highly correlated, with a correlation coefficient of 0.76. For 49 out of 78 data points, the predictions and observations agreed within a factor of 4. The model over-predicted the concentrations in central Europe and under-predicted the concentrations in much of Africa, in particular West Africa. Potential weaknesses identified in the chain of models include an under-prediction of the rate of decrease in PCB concentrations in air since the 1980s and inadequate treatment of food sources. We conclude that we have come a long way towards meeting this grand challenge for PCB 153, but there remains room for improvement! References U. Schenker et al. Environ. Sci. Technol., 2005, 39, 8434-8441. K. Breivik et al., Environ. Sci. Technol., 2016, 50, 798-805. M. McLachlan et al., Environ. Pollut., 2011, 159, 1442-1445. G. Czab and M. S. McLachlan, Environ Toxicol. Chem., 2004, 23, 2356–2366. https://undatacatalog.org/dataset/gemsfood-consumption-database M. van den
Risk assessment of Nanomaterials: innovative approaches and application of recent research developments to regulatory science

586 Regulatory tools and activities for environmental risk assessment of nanomaterials in ECHA


The European Chemicals Agency (ECHA) implements the REACH Regulation (EC No 1907/2006 (Regulation on Classification, Labelling and Restriction of Chemicals), the Biocidal Products Regulation (BPR, Regulation (EU) 528/2012), and the Classification, Labelling and Packaging (CLP) Regulation (EC No 1272/2008). Industry and authorities need to fulfill their obligations regarding these regulations also for nanomaterials as for any other form of a substance. Nanomaterials are implicitly covered by the substance definition of REACH Regulation 1907/2006 although there are no explicit requirement laying down NM specific obligations. ECHA’s experience has shown that REACH would benefit from nanomaterial-specific provisions. The BPR has partly implemented the Commission recommendation of 18 October 2011 on the definition of nanomaterials article 3(1)(e). It states that the approval of an active substance does not cover nanomaterials explicitly mentioned (Article 4). ECHA currently performs three type of activities to implement REACH, CLP and BPR regulations and to support these processes aiming at ensuring safe use of nanomaterials (NM): REGULATE: formal processes under regulatory frameworks, whereby ECHA uses the legal instruments available under REACH (substance/dossier evaluation, authorisation and restriction), CLP and BPR; SUPPORT: helpdesk, meetings with stakeholders and with Registrants, Nanomaterials Expert Group (NMEG); COMMUNICATE: ECHA Nanomaterials web-site, conferences, workshops, communication throughout the supply chain and in a broader context e.g. EUON and press. This presentation will provide a summary of the multiple actions taken by ECHA to address NM under REACH, CLP and BPR; Dossier and substance evaluation, NMEG, EUON and ECHA’s involvement at OECD level. Communication is currently considering specifying some of the technical provisions in the OECD ECMA and the REACH Annexes. This would allow more efficient efforts towards safe use of NM and decreased uncertainties in the regulatory processes. In addition, ECHA highlights the need for good coverage of standard methods applicable to NM to produce adequate information for regulatory risk assessment.

587 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.

588 Inventory of available tools, methods, approaches and best practices on nanomaterials/nanotechnologies

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The EC4SafeNano initiative, founded by Horizon 2020 is an ongoing effort to build a European Centre for Risk Management and Safe Innovation in Nanomaterials and Nanotechnologies. EC4SafeNano aims to bridge the gap between scientific knowledge on hazard and risk, and ‘fit-for-purpose’ risk management tools and strategies supported by measurement and control methods. The Centre of European organisations will offer services for Risk Management and Safe Innovation for Nanomaterials & Nanotechnologies. One of the first actions of the project was developed an inventory of available resources related to nanosafety issues. Indeed, until now, many tools and studies which aim to improve human and environmental nanosafety have been developed by research organizations and EU funded projects. Therefore this inventory have the aim to give a useful overview on tools, methods, standards, standard operating procedures (SOPs), guidance documents and best practices in nanosafety. Quality criteria are included to give users the possibility to select or suggest further examples based on the recommendation that approved the standard (and thereby indirectly the procedures followed to come to a standard), the level of evaluation and validation of the resources or the acceptance of the resource in view of the REACH legislation. During the project and after the duration of the project this overview will be updated when new information or updated versions of resources become available or when new resources are introduced by a mechanism later to be defined. Moreover this inventory will be published on the EC4SafeNano website. There is a large number of Standards (77) and SOPs (136) that can help the end user to conduct testing on toxicity and eco-toxicity, or measurements in workplaces and environment. One important issue is the scarce number of trainings available only 5. This aspect will be addressed in the EC4SafeNano project to identify the specific training needs and that be useful for the understanding of environmental risk. A large amount of information related to the environmental assessment of nanomaterials and nanotechnology is very low. This aspect is covered only in 6 out of the 28 included tools, and 4 out of 43 Guidance and Best practices. This shows that, at the moment, aspects such as eco-toxicity and methodologies for the environmental risk assessment and life cycle assessment have most likely not been deeply investigated.
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 in 2020 for 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-CeO2 > 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. Boulis, National Center for Scientific Research / Institute of Nanoscience and Nanotechnology; S. Zervou, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; K. Manolidi, NCSR Demokritos; T.M. Triantis, NCSR Demokritos / Institute of Nanoscience and Nanotechnology; T. Kaloudis, EYDAP SA / WATER QUALITY CONTROL
Cyanotoxins (CTs) produced from cyanobacteria in surface water during harmful algal blooms can pose significant threat to human health and the environment. Their analytical determination in both biomass and water is a demanding task as CTs comprise a large variety of compounds with different structural and physicochemical properties, i.e. cyclic peptides (microcystins, MCs and nodularins, NODs) and alkaloids (cylindrospermopsin, CYN, anatoxin-a, ANA-a and saxitoxins, STXs). The most important issues that make the CTs’ analysis challenging are the large number of variants of various classes, the limited availability of analytical standards and insufficient validation data. Moreover, different methods of analysis are usually required for each class of CTs in order to achieve acceptable analytical performance. Based to the above there is a need to develop efficient multi-class/variant method protocols for analysis of as many as possible CTs. Our laboratory has recently developed and validated SPE-LC-MS/MS determination of multi-class CTs. As an example, analysis of 12 MCs ([D-Asp3]MC-RR, MC-RR, MC-YR, MC-HyR, [D-Asp3]MC-LR, MC-LR, MC-HiR, MC-WR, MC-LA, MC-LY, MC-LW and MC-LF), NOD, CYN and ANA-a in one run can be achieved. In addition, validated multi-variant methods for the analysis of STXs based on HILIC-MS/MS have been developed. These methods have been combined in workflow to analyze multi-class toxins efficiently. The aim of this study was to demonstrate the applicability and efficiency of a proposed workflow for multi-class/variant determination of CTs. Furthermore, to detect and identify a wide range of CTs in Greek lakes never studied before, using this validated tool, Results of a monitoring survey in Greeks lakes showed that the proposed LC/MS/MS based workflow provided unequivocal and definitive identification of multi-variant/class toxins, avoiding the drawbacks of bioassay techniques that have been used previously. Using the proposed workflow a wide range of MCs ([D-Asp3]MC-RR, MC-RR, MC-YR, MC-HyR, [D-Asp3]MC-LR, MC-LR, MC-HiR, MC-WR, MC-LA, MC-LY, MC-LW and MC-LF), NOD, CYN, ANA-a, STX and neoSTXs were identified in Greek lakes for the first time. Acknowledgements The authors thank CYANOCOST – COST Action ES 1105 www.cyanocost.net

593 Interactions between cyanobacteria and daphnia G. Bogdáj, UMR CNRS Ecobio; M. Bormans, UMR CNRS Ecobio / UMR Ecobio; C. Edwards, L. Lawton, Robert Gordon University / IDEAS Research Institute; E. Briand, IFREMER - Centre Atlantique / Laboratoire Phycotoxines / Unité DYNECO - Département ODE; C. Wiegand, Université de Rennes 1 / UMR CNRS ECOBIO
Thanks to their adaptation cyanobacteria organized lacustrine, marine and terrestrial ecosystems. 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 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 10^5 cells/mL, reduced feeding and survival, moreover altered detoxication and antioxidant response as well as the energetic budget. Exposures to spent media from M. aeruginosa PCC7806 mcy- are currently in progress. Vice versa, Microcystis aeruginosa PCC7806 mcy- was exposed to 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 hydrogen peroxide 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 Teratogenic retinoid-like compounds produced by cyanobacteria into surface water K. Hilshchrova, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment RECETOX; E. Sychora, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment RECETOX; E. Sychora, Masaryk University, Faculty of Science, RECETOX / Research centre for toxic compounds in the environment RECETOX; E. Sychora, Masaryk University, Faculty of Science, RECETOX; L. Sehlal, Masaryk University Faculty of Science RECETOX / RECETOX Research Centre for toxic compounds in the environment; T. Prochazkova, Research Centre for Toxic Compounds in the Environment, Faculty of Science, Masaryk University / RECETOX, center for toxic compounds from the environment; S. Scholz, Helmholtz Centre for Environmental Research / Department of Bioanalytical Ecotoxicology; M. Smutna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment One of the biggest worldwide problems in aquatic ecosystems is the formation of cyanobacterial water blooms that can have adverse effects on organisms. 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
595 (Co-)Production Dynamics of Cyanobacterial Peptides
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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 and non-toxic compounds. Information on the 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 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 counts and biomass measurements. 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.

596 Development of methods for Measuring Total Microcystins in Fish Tissue using the 2-methoxy-3-methyl-4-phenylbutyric acid (MMPB) procedure
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 by Cyanobacteria, Prymnesium parvum (Prymnesins), and Euglena sanguinea, including microcystins, saxitoxins, cylindrospermopsins, anatoxin-a, prymnesins and euglenophycin. The objective of the first phase of this research was to spike extracted and cell counting biomass with 73 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 congener measurements. Extraction methods and analytical methods being developed for this research will be used for field 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. Detections 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
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Saponins are a class of bioactive natural compounds. Due to their detergent-like structure, saponins have a lot of applications, e.g. as biopoeidcs 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 quinoa 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 26.1, while decreased to 0.06 ±0.01 at pH 10.0. The hydrolysis was also influenced by temperature with an activation energy of 36.9 ±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 (HC) derived from the SSD’s of saponins from quillaja bark, tea seed coat, and quinoa 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
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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, 5% environmental organizations, 5% policy makers, and other. Following question solicitation, questions were separated into broad topic areas including, AOP networks, quantitative AOPs, collaboration and communication on AOPs, AOP discovery and development, extrapolation, exposure/toxicokinetics considerations, and AOP application. An expert-ranking exercise was then conducted to identify high-priority questions for each category and from this, four key themes emerged including future AOP research and regulatory initiatives. These themes were used as workshop topics for a Pellston™ Workshop, including: AOP networks and their applications; quantitative AOPs and
599 Adverse Outcome Pathway networks: development, analytics and applications
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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 for structuring regulatory decision principles and regulatory decision-making. 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 outlines expert开展 exercise, and answers to FAQs. AOP networks, and 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 traditional chemical safety assessment. 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 views or policies of their employers or institutes.

600 Building and Applying Quantitative Adverse Outcome Pathway Models for Chemical Hazard and Risk Assessment
S. Scholz, Helmholtz Centre for Environmental Research / Department Bioanalytical Ecotoxicology; R. Ashauer, University of York / Environment; R. Connolly, US EPA RTP; B. Landesmann, JRC, European Commission; C. Mackay, Unilever; C. Murphy, Michigan State University / Department of Fisheries and Wildlife; N. Pollesch, US EPA / ORD NHEERI; Mid Continent Ecology Division; J. Wheeler, Dow AgroSciences; A. Zupanic, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology; E.J. Perkins, US Army Engineer Research and Development Center / Environmental Laboratory.

Quantitative adverse outcome pathway (AOP) models are used to translate mechanistic biological data into adverse 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.

The adverse outcome pathway (AOP) framework serves as a knowledge assembly and communication tool to facilitate translation of mechanistic (e.g., molecular, biological, histological) adverse outcomes to adverse chemical safety assessments for human health. While 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 evident.

This presentation will identify various stakeholders who currently, or could 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.

603 Adverse Outcome Pathways: Moving from a scientific concept to a globally accepted framework
M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre; C. LaLone, U.S. EPA / Mid Continent Ecology Division

The adverse outcome pathway (AOP) framework has gained significant international traction as a systematic approach for capturing existing knowledge to transparently link mechanistic data to apical toxicity endpoints as a means to inform research and risk assessment. While the framework has evolved significantly since 2006, the vision of a widely accepted framework has not yet materialized.

This presentation will offer an overview of the AOP framework, focusing on its development, recent advances, and ongoing challenges. We will discuss the critical role of AOPs in current and future approaches to risk assessment and regulation, and briefly review how AOPs are being used in chemical decision making.

The presentation will also highlight future directions and potential areas for collaboration. This includes the need for standardized data formats, open accessible databases, and computational tools to facilitate the use of AOPs in regulatory contexts.

Finally, we will provide an update on the development of AOPs for human health and environmental exposures, with a focus on the development of AOPs for human health.

The presentation will conclude with a discussion of the challenges and opportunities for advancing the AOP framework, including the need for interdisciplinary collaboration and the integration of AOPs into existing regulatory frameworks.
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 Scanning” 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) Pellan Symposium 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 Pellan 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 regulatory agencies and manufacturers. 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 Swedish aquatic ecosystem and in human milk

E. Nyberg, A. Bignert, 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 Institut 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 German environmental specimen bank

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In the last century, conventional brominated flame retardants (FRs) such as polybrominated diphenylethers (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 ethylenes, 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 in samples, their accumulation and in particular, those going back to the 1980s, e.g. from coastal herring gull eggs, freshwater fish, tree leaves and roe deer 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


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 Ecosystem Specimen Bank (MESB) at NIST for future national, international chemical and environmental risk assessment. Since the start of the monitoring, concentrations of PCBs, DDTs, HCHs and HCB have decreased considerably in human milk. However, the non-linear trends differ, 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.

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 maintained as a long-term archival of biological and environmental specimens, stored and processed in polytetrafluoroethylene (PTFE) based materials, have recently been conducted. In addition, alternative uses of these cryopreserved specimens including, 1) a detailed proteomic profiling of tissues used to evaluate a new high-coverage well-scaled genome, and 2) the discovery of using total mutagenesis as an alternate method to genetic species identification, have also been conducted and will be discussed.

608 DNA banking and its relevance for biodiversity research

J. Aastrup, 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...
identification via DNA barcoding and high throughput sequencing, such samples can be most helpful in documenting and interpreting environmental change. Accumulated snippets of free DNA in soil or water samples (freshly collected or from ESBs), so-called environmental or eDNA, enable the comprehensive appraisal of species compositions in a multitude of environments. DNA extracted from ESB samples should be deposited in dedicated DNA banks in order to make this resource available to the scientific community and the long evolution DNA analysis methodologies (which may prompt repeated analyses of samples over time, with ever-increasing amounts of genomic data recovered). Thus, by adding DNA banking to their service spectrum, ESBs can considerably increase their visibility and public demand. Furthermore, they can foster knowledge aggregation at the biodiversity level around their ESB samples, making these more valuable.

609 Discussion on environmental specimen banking in research and regulation

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), large 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 ERICA-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 uncertainties and limitations for the proposed approach are linked to exposure data in terms of speciation and bioavailability; time consuming and subjective effective 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 23238 (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. LevY, Univ. Paris Sud / ESE UMR 8079; J. Loret, o. schlosser, CIRSEE Suez Environment; a. guillon, Suez / CIRSEE; m. favier, INERIM Institut Cochin; v. domengeau, Biodiv. Université Paris Sud; M. Binbot, V. Huteau, Univ. Paris-Sud / UMR ESE; m. pleba, b. marinas, University of Illinois at Urbana Champaign Assessing health risks associated with organic micropollutants 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-treated water and bottom-mineral water. 2 generations of mice (10 males, 10 females for each type of water) were fed with contaminated drinking 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 OC-2D with mass spectrometry), offering a new vision of the contaminants diversities. In vitro bioassays were used to evaluate endocrine disrupting effects (ER and AR receptors), 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 micropollutants. The presentation will show the detailed protocol and the major conclusions of the study. This work is based on the union of in vivo and in vitro tests and allows enhance our knowledge on the 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

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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 classed 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 the individual synergic compounds that each exceed their expected from the sum of individual contaminants). Diffusive 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 Chelex-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 elongata. Non-interactive and synergistic toxicity were observed in the two algal 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 field deployments 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?

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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...
(ERCMs) 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 SpeediK™ passive samplers deployed in and outside of the harbour of Zeeland (Belgium) to spike several 24 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 analysis was performed. Quantification of metabolites was performed with GC-MS and LC-MS. 100+ personal care products, pesticides, pharmaceuticals, (alky)lphenols, 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 multivariable 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. Lahm, Bioinformatic consultant; S. Chelinho, CFE  Centre for Functional Ecology; S. Pieper, University of Coimbra; N. Capela, CFE  Centre for Functional Ecology / Department of Life Sciences of Luz, University of Coimbra; T. Lettieri, European Commission Joint Research Centre; D. Marinov, European Commission Joint Research Centre; D. Napierska, 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, ISPRA 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 algae-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 gene expression profile pattern. The results show that the mixture induces a pattern similar to the ones induced by the single herbicides Diuron and Isonicotron. 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.

**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. Roembe, ECT Oekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences; T. Natal da Luz, University of Coimbra / Institute of Environmental Sciences; 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 Commission's (2008) guidelines 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 accuracy of the lab to field extrapolations might lead to underestimation of the toxicity of test chemicals for 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 Lafa 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 on the identification of key parameters influencing toxicity in different groups of species in order to create 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, ANSES; A. Bouzid, ANSES; Y. Bayona, ANSES; Y. Bayona, ANSES; F. Williams, Joint Research Centre; D. Napierska, European Commission Joint Research Centre; D. Marinov, European Commission - Joint Research Centre / Directorate D Sustainable Resources Water and Marine Resources Unit

The soils used for ecotoxicity testing cover for each metal a wide range of soil standards for metals in soil for different protection goals (e.g. remediation regia extractable) (i.e. total (i.e. regia extractable) or 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. Litherland, T. ARCHIE; L. Seal, Joint Research Centre; J. Chowdhury, International Lead Association / Senior Scientist -Environment

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 legislation on chemical management (REACH) and the data were therefore primarily used to derive provisionally no effect concentrations (PNEC) for respective risk assessment. To facilitate a more flexible derivation of ecological quality standards for metals in soil 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 toxicity data for the most direct effects of the metals Cd, Co, Cu, Pb, Ni, Mn 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 optional tools are included to allowance of 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 ecologically sound 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. This can also be quoted as a decisive factor, but the all-explaning 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 thorough monitoring and regulation of the use of pesticides on specific sites and 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 thresholds 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. Roembke, ECT Oekotoxikologie GmbH; J. Sousa, University of Coimbra / Department of Life Sciences

In February 2017, the 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 additional review is to determine 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 and safe 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.

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

A. Toschki, Research Institute gaiac; M. Hammers-Wirtz, Research Institute 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

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 new industrially 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 [1] Bumann A., Curis 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., Drzał Ł.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. Waste Polym. Recycl. 2015. 1: 112-123. 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. Mistrutta, University of Palermo Lithium-ion batteries (LIBs) are the dominating storage technology for electric vehicles (EVs). Different types of LIBs, using diverse cathode materials, are available on the market, such as LiMnO2, Li(Ni1-xCo0.5Mn0.5)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 chains of these materials. In LIBs and in general in EVs. In this context, lithium rich layered oxides from the class xLiMnO2(1- x)LiMO2 (M=Ni, Co, Mn), known as LNO – NMC, 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 electric Plug-in EVs with the following life cycle stages: 1/3-3/4 of the impacts are accounted on the mineral, fossil and renewable resources depletion (MFRDR); to estimate the requirement of CRMs; to identify the contribution of each cell component to the MFRDR; to compare the LMO-NMC LIB cell technology with an NMC cell technology available in the literature, with reference to the MFRDR and CRMs requirement. The LMO-NMC battery technology is modelled as 0.5LiMO2– (1/3-Ni1/3-Co1/3-Mn1/3)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 MFRDR of 0.34 kg Sb eq. The relevant share of MFRDR (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 MFRDR 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 MFRDR 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. Moccia, University of Roma Tre / Department of Business Studies; R. Salomone, L. Giuttari, G. Saija, 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 by 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

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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 polarities 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 vertical 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 the e-bicycles, including 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. Cuttai, C. Chiarini, P. Porta, ENEA; M. La Monica, C. Scaglìarino, CINGeo

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 consumption 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 the 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, IFPEN / Economics & Technology Intelligence; A. Benoist, CIRAD / UPR BioWoobELSA 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 efficiently enforced by energy policies (e.g. the French Transition for Growth Act). LCA scholars increasingly assess the environmental performance of the advance biofuels, but mainly from a static energy resources, as currently enforced by energy policies (e.g. the French context, the transportation sector). Energy production and consumption is the main driver for anthropogenic GHG emissions, and in the French context, the transportation sector. Results are therefore limited to linear simplifications, whereby the time- dynamic Cbio flows between the atmosphere and the biosphere. The assessed Cbio flows primarily originate from lignocellulosic biomass and their co-products generated from MIRET outputs under business as usual and normative scenarios. The transformed Cbio 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 Cbio sequestration potentials and climate benefits of lignocellulosic biofuels. The combination 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 (Cbio sequestration) options influenced by policy and decision constraints. Future refinements addressing other bioenergy paths are envisaged.

Developments in the use of bioassays for chemical and environmental risk assessment (II)

628 SIMONI: Smart integrated monitoring of the water quality

R. van der Oost, Wateren / Onderzoek en Advies; G. Sileno, Wateren / Research and Development; M. Thao Nguyen, Waterproof, L. Moria, Wateren / Water Systems

At present, regular water quality assessment is almost exclusively performed by target chemical analysis of substances. Scientific research over the last decades, however, demonstrated that water quality assessment with only chemical analyses is not reliable. Since over 100,000 harmful substances may be present in the aquatic environment, a paradigm shift from ‘substances’ to ‘effects’ has to be encouraged in order to implement a more holistic approach in regular monitoring. Therefore, an alternative Smart Integrated Monitoring (SIMONI) strategy has been developed by Dutch water research institutes. The purpose of this 2-tiered strategy is to obtain more reliable information on the chemical water quality without increasing the monitoring costs. Key factors for generating this model were the selection of the most relevant bioassays and the design of effect-based trigger values (EBT). Tier 1 of the strategy combines micropollutant concentration by passive sampling with testing of 15 bioanalytical endpoints. This hazard identification makes the distinction between low, acceptable and increased ecological risks. Only at sites where tier 1 indicates increased ecological risks, a customized tier 2 research is performed to identify the chemicals that cause the bioanalytical effects and to evaluate if observed in vitro effects pose a serious in vivo threat to the ecosystem. The present paper is focused on demonstrating the field feasibility of the SIMONI strategy. The strategy has been applied and validated in more than 100 Dutch field studies. Results of several of these monitoring studies will be presented in order to demonstrate the field feasibility of the SIMONI strategy for identifying hot-spots of chemical pollution. It is applied at ecologically generally occurred at agricultural sites. In addition, increased ecological risks were also observed at waters receiving wtp effluents, sewage overflows and landfill runoff. A tier 2 approach is the assessment of the mixture toxic pressure on the ecosystem by using chemical analytical results for msPAF determination (potentially affected fraction of water organisms due to multiple substance stress). At these sites with increased ecological risks due to micropollutants, similar classifications were obtained with bioanalytical and extensive chemical analyses. The tier 2 research at agricultural greenhouse areas identified eight pesticides contributing most to the increased environmental risks.

629 Bioassay battery responses to POCIS and Speedisk passive sampler extracts

M. de Baat, University of Amsterdam / IBE-DAME; M. Thao Nguyen, Waterproof; R. van der Oost, Wateren / Onderzoek en Advies; W. van den Berg, Waterproof Laboratory, Research and Validation; P. de Voogt, University of Amsterdam / IMED; M. Kraak, University of Amsterdam / IBE-DAME

A large portion of the toxic substances ecotoxicologically explained by compounds that water authorities regularly monitor. Since chemical analysis of the myriad of substances present in the aquatic environment is practically and economically not a viable option, there is a growing interest in effect-based monitoring. Additionally, concentrations of compounds typically vary over time and therefore traditional grab sampling only provides a snapshot of the chemical make-up of a water body. To estimate threat to surface water this limitation by exposing a sorbent to the target environment, accumulating compounds from the water over time. Hence, there is an urgent need for a time-integrated effect-based monitoring strategy that employs a combination of passive sampling and bioassays, thus detecting bioanalytical responses by mixtures of all bioavailable compounds. Many pollutants of emerging concern are polar compounds, underlining the need to standardize the employment of polar passive samplers in such monitoring strategies. The aim of the present study was, therefore, to determine bioassay battery responses to extracts of two types of polar passive
The gene TRα is a non-PAHs, methyl mixtures. Using the DR approach, which aimed to identify major toxic mo contributors to specific toxicity effects. The AhR approach, which aimed to identify major toxic mo...

Toxicology; L. Svrzková, Veterinary Research Institute / Chemistry and Toxicology; K. Geneste, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; M. Péchenko, Veterinary Research Institute / Chemistry and Toxicology; L. Svrzková, Veterinary Research Institute, Brno / Chemistry and Toxicology; J. Necáš, M. Ciganek, Veterinary Research Institute, Brno / Chemistry and Toxicology; I. Bartonková, Z. Dvořák, Faculty of Science, Palacký University, Olomouc; J. Tomášek, Institute of Experimental Medicine, 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, airborne 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 (REPs) for a large dataset of poly cyclic aromatic compounds, including PAHs, methyl-, nitr- and oxy-PAHs, thiophenes, dinitrophenols, benzoazines 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 and selected individual classes of organic contaminants. The general outline of those studies will be illustrated using an example of a detailed in vitro toxicological evaluation of standard reference material of diesel exhaust particles (SRM 2975), with an aim to document both the complexity of the observed effects and the difficulties faced when applying these data in risk assessment of complex mixture. [The study was supported by the Czech Science Foundation, grant no. P503-12-G147.]

**632 Hormone-like activities in waste water characterized by CALUX bioassays, UPLC-Q-TOF directed analysis and Effect-directed Analysis**

Y. van Oorschot, R. ten Broek, The Water Laboratory; M. Lamore, VU University, Department Environment & Health / Department Environment & Health; N. Zwart, VU University Department Environment & Health; C.J. Houtman, The Water Laboratory

Emission of compounds with biological activities from waste water treatment plant (WWTP) to surface waters is a topic of concern for ecology and drinking water companies. We investigated the occurrence of hormone-like activities in WWTP samples and pursued to identify compounds responsible for them. To this aim, CALUX bioassays and a UPLC-Q-TOF target analysis method for hormones used in high volumes in pharmacy were applied. In addition, a novel high throughput Effect-directed Analysis (HT-E DA) platform was used to separate compounds into the extracts with high resolution LC-tRaciation creating 288 4.79 sec.-frations that were tested in the bioassays. In parallel, QToF high resolution MS data were recorded to correlate compound identity to peaks from the ‘bioassay chromatograms’ reconstructed from the bioassayed fractions. All five types of activities tested were observed in the WWTP samples. Androgenic and estrogenic activities were almost completely removed during WW treatment, anti-androgenic and anti-estrogenic activities were partially removed. Androgenic and estrogenic activities were present in similar concentrations in untreated as in treated WW. The glucocorticoid activity in influent was fully explained by predniscarbate, triamcinolone acetonide, dexamethasone and amoxicillin. In effluent however, detected hormones could only explain 15% of the activity, indicating the presence of unknown (metabolites of?) glucocorticoids in effluent. The androgenic activity in influent and effluent can be attributed to the presence of unknown androstenedione and testosterone. Application of the HT-E DA-platform delivered bioassay chromatograms of the WWTP effluent in which active compounds were separated into sharp peaks. The glucocorticoid activity appeared to be caused by at least four different compounds (peaks), not being dexamethasone. The androgenic activity was fractioned into a small peak probably attributable to co-elution of testosterone and androstenedione. The QToF MS data are currently interpreted to elucidate the identity of the unknown glucocorticoids. Also bioassaychromatograms of other endpoints will be discussed. This study demonstrates the value of toxicity profiling with bioassays as first tier in the monitoring of water quality. In case observed activities exceed trigger values, additional risk assessment is needed and the HT-E DA platform can help to characterize and ultimately identify the responsible compounds.

**633 Non-target screening and identification of emerging pharmaceuticals and their transformation products in wastewaters**

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Wastewaters represent a major pathway of introduction of EDCs into the aquatic environment. Considering the university of concern for ecology and drinking water companies, 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 wildfire. 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 estrogens, androgens and glucocorticoids 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 effluent were also detected in influent and induced by the transformation 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; S. Sherk,  University of Saskatchewan / Toxicology Centre; M. Hecker, University of Saskatchewan / School of the Environment & Sustainability and Toxicology Centre

Nechako white sturgeon (Acipenser transmontanus) are 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, the Style of Forever Forested 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 volunteers. 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. Fareenhough, University of Manitoba / Soil Science; W. Ross, University of Manitoba / Centre for Human Rights Research; R. Mc, University of Manitoba / Department of Soil Science; R. Patidar, University of Manitoba / Department of Microbiology; G. Amara, University of Manitoba / Department of Soil Science; 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 uses for: engaging communities and students in research training activities, Indigenizing 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

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Many communities in Canada’s North are increasingly concerned about the impacts of large-scale socio-environmental changes, such as climate change and insecy pieces important on both local and global levels. For Indigenous communities, the environmental impact of mining, including the large number of rare earth element mining projects that are currently being developed, is an increasing concern. 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 in particular 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 Kuujjuaapik-Whapmagooastuik (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 multiple First Nations communities of Kuujjuaapik. 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 of economic and cultural importance to the local region. The importance and value of 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 Papatānuku: 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-saptoxin 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 community-driven groups to work on the contaminated lands. These groups are composed by indigenous members of Ngati Awa, whilst being strongly supported by scientists, 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 management however, is the role of indigenous knowledge – 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 Papatānuku research collaboration – using a synchronistic approach –
whereby 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, Ninti ONE Foundation

On 18 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 peoples are linked with their land (including waterbodies) by their ancient traditions and continue to occupy 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 through a series of visits for consultation 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 environmental flow 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 protection. For Australia’s First Peoples, occupying an ever drying landscape, traditional knowledge of finding, re-finding and protecting water sites has been integral to their survival for so long. This paper will explore relationships between First Peoples and water planning and environmental water management in three ways. Firstly, history, challenges and institutional responses in integrating First Peoples cultural values into water planning, science and management. Secondly, propose a series of on-the-ground applications of cultural water and environmental water empirically. Finally, integrating First People’s science into water management will be assessed through comparisons between the Australian situation through case studies looking at models and methodologies.

Improvements in environmental exposure assessment: Development and application of tools across industry sectors, regulatory agencies, and international boundaries (II)

640 Tap water intake of poly- and perfluoroalkyl substances (PFASs) in relation to serum concentrations in a nationwide prospective cohort of U.S. women

X. Hu, F. Laden, Q. Sun, P. Grandjean, Harvard University; L.W. Yeung, University of Orebro / Department of Chemistry; E.M. Sunderland, Harvard University / School of Engineering and Applied Sciences

Drinking water advisory levels have been adopted by many regulatory agencies to reduce chronic exposure to persistent fluorochromes. However, most U.S. advisory levels are based on the assumption of approximately 20% of overall PFAS intake comes from drinking water. Better characterizing the relative importance of drinking water to overall human exposures is important for developing health protective guidelines. Most previous investigations that have associated drinking water PFAS exposures and total body burdens of these compounds have focused on highly contaminated sites. Exposure to PFASs for the general population of individuals from geographically diverse areas are thus less understood. Here we investigate the relative importance of drinking water for total PFAS exposure among women in the Nurses’ Health Study (NHS), a large U.S. based cohort study. Our analysis included U.S. women who provided a residential drinking water sample in 1989-1990. We measured concentrations of 11 PFASs in a subset (n=11,002) of archived drinking water samples and serum samples. We evaluated the relative importance of home tap water for measured levels of PFASs in human using both statistical and toxicokinetics (TK) models. Results suggest that home tap water is a significant exposure source for general American women. In 1989-1990, the median contribution of drinking water to serum PFASs in women in the NHS cohort was 8.8% to 30% for the five PFASs modelled. This ratio varies across individuals and is, on average, up to 4.9 times higher for PFASs. We will further investigate how this ratio varies geospatially and whether it is associated with distance to well-known point sources. The spatial analysis results will also be discussed in the presentation. By comparing PFAS concentrations in archived tap water sample with recent tap water samples matched on the township, we found the fraction of quantifiable PFASs (i.e. known PFASs) has decreased in most towns and unknown extractable organic fluorine (EOF) has increased. Our analysis suggests tap water may be a significant exposure source for five PFASs among a group of U.S. women from diverse geographical areas. Increases in unquantified EOF in recent tap water suggest additional quantification would be worthwhile. Other exposure sources such as consumer products are suspected to dominate overall exposure of individuals in the NHS cohort prior to the restrictions and regulations of legacy PFASs in the U.S.

641 Consideration of the bioavailability of metals and metal compounds in freshwaters in regulatory frameworks

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Recent research has demonstrated that both total and dissolved metal concentrations are not the only appropriate parameters for the risk assessment of metals in aquatic systems. There is an increasing awareness by leading regulatory bodies in the USA, Europe and other countries that the bioavailable fractions of metals could be better descriptors of their risks. The principal concept of metal bioavailability is the Biotic Ligand Model (BLM) which allows site-specific assessments of metals’ risks by considering the environmental factors which determine the bioavailability of dissolved metals in the aquatic environment. For many metals bioavailability in freshwaters is modulated by dissolved organic carbon (DOC) concentrations, water hardness, the pH of the water and other factors such as temperature, concentrations of further ions and suspended solids as well as metal speciation. Metal-specific BLMs were proposed for different biological species and both, acute and chronic exposures. The BLM approach has been described extensively in the scientific literature, and BLMs have been applied for the risk assessment of metals and metal compounds (e.g., for copper and zinc in the EU). In the past, the broader use of the BLM approach for the site-specific evaluation of surface water monitoring data was hampered by the huge amount of requirements of the original BLMs (several site-specific water parameters). But the recent development of user-friendly BLM-based bioavailability tools (e.g., met.net, www.PNEC-pro.com) now allows the consideration of bioavailability for the evaluation of freshwater monitoring data of relevant metals. Such tools, which only need a basic set of easily available water parameters as input (mostly pH, Ca concentration, DOC, and dissolved metal concentration), are now consider the bioavailable fractions of these metals. In this contribution, the advantages and possible drawbacks of BLM-based bioavailability tools are presented highlighting feasibility, ranges of validity, and comparability between tools. Finally, recommendations for the regulatory implementation are given. This contribution is based on the outcome of the IUFAC-supported project “Consideration of bioavailability of metals/metal compounds in the aquatic environment” (#2011-060-1600).
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 Environmental Science; K. Fox, 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 consistency of chemical biomarkers from 16 different classes of chemicals from databases, literature survey, 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, biomarkers have been increasingly used to assess the potential impacts of pollutants at different levels of the aquatic environment. In the present study, we evaluated the consistency of chemical biomarkers from 16 different classes of chemicals from databases, literature survey, and quantitative structure activity relationships (QSAR) when needed. Total mercury concentrations were determined for both individual fish fillets and carcasses as well as for age-grouped pools of both. Organic PS and fat contents were determined only in the fish fillet and carcass pools. Data are evaluated to derive recommendations for an optimal WFD biota monitoring and reporting. An important aspect is how biota burdens of PS are influenced by sample collection. Which fish species are most appropriate? Which age/size class is 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.

464 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 organisms' responses to pollutant exposure. Therefore, the aim of the present study was to verify the suitability of biochemical responses of estuarine fish (Microspogonius forneri), copepod (Acartia tonsa) and crabs (Callinectes sapidus) as biomarkers to evaluate the environmental quality assessment in tropical estuaries of Maranhão State, Northeast Brazil. Thus, we evaluated biomarker of metal exposure as well as other metal-like proteins (MTLP), biomarker of organic exposure as 7-ethoxyresorufin-O-deethylase (EROD), and biomarkers of general effects like lipid peroxidation (LPO) and acetylcholinesterase (AChE). MTLP and LPO concentration were analyzed in copepod whole-body, crabs and fish hepatopancreas, while EROD activity were analyzed in fish hepatopancreas and AChE inhibition in copepod whole-body, crabs hepatopancreasam and fish muscle and brain. Samples were collected in three different sites along two estuaries (São Marcos Bay and São José Bay), in two seasons (dry season/August and rainy season/January) in three different years (August/2012; January/2013; August/2013 and January/2014). In both estuaries, a high degree of heterogeneity were observed in biomarkers response over the two years of study, with considerable temporal and spatial changes. However, analyzing all biomarkers studied, regarding organisms and tissues, it is possible to observe at least two biomarkers alteration in both estuaries and season, reaching up to seven different biological responses in rainy seasons. The responses confirmed the initial expectation that both São José Bay and São Marcos Bay are subjected to the impact of the adjacent river basin drainage. In this context, biomarkers response were able to differentiate the site of exposure (estuary versus non-estuary) which are affecting the estuaries along different seasons and year as well as the effects on local species. Regards test organisms, estuarine fish (Microspogonius forneri) showed to be more sensitive to environmental alterations, revealing most of the results obtained. Therefore, these results show that biomarkers is a promising tool for the assessment and monitoring of macro-tidal estuaries from tropical aquatic ecosystems impacted by anthropogenic activity.

465 Using Paleocotoxicology to Assess the Toxicity of Lake Sediments Impacted by Legacy Gold Mining in Yellowknife, NT, Canada

C. Cheney, University of Ottawa / Biology; M.P. Pothier, J.R. Thiessen, 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 / Biology

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/size class is 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.

Ecotoxicology of micro and nanoplastics: Mechanistic

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646 Wastewater-based microplastics: Presence in wastewater effluent and effects on freshwater organisms

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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., plastic additives, sorbed pollutants, and their potential interactions, are less 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-targeted 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 polycarbonate acid (PLA) were cut and extracted in a sonication-assisted, solvent-based procedure mimicking worst-case leaching. The extracts were tested for unspecifical 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 unspecifical 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 antioxidant activity. In contrast, PET extracts were less toxic with only one sample inducing oxidative stress. Interestingly, all PLA extracts produced a very high unspecifical 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 unspecifical toxicity, oxidative stress and endocrine activity. So far, no toxicity has been consistently reported for a higher number of plastic products, indicating a toxicological 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 multixenobiotic resistance (MXR) inhibition in the monogonont rotifer (Brachionus koreanaus)

C. Jeong, J. Lee, Sangyunkwan University

Microplastics 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 water flea (Ceriodaphnia dubia) and a sediment-dwelling midge larva (Chironomus tepperi), 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. dubia to microplastics, with fibres showing more significant effects, though chronic effects were only observed at concentrations six times higher than environmental levels. Further, exposure to an environmentally relevant concentration of microplastics adversely affected the survival, growth and emergence of C. tepperi. Size-dependent effects were observed with microplastics, with beads in the size range of 10-27 μm showing more pronounced effects. Our research 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. Völker, Institute for Social-Ecological Research; M. Wagner, Norwegian University of Science and Technology / Department of Biology

Plastic particles within the microns range (microplastics, MP) are increasingly recognized as vectors and carriers for a wide range of 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, the objectives of the present study were to investigate the sorption kinetics of two models pollutants to LDPE (Low Density PolyEthylene) microparticles 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 absorbed by the MPs was constantly decreased. 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, phosphorylation related enzymes and EROD activity) between the control group and fish exposed to virgin MPs, spiked MPs or control alone. 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 molecular biomarkers in marine mussels

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Plastic particles within the microns range (microplastics, MP) are increasingly present in marine ecosystems. One of the most concerning aspects of MP in marine
Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (II)

Dissipation of the carcinogenic ptaquiloside in water resources

L. Rasmussen, Metropolitan University College; J.S. Wu, F. Clausen-Kaas, University of Copenhagen; J. Sanderson, 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

Ptaquiloside (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: \( k_{\text{obs}} = k_{\text{act}} \cdot [\text{PTA}] \). The rate constants are: \( k_{\text{act}} = 25.7 \pm 1 \cdot 10^{-3} \text{ h}^{-1} \) and \( k_{\text{act}} = 9.5 \pm 6 \cdot 10^{-3} \text{ h}^{-1} \) and \( k_{\text{act}} = 4.8 \pm 6 \cdot 10^{-3} \text{ h}^{-1} \). 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 degradation of PTA under natural conditions using 10 different surface and groundwater samples from Denmark and to compare the degradation kinetics with the existing model for hydrolysis. Degradation 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 persists 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 groundwaters 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 fresh waters, and algae and microorganisms with a particular eye on freshwater cyanotoxins.

Dissipation of the carcinogenic ptaquiloside in water resources

L. Rasmussen, Metropolitan University College; J.S. Wu, F. Clausen-Kaas, University of Copenhagen; J. Sanderson, 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

Ptaquiloside (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: \( k_{\text{obs}} = k_{\text{act}} \cdot [\text{PTA}] \). The rate constants are: \( k_{\text{act}} = 25.7 \pm 1 \cdot 10^{-3} \text{ h}^{-1} \) and \( k_{\text{act}} = 9.5 \pm 6 \cdot 10^{-3} \text{ h}^{-1} \) and \( k_{\text{act}} = 4.8 \pm 6 \cdot 10^{-3} \text{ h}^{-1} \). 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 degradation of PTA under natural conditions using 10 different surface and groundwater samples from Denmark and to compare the degradation kinetics with the existing model for hydrolysis. Degradation 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 persists 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 groundwaters 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 fresh waters, and algae and microorganisms with a particular eye on freshwater cyanotoxins.
de Cataluña / Centre de Estudis del Rius Mediterrani; M. Abril, Universitat de Vic / Universitat Central de Catalunya / BETA Technological Centre; M. Ricart, Universitat de Vic / Universitat Central de Catalunya / BETA Technological; N. Sellares, Universitat de Vic / Universitat Central de Catalunya / Centre d’Estudis dels Rius Mediterrani; J. Colon, S. Ponsà, Universitat de Vic / Universitat Central de Catalunya / BETA Technological Centre The Mediterranean region is one of the most densely populated and industrially developed area in Spain. As a consequence, most of the rivers in this region are impacted by multiple anthropogenic stressors. One of these rivers is the Ter River (NE Spain), where human pressures are diverse and have increased in the last decades because farming, urban development and industry practices depends on its water. In addition, fluctuations in water discharge due to the Mediterranean climate create a high variability of conditions along the Ter River. One of the major problems detected in Ter River in the recent years is the appearance of geosmin. This is a metabolite generated mainly by cyanobacteria and actinomycetes that, when die, is released into the water, giving it a bad smell and taste. Although some studies have described that the production of this metabolite depends on environmental conditions, the factors associated with its production are still not clear. This supports the need for an ecosystem approach of water supply companies, since they cannot predict its appearance and have to act when customers complain it arrives. The aim of this study is to evaluate the co-relationship between physicochemical parameters and geosmin appearance along the Ter River during one year, and to study seasonal variability of geosmin concentration. The study has been performed in four sampling sites across the upper-middle part of the Ter basin. The sampling frequency varied throughout the year, depending on the potential occurrence of blooms in different periods, from February to June, and June to December. Sampling was performed monthly. The parameters analysed have been nutrient concentration, suspended solids, organic material, turbidity and geosmin concentration in water. Biofilm samples were taken in order to analyse the chlorophyll a content. The results obtained clearly reflected the seasonal variation in the occurrence of cyanobacteria. They identified its maximum concentration being in winter (32 ng/L). They also evidenced the N/P ratio as one of the key factors involved in the geosmin formation. However, a more in-depth analysis of the N/P ratio in water is still necessary in order to explain the mechanisms that generate the geosmin formation within the organism. For this reason, a mesocosms experiment that tests the influence of the N/P ratio on the geosmin formation within the biofilm could be the next step to follow.

656 Italian guidelines to assess and manage the risk associated to cyanobacteria blooms in water during bathing and recreational activities

M. Matanelli, Istituto Superiore di Sanità / Dip. di Ambiente e Salute; E. Funari, F. Buratti, Istituto Superiore di Sanità / Dept. of Environment and Health; E. Testai, Istituto Superiore di Sanità / Dip. di Ambiente e Salute Many species of cyanobacteria thrive in different aquatic environments, where they can produce cyanotoxins with different toxicological profile. The still growing anthropic pressure and climate changes are causing the expansion in terms of time and space of their blooms, increasing the concerns for human health in several exposure scenarios. The Italian guidelines for the management of cyanobacterial blooms in bathing water, firstly drew up for the implementation of European bathing water directive (Directive 2006/7/EC), have been recently updated. A risk-based approach has been developed after a thorough revision of the current scientific knowledge on cyanobacteria distribution in the Italian Lakes and on cyanobacterial intoxication, nutrition, toxins and their toxics potential. A critical overview of the available standardised test methodology for the exposure to cyanotoxins, during recreational activities, has been individually examined, to develop a framework of thresholds and actions aimed at preventing harmful effects for bathers. Three phases of attention relative to monitoring plans have been consequently defined: routine, alert and emergency, suggesting the actions to take at any moment. Parallel to environmental monitoring, a multi-disciplinary surveillance system has been proposed, aimed at collecting important information through a screening action by local workers (lifeguards, local health units, restaurant staff, etc.). A suitable testing strategy which also takes into account the available test methods and knowledge on birds’ and other vertebrates’ nutrition 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 for the identification of 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 the following 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 extrapolation among oviparous vertebrates is scientifically justified e.g. in the case of the steroidogenesis pathway leading to reproductive dysfunction (extrapolation among taxon with more specific than mammals). 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

L.H. Schoenfuss, St. Cloud State University / Aquatic Toxicology Laboratory; L. Thomas, St. Cloud State University / Biological Sciences; L. Wang, St. Cloud State University / Chemistry; G. Cipollini, St. Cloud State University / Aquatic Toxicity 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 was conducted to determine 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, alkylphenols, pharmaceuticals and personal care products. Agriculture influenced sampling sites contained herbicides and pesticides in addition to BPA and alkylphenols, 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 modified control concentrations enhanced fecundity in the F2 and 3 generations, whereas 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; J. Evesen, Norwegian School of Veterinary Science; L. Evesen, The Arctic University of Norway; F. Falciani, University of Lisbon; 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; M. Chen, National University of Singapore; I. Sylte, The Arctic University of Norway / Institute for Water Research; B. Salbu, Norwegian University of Life Sciences; I. Ytle, The Arctic University of Norway / Department of Medical Biology; D. Lillievne, U.S. EPA / National Health and Environmental Effects Research Laboratory; N. Vinas, Mississippi State University / Biomolecular Research and Development; B. Sandved, 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 presence of well-defined endocrine system and subcellular 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 vertebrates 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 EDCs 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 edcysone receptor (EcR) and the Juvenile Hormone (methyl farnesoate) receptor (MFR) have been identified to be important in crustaceans. The present paper focus on the application of AOPs to (1) develop linkage between endocrine mechanisms and adverse outcomes, (2) identify knowledge gaps and inform testing strategies, (3) identify sensitive species/taxa, (4) identify likely define ED endpoints suitable for Integrated Approaches for Testing and Assessment, (5) identify potential EDCs and 6) practical implementation of AOP in tier testing (e.g. a fish life cycle test). A number of emerging contaminants (especially endocrine relevant exposure scenarios. Acknowledgement - Funding from RCN-221455 A_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. Klung, 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 importance of specific chemical pathways do not adequately detect all EDC mixtures 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. Wiltje, 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. Braumueck, University of Heidelberg / Centre for Organismal Studies VTGelogenin (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) by anti-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 / test fish. Thus, we investigated the effects of two well-known hepatotoxics, acetaminophen (APAP) and isoindaz (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: (1) mRNA expression of different endocrine-related (tg1, vtg3 and esr1) and hepatotoxicity-related marker genes (fahp1, apoal, cyp2k19 and cyp3a65) in the liver; (2) hyaluronic acid (a biomarker for liver toxicity) levels in head/tail homogenates; (3) 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, significant differences in VTG levels were observed 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 pathway (AOP) 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 S. Kroesen, Fraunhofer IME - Institute for Molecular Biology and Applied Ecology; C. Schaefers, Fraunhofer-Institut / Ecotoxicology; E. Bruns, Bayer AG, Division Bayer CropScience; H. Segner, University of Heidelberg / Centre for Organismal Studies; C. Schaefers, Fraunhofer IME / Ecotoxicology

The discussion about the regulation of endocrine disruptors (EDs) 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 single pulse exposure to an ED might generate - 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 expose different life-stages (group A: 40 eggs, group B: 20 juveniles, group C: 16 adults) to a known ED, Tamoxifen citrate (TC). Observed endpoints include early-life-stage mortality, growth and reproduction of fish originating from group C. 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 to 250 µg/L). Changes in egg morphology were noticed shortly after exposure (group C). Correspondingly, F1 fish originating from group C 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 F1-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 dissipation 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, E. Papa, University of Insubria / 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 bioaccumulation in 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) model is the metric for assessing bioaccumulation potential in air-breathing organisms of approximately 13W. Nichols, U.S. EPA / ORD 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

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Despite the fundamental value of bioaccumulation rate information, relatively few measured in vivo data are available for humans compared to the thousands of chemical property data (e.g., Kow) and bioaccumulation and biomagnification processes, and can lead to overly conservative estimates ("false positives"). Moreover the study highlights the key role of biotransformation in bioaccumulation assessment for air-breathing organisms and highlights the need for reliable data on biotransformation to effectively categorize chemicals for hazard.

666 Sediment-associated cyclic volatile methylsiloxanes: Biotransformation in a freshwater oligochaete and an estuarine polychaete

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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 underestimate 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, biotransformation of these xenobiotics may be able to metabolize organic contaminants (i.e., biotransform), 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 behaviour may add compound uncertainty to predictions of bioaccumulation and trophic transfer.

667 Toxicokinetics and biotransformation products of diuron and 3,4-DCA in the developing zebra fish embryo (Danio rerio)

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Diuron is a commonly used phenylamide herbicide which acts by interrupting the photosynthetic electron transport chain. Like other phenylamide herbicides diuron is bio-transformed to 3,4-dichloroaniline (3,4-DCA) which occurs in plants, the liver of vertebrates and in soil. Fish embryos do not possess the same metabolic potential as adult fish. It was not determined so far if different embryo stages differ regarding toxicokinetics and metabolism. In this study, we investigated the toxicokinetics and 3,4-DCA and diuron metabolites coming from parent compounds or metabolites. We addressed the following questions: What are rates of uptake and elimination of diuron and 3,4-DCA in different zebrafish embryo stages? Is diuron biotransformed by the embryo via which metabolic pathway? Does the embryo’s chorion form a barrier for diuron and 3,4-DCA mitigating the compounds’ toxicities? Information on these aspects is valuable for the understanding of the toxicity of phenylamide herbicides to fish embryos. For determining tissue concentrations after different times of exposure, freshly fertilized zebrafish eggs were exposed to the EC20,0, i.e., for diuron 2.86 mg/L and for 3,4-DCA 1.41 mg/L. Pools of 7 embryos were shock-frozen at 13 time points from 1.5 to 120 hours post fertilization (hpf). The test compounds were extracted from the embryo tissue with MeOH/H2O and quantified using liquid chromatography-mass spectrometry (LC-MSMS). Depuration of test chemicals from the embryo tissue was examined in five different developmental stages of embryos that upon exposure to chemicals were transferred to clean medium and then sampled after 0.5, 1.5, 3.6 and 24 h. The tissue concentrations for diuron reached T50 for embryos, around 48 hpf, T90 for 3,4-DCA was between 8 and 24 hpf. Based on the data for internal concentrations upon different exposure times uptake and elimination rate constants (ka, kdis) were determined. Both elimination rates and residual of initial concentration after 24 hrs. of depuration differed between embryo stages. The search for possible metabolites showed that 3,4-DCA was transformed into 3,4-dichloroacetamide in the embryo and two products of N-demethylation of diuron were found. This confirms that both phase I and phase II metabolic enzyme activities are active from the first hours of embryo development and pinpoint to the biotransformation capability of the zebrafish embryo at this early stage.

668 Application of a generic fish PBTK model for binary mixtures of chemicals

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The integration of mechanistic approaches in Environmental risk assessment requires the integration of processes to move towards estimating internal dose from exposure or environmental concentrations (external dose) to predict toxicity in each taxa or the whole ecosystem. In this context, the overall objective of this work is to develop models to integrate TK data for environmental risk assessment of single and multiple chemicals. Three steps were defined to fulfil this objective: (i) Data collection of biological, physiological, and toxicological variables to calibrate and develop PBTK models, (ii) Development of PBTK models for environmental risk
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 hydrobicity [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.

669 Application of Aqueous and Dietary In-Vivo Bioaccumulation Tests to Determine Biotransformation Rates, Elimination Rates and other Bioaccumulation Metrics

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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.
MO001
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

Diluted bitumen (dilbit) 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 an 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 submerge 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 (ISD-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 effect (ethoxyresorufin-O-deethylase (EROD) enzyme activity); 2. Thyroid hormones levels (sensitive biomarker 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 dilbit spills and remediation strategies planned at Lake #260 at the ISD-ELA. In keywords: oil spill, endocrine disruptors, metamorphosis, Wood frogs

MO002
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 discharge in Nigeria. This study utilized a structured 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 assessment of discharge properties and associated risks like SPME-GC and Microtox. In addition higher tier tools were applied like two way GCxGC, PETROTOX modelling and several levels of plume dispersion assessment. 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 at oil in water levels above 25mg/l there is low concern related to the environmental risk of the hydrocarbons in the PW discharge. Phenols and BTEx 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 chemistries 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.

MO003
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 the difficulty 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 themselves. 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 zebralphi 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 (WAFOIL+D) or without dispersant (WAFOH) at different conditions of temperature and salinity. For WAF produced in marine water, polydimethylsiloxane (PDMS) sheets were incubated in the WAFoIL/WAFoIL+D and then used as passive dosers. Exposure to the dispersant caused 100% of mortality at concentrations ≥50 mg/L. Increased prevalence of malformations was observed at concentrations of 10 µg/L for WAFoIL and WAFoIL+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 WAFoIL and WAFoIL+D produced in different conditions. Although no clear differences were observed in relation with the temperature production of WAFOIL+D, in general greater sublethal effects were observed in embryos exposed to WAFoIL without dispersant compared to WAFoIL. Zebralphi 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 CTM2016-11130-R) and MECED (FPF grant to A.E.), the Basque Government (consolidated research group IT810-13) and the University of the Basque Country (UIF 11/37).

MO004
Behaviour and effects of a marine diesel oil in a semi-static exposure experiment using mussels (Mytilus spp.) from the Baltic Sea
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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 PAHs in water, accumulated in the mussels (Mytilus spp.) exposed to a common type of low-sulphur 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 set up 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 Envirolux HC-500 fluorometer sensor. Another sensor was used to collect auxiliary data on temperature, turbidity and chl a concentration (mussels fed with algae). Biomarkers of oxidative stress, biotransformation, neurotoxicity and bioenergetics were measured from mussels exposed to WAF for one week 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. 30ng/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.

MO005
Biliary PAHs and enzymatic biomarkers in the teleost Eucerogphis brasiliensis along four tropical estuaries in the Brazilian Northeast
J.S. Silva, R.N. Alves, UFPE Universidade Federal de Pernambuco / Zoology;
Human originated contaminants can appear diluted in estuarine and marine waters or accumulate in sediments. Chemical analysis provides key data on toxicant levels but gives limited inputs on their potential biological effects. The combination of biological responses with chemical data is essential to improve the assessment of environmental pollution. In this context, the use of benthic species for the assessment of biological effects of marine pollution is crucial for marine environment monitoring. In the Bay of Biscay, the common flatfish Solea senegalensis is exposed to different levels of pollution. In this study, we aimed to evaluate the potential of Solea senegalensis to bioaccumulate environmental contaminants, particularly bioaccumulation of sulfur and nitrogen containing hydrocarbons (PAHs) and to support development of quantitative bioaccumulation. This study used Solea senegalensis to infer the role of tissue and gut biotransformation in mitigating observed experimental results to model predictions for non-genotoxic effects in fish. Environmental and marine pollution is particularly harmful to estuarine species and can give rise to high levels of bioaccumulation. Environmental pollution is a serious problem that has increased in recent years, leading to an increase in environmental bioaccumulation. Algal blooms, agricultural runoff, and industrial activities are all sources of pollution that contribute to the accumulation of pollutants in the environment. The study of bioaccumulation is important for understanding the ecological effects of pollution and for improving environmental management strategies. This study aimed to evaluate the potential of Solea senegalensis to bioaccumulate environmental contaminants, particularly sulfur and nitrogen containing hydrocarbons (PAHs), and to support the development of quantitative bioaccumulation models. This study used Solea senegalensis to infer the role of tissue and gut biotransformation in mitigating observed experimental results to model predictions for non-genotoxic effects in fish.
Marine Biology and Biotechnology PIEUVHU
Biomarker approach has been widely used in mussel monitoring programs for several years. However, to up knowledge it has not been commonly used in high latitude study areas. In order to establish reference values of cellular and tissue 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 Tromsø (69º 40´N) and Trondheim (63º 26´N) were sampled in early autumn of 2016 and late summer 2017. Different tissue-level biomarkers including cell type composition (VvBAS) in digestive gland epithelium, structural changes of digestive alveoli (MLRT/MET), relative proportion of digestive and connective tissue (CTD) and histopathological alterations in the digestive gland were measured. In addition, lipofuscin and neutral lipid accumulation in the pyloric caeca were determined, as these are risk factors for paralytic shellfish poisoning, neurotoxicities, and algal toxins in mussel tissue. All the results showed that in high latitude environments the selected biomarkers respond similarly in both study areas indicating the suitability of the selected biomarkers in order to be applied in the Northern Atlantic Ocean. Acknowledgements: Work funded by, EU GRACE Project (Grant Agreement Number 679266), Basque Government (IT810-13) and UPV/EHU (UFI 11/37).

M0010

Cytotoxicity of the WAF of naphthenic North Sea crude oil with and without dispersant in hemocytes of the marine mussel Mysis galloprovincialis (L.) G. Nicolussi, University of the Basque Country / CBET 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, 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: D. Bilbao, University of the Basque Country (UPV/EHU) / IBEA Research Group, Department of Zoology and Animal Cell Biology Faculty of Science and Technology; M. P. 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: Oil pollution coming from accidental oil spills and from activities related to oil production is a serious risk to marine ecosystems. The aim of this work was to apply an in vitro approach using hemocytes of the marine mussel Mysis galloprovincialis as a model to evaluate the toxicity of the water accommodated fraction (WAF) of naphthenic North Sea crude oil produced at different temperatures (10, 15 and 20°C) with and without the dispersant Finosal OSR 52. In order to evaluate the contribution of the dispersant on the toxicity of the WAF plus dispersant, the cytotoxicity of the dispersant alone was also tested. Primary cultures of hemocytes were exposed in glass covered microplates to different dilutions of WAF (0.25, 2.5, 25, 50 and 100%) with and without the dispersant and to the dispersant alone at the same concentrations present in the WAF dilutions of oil plus dispersant (1.25, 12.5, 125, 250 and 500 mg/L). After 24 h exposure, cytotoxicity (MTT test) and ROS production were measured. WAF was moderately cytotoxic to mussel hemocytes. WAF produced at different temperatures showed similar cytotoxicity to hemocytes. A slight but significant decrease in cell viability occurred at 25, 50 and 100% WAF (p < 0.05) in comparison to controls (10, 15 and 20°C). These results suggest that relevance of temperature of WAF production on its cytotoxicity is limited. WAF caused a significant induction of ROS production in hemocytes, indicating occurrence of oxidative stress. When tested alone, the dispersant caused a slight but significant decrease in cell viability at the two highest concentrations. However, WAF produced with dispersant at the three different temperatures was not toxic to hemocytes. These results appear to indicate that the dispersant efficiently reduced the toxicity of the crude oil WAF in the selected cell model. Overall, the in vitro toxicity testing approach in mussel hemocytes could be used as a rapid screening tool for environmental risk assessment of oil spills and oil response strategies in the marine environment. *Funded by EU H2020 GRACE project (679266), Spanish MINECO NACE project (CTM2016-81130-R), Basque Government (consolidated research group IT810-13) and UPV/EHU (UFI 11/37).

M0011


Inorganic cation and amine determinations are important to assess salt build-up in wastewater systems and the neutralizing solutions, or to meet regulatory discharge compliance from petroleum and municipal treatment plants wastewater. Additionally, municipal water plants require cation determinations to monitor secondary water characteristics. In the petroleum industry, alkanolamines (monoethanolamine, diethanolamine, and methyldiethanolamine) are used routinely to prevent corrosion during transportation to the refinery or to remove sour gases during the refining process. In the pulp and paper industry, alkylamines and alkylammoniums are used to disperse flocculated particles in the paper mill. In the marine environment, the marine biota (phytoplankton and zooplankton) are exposed to accidental pollution. We also found that although the palm stearin had little effects on marine animals, it was toxic to microalgae species as reflected by growth inhibition. Its toxic mechanisms on the microalgae may be associated with its ability to form micelles, produce ROS and desolvation. Limit of Detections were single digit or double digit µg/L for most analytes. The experiments showed that typically sodium, ammonium, and primary amines were the primary contaminants in the scrubbing amines.

M0012

Distribution and ecological risk assessment of palm stearin in coastal marine environments of Hong Kong after an accidental pollution in Pearl River Estuary, South China G. Zhou, R.W. Lai, R.C. Sham, C. Lam, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; K. Yeung, J.C. Astudillo, The University of Hong Kong / K.K. Ho, The University of Hong Kong / The Swire Institute of Marine Science; K.K. Ho, The University of Hong Kong / M.M. Yung, J.K. Yau, The University of Hong Kong / K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science

On 3 August 2017, two container vessels collided in the Pearl River Estuary, southwest of Hong Kong, leading to release over 1,000 tonnes of palm stearin into adjacent waters. About 200 tonnes of palm stearin reached the adjacent waters of Hong Kong after two days. However, toxicity of palm stearin to marine organisms is unknown. This study, therefore, aimed to examine its contamination levels in seawater, sediment and animal samples collected from seven locations along the south coast of Hong Kong; determine its toxicities to selected marine organisms including microalgae (Isochrysis galbana and Chaetoceros gracilis), the copepod (Tigriopus japonicus), the MSW (mussel soft exoskeleton), and the fish (Oryzias melastigma), and derive interim water quality guidelines (WQG) of the palm stearin and thereby assess its ecological risks to local marine ecosystems. Samples of the palm stearin, surface seawater, sediment and three intertidal gastropods were collected twice (within seven days and four months after the incident) in six locations along the south coast of Hong Kong. Fatty acids in these samples were detected using gas chromatography-mass spectrometry. The intent of this study is to establish the first comprehensive investigation on the ecological risk of the palm stearin in the world, and the results will facilitate informed decision-making by the environmental authority.

M0013

Ecological impacts of larvicidal oil on the marine ecosystem: implications on its management K. Yeung, The University of Hong Kong / K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science

Mosquitoes are some of the most influential insects to mankind in the world due to their ability to transmit diseases to humans, resulting in millions of deaths every year. Prevention of mosquito-borne diseases and elimination of mosquitoes are important to protect human health. Among different methods of eliminating mosquitoes, the use of larvicidal oil is the most common way being employed in Hong Kong. However, larvicidal oil will be eventually released into the marine
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 (saturated and aromatic) amounting to 84.7% of the total concentration. 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 Isochrysis galbana and Chaetoceros gracilis (primary producers), the intertidal copepod Tigriopus japonicas (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. Hence, monitoring and control on the use of larvicidal oil as mosquito control pesticide would be urgently needed to mitigate its ecological risks.

**MO014 Effects of a coastal oil spill on marine invertebrates and their potential to recover**

F.M. Lemos, S. Silva, Instituto Politécnico de Leiria / MARE IPEleiria

There has been an increasing public concern and focus on marine contamination issues mainly due to the arising of emergent pollutants, posing a major threat to human and environment. Subsequently, the contamination by polycyclic aromatic hydrocarbons (PAHs) remains one of the most ubiquitous sources of pollution in the marine environment, being reported to elicit toxic, carcinogenic and mutagenic effects on marine biota. Moreover, the assessment of these impacts in coastal invertebrates after a spill, the extent of these effects and energetic trade-offs, potential recovery, and even which species to use is still deemed for an effective environmental contamination assessment. After an accidental industrial oil spill at the rocky shore of Peniche, Portugal in the summer of 2018, the water was analyzed during the low-tide for PAHs one week later and regularly throughout six months in the spilled beach and in 7 other rocky beaches in the vicinity. Also, at all locations, Patella depressa and Gibbula umbilicalis organisms were collected, and several biomarkers were assessed for both species, such as the neurotoxin x (1) from exposure to acetylencholinesterase, oxidative stress enzyme catalase and superoxide dismutase, oxidative damage DNA damage and lipid peroxidation, energy metabolism lactate and isocitrate dehydrogenase, and electron transfer system, and carbohydrates, lipids and proteins energy reserves were assessed. The impacts of this oil spill over the two coastal invertebrate species’ biomarkers was compared over the differentially PAH contaminated sites and their sensitivity evaluated. Also, organism’s ability to recover over time was also assessed and these tools and species potential for costal monitoring pollution scenarios discussed.

**MO015 Effects of oil exposure on visual function in early life stage fishes**

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The Deepwater Horizon oil spill released millions of barrels of oil into the Gulf of Mexico, coinciding with peak spawning periods of ecologically important fish species, such as the mahi-mahi ( Coryphaena hippurus), red drum (Sciaenops ocellatus), and sheepshead minnow (Cyprinodon variegatus). Downregulation of genes important in eye development and function, as well as morphological abnormalities have resulted from polycyclic aromatic hydrocarbons (PAHs) present in the oil at concentrations less than 10 µg/L, impact visual function. Mahi-mahi, red drum, and sheepshead minnow embryos were exposed to weathered crude oil and assessed for visual function using the flicker-fusion principle to monitor an optomotor response, with subsequent histological analysis taken of each larva's retina. Oil-exposed larvae exhibited a reduced PAH-dependent optomotor response with a reduction in retinal layers and neuronal connections that play an important role in visual function and image processing. The present study provides evidence that weathered crude oil affects the visual system in developing larval fish, and relates oil-induced histological effects to behavioral endpoints. 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).

**MO016 Effects of oil spill on coastal seaweed in the Arctic**

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In case of an acute oil spill response operation, decision making regarding the operational response strategy and prioritizing biology at risk must be resolute. For that a Net Environmental Benefit Analysis, NEBA, is often performed to achieve the optimal environmental benefit with respect to choice of oil spill combat methodology and biology at risk. To provide data for assessing the ecological impacts of oil spills in the Arctic areas, the effects of oil smothering of the macroalgae Fucus distichus, which is a dominant species in the intertidal zone of the coasts in the Arctic, as well as its self-cleaning potential by wash in sea, were studied. Effects of four different oil types were tested, including crude oil types, bunker oil and marine diesel inhibited photosynthetic activity, whereas the three other oil types stimulated the activity. Thus, in general, the results indicated 1) that oil smothering was relatively fast washed in 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 some other species potential for coastal monitoring pollution scenarios discussed.

**MO017 Effects of water accommodated fractions of crude oil on the Baltic Sea blue mussel Mytilus trossulus at different salinities**


In the Baltic Sea accidental oil spills are mainly combated using mechanical recommendations since the chemical dispersants may cause severe toxic effects on marine organisms. In addition, the use of dispersant and oil under brackish water conditions is not well studied. In the present study, impacts of a crude oil and the dispersant Finsol 51 on marine biota were investigated under cold conditions (5°C) at two salinities corresponding to the German (15.0) and southern Finnish coastal areas (5.6). Baltic Sea blue mussels (Mytilus trossulus) were exposed to the water accommodated fraction (WAF) and dispersed WAF (WAF-D) of naphthenic North Sea crude oil in a semi-static aquarium experiment. Concentrations 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 acetylencholinesterase, glutathione-S-transferase, catalase and glutathione reductase activities, lipid peroxidation, and protein carbonylation. In addition, changes in Mytilus-associated bacterial communities extracted 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 C10-C20). A significantly higher oil concentration was observed at the lower salinity WAF-D WAF-D with 44 mg/L oil at 5.6 and 1.82 mg/L oil 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 by determining the ability of oil to concentrate in water and as biological effects observed in the exposed biota. This should be taken into careful consideration when designing oil spill mitigation procedures in the Baltic Sea.

**MO018 Multiple biomarkers on the estuarine guppy Poecilia vivipara to monitor two integrated tropical estuarine ecosystems**

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Integrative approaches using biological responses in multiple organization levels are essential for environmental monitoring of tropical estuarines 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
soil characteristics, the group composition was determined for each borehole of all microlocations, taking into account the lithological profiles. Results of our research showed that in all samples the most represented were polar 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 groundwater, consequently, underground and surface water resources are at risk of contamination. Results of our investigations provided valuable assessment into adequacy and sensitivity of ecotoxicological studies, and validation of regulatory PMW management methodology. The PW is additionally characterised at a substance level, highlighting the risk can be mapped specifically to the installation area providing an overall risk assessment of the discharge. If the result is out of the range of the discharge permit, the application of the RBA is required to comply with the EU’s regulation and the other regulatory requirements. Processing the information generated by the RBA, each PWMP would be specific to the discharged effluent, platform and area, aiming to minimise environmental risk of each PW discharge. The RBA method is a six-step process. The steps are based on a standard method where a Predicted Environmental Concentration (PEC) and a Predicted No Effect Concentration (PNEC) of the PW or individual products are determined, and a PEC/PNEC ratio is calculated. The PEC/PNEC ratio and Environmental Impact Factor (EIF) which describes a PEC/PNEC ratio in a specified volume of water characterises the potential risk imposed to the receiving environment. With use of a decision tree, the Perez et al. (2009) approach was used in the risk assessment of complex petroleum based contaminants. The PWMP must be adopted to comply with the RBA regulatory requirements. Processing the information generated by the RBA, each PWMP would be specific to the discharged effluent, platform and area, aiming to minimise environmental risk of each PW discharge. Previous studies suggested cortisol can be associated with behavioural phenotypes, and that developmental cortisol levels may pre-determine the behavioural phenotypes found in a population of exposed fishes. Complex behaviours are sensitive sublethal endpoints that could be used in the risk assessment of petroleum based mixtures. The inclusion of complex behaviours in toxicological studies brings ecological relevance to a biomarker dominated field.
MO023
Risk-based assessment of produced water discharges - need for alignment
M.G. Snit, 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 produced 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 toxicant studies and modeling, 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 500 m, the other might apply 100 m (USEPA). 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 hydrocarbon (TPH) were analysed from samples collected from 23 stations since 1984 from Kuwait coastal waters. Here it was investigated whether concentrations of these determinates are at levels above Kuwait and internationally established assessment criteria (AC). The results indicate that Cu 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 trend in these metals is significant for Cd and Hg. No determinated 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 Naphthene North Sea crude oil WAF, dispersant and their mixture: sea urchin bioassays
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Maritime traffic and oil platforms in the North and Baltic Sea have been growing due to increased exploration and production activities. 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 toxicant studies and modeling, 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 500 m (OSPAR) another might apply 100 m (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.

MO026
Temporal variability of acute toxicity of Produced Formation Water discharged from offshore platforms: the responses of sea bass (Dicentarchus labrax L., 1758) larvae
L. Mariani, L. Messina, CNR-IRSA / RSA; E. Magaletti, B. Di Lorenzo, F. Onorati, C. Virno, Lamberti, ISPRA Institute for Environmental Protection and Research
The Higher Institute for Environmental Protection and Research (ISPRA) is responsible for the evaluation of the potential environmental impact on marine ecosystem caused by the Produced Formation Water (PFW) 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, rotifers, crustaceans, echnodinera and fishes. The PFW 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 presents the specific toxicic within the whole study: the test, variability of the acute toxicity responses of fish to PFW collected on two off-shore gas platforms in three years (2003-2005). More sensitive life stages (post larvae of 25-45 days old) of European sea bass (Dicentarchus labrax L., 1758) were used. Tests were performed over 24° and 96° of the dilutions. 6.25-12.50-25.00-50.00-100.00 % PFW were used. The LC50™ on post larvae ranged from 17.67 % to 37.42 % PFW. The LC50™ on post larvae ranged from 6.68 % to 16.51 % PFW. The PFW acute toxicity responses showed a temporal variability of PFW as it is highlighted by standard deviation values of LC50 data: exposure 24h (25.61 ± 7.02% PFW); 96h (10.8x4 ± 3.37% PFW).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 W.

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. Idowa, University of Manitoba; J. Stetefeld, University of Manitoba / Chemistry; G. Tomy, Department of Fisheries & Oceans / Department of Chemistry Polyyclic 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), which are important because they have been identified as priority compounds by the United States Environmental Protection Agency. However, there are other important PACs that to date have received less attention. These include halogenated PAHs, non-halogenated alkylated PAHs and heterocyclic aromatic compounds that contain S-, O- and N-atoms. Halogenated PACs especially those containing chlorine atoms are likely to be more environmentally persistent than their non-halonogenated analogues because of the presence of the halogen atoms. In addition, the toxicity of some halogenated PAHs have been found to be similar to dibenzo-p-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 bioaccumalate in biota samples. Here we present a method based on high resolution mass spectrometry coupled to mass spectrometry using specific multiple reaction monitoring (MRM) ion transitions in 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. Preliminary results show that 1-chlorophrene is present in this sample. In addition, we observed multiple peak reports on a marine tissue extract for chloro-anthracene/phenanthrene but we do not have authentic analytical standards to match retention times. Work is ongoing to identify other halogenated compounds present in biological samples from Canada.

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. Pampanin, 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 in collaboration with the Norwegian Continental Shelf (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 study, no contamination by drill cuttings were among the 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.

MO029 Tissue-level biomarkers and histopathological alterations in mussels (Mytilus trossulus) from the Baltic Sea exposed to water accommodated fractions of crude oil

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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 (dispersant Finnos ORS 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_vbas) of the digestive gland epithelium, structural changes of digestive alveoli (mean luminal radius/mean epithelial thickness, MLR/METh), mean epithelial thickness/mean diverticular radius (MET/MDR), connective/diverticular ratio (MET1/MDR1), digestive gland, gonad and gills. V_vbas increased significantly after 1 d in mussels exposed to WAF and WAF-D at the salinity of 15.0, and decreased afterwards. MLR/METh 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 than at 15.0. Pathological responses (atrophy, vacuolization, haemocytic infiltration, granulocytoma) were assessed, being more evident in mussels exposed to WAF and WAF-D (21 d). 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°769296) and a Basque Gov. fellowship to EGU

MO030 Toxicity of diluted bitumen to freshwater fish and invertebrates

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The bitumen may involve serious environmental impacts and chronic toxicity of two blends of diluted bitumens ("dilbit") and weathered dilbit on freshwater fish and invertebrates after exposure to videndiferent concentrations of physically-dispersed (water accommodated fraction; WAF) and chemically-dispersed (chemically-enhanced WAF; CEFWA) 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 (Oncorhyncus mykiss), and two invertebrate species, daphnia (Daphnia magna) and ceriodaphnia (Ceriodaphnia dubia). For fathead minnow, unweathered AWB demonstrated a significantly higher toxicity (LC50-96h h = 0.628 g/L) compared to the weathered AWB (LC50-96h = 2.06 g/L). Chronic toxicity tests showed that fathead minnow lethality was also higher for AWB (LC50-7 d = 0.593 g/L) compared to the weathered AWB (LC50-7d = 1.31 g/L) whereas larval growth loss was lower for AWB (IC52-7d = 0.312 g/L) compared to the weathered dilbit (IC52-7d = 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 = 7.16 g/L). LC50-7d 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 (IC52 < 1.0) than with the weathered CLB (IC52 = 1.99 g/L). Volatile organic compounds (VOC), polyacrylic 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 pol and apolar fractions

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Regulation of produced water (PW) discharges on the Norwegian continental shelf is based on a maximum oil toxicity of 1 ml/L, with cover, limits 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 components that contribute to toxicity. One collection of oil samples originated from four oil platforms on the Norwegian continental shelf. PWs were selected from oil fields of different operational ages, which produce oils exhibiting different physical and chemical properties. Samples were subjected to extraction with dichloromethane, followed by fractionation into apolar and polar fractions using solid phase extraction, recovery 80 % of the GC amenable material in these fractions. The total extracts and fractions were thoroughly characterized using GC–MS, GCxGC–MS, LC–Orbitrap–MS, and by direct infusion FT–ICR–MS. The total PW extract, as well as the apolar and polar fractions were subject to acute 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 analysis). For the polar fractions, the toxicity was mainly attributed to the polar fraction, with LC50 values ranging between 0.17–0.57 mg L–1. Interestingly, toxicity was mainly attributed to the apolar 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 illustrates that PWs are substances that are amenable to GC, with cover, limits of which are currently poorly characterized. Polar fractions may contain compounds not amenable to GC, or that 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 alternative methods of characterization are needed for regulation of PW discharges.

MO032 Toxicokinetics of oil components in Arctic copepods

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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 position of Calanus hyperboreus in the food 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. Calanus 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 samples from CIII and CV at the end of each exposure period were subjected to extraction with dichloromethane, followed by fractionation into apolar and polar fractions, were measured at 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
MO033 Two Dimensional Gas Chromatography for the analysis of polycyclic aromatic compounds and their alkylated homologues in environmental samples

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Polycyclic aromatic compounds (PACs) and their alkylated homologues are ubiquitous and known environmental contaminants. Due to their structural diversity and complexity of alkyl-substituted PACs, the resolution of individual alkyl congeners, 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 elucidation of PACs and PAC alkyl homologues were performed from muscle samples and separate whole fish samples, and the results were compared to sites with medium and low seabird influence. 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, however, 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 polychlorinated diphenyl ethers (PBDEs), and chlordane (CHLs).

No association was observed between contaminant concentrations in CollemboLa and habitat. DNA fragmentation was higher in CollemboLa from sites with high seabird influence, compared to sites with medium and low. No differences in micorucleus 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 micorucleus frequency were associated with both seabird and contaminant exposure and the cumulative effect of these factors may contribute to this difference.

MO034 Using the hagfish (Myxine glutinosa) to study biological effects of a wreck filled with chemical munitions

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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 loaded with CWAs were intentionally sunk and are still laying on the deep bottoms (ca. 600 m) of the areas in different states of deterioration by corrosion. The current status of the CWAs in the whales is unknown; if released into the environment they may have significant deleterious effects on local marine biota. Within the research programme of the EU Baltic Sea Region Interreg project DAIMON (Decision Aid for Marine Munities, www.daimonproject.com), one of these whales was selected to study the leakage of CWAs and their possible biological effects. From the few fish species that inhabit the studied depth range in the region, the hagfish (Myxine glutinosa), a sediment-dwelling chordate, was selected as target organism for chemical analyses of CWAs in tissues and biological effect studies. Samples were taken using bait traps near the wreck and from a reference area known to contain no wrecks. Liver, muscle and brain were used as biomarkers (including lipid peroxidation, protein carbonylation, glutathione-S-transferase, glutathione reductase and catase activity) and for histopathological biomarkers, and muscle tissue was analyzed for acetylcholinesterase activity. Chemical analyses were performed from muscle samples and separate whole fish samples, and the results indicated the presence of oxidized forms of CWA-related phenylarsenic compounds in most of the muscle samples. Established biomarker methods used widely in various fish species were shown here for the first time to be applicable also in hagfish. However, only minor differences in the measured biomarker responses between individuals collected from the wreck and the reference area could be observed. Based on this study, the hagfish is regarded as a suitable candidate for ecotoxicological studies of deep marine areas. More information on the biology of hagfish and the natural variability of their biomarkers is needed to distinguish true effects of hazardous substances.

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

MO035 Seabird-derived contaminants and genotoxicity in CollemboLa from the Arctic

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Seabirds 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 biovectors of contaminants from ocean to land. The tundra near bird cliffs is heavily influenced by nutritious and contaminant-enriched guano and is generally characterised by rich and diverse vegetation. In these areas, springsail (CollemboLa) contribute to a high proportion of soil biomass. In this study, we play a vital role in the decomposition of guano and in mineralisation. 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, however, 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 polychlorinated diphenyl ethers (PBDEs), and chlordane (CHLs).

No association was observed between contaminant concentrations in CollemboLa and habitat. DNA fragmentation was higher in CollemboLa from sites with high seabird influence, compared to sites with medium and low. No differences in micorucleus 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 micorucleus frequency were associated with both seabird and contaminant exposure and the cumulative effect of these factors may contribute to this difference.

MO036 Higher contaminants and poorer condition in an Antarctic avian top predator from 2001 to 2013

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South polar skuas have been 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 skua were sampled during the breeding season of 2013/2014 in Svarthamaren, Dronning Maud Land, Antarctica. Whole blood was analysed for 87 OHCs of which 56 were detected. Stable isotope ratio of carbon (δ13C) and nitrogen (δ15N) 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 contribution of contaminants with lower carbon number. Overall, no association was found between seabird influence and contaminants. However, lack of associations could also be due to influence of migration, wintering habitat and different turnover rates in OHCs and isoprenes. Skuas from 2013/2014 had significantly higher concentrations of most OHCs and a lower body condition than skuas from 2001/2002. δ13C, Mirex and HCB increased with 10.5%, 40% and 60%, respectively, between 2001/2002 and 2013/2014. Ratios of Mirex/ΣPCB 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 (Thalasia antarctica), the main prey

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of south polar skua during the breeding season. Keywords: Antarctic, 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-Florido, Instituto de Ciencias Biológicas de la UNAM; E. Pérez-Alvarez, Universidad Autónoma del Estado de Mexico / Environmental Toxicology; L. Gómez-Oliván, Autonomous University of the State of Mexico / Chemistry; M. Galar-Martínez, Instituto Politécnico Nacional, Escuela Nacional de Ciencias Biológicas; N. San Juan Reyes, Autonomous University of the State of Mexico / Chemistry; O. Dublan-Garcia, Universidad Autónoma del Estado de México / Medicine; M.D. Churruca, J. Hernandez-Narváez, Universidad Autónoma del Estado de Mexico / Toxicology

Hospital effluents are important from the ecotoxicological point of view and are an important source of polluters 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 15 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 (Estado de Mexico) in this species and compare with Xenopus laevis, a species that is used as a preferred biomonitor, using the frog embryo teratogenesis assay: Xenopus (FETAX). For this purpose oocytes in mid-blasta 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 lethal concentrations and teratogenic indexes indicated that the hospital effluent 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.

MO038 Monitoring fish health in a densely populated catchment in Central Germany M. Schweizer, University of Tuebingen / Animal Physiological Ecology; A. Dieterich, S. Betz, Eberhard Karls Universitat Tübingen / Animal Physiological Ecology; N. Corral Morillas, Eberhard Karls Universitat Tübingen; C. Dewald, Eberhard Karls Universitat Tübingen / Animal Physiological Ecology; D. Leim, Eberhard Karls Universitat Tübingen; L. Miksch, S. Nelson, V. Prozmann, J. Rudi, Horloff, Eberhard Karls Universitat Tübingen / Animal Physiological Ecology; R. Triebkom, University of Tuebingen / Animal Physiological Ecology; H. Köhler, University of Tuebingen / Animal Physiological Ecology

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 discharges. To get a broad overview of the situation fish face 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), G6PD activity (glucose-6-phosphate dehydrogenase, which is responsible for transforming the neurotransmitter acetylcholine into choline and acetate. A decreased level of cholinesterase (ChE) activity in the animal tissue is a strongly indicative sign that some type of exposure to an inhibitory agent of this enzyme has occurred. Our objectives were to document ChE levels in house sparrows in response to their exposure to an OP product used in agriculture and determine the extent of their negative effects on birds. In the University Campus (UJED, Durango, Mexico), we collected 19 house sparrows and serum ChE activity was determined by spectrophotometry before and after the consumption of food treated with malathion. The results show a ChE inhibition (11.58 %) after treatment (p = 0.03), also we observed nonsignificant
relationships (Pearson, R2=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 sparrows 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 Modelling; T. Preuss, Bayer Ag / Environmental Safety; M. Ebeling, 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 first 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 to be between the non-toxic and the lower toxic levels, which suggests that less adverse effects could be expected under realistic worst-case field conditions.

MO043 Biomonitoring and validation of non-invasive samples for the analysis of metals in freshwater turtles
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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 (e.g. Valle de Alcudia-Sierra Madrona district for Pb, Almadén district for Hg) in Central Spain were analysed. 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 concentration of metal in the carapace scales and the blood level of the same metal. The feeding habits of freshwater turtles is considered very vulnerable to salinity changes. In this context, the present study aimed at evaluating the ecotoxicological risk of Bti for amphibian populations, especially in areas of high salinity or with high exposure levels to metal contamination.

MO045 European common frog (Rana temporaria) larvae show sub-cellular responses under field-relevant Bacillus thuringiensis var. israelensis (Bi) 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 (Bi) 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 of 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
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Worldwide coastal low-lying ecosystems are experiencing an increased salinity due to climate change and sea level rise. Coastal wetlands are considered very vulnerable to salinity changes. 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 number 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 26°C. The following parameters were monitored at the end of the test: 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 influence in the temperature was not observed. Adverse effects were observed at the lowest tested salinity levels, which suggest that these species are highly vulnerable to small salinity increases and would be at high risk under seawater intrusion scenarios. Keywords: Salinity; toxicity; amphibia

MO047 EFFECTS OF THE EXPOSURE OF LARVAS OF Dendroplus cusubianus (ANURA: HILDIAE) TO WATERS CONTAMINATED BY ANTHROPOGENIC ACTIVITIES IN A RIVER BASIN OF THE COLOMBIAN ANDES

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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 to their basic life cycle, which has made them ideal models in aquatic ecotoxicology. The objectives of this work were: 1) to determine if tadpoles of D. colombiana 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 AMPHTOX 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), 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 registered times of metamorphosis, show a time of this process that approximates to the time that the species experimented in the control (134 days) and probably, to the time of this in situ.

MO048 Risks for amphibians and reptiles by dermal exposure to pesticides

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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 water bodies only to lay their eggs. Some amphibians and reptiles migrate long distances through fields and some reside in fields and plant margins where they can be exposed to pesticide residues in food items, water, soil and plant surfaces. A number of studies indicate that pesticide exposure can lead to severe impacts with up to 100% mortality from overspray at field rates for some pesticides. Dermal exposure was identified as an important exposure route in the EFSA opinion. The aim of the current study was to investigate different options to address the risk from dermal exposure by overspray and contact to soil and plant surfaces. Existing exposure models were reviewed with regard to their suitability for amphibian and reptilian risk assessment. This included comparison of parameters used in model calculations, comparison of sensitivity to dermal exposure and worst case exposure calculated to estimate the dermal risk for amphibians and reptiles. Greatest dermal exposure from overspray and to compare it with exposure from contact to soil and plant surfaces. In addition a novel approach was developed to estimate the uptake from soil and plant surfaces. Mammalian dermal toxicity related to local effects and dermal adorption data may be used as surrogates for reptiles but not for amphibians. The development of a test method investigating local effects on amphibian skin, as well as the establishment of a validated exposure assessment of body burden following exposure via the dermal route is needed. Comparison of body burden by overspray to body burden by exposure to treated soil or foliage showed that the maximal body burden by overspray was lower than the maximal body burden by passive or active dermal exposure from soil or by contact to foliage. An approach was suggested which can combine oral and all dermal exposure routes in one overall body burden which could form the basis for a realistic risk assessment.

MO049 Evaluating the Role of Fish as Surrogates for Amphibians in Ecological Risk Assessment

S. Glaberman, University of South Alabama / Biology; J. Kiwiet, University of South Alabama; C. Aubee, US Environmental Protection Agency / Risk Assessment Division Office of Pollution Prevention and Toxics

Ecological risk of chemical exposure to aquatic-phenile amphibians is historically evaluated using surrogate toxicity data from standard fish species. Recently published meta-analyses indicate that amphibian ecotoxicology testing and correlations both groups are similarly sensitive to a range of chemicals. However, these analyses are limited because the amphibian data reported in the peer-reviewed literature are variable both with respect to experimental design and test species. In 2010, the U.S. Environmental Protection Agency began receiving ecotoxicity data for a standard amphibian test species (Xenopus laevis) as part of the Endocrine Disruptor Screening Program. As part of this effort, we aimed to inform a determination of potential thyroid interaction within the context of other endocrine screening studies, they also contain valuable data on survival and growth that can be compared to existing fish data for a given chemical. We used this dataset to compare no observed adverse effect concentration (NOAEC) values for survival, body weight, and length data between fish and amphibians for 45 different pesticide active ingredients. Overall, the results indicate that fish are a reasonably good predictor of amphibian toxicity as there were no statistically significant differences in NOAEC values between the two groups for the endpoints examined. However, toxicity endpoints were lower in amphibians as compared to fish approximately half the time across chemicals, challenging the notion that fish are consistently more sensitive than amphibians. Disclaimer: The views expressed in this presentation do not necessarily represent the views of the U.S. EPA or the United States.

MO050 Long-term survival of mancozeb exposed common vole populations from one to the following reproductive season in Germany

F. Von Blankenheug, J.L. Ehlers, Rifcon GmbH

Rodent field effect studies relevant for pesticide risk assessment typically take place during crop development from spring to autumn and thus within a single reproductive season. However, animal survival covering multiple reproductive seasons has only rarely been considered. This includes also microtine rodents such as the common vole (Microtus arvalis), as they are considered as rather short-lived vertebrates. However, overwintering individuals are important for the survival of 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 effect 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 next reproductive cycle. Reproductive parameters recorded as indicators of potential long-term effects from exposure, were body and reproductive measures 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, Uppsala universitet, Dept. of Environmental Toxicology / Dept of Environmental Toxicology; M. Ortiz Santalices, Instituto de Game and Wildlife Research (IREE) / UCLM-CSIC-JCCM; S. Peiper, German Federal Environment Agency (UBA) / Plant Protection Products; S. 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 (EFSA 2017). A central task of the EFSA working group was to understand how well important life stages, exposure routes and endpoints are covered by existing standard test guidelines for 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 next reproductive cycle. Reproductive parameters recorded as indicators of potential long-term effects from exposure, were body and reproductive measures 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.
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 current 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 authorization.

**MO052 Amphimove: Moving patterns and microhabitat selection of European anurans in agricultural landscapes**


The current decline of amphibian populations on global and local scales is discussed across the entire 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. Species in terms of physiology (e.g., permeable skin) and ecology (e.g., aquatic or terrestrial life-stages in different environments) make this task in particular to 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 Amphimove is to fill the gap on terrestrial life-stages risks 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**

J.A. Doering, J. Sadowski, J. Schröder, J. Sadowski, University of Coimbra; M. Ortiz Santallietra, Institute for Game and Wildlife Research (ICRE) UCLM-CSIC-JCCM; M. Paérez, J. Sadowski, ICRE-UCLM / Instituto de Game y Zootecnia, Universidad de Castilla La Mancha; J. Martinez-Haro, Instituto de Game and Wildlife Research (ICRE) UCLM-CSIC-JCCM; R. Ribeiro, Universidade de Coimbra / Life Sciences; R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre; I. 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, 768.2-3130.5 vs 0.11 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. 63.9-136.6 p <0.01), suggesting that MT 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 mg/g, from Pb site 118-491.6 mg/g; Pb-exposed: from reference site 369.79-5476.00 mg/g from Pb site 9043.5-76852.4 mg/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 under conditions of moderate stress were significantly lower than in the laboratory (105.99-138.66 vs 29.72-41.70 µg/g; p<0.05). This could be a 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 Príncipe**

I.P. Morão, S.C. Novaes, Polytechnic Institute of Lisbon / MARE IPLeiria; I. Vieira, A.M. Teixeira, National Research Institute for Conservation and Biodiversity (INPRE) / Wildlife Research (IREC); A. Coelho, Universidade de Trás-os-Montes e Alto Douro / Department of Environmental Chemistry; J. Moraes, CSIC / Department of Environmental Chemistry; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria

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 they respond to metal stressors. The aim of this project was to assess the metal concentration 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 RNAlater 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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**MO054 Do historically metal-exposed amphibian populations acquire resistance to lethal levels?**

F. Asola, University of Coimbra; M. Ortiz Santallietra, Institute for Game and Wildlife Research (ICRE) UCLM-CSIC-JCCM; J. Paérez, J. Sadowski, ICRE-UCLM / Instituto de Game y Zootecnia, Universidad de Castilla La Mancha; J. Martinez-Haro, Instituto de Game and Wildlife Research (ICRE) UCLM-CSIC-JCCM; R. Ribeiro, Universidade de Coimbra / Life Sciences; R. Mateo, IREC-CSIC- UCLM / Grupo de Toxicología de Fauna Silvestre; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

The aims of this study were to determine oxidative stress and metal burden in anuran tadpoles from historically metal exposed populations (Hg/Pb), and 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 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, 768.2-3130.5 vs 0.11 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. 63.9-136.6 p <0.01), suggesting that MT 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 mg/g, from Pb site 118-491.6 mg/g; Pb-exposed: from reference site 369.79-5476.00 mg/g from Pb site 9043.5-76852.4 mg/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 under conditions of moderate stress were significantly lower than in the laboratory (105.99-138.66 vs 29.72-41.70 µg/g; p<0.05). This could be a 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.
eggs are not exposed to environmental risk. This study represents the first attempt to address pollutant levels and the biological impairments of such stressors in these turtle species nesting in S. Tomé and Príncipe, 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
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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 cannot 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 contents 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, and lead were found in the crocodile eggs. Eggs from the critically endangered Leatherback Turtle in Africa are also analysed 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. Andreea, EFSA - European Food Safety Authority / Pesticides
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 risk 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 cover the consumers consumption risk assessment as (to derive such DT50 values) 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 specific 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 raligoat 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 Pelophylax perezi populations - Could historical exposure drive species distributions?
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. Pelophylax perezi is distributed along all coastal territory in Portugal, where there are some populations historically exposed to salinity 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. perezi originated from reference and salinized natural populations. Embryos ( Gosner stage 8-10) were exposed for 96h, and to what concerns to the input of pollution 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 hatchling, 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 mMCl- for seawater and NaCl, respectively). As well, for the sub-lethally exposed end point (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
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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, particularly in terms of 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 hatchling, 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 mMCl- for seawater and NaCl, respectively). As well, for the sub-lethally exposed end point (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.

MO060 Estricogic effects of an Organophosphorous Flame Retardant (TCPP) on Edible Sea Urchin “Paracentrotus lividus”
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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 disruptors, 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 housed in 2 gelatin capsules with formaldehyde and TCP (1 and 10 mg/l) were evaluated. TCP exposed (1 and 10 mg/l), were maintained in controlled conditions and analyzed at 7 and 28 days. TCP exposure did not cause histological damages in the gonads, and the bioaccumulation in the tissues was moderate (mean BCF=28 L/Kg WW.). However, the results of the GI in this study, support the idea of an endocrine disruption action of TCP in females exposed to the compound, thus the compound could be catalogued as estrogenic for this marine biological model. Keywords: Edible Sea Urchin, Organophosphorous flame retardant, endocrine disruptor.

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. Antidepressants, like fluoxetine, are frequently 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, DNA damage). 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

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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 coerulealba) were used to investigate levels of polychlorinated dibenzo-p-dioxins and furans (PCDD/Fs), dioxin-like polychlorinated biphenyls (DL PCBs) and polybrominated diphenyl ethers (PBDEs) using a gas chromatograph 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 (l.w.) (range: 474-3840 ng/g l.w.), with males showing statistically higher values than females (A. Bartalini et al.). Adverse health effects can be attributed for over 93.3% of total TEQs. Mono-ortho PCB congeners represented on average 99.9% of total DL PCBs, but their TEQ contribution was similar to non-ortho PBDEs. PCB118 was the most abundant compound (236-1970 ng/g l.w.) and gave the highest contribution to the total TEQs (30.5%), followed by PCB126 (29.4%). The predominant non-ortho PCB congener was PCB177, suggesting a higher exposure than elimination rate. Median level of PCDD/Fs was 23.9 pg/g l.w. (14.0-35.0 pg/g l.w.). In contrast to what has been previously reported, the most abundant congeners were 123478-HxCDF (0.85-10.6 pg/g l.w.) and 2378-TCDF (1.69-4.95 pg/g l.w.), while 2378-PCDD and 23478-PCDF provided the highest contribution to TEQs. Total TEQ values ranged from 54.0 to 94.6 pg/g l.w. in females and from 99.0 to 250 pg/g l.w. in males, exceeding the TEQ threshold value associated with adverse health effects. The median value was 456 ng/g l.w. (219-1660 ng/g l.w.), with statistically significant differences between males and females (Mann–Whitney U test p=0.0472). These levels rivel and even surpass those reported in other marine mammals in the same area. TetraBDEs were the most abundant congeners, with BDE47 ranging from 39 to 560 ng/g l.w. These results confirmed how the Mediterranean subpopulation of striped dolphin is currently subject to a major threat of environmental pollution. To date, few studies have focused on the evaluation of TEQ values and PBDE levels on this subpopulation. Toxicological and risk assessment studies on this species, recognized as an ocean health sentinel at a sub-basin scale, may provide an early indication of potential adverse health effects.

MO063

Assessment of POPs in stranded sperm whales (Physeter macrocephalus) from the Mediterranean Sea

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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 assessed POPs in blubber samples from stranded sperm whales from 2009 to 2016. Fresh samples were spiked with a suit of PCDD/Fs, PCBs, and PBDEs 13C-labeled 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>PBDEs>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 were in the same order of magnitude that those reported for 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 that those reported for sperm whales from the Sea of Cortez and from Australia. Regarding PBDEs levels, our results were lower that those reported for sperm whales from North Atlantic. The PCDF congener profile (hexa>penta>octa>nona>hepta>octa) was relatively similar to those reported for sperm whales from Australia and to those reported in blubber of striped dolphin (Stenella coerulealba) from the Mediterranean Sea. In contrast, the PCDD congener profile (hexa>penta>hepta>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 l.w. and surpassed the level’s threshold of 210 ng/g l.w. in biomass in the Atlantic Ocean 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 genephyras) from southern Brazil

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Vomeration (self-induced regurgitation) is considered to be an exposure 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 genephyras from two estuarine systems of southern Brazil impacted by agricultural and industrial runoff: Laguna do Seringal System (LES) and Patos Lagoon Estuarine (PLE) (n=10). Antioxidant enzymes and mRNA transcript levels of genes related to xenobiotic detoxification (Ahr, Arnt, Cyp1A1, Gst, Mt2), antioxidant defense (Gst-γ, Gpx4, Gr) and immune response (Il-1, Mhc-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, ZDDTs, Mirex, Chlorodanes (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 ΣPCBs. Overall, results indicate that the skin of bottlenose dolphins is altered due to exposure to ΣPCBs and PBDEs, which co-occurred 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 influence might also have been overshadowed by the effects sampling season. Nonetheless, results indicate a sufficiently high exposure to PCBs and PBDEs. The present study investigated a battery of stress indices in blood and liver of Eleonora’s falcon (Falco eleonorae Géne, 1839), a colonial breeding raptor of the Mediterranean that overwinters in SE Africa, mainly in Madagascar. In particular, cholinesterase (ChE), acetylcholinesterase (AChE) and butyrylcholinesterase (BChE) activity, as well as cellular abnormalities (MN assay) were measured in blood samples collected from wild individuals, captured on the island of Antikythira (Greece), in May (N =13) and September (N =19). 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 - 11.34±0.829 nmol mL-1 min-1 in May and 1.444±0.079 - 9.31±0.618 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 cytoplasmic 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 found to be generally relevant to the local bird population. Contents of metals in liver of Eleonora’s falcons were not at risk for adverse effects due to OC pesticides, PCBs, PBDEs, and Hg. Surprisingly, all the contaminants were present at low concentrations and below those that could be associated with adverse effects; however, altered structure, composition and function, were detected in the livers and kidneys of most samples. A novel coccidian Eimeria sp. was also detected in the kidneys of several cormorants. Our results suggest that aquatic birds using the Trinity River watershed and contaminated areas are not at risk for adverse effects due to OC pesticides, PCBs, PBDEs, and Hg. These results should be useful to wildlife managers regarding concerns over contaminant impacts of the Trinity River on wildlife.

MO067

Teaching the effects of a neonicotinoid insecticide on songbird migration

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Recent decades have seen a dramatic increase in the application of neonicotinoid insecticides, which are now the most widely used class of insecticides in the world. Migratory seed-eating birds that use agricultural landscapes for refueling may be particularly susceptible to the neurotoxic effects of neonicotinoids. Effects on refueling or orientation behavior could have significant fitness consequences; however, the influence of neonicotinoids on migratory ability is poorly understood. We used white-crowned sparrows (Zonotrichia leucophrys) during spring migration to assess the direct effects of imidacloprid on the migratory behavior of seed-eating passerines. In a previous captive study, we found birds exposed to field relevant concentrations of imidacloprid experienced significant mass loss and stopped orienting correctly in behavioural trials, whereas control birds maintained body mass and a seasonally appropriate northward orientation. To corroborate results from captive trials on free living birds, we conducted a study on radiotagged white-crowned sparrows following a single oral dose of imidacloprid. Birds were caught in Ontario, Canada during spring migratory stopover and exposed to imidacloprid via gavage to a concentration of 2.0 mg/seed (n = 10 birds) or either 1.2 mg/kg bw or 3.9 mg/kg bw (n = 12 birds/treatment). Birds were held for approximately 6 hours, and their body mass and food intake were monitored. Individuals were then tagged with uniquely coded transmitters and released into into a MOTUS array of automated telemetry towers in Southern Ontario, Canada to track their movements on a landscape scale. We found that high dose birds significantly reduced food consumption, and imidacloprid exposed groups lost a significant amount of body mass relative to controls within 6 hours of dosing. Using automated telemetry data, we found that birds with the longest stopover durations were in the imidacloprid treated groups. Further analysis of the telemetry data is being used to determine effects on speed of travel and direction of migratory movements across a large water barrier.

MO069

A synthesis of the interactions between anticoagulant rodenticides and wildlife

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Anticoagulant rodenticides (ARs) are the mainstay of rodent control throughout the world. Regulatory risk assessments indicate ARs pose a significant risk to non-target wildlife but AR use remains widely authorised because the benefits (particularly to human health) are deemed to outweigh the environmental risks. Recently, an authoritative reference text, prepared by 24 international scientists, reviewed the main issues related to ARs and wildlife, specifically: AR use, regulation, exposure pathways, toxicity, mechanism of action, pathology, pharmacokinetics, genetic resistance, non-target risk and its mitigation, alternatives
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 behaviour processes; >50% of predatory species contain AR residues; AR residues in non-target species exposed to a high density 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 drinking, agriculture and grazing may cause reduced non-target species population declines, but there is no clear evidence for secondary AR exposure causing population declines. Alternatives to ARs (e.g., bromethalin, cholecalciferol, zinc phosphate) also pose a significant risk to non-target wildlife, livestock, companion animals and people. There are a number of key information needs to better understand the environmental risk from ARs. These are: improved understanding of ARs through impacts and risks 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.

MO707 Environmental determinants of the exposure to anticoagulant rodenticides in non-target species


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 2017 (in the region of Murcia, Spain). The sampling included 361 1st year (11 reptile, 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 livestock density and types and surface of crops. SGARs residues were detected in 63 (34%) of the analysed animals. Ten species (corresponding 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%), stone martens (23%), 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 Uncommon urban land area (Urban ecological condition) A covariate, University of Jerez, University of Alcalá, University of Murcia, and Municipal Council of Jerez de la Frontera (Spain) was found to be the best predictor 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 develop agricultural and mixed farming systems that fit with the aesthetics of the attractive ecosystem in the urban areas or around farms, which can actually constitute an ecological trap for them.
The potential of feathers as a biomonitoring tool for fluoxetine in wild birds

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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. Fecal 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 avian 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/MS for fluoxetine and a major metabolite, 4-hydroxy-fluoxetine. Preliminary results indicate that fluoxetine is detectable in the feathers and will present information on the concentrations present and whether they are correlated with levels in other tissues such as liver and brain. We discuss the extent to which feathers have potential as tools for monitoring the occurrence and severity of exposure to fluoxetine in wild birds.

Field-effect studies as a suitable method to assess effects of plant protection products on free-living common voles (Microtus arvalis): A case study with the fungicide iprodione

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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 presented study, it was examined if there were any long-term effects from repeated foliar spray applications of the fungicide iprodione on populations of the common vole, Microtus arvalis. The field-effect study was conducted in Germany during the main reproductive period of the common vole on 14 commercially used grassland fields. Regular live-trapping sessions which followed a capture-mark-recapture design were conducted from June to November 2014 on treated and untreated (control) grassland fields, as well as in adjacent habitat. Survival of animals, reproduction rates and body weight, reproductive performance, and survival rates were determined and analyzed using linear mixed models. Results of the study will be presented in detail in the poster. The results support the fact that field-effect studies, which investigate effects under real use conditions and are included as higher tier refinement option in the EFSA Bird and Mammal Guidance Document (EFSA, 2009), are a useful tool for the higher tier risk assessment, even though no internationally agreed standard protocol for mammal field-effect studies is existing yet.

Monitoring NSAIDs in carrion and avian scavengers form Spain: preliminary results after diclofenac registration for veterinary use

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The serious impact of diclofenac on Asian vultures raised the alarm of the deficient environmental risk assessment of some veterinary drugs. In the case of diclofenac, there was an evident gap in the knowledge of the high toxicity that this non-steroidal anti-inflammatory drug (NSAID) has in Old-World vultures that can feed on treated livestock (LD₅₀ in Gyps bengalensis of 98-225 μg/kg body mass). Diclofenac scavengers (vultures and vulture-like scavengers) are the only avian groups of interest in Asia, in 2013 this drug was authorized for use in veterinary medicine in Spain and other countries in the European Union with the consequent risk of repeating the situation generated in Asia. In this work, we have studied the presence of NSAIDs in carrion animals (kidney, liver and muscle of pig, n=125) supplied in “muladares” to feed vultures. We have also studied the presence of NSAIDs residues in tissues of avian scavengers (Sturnus vulgaris; n=27) found dead with suspicion of being intoxicated. NSAIDs were detected in tissues of four pigs (3.2%). Low levels of flunixin were detected in liver (4.1 ng/g) and kidney (7.9 ng/g) of two pigs; meloxicam was detected in the liver of one pig (23.8 ng/g) and diclofenac was detected in the muscle of another pig (170.5 ng/g). This level of diclofenac was relatively high, but kidney and liver of the same animal were negative for diclofenac presence. An examination of this muscle sample showed a pale area adjacent to a congestive portion that may correspond to the injection point of the diclofenac in the pig. Flunixin was the only NSAID detected in the studied avian scavengers. Two out of 22 Eurasian griffons (Gyps fulvus) analysed had 530 and 23 ng/g of flunixin in liver. Another cinereous vulture (Aegypius monachus) had 2.83 μg/g of flunixin in liver, but it was diagnosed as an atrogeneric poisoning at the wildlife rehabilitation center. Lesions in the kidney and visceral gout have not been observed macroscopically or microscopically in 15 Eurasian griffons analysed. Residue levels in carrion and scavengers indicate a limited risk of poisoning, possibly because treated livestock died several hours after NSAID injection. However, veterinary use of NSAIDs can still be a threat for scavengers if veterinarians and farmers ignore the associated risk when treated livestock is used to feed vultures.

Different approaches comparison for evaluation of hypopharyngeal glands (HPG) potential as bioindicators


Honeybees (Apis mellifera L.) are beneficial arthropods that play important roles in natural pollination and 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 EFSA guidelines (EFSA 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 head (linear and quantitative measurements, imaging); - 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 both 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.

Bird and mammal focal species for pesticide risk assessment in rice

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Ecotoxicological risk assessment for birds and mammals is required for the registration of pesticides in Europe to assess potential risks to wildlife through contaminated diet items. To ensure a realistic and reliable risk assessment, bird and mammal focal species should be used that are representative for the species actually occurring in the crop of concern. However, in the relevant guidance document on bird and mammal risk assessment by the European Food Safety Authority (EFSA), rice is to be pooled with other cereals such as wheat and barley, despite the obvious peculiarity of rice cultivation. The generic focal species considered for rice are thus those known from the dry environments of cereal fields. To address this issue, we conducted a comprehensive literature review on bird and mammal species regularly occurring in rice paddies at the relevant time periods of potential pesticide exposure to identify appropriate focal species candidates for risk assessment. Our results show that the relevant species occurring in the wet environments of rice paddies indeed clearly differ from the focal species suggested for risk assessment for wildlife in cereals and thus provide a baseline for more realistic and rice-specific risk assessments for birds and mammals.

MO073

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MO078
Non-invasive assessment by feathers of lead exposure and its relationship with stress hormones in bearded vultures from the Alps

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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 the reintroduction projects and one of the causes is lead poisoning. This study evaluates the use of feathers as a bioindicator for monitoring lead exposure in bearded vultures, which can be an alternative to the traditional blood sampling method. The study suggests that feathers can be a useful tool for monitoring lead exposure in the Alps and provides valuable information for future reintroduction projects.

MO081
Assessment of exposure and effects of Hg levels in feathers of White-tailed eagles (Haliaeetus albicilla) and Northern goshawks (Accipiter gentilis) nestlings from Norway

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Anthropogenic activities have led to a global increase of Mercury (Hg) in the environment. Due to its bioaccumulative and biomagnifying properties, Hg can be harmful to birds and other organisms at higher trophic levels. This study aims to assess the exposure to Hg and its effects at the biochemical/physiological level in White-tailed eagles (Haliaeetus albicilla) and Northern goshawks (Accipiter gentilis) nestlings from Norway. Samples were obtained from nestling WTE and Northern goshawks (NG) in 2014, 2015, and 2016. A total of 14 polychlorinated biphenyls (PCBs), 7 organochlorinated pesticides (OCPs), 5 polybrominated diphenyl ethers (PBDEs) and 8 PFASs were quantified in over 50% of the plasma samples at each location and year. Our results show higher Hg concentrations in Beigren (median and range: ΣPCBs: 5.1 ng/ml (1.5–59.1 ng/ml), ΣOCPs: 4.2 ng/ml (1.3–52.2 ng/ml), ΣPBDEs: 0.3 (0.1–2.6 ng/ml) and ΣPFASs: 20.8 ng/ml (7.2–52.9 ng/ml)), than Smøla (median and range: ΣPCBs: 3.9 ng/ml (0.8–34.7 ng/ml), ΣOCPs: 2.4 ng/ml (0.9–15.5 ng/ml), ΣPBDEs: 0.2 (1.1–1.5 ng/ml) and ΣPFASs: 4.6 (4.6–46.7 ng/ml)). The analyses of thyroid hormones have been carried out and the results will be presented at the conference with biological parameters and OHCs.
Patuxent Wildlife Research Center

Highly brominated flame retardants are being replaced by alternative flame retardants such as Tetra bromobisphenol 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, textile, 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 US. Environmental Protection Agency (EPA). 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 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 hatchings 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
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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, many of the studies on the effects of contaminants, lead to expect that a change in the concentration of one component has effects on offspring traits that depend on 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 savii, Nyctalus leisleri, Pipistrellus pipistrellus, Pipistrellus pygmaeus). Concerning the metal concentration obtained in each sampling tissue, significant differences were found between the concentrations obtained in each species for all the metals (Ps < 0.05), except for Zn (Ps > 0.223). Significant differences were also found between the non-lethal and lethal samples. Metal concentrations in organs and metals (Ps < 0.001). Depending on the metal, the organ/tissue that showed the highest concentrations varied, but even so fur and wing presented the highest concentrations of most of the metals. These results support the hypothesis that non-lethal samples may be useful for studies on wildlife ecotoxicology, and may help to define a protocol capable of being applied at large-scale, to investigate the risk of metal accumulation for bats. For this purpose, non-lethal samples are the best option, and as demonstrated by this study can yield reliable results. Our results therefore provide valuable insights for development of further studies, aiming to understand the importance of metals as a cause for some of the observed declines in bat populations worldwide.

MO084 Metallic element composition of egg contents and eggshells of the Kelp Gull

Larus dominicanus
J.D. van Asswegen, North West University (Potchefstroom Campus) / Unit for Environmental Science and Management; L. Nel, N. Strydorn, 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, Ti, 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 Ti it was 0.00017 and 0.00022 mg/kg dm, for U it was 0.00057 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 Ti (p = 0.0013) concentrations showed significant positive regressions 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
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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 relict 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. Metal concentrations (Cr, Cadmium (Cd), Cobalt (Co), Copper (Cu), Lead (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 on dry weight basis) compared to other samples. Egg shells from marine environments (Corsica and Balearics) 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 osprey 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. Polaroni, 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 components that have both independent and combined effects on offspring phenotype. Functional interactions between egg components, such as antioxidants and contaminants, lead to expect that a change in the concentration of one component has effects on offspring traits that depend on the concentration of other interacting components. 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 nonreactive 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 largely unknown. In the present study we investigated the effects of vitamin E 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 ng/g yolk of BDE-47 both independently and in combination. We tested 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. LIEGAY, University of Bordeaux / UMR EPOC CNRS 5805; B. ETCHEDVRIER, 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 (Bordeaux - FRANCE) with up to 15,000 individuals. Freshwater pearl mussels are 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 eco-toxicological 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 lifestyle 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 Efate Modelling; M. Foudoulakis, 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 refinement and population modelling help to reduce uncertainty by providing additional insight 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. Jollet, University of Michigan; L. Huang, University of Michigan / Dept of Environmental Health Sciences; P. Fantke, Technical University of Denmark / Quantitative Sustainability Assessment Division

Direct exposure of consumers to chemical ingredients within our daily products is an important pathway to chemical intake do field (via a consistent framework and directly applicable tool to determine factors based on scientific consensus for assessing life cycle exposure and toxicity impacts of chemicals in LCIA, as an input to the LCIA guidance efforts of the Life Cycle Initiative.

MO091 Towards the integration of an Agent-based Model into LCA framework to assess dynamic indoor air quality A. Micoller, University of Bordeaux / The Life Cycle Group CyVi; P. Loubet, University of Bordeaux / ISM CyVi; F. Tailleard, University of Bordeaux / I2M GCE; G. Sonnemann, University of Bordeaux / ISM CyVi

The construction sector, representing 44% of the total final energy consumption in Europe, is recognized as a major hotspot of resource use and environmental impacts. Thus, strong efforts are made to encourage the design of environmentally friendly buildings. However, the airtightness of low energy buildings has created particularly confined and polluted indoors. Indoor pollution has been raised as a major public health issue since we spend on average 80% of our time in indoor spaces. Designing sustainable buildings with good indoor air quality is even more challenging since this latter is strongly influenced by occupant’s lifestyle and behavior. Life-cycle assessment (LCA) is a relevant methodology to account for impacts from indoor air while avoiding potential burden shifting from the life cycle of energy or materials used. Nevertheless, the current use of LCA faces scientific obstacles such as: (a) the inclusion of the dynamical effects of indoor pollution on human health and (b) the consideration of the behavior of the occupants. In order to address these concerns, a model of autonomous agent has been developed structured around (i) an agent-based model Li-BIM (Live in BIM) which explicitly represents human behavior, (ii) a physical model to capture the building thermal behavior, (iii) the numerical representation of the building (BIM) and (iv) an innovative indoor air quality model Be-BIM (Breathe in BIM). Li-BIM is an operational model which simulates the behavior of the occupants based on an evolved occupational cognitive and social framework. Be-BIM is currently being developed as a dynamic and localized fate model sensitive to users’ behavior and the built environment dynamic of a house, within BIM. Therefore, Be-BIM will (i) generate the inventory data for dynamic pollutant emissions and (ii) assess the local impacts from air emissions. Expected outcomes of our integrated model include characterization factors for human toxicity due to indoor air which are dynamic and spatially differentiated at the scale of the building. Eventually, our model will allow the comparison of life cycle impacts of different building scenarios with a specific focus on indoor air quality suited for residential dwellings.

MO093 Adding the resource dimension to the WULCA framework on assessing freshwater use in LCA
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Effective management of freshwater resources is recognized as being vital at present, existing LCIA methods for water use do not entirely reflect the state of such a vital resource remaining for future generations. Thus, the objectives of this project are to (1) identify how freshwater resources can be described as an entity to protect within the Area of Protection (AoP) natural resources, (2) describe the impact pathways affecting this resource, and (3) propose a characterization framework to assess the impacts from the identified impact pathways. Freshwater resource has a particular status in LCA resource modeling. First, it exists in the form of three types of resources: flow, fund, or stock. Then, in addition to being a resource for human economic activities (e.g. hydropower), it is above all 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 directly determined pathways to freshwater and the indirect 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.

MO094 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. Campanili, IRD, UMR LISAH; S. Follain, Montpellier SupAgro, UMR LISAH; J. Burte, CIRAD / UMR GEAI; N. Benaisa, National Agronomic Institute of Tunisia / Science de la production végétale; C. Sinfort, ITAP, Irstea, Montpellier SupAgro, UMR LISAH; S. Follain, Montpellier SupAgro / ELSA-PACT Industrial Chair
Soil is a rare natural resource and it is at the center of the main issues in agronomy, environment and land use planning. At global level, erosion is one of the major soil degradation processes and it is responsible for the decrease in agronomic potential of soils and in agricultural land surfaces. Water and soil conservation works (WSCW) are built to protect soil from erosion. The financial and environmental cost the WSCW construction is very high. However, the positive impacts of WSCW are not taken into account in Life Cycle Assessment (LCA). The objectives of this study is to integrate the impact of WSCW on soil quality in LCA. There are different types of WSCW with different functions and they act differently on erosion process. In this study we focused on contour ridges as a type of conservation works because they are associated to crop systems. Contour ridges are generally built in upland areas to reduce runoff and erosion, to increase on-site deposition of eroded particles and to increase local water infiltration. Contour ridges modify water and soil flows at catchment scale, so it is necessary to use a model able to calculate the inventory flow at the catchment and not only at the plot level. In this study we present a methodology to integrate the impact of contour ridges on topsoil erosion at the catchment level and to compute characterization factors in presence of such WSCW. The proposed method was applied in a case study in semi-arid context in central Tunisia (Merguellil watershed) which presents the issues of over-exploitation of water resources, accelerated land degradation and a high expansion of conservation works. In order to highlight the impact of WSCW on topsoil erosion, a set of water and soil conservation works (WSCW) were simulated in the LCA software and total SOC and land use types were tested. For life cycle impact assessment, we focussed on two midpoint impact categories on soil quality of LANCA model : erosion resistance and mechanical filtration. The results showed how contour ridges can modify topsoil erosion process and thus the impact on soil ecological functions for several production systems. In conclusion, it is necessary to integrate the positive impacts of WSCW in LCA for the select and used 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 being conducted including 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. Keywords: LCA, LCIA, EoL, Exposures, Characterization, Consumer Products - 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.

MO099 Combined use of Mixed-Integer Optimisation and Thermodynamic, Molecular and Charge Density attributes for predicting Life Cycle Production
Impacts of Chemicals
R. Calvo-Serrano, G. Guillén Goslábez, 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 log KOC values 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 profile partitions, being able to obtain reasonable LCA impact estimates such as Global Warming Potential (GWP)(33.55%) or Eco-Indicator99 (EIP)(18.34%).

MO100 Development of USEtox characterisation factors for micropollutants in effect assessment
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 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 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 Assessment of freshwater ecotoxicity with USEtox
M. LOT, CEHTRA; P. Thomas, CEHTRA SAS; F. Sahigara, KREATIS; M. Jacob, TOTAL SA

USEtox is determined as the reference tool for freshwater ecotoxicity impact evaluation in LCA context. By the way, it is recommended by several institutes: by European Commission for PEFOE/F project, by JRC-IES in ILCD handbook, by WiserLife project promoting the sustainability of chemicals and by USEPA in TRACI tool manual. An assessment of the relevance of the Characterisation Factor (CF) with its associated factors was realized. We found that CF appears to be significantly influenced by the effect factor (EF), implying that the 2 others factors, XF (Exposure Factor) and FF ( Fate Factor), do not intervene, or very little, in the final calculation of CF. This finding is surprising because the XF and FF factors show influence the calculation of CF as they represent, significant fate adjustments: substance bioavailability (XF) and its presence in the medium (FF). Hence, the influence of each factor was analysed in more detail and some inconsistencies were noted. For EF, USEtox includes an extrapolation calculation for acute to chronic toxicity (called Acute-to-Chronic Ratio). This extrapolation is not always reliable and will certainly not be applicable for substances with a log Kow>6 where acute toxicity is superior to solubility but chronic toxicity may still occur. Moreover, the value used for the ACR seems inappropriately low and should be different according to the mode of action of the substance. For XF, adsorption starts to reduce XF at log Koc around 5 whereas adsorption of organic substances is generally considered to become highly significant in ecotoxicological studies performed at low concentrations from log Koc of 4. Overall, the XF seems to be overestimated in this model for the majority of substances with a log Kow between 3 and 5. For FF, one of the parameters that most influences its calculation seems to be the biodegradation, which alone can alter the relationship between the EF and the CF by an order of magnitude (between a highly persistent and a highly biodegradable compound). However, the relative influence of biodegradation (and the other FF parameters) on the CF is too limited compared to the EF value. Indeed, the difference between the minimum and maximum biodegradation on CF is approximately 2 orders of magnitude while the EF itself spans at least 8 log units. Thus, because of these inconsistencies, it is crucial to discuss the relevance of each factor with the aim of improving the model providing a more realistic approach.

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 midpoint eutrophication methods in life cycle assessment (LCA). Current eutrophication methods in LCA are limited. Most LCA methods 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, sediments, soils, 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, Noone K, Perrson Å, Chapin FS, Lambin 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 consequences for marine ecosystems. Science 321: 926-929. Disclaimer - The views and conclusions contained herein 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 tools, 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 photoreactors; they may be installed at large scale in natural environments, such as freshwater ponds or offshore cultivation 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 L. Sánchez-De Castro, D. Garrain, Y. Léchon, CIEMAT / Energy Dpt Energy Systems Analysis Unit

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 their scope, from local to global. After having successfully considered the main 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 b) the AWARE method developed by WULCA working group (http://www.wulca-waterlca.org), a midpoint water use indicator representing the relevant Available Water Retaining per area in a watershed.

MO105 Identification of methodological challenges remaining in the assessment of a water scarcity footprint P.J. Schieving, University of Aveiro / Department of Environment and Planning; b) Ridoutt, CSIRO; L. Arroja, A. Dias, University of Aveiro / 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) 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 groundwater). After defining a consistent terminology and state-of-the-art of the methodologies to consider this impact category, this work addresses the state-of-development of both WFA and impact LCA-based WF approaches, identifying recent impact LCA-based WF methods, and the following methodological challenges that need to be overcome to establish a consensual and comprehensive impact LCA-based WF method: (1) accounting and assessing the potential environmental impacts of green water flows; (2) inventory of actual blue/ freshwater consumption in agriculture; (3) temporal and spatial variation to establish explicit characterisation factors (CFs); and (4) adequate connection between inventory flows and spatial-temporal explicit CFs. Robust and reliable methods, and guidelines for assessing and reporting WF results are needed. It is crucial to ensure the applicability of the WF by non-academia, ensuring standard setting and reporting for a general public audience as a means of assessing the potential environmental impacts of freshwater stress and raising awareness of a sustainable use of freshwater resources. A distorted comprehension of the WF results, without understanding the effects of the land-use and land cover change and water irrigation on the WF damage, and without considering spatial differentiation, can represent a danger and pitfalls for decision-making.

MO106 Filling the Gap of Overfishing in LCA: 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. Keller, R. Itten, Zurich University of Applied Sciences / Institute of Natural Resource Sciences

There is a lack ofLCIA 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 maximum 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 for by-catch. 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 presented by means of a full single-score LCIA of meat 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 L. Vázquez-Rowe, Pontifical Catholic University of Peru / Civil Engineering Environmental Science; D. Verán-Leigh, Pontificia Universidad Catolica del Peru / Civil Engineering Environmental Science

According to recent reports, hydropower currently accounts for over 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 emissions due to the emission of biogenic CO2 during construction and decommissioning. 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, fossil depletion 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 temperature that is 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. Guevara, Radboud University Nijmegen / 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 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. CEs 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 from WWTP emissions from year 2000 compared to year 1900 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 effects of nitrogen and phosphorus 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. Ciroth, 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. Results were based on the Flemish environmentally extended input-output model. The Flemish EEIO 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 in 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. While 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 Carbon and material footprint of consumption in Flanders - an input-output based assessment A. Ciroth, VITO NV; K. Boonen, M. Christis, VITO; E. Vander Putten. VMM-MIRA

Building of large-scale inventories of emissions and resources and applications for environmental footprints of territories, nations and sectors (P)
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 process, 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 peak electricity consumption, 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 Population and Public Health

Tetiant on life cycle assessment (LCA) involves explicit assumptions and major uncertainties associated with the source of electricity across two main dimensions: spatial and temporal. There is a need within the LCA community for an approach that addresses this ambiguity and allocates environmental impacts as a function of marginal and time-specific variations. In our study, particular attention is paid to the dynamic characteristics of two buildings’ electrical energy consumption in relation to the regional electricity grid, making our findings indicative of a transcontinental general relationship.

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 impacts of public transport systems. However, there is no single platform, software or tool for comparing the energy consumption over the life cycle. The objective of this study was the development of an LCA based framework to evaluate, analyse 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 boundary comprises all environmental impact categories of the life cycle from 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.
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 DFOP should also be assessed. Testing of the criterion for metabolite fits showed that it was equally applicable to such cases. Together, this can 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.

MO120  "Southside" - Bridging the hemispheres - Global use of field trials based on ecoregion similarities between New Zealand, Chile and Europe

B. Gottesbauren, BASF SE / Crop Protection, Environmental Fate Modelling; H. Bayer, BASF SE; K. Platf, BASF SE Agrarzentrum Limburgerhof / Environmental Fate Modelling; B. Erzgraeb, BASF SE; F.P. Donaldson, BASF Corporation / APID/EUR; J. Goulet-Fontin, 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 (ENASGIS) had been developed (OECD 2016) for gaining acceptance of field studies conducted in North America to Europe and vice versa. Such studies are not feasible due to the distances and conditions needed to extend to other regions of the world. An experimental and GIS/modeling feasibility study ("Southside") was initiated to demonstrate if TFD studies conducted in the Southern hemisphere (i.e. New Zealand, Chile) under climatic, soil and cropping conditions similar to conditions in the Northern hemisphere may deliver similar soil degradation rates and DegT50 endpoints than those from Europe. Similar similarity zones were identified between the New Zealand and Chilean sites and EU / NAFTA using the OECD ENASGIS 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 annual rainfall of – 780 - 970 mm. In Chile the sites were located in the Region del Bio-Bio east of Concepción having an average annual 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 formulations 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 pF2) 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^2-error) were in both acceptable. The normalized SFO DegT50 in 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.

MO121 Residues of currently used pesticides in Central Europe arable soils: status quo, managed risks and consequences

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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 tert-butylazine (t-butylazine) in soil, the conclusion was that banned toxic simazine is still introduced significantly to the soils as an allowed impurity of massively applied tertbutylazine. 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 to 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).

MO122 Does the TOXSWA model simulate reliable concentrations in FOCUS surface water scenarios for a single segment water layer ?

P.I. Adrianae, Alterra Wageningen University and Research Centre; W. Beltman, Alterra Wageningen UR

DegT50 were compared to the experimental 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^2-error) were in both acceptable. The normalized SFO DegT50 in 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.

MO123 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 or 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 conditions and the context sensitiveness 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.
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. Boelehan, Bayer AG, Research & Development, Crop Science; G. Spickermann, ADAMA Deutschland GmbH; D. Schaefer, Bayer Crop Science / Environmental Safety

The calculations 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; Goeritz, 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 consent. 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. Pestic. Nat. Environ. 2015; 172: 274-280; E10: Klimowicz G (2015): Multiyear FOCUS surface water modelling: Options and Proposals for Realisation. XV: Symposium in Pesticide Chemistry. Placencia, 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, Barcelona. 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, T. Kleinmann, WS-Scientific 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 aim is to find DT50 and KOC values which trigger runoff and drainage amounts 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 KOC/DT50 variation. Using automated FOCUS surface water simulations PEC50 were calculated for different scenarios as different application times within the registration period and spray drift as entry paths to focus solely 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

T. Galé, Luxembourg Institute of Science and Technology; M. Bayerle, D. Pittius, 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 (PS) is a technique with a focus on water quality, that is used to identify the majority of the time that is needed 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 autosampling 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 intended 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 terbutylazine in a mesoscale agricultural catchment using passive sampler data

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The impact of agricultural practices on water pollution can be assessed by process-based reactive transport modelling using catchment scale models. Most current studies only use equilibrium relationships that do not consider calibration and validation. Thus, even if the applied model is spatially distributed, predicted spatial differences of pesticide load cannot be directly compared to observations. In this study, we applied the spatially distributed reactive transport model Zin-AgroTria in the mesoscale (78 km²) catchment of the Wark River in Luxembourg in order to simulate concentrations of terbutylazine in river water. In contrast to former studies, we used six sampling points, equipped with passive samplers, for pesticide model validation. At each sampling point, event mean concentration of six events from May to July 2011 were calculated by subtraction of baseflow-mass from total collected mass assuming time-proportional uptake by passive samplers. Continuous discharge measurements and high-resolution wind- and rainfall data were used during event periods for model calibration and validation. Detailed information about maize cultivation in the catchment and nation-wide terbutylazine application statistics (average of 341 g/ha in the 3rd week of May) were used for a definition of the pesticide input function of the model. The hydrological model was manually calibrated to fit baseflow and spring/summer events. Substance fluxes were calculated using 1000 Monte-Carlo simulations of physicochemical substance properties to perform a probabilistic forecast. Results show that passive sampler data can be used to derive the main source (80-95%) of terbutylazine in the main channel and surface water fluxes to be the most important pathways in the tributaries. Simulation results suggest that 0.07-0.14 % of applied terbutylazine mass was exported to the river in the Wark catchment. In addition to calibration of substance characteristics, passive
MO129  
Recalibration and cross-validation of pesticide trapping efficiency equations for vegetative filter strips (VFS) using additional experimental data  
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Vegetative filter strips (VFS) are widely used for mitigating pesticide inputs into surface waters via surface run-off and erosion. To simulate the effectiveness of VFS in reducing surface runoff volumes, eroded sediment and pesticide loads the model VFSMOD (Muñoz-Carpena and Parsons, 2014) is frequently used. While VFSMOD simulates infiltration and sedimentation mechanistically, the reduction of pesticide load in surface runoff by the VFS (delta P) is calculated with the empirical multiple regression equation of Sabbagh et al. (2009). This equation uses the following inputs: predicted reduction of total inflow (delta Q) and eroded sediment load (delta E), 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 the input parameter range. 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 recalculate the Sabbagh and Chen equations. Moreover, a self-categorization 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.

MO130  
Vanda - Visualize and Assess: a tool for the pesticide risk mitigation in surface water  
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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 work is to develop an interactive, easy-to-use tool to evaluate the potential impact of water contamination, assess the potential pesticide risk and identify areas where to introduce mitigation measures to reduce the contamination, and consequently to reduce the risk in the surface water compartment. The datasets to start with are the monitored concentrations of pesticides in surface water, produced by the Regional EPA. These values are used in this context as Measured Environmental Concentration - MEC. The ratio MEC/PNEC is proposed in this work as a sort of risk assessment, even though the limitation and the complexity of usage of monitored data is well known. In addition, the ratio MEC/EQS - Environmental Qualitative Standard (annual average concentration), is considered, to address the water quality with respect to the regulatory limit for pesticides in surface water (Directive 2000/60/EC). A MS Excel tool has been developed to map the monitored residues of pesticides, assess the potential pesticide risk (MEC/PNEC) and identify “hot spots”, that is areas where mitigation measures should be included. The tool is thought to be an anyone-can-use one, even with no particular knowledge of GIS or database management. Its peculiarity to be built inside MS Excel gives itself the possibility to share and to ease the dissemination of results. For more advanced mapping, the tool can interact with ESRI ArcGIS. The openness of Vanda makes it a tool suitable to work with other environmental compartments or other environmental theamatics.

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  
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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 Time (FOCUS PAT), which selects an application date, referred to herein as CRD PAT) a different set of criteria is applied 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 nuisance 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 model US pesticide usage introduced a community action framework to reduce the risk in the surface water compartment. The datasets to start with are the POCIS and the POCISny 0.1µm: one for the first five days of the experiment and one for the overall experiment (Rs=0.19±0.02 L.day⁻¹). POCISny 30µm followed the same pattern than in the laboratory experiments, Chemicals Regulation Division / Environmental Fate / Public Health; A. Moretto, Università degli Studi di Milano

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 realistic worst case scenarios, designed to be protective of a wide range of usage situations, to a more realistic representation of usage environments that are typical and average. Two types of integrative samplers, the classical POCIS (Polar Organic Chemical Integrative Sampler) (with Polysulfonelfume membranes), and the POCISny 30µm followed the same pattern than in the laboratory experiments, Chemicals Regulation Division / Environmental Fate / Public Health; A. Moretto, Università degli Studi di Milano

The uncertainty of the tropical weather in the French Caribbean makes spot sampling of chlordene obsolete and new approaches should be explored to model the fate of this molecule in aquatic systems. Three types of integrative samplers, differing by their membrane, were calibrated in laboratory and on field for 14 days for the molecule chlordene: the classical POCIS (Polar Organic Chemical Integrative Sampler) (with Polysulfonelfume membranes), the POCISny 30µm (with nylon membranes), and the POCISny 0.1µm. Calculated sampling rates (Rs) were corrected by a PCR ( Performance Reference Concentration) approach. Laboratory calibration was done in triplicates under a continuous flow system, and the field calibration was done in tricipates in river Capeteree (Guadeloupe, French Caribbean). Rs in laboratory calibration were 0.30±0.02 L.day⁻¹ for the POCIS, 0.09±0.01 L.day⁻¹ for the POCISny 0.1µm and 1.54±1.38 L.day⁻¹ for the POCISny 30µm. Two distinct Rs have been calculated for the POCIS and the POCISny 0.1µm: one for the first five days of the experiment (Rs= 0.19±0.01 L.day⁻¹ for POCIS; Rs= 0.48±0.50 L.day⁻¹ for NOCIS 0.1µm) and one for the overall experiment (Rs= 0.19±0.02 L.day⁻¹ for POCIS; Rs= 0.43±0.01 L.day⁻¹). POCISny 30µm followed the same pattern than in the laboratory calibration and reached equilibrium after 3 days, with a Rs significantly higher than
in the laboratory calibration (Rs=4.82 ±1.93 L mg⁻¹). POCIS and POCISny samplers can accumulate chlorodene 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

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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 at these sites were collected from April to October in 2012 and 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, iprobosfen and difluzamide as fungicides were mainly detected in rice season. While other fungicides including dimiconazoel, propiconazole, fenarimol, nuralm 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, fenphosphate and prothiofos, two carbamates, carbofuran and fenobucar, and endosulfan were detected with low frequencies and low residue levels. Some water samples at these sites were collected from May to April the following year, and these results were compared to those of the other years.

**MO135**

Occurrence of 14 representative pesticides in surface and ground waters of the State of São Paulo, the biggest sugarcane producer in Brazil

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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, chloroamide, diuron, hexazinone and tebuthiuron), 3 fungicides (azoxystrobin, carbendazim and tebuconazole), 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 0.1 to 22 ng L⁻¹ and from 2.6 to 74 ng L⁻¹ respectively, 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%), carbendazim (93%), tebuconazole (91%), malathion (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, carbendazim, atrazine and malathion. For the groundwaters the most frequently detected pesticides were atrazine-2-hydroxy (24%), imidacloprid (14%), carbendazim (10%), tebuthiuron (10%), atrazine (10%) and diuron (10%). The pesticide that presented the highest concentration for this matrix was tebuthiuron, reaching 107 ng L⁻¹.

**MO136**

Exposure scenarios for aquatic risk assessment of pesticides in Brazil

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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. Surface water scenarios 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 runoff 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

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The occurrence of herbicides in surface waters of intensively cultivated catchments can originate from a variety of sources. These include transport via runoff and infiltration 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 sources of the herbicide detections 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 application of an appropriate and adapted model for soil and water model distinction 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 farmyards 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

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The Douro River is an international water river that passes through extensive agricultural fields, of both Portugal and Spain, before reaching the estuary at Porto and Gaia cities. Therefore, the presence of pesticides is suspected. Accordingly, the evaluation of 56 pesticides of different categories (insecticides, herbicides, and fungicides) should be viewed as a priority for this habitat due to their negative impacts on the biota. For this purpose, water was collected over one year at six sampling sites in the Douro River estuary. Samples were extracted by solid-phase
extraction and quantitatively analysed by gas chromatography–mass spectrometry (GC-MS). Results show that 96% of measured pesticides were detected in 79% of the quantified samples and that twelve compounds showed concentrations well above the limits established by the 2013/39/EU Directive. Individually, the concentrations of the analysed pesticides ranged from 39 to 1265 ng/L. Since the occurrence of these compounds happens in mixtures, we conducted a theoretical hazard assessment considering the average and the maximum environmental mixtures of all measured pesticides. The theoretical approach suggested that invertebrates were the most sensitive group. Therefore, short-term exposure in vivo assays using Artemia salina and Daphnia magna were done. These results disclosed significant toxic effects of the analysed mixtures - high mortality rate and abnormal swimming behaviour - over the exposed animals. Both approaches (theoretical and experimental) have provided realistic results that confirm the assumptions on this estuarine environment and of other comparable. Acknowledgements: European Regional Development Fund (ERDF) through COMPETE, Framework of the Structured Program of R&D&I INNOVARM – Innovation and Sustainability in the Management and Exploitation of Marine Resources (NORTE-01-0145-FEDER-000355), Research Line ECOSERVICES, supported by the Northern Regional Operational Programme (NORTE2020), through the ERDF. ICBS – U. Porto. Keywords: monitoring, Artemia salina, Daphnia magna, pesticide mixtures

MO139 Monitoring programme to investigate the presence of myclobutanil and its soil metabolite in Italian groundwater following use in pome fruit, stone fruit and vineyards

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Regional registration in Italy, FOCUS groundwater modelling showed that the PECgw for its soil metabolite (X1129885; up to 6% of applied) reached up to 2 µg/L. This was accepted at EU level since the metabolite is not toxico logically relevant. However, according to national rules, this triggers a groundwater monitoring study for a metabolite when the PECgw is >0.75 µg/L. For completeness, myclobutanil was also monitored. To allow for a robust monitoring study, it was necessary to identify monitoring areas with the following characteristics; (i) representative of an intensive use of myclobutanil, and (ii) reflect important worst case scenarios for Italy. To facilitate this, a GIS-based indicator (PLI Potential Leaching Indicator) was developed to integrate information about sales data, the spatial distribution of the target crops and the distribution of the FOCUS groundwater model scenarios throughout Italy. Use of the PLI allowed five suitable areas to be identified (Bolzano and Trento for apple trees, Verona for stone fruit and grapes, Forlì-Cesenा for pear trees and stone fruit, and Matera for stone fruit). These areas are also representative of the FOCUS groundwater scenarios relevant in Italy (Châteaudun, Hamburg, Piaccenza and Thiva). In each area, five monitoring wells were identified to cover a range of parameters (depth to groundwater, hydrology, pedology, and presence of the target crops). Subsequently, a three year monitoring campaign was conducted (autumn 2014-spring 2017). From a total of 150 samples analyzed, the concentrations of myclobutanil and its soil metabolite (X1129885) were below the LOD (0.001-0.002 µg/L). In about 45% of the samples, the number of positive detections was 23 and of these, 20 samples showed concentrations well below 0.01 µg/L. Only in one sample did the measured concentration exceed the trigger value of 0.1 µg/L. However, a number of factors indicate that this is due to point source origin. Even better results were obtained for X1129885 where the number of positive detections was only 13, with concentrations less or very close to 0.01 µg/L. Based on these results it can be concluded that given the actual use conditions, the probability of myclobutanil and its soil metabolite exceeding the threshold value of 0.1 µg/L in groundwater in Italy is very low.

MO140 Identification of areas at risk of groundwater leaching in Italy for the fungicidal 1,3-dichloropropene

R. Verro, University Milano - Bicocca - Lybra ambiente e territorio S.r.l./ Department of Earth and Environmental Sciences; R. Bradascio, Dow AgroSciences Italia srl/ RD; C. Vai, Dow AgroSciences Italia s.r.l.; A. Finizio, University Milano - Bicocca / Department of Earth and Environmental Sciences; 1,3-Dichloropropene (1,3-D), also known as Telone™, is an active substance used worldwide in soil fungicid products for the control of cyst and free-living nematodes. It is used in a variety of crops including fruiting and vegetable crops. Soil sorption studies have shown that 1,3-D and its metabolites present characteristics of highly mobile molecules with a potential to leach into groundwater when applied in vulnerable areas such as sandy soil and in areas characterized by shallow groundwater. European member states have a wide range of groundwater monitoring activities for plant protection products and their metabolites, but analysis of 1,3-D and its metabolites is not currently part of the routine programme. In this study we illustrate a methodology allowing to identify areas most at risk where monitoring should be focused in priority, taking the example of Italy. The methodology considers three parameters: i) crops distribution, ii) soil properties and iii) 1,3-D use. The data, structured as layers of information are managed within a GIS, and are intersected to get the so called Uniform Geographic Units (UGU) which are areas of uniform in their characteristics and are representative of a specific set of values parameters. The data about the spatial distribution in Italy of crops where the 1,3-D is applied were first gathered from the last agricultural census, which provide information at a provincial scale. Successively, these data were refined at municipality scale. The identification of sandy soil areas in Italy was performed using pedological information extracted from different official sources. Subsequently, the information was used to identify areas where the percentage of sandy soils falls among three different categories (< 60%, 60-80%, >80%). Also these data were structured as GIS layers, which were processed and represented using the same GIS of the crop distribution. Overlaying the crop distribution and sandy soil areas and by merging the two databases, it was possible to identify sub-communal areas where crops and sandy soils coexist, characterizing the extension in relation to the rest of the municipality and the province. Finally, by considering 1,3-D sales data, it was possible to refine the areas previously identified and quantify the percentage of areas potentially at risk of leaching where Telone™ is applied.™ of DowAgroSciences

MO141 Development of an European Tier 3+ Spatially Distributed Modelling Framework

G. Hoogeweg, Waterborne Environmental, Inc. / Data Technologies; P. Sweeney, Syngenta Higher tier groundwater assessment in the European Union (EU28) allow the use of spatially distributed modeling approaches for the assessment of groundwater and exposure of soil organisms to a distribution of a defined number of pesticides. These models can reflect local conditions and capture the spatial variability of the landscape and weather patterns. An advanced modelling framework, based on the GeoPEARL 4R model was developed for the EU28. This model fills the niche for higher Tier assessments needs. This modelling framework represents over 1,340,000 km² of arable agricultural lands in Europe. Nearly 382,000 unique soil weather, FOCUS zone combinations represent the variability of the landscape and climate. Datasets to populate the model, included CORINE land cover, soils data (ESDB), ESPB Derived Data for Modelling and HYPRES, EFSA organic matter) and the JRC MARS 25km gridded daily weather data. Agricultural management practices, irrigation, and cropping scenarios are gleaned from the standard FOCUS model parameters, but can be updated as needed. The framework (EMF2014) can be used for EU28, member state, FOCUS zones or crop specific groundwater vulnerability assessments, screening of existing and new plant protection products, context setting of standard scenarios, test sites, and lysiometer, site selection. In this presentation we will show how we developed the framework and several example outputs as well as discuss the implications of conducting large-scale distributed modelling assessment.

MO142 Influence of aquifer parameters on groundwater residue concentrations

F. Hegler, DR. KNOELL CONSULT GmbH; D. Liss, SGS Institut Fresenius GmbH/ Agro; W. He, DR. KNOELL CONSULT GmbH; O. Naeb, SGS Institut Fresenius GmbH; S. Rottig, DR. KNOELL CONSULT GmbH / Environmental Fate / Modelling / GIS FOCUS leaching models are used in a regulatory context to calculate pesticide leaching flux concentrations in 1 m depth (PECgw; “Predicted Environmental Concentrations in groundwater”) from the unsaturated to the saturated zone. These values are used in risk assessments to evaluate the impact of plant protection products on groundwater. In higher tier groundwater monitoring studies the properties of the saturated zone add additional complexity influencing actual pesticide residue concentrations in shallow groundwater. In this work the impact of groundwater flow velocity and aquifer porosity on groundwater residues for a defined leachate concentration (i.e. decoupled from the unsaturated zone) was determined. In a sensitivity analysis for a hypothetical scenario of aquifer parameters the impact on the resulting residue concentrations in groundwater was quantified. For the sensitivity analysis FOCUS model outputs for selected scenarios were combined with realistic aquifer parameters for some representative regions in northern Italy and Germany. In these regions the relevant shallow aquifers are variable in terms of hydraulic conductivity, gradient and effective porosity and provide a representative parameter range.

MO143 Implications of Dataset Selection and GIS Processing on Modelling

G. Hoogeweg, Waterborne Environmental, Inc. / Data Technologies; M. Geuvara, Waterborne Environmental Inc / Modelling Groundwater assessment guidelines provided by the FOCUS groundwater working group (2009) and EFSA (2014) describe succinctly a multi-tiered modelling framework that includes spatio-temporal assessments in the higher tiers; e.g., tier 3a and 3b. As part of the spatio-temporal assessment several GIS and daily climate
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 modeling results. Basic assumptions regarding aggregation of data, data slicing for determining climatic zones and data resolution influence our modelling results. In this poster, we will show the implications of data selection and data processing on a distributed modelling framework centered around GeoPEARL 4R. Specifically we will focus on differences between datasets, data 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 tools 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/SEAGFest). The main issues when dealing with groundwater monitoring data integration were related to site selections and related vulnerability, 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. Menaballi, International Centre for Pesticides and Health Risk Prevention

The calculation of Predicted Environmental Concentration of pesticides in groundwater (PECgw) is a crucial point in the risk assessment and 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 PECgw values are anticipated 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 confirm 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 PECgw calculations, are proposed for all substances. This approach can minimize 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. Gimona, The Danish Environmental Protection Agency / Pesticides and Gentechology; W. Koenig, UBA Umweltbundesamt; A. Boivin, ANSES; A. Poot, Cgbg; A. Schwen, AGES; M.E. Balmer, Plant Protection Chemistry; A. Massey, Chemicals Regulation Directorate; W. Tüting, 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 publicly available or available only in an aggregated form in a report, (ii) most data does not exist in the national language of the origin country only, which makes it hard for other countries to access it, (iii) the interpretation of groundwater monitoring data 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. Reikens, E. Hellpointner, Bayer AG, Research & Development, Crop Science / Environmental Safety; D. Sausset, Bayer Crop Science / Environmental Safety

Recent regulatory interest in the wash-off process resulted in a proposal to the that the effects of wash-off should be generally 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, EFSA has stated that effects of wash-off should not be considered as additional soil loading but rather as average effect (EFSA 2015, 2017). The foliar wash-off factor of a compound is a product (formulation) specific modelling input parameter that can be experimentally determined. A generic experimental study design has been derived in a workshop organised by the European Crop Protection Association (ECPA). This study design was used for the experimental determination of wash-off factors for modelling purposes. Overall 25 individual wash-off factors have been determined experimentally, mainly under GLP. The data set comprises 12 formulations, 8 compounds and 6 crops. Experiments consider one heavy rainfall event of 15 mm over one hour, applied 24 hrs after foliar pesticide spray. The determined 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. EFSA 2010: PPR 2010/137 – Pesticides – Exposure on organisms in soil. EFSA 2012: Scientific Opinion 2562 – Science behind the guidance on soil scenarios EFSA 2015: Guidance Document 4093 - Predicting environmental concentrations in soil EFSA 2017: Guidance Document 4982 - Predicting environmental concentrations in soil

MO148 Leaching and plant uptake of trifluoroacetic acid (TFA) under cropped outdoor conditions
G. Reikens, M. Beckmann, Bayer AG, Research & Development, Crop Science / Environmental Safety; K. Hammel, Bayer AG, Crop Science Division / Environmental Safety; U. Kößler, Bayer AG, Research & Development, Crop Science / Environmental Safety; M. Lamboeuf, 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. As 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 product classes (e.g. refrigerants like HFCs and HCFCs, anaesthetics, 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 PDEL 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
under dynamic outdoor conditions; the hydropnic 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. Michielsen, H. Stallings, P. Van Velde, 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 boom 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 sprayer boom movements are investigated both experimentally and on simulations using the spray drift model IDEFICS. Downwind deposits of spray drift were measured alongside a trench at a height of 2 m downwind. Consequently, the part of the spray that is applied recorded during the experiments. Horizontal and vertical movements of the sprayer 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 deposits 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

Pesticide applications in tree nurseries involve spraying techniques that apply the pesticide in upward or sideways direction. Particularly for high avenue trees the downwind loss of pesticides due to spray drift can be relatively large. The upward directed part of the spray that is blown towards the top of the trees may reach heights above the trees, where wind can take the spray cloud and move it far downwind. Usually, the branches and leaves at the lower part of the stems of high avenue trees may pass underneath the tree canopies and reach downwind areas easily. Measurements of downwind spray deposits for tree nurseries indicate deposition levels comparable to those occurring for fruit orchards, which are well above those occurring when spraying arable crops. The current paper deals with the worldwide exposure assessment for pesticides applied to tree nurseries reaching downwind field watercourses in the Netherlands. High avenue trees, nurseries with the younger spindles and transplanted trees are considered as well. Although the total area of tree nurseries is limited, exposure risk to edge-of-field watercourses is important enough to investigate. Spray drift mitigation techniques are considered and evaluated as well.

MO151 Investigating the exposure of residents to pesticides due to airborne spray drift
H. Holterman, Wageningen University & Research / Agrosystems Research; J. Van de Zande, J. Michielsen, H. Stallings, P. Van Velde, Wageningen University and Research / Agrosystems Research

In the Netherlands around 90,000 people 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 project involves both measurements and simulations of airborne spray drift. Volatilization is investigated for several days after spray application. Outdoor and indoor exposure of residents to pesticides due to airborne spray drift is studied using the IDEFICS spray drift model for boom sprayers. The CEC the simulations result in 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.

MO152 Risk assessment for consumers of co formulators used in Plant Protection Products. Case study of polymers
P. Adrian, M. Liegeois, M. Durrieu, B. Jouanol, CEHTRA SAS

Risk assessment is a key tool to derive safety conclusions for human health. In the case of co formulators used in the formulation of Plant Protection Products, there is no regulatory guidance on how to conduct a risk assessment for co formulators in 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) but 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 formulator. 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
Xavier 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) and the 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 are 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 consumers are exposed through the diet. 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
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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 risk for the residues is important. Flubendiamide is used as a co formulant with conventional insecticides. The applicator’s exposure was carried out for Dermal exposure measurement, whole body dosimetry (WBD) was performed, which consists of cotton/polyester outer clothes and cotton inner clothes. Hand exposure was measured by washing of nitrite gloves and hands, while head exposure was monitored by face/neck wipe technique. Inhalation exposure was evaluated with personal air sampling pumps and IOM sampler (glass fiber filter). Analytical limit of quantitation was 5.0 mg/mL, with good linearity (R² > 0.99) of calibration curve. Recovery (77–117%) of insecticide from various exposure matrices were reasonable including field recovery (77–100%). Field exposure assessments were carried out by 8 replicates. During application, total

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dermal exposure of flubeniamide was 3635.7 μg, while that of mixing/loading case was 815.3 μg. Hand exposure of flubeniamide (688.7 μg) in mixing/loading was higher than that of 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 be 0.09 using 6 μg/kg/day of acceptable operator exposure level, suggesting that health risk of agricultural applicator during treatment of flubeniamide for cabbage field would be minimum. Keywords: Flubeniamide, exposure, risk assessment, whole body dosimetry, 1OM, cabbage *Corresponding author: kj2404@sinu.ac.kr; Tel, 82-02-880-4644

MO155

Multi-focus Surface Water Calculations: What do they mean for real regulatory cases?

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The surface water 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., the evaluation of the original FOCUS-surface 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 experimental data with which such surface water calculations can be validated. Surface water exposure is strongly driven by individual weather events triggering run-off or drain-flow, 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 procedure 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

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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 sufficient for Spinosad, for which 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 artificial runoff was organised to simulate the flow generated in a source area of 500 m² flowing in a run-on 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 2.2 hours using a runoff generator (flow of 85 mm/h). Water content of the precursor (Spinosad) of spinosyn B of D was increased into 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, spinoxamine and fluopyram. In September 2016, EFSA organised a technical meeting with stakeholders on its new guidance to exchange views. 1EFSA 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):4594, 129 pp. doi:10.2903/j.efsa.2016.4594. 2OECD (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. 3Info 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. Scholthiem, 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; I. Ebersbach, Fraunhofer IME, Institute for Molecular Biology and Applied Ecology; J. 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 variable aspect of metabolic activity to the existing BCF prediction of the European Commission, EFSA prepared a guidance on the residue definition for dietary risk assessment which intends to complement the OECD guidance. In this study a total of five substances with different characteristics, four substances with logKow values ranging from 2.5 to 4.5 and one ionic substance, were tested both test systems. To obtain a more detailed understanding of the metabolic activities in H. azteca, its metabolism of the five tested compounds were compared to the metabolites generated in vitro by rainbow trout hepatocytes. The results show that Hyalella BCF testing, in addition to in vitro assays and in silico predictions, may help to reduce, refine, and replace the classic BCF estimation with fish in accordance to regulatory needs.
MO159 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 steroidogenic 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 (Percidae). 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 for 1145 to 6088 nM among these species, for the environmental concentrations of fadrozole. This suggests that intrinsic differences in sensitivity to inhibition of aromatase could be greater than 60-fold among fishes. Paddlefish (Polyodon spathula), 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 letrozole, 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 adverse outcome pathway (qAOP) that incorporates 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.

MO160 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 toxicological 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 investigated 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 (Abramus brama) collected annually between 1990 and 2016. Scales were dried, calcinated and mineralised using concentrated nitric acid. After digestion, 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.

MO161 Assessing differences in sea turtle organ sensitivity using cell-based toxicity assays

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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 wide range of 13 cell models. Differences in intraspecies cell sensitivity were 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.

MO162 Comparison of rat liver S9 to an animal-free alternative ewoS9R in the Ames fluctuation assay

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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 money-consuming method avoiding animal experiments. The use of animal liver S9 is derived from the Ames fluctuation assay and the Ames fluctuation test was established as a less time and labor-intensive test (Ames test). This technique improves the sensitivity and the data output of the fluctuation test. It enables a precise measurement of the oxygen transfer rate (OTR) and therefore conclusions on growth and metabolism of the bacterial culture. Furthermore, it can be implemented as an online-monitoring system on mutagenicity in applications like drinking water monitoring. However, as the Ames test is conducted with a microorganism, it lacks the metabolic activation of a mammalian metabolism. Hence, the mutagenicity of promutagens would be underestimated. Therefore, the bioassay is supplemented with an animal-derived product the rat liver S9. In animal experiments rats are treated with toxic substances via percutaneous or intravenous injections or feeding. Subsequently, the animals are euthanized to obtain the liver, which is homogenized, centrifuged and frozen. The commonly used rat liver S9 is a necessary component for various in vitro tests to increase the information about potential mutagenic substances. However, this product varies in its enzyme consistency and purity from batch to batch. Therefore, in the context of 3R to reduce animal experiments and to obtain more reliable in vitro test components should be introduced. In the present study, we investigate the applicability of a substitution of rat liver S9 with the biotechnological animal-free ewoS9R in the Ames fluctuation assay and the Ames-RAMOS system. Therefore, we investigate 26 promutagens with both metabolic systems. Preliminary results suggest that ewoS9R is a suitable alternative to rat liver S9.

MO163 QSAR: a predictive approach for electronic cigarettes toxicological assessment

D. Zarini, University of Insubria; E. Papa, A. Sangion, University of Insubria / 178 SETAC Europe 28th Annual Meeting Abstract Book
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 / Center for Health and Environmental Risks; 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 stage. As a tool for prescribing toxicity in daphnia and fish, two QSAR programs with R² values ranging from 0.7 to 0.9 and Q² values ranging from 0.7 to 0.8. These models were used to perform a screening of the acute toxicological profile of the 265 molecules of interest and to compile a priority list of substances of potential toxicological concern. This preliminary study represents a first step toward the hazard assessment of e-liquids and for the identification of safer alternatives to e-cigarettes and potentially harmful ingredients screened from the chemical structure. However, additional work still needs to be done to make these products safe for human use.

MO165
Optimization and Accessibility of the Eco-Database and the Ecotoxicological Threshold of Concern (ecoTTC) tool
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MO167
Screening of metabolic- and neurotoxicity of environmental chemicals using C. elegans and transgenic zebrafish models
Y. Tanen, 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 likely targets for adverse effects of pharmaceuticals included in cigarette emissions. It is estimated that up to 34% of all pharmaceuticals in cigarette emissions are delivered to humans via cigarette smoke. However, additional work still needs to be done to make these products safe for human use.
environmental disease. Epidemiological evidences show that the disease is associated with exposure to hazardous chemicals. However, causal relationship has not been clearly understood. In the present study, we aimed to elucidate the link between occurrence of metabolic or neuro disease and exposure of environmental chemicals. We first screened potential of environmental chemicals on the disease model organisms, C. elegans and Zebrafish. To maximize the advantage of these model organisms, for the in vivo chemical screening using C. elegans mutant; oga-1(ok1207), og-1(ok1474), ngl-1(ok259), transgenic zebrafish, Tg(T2Kins:nB-mCherry) and Tg(elav3:EGFP)kn3. The highly conserved O-GlcNAc transferase, OG T and O-GlcNAcase; OGA genes are related to type 2 diabetes and null mutations cause alterations in C. elegans carbohydrate and lipid metabolism. Neurogin LG1- control synaptic function, which is conserved from nematodes to mammals, is linked to attention-deficit hyperactivity disorder (ADHD). Tg(T2Kins:nB-mCherry) fish express insulin nitroreductase (InsNTR) mcherry fusion protein in the pancreatic β-cell and Tg(elav3:EGFP)kn3 fish express GFP in most post-mitotic neurons. Various category of environmental chemicals, such as, heavy metals (i.e. arsenic, lead, cadmium), ECDS (i.e. Nonylphenol, Bisphenol-A,EDF,B) and biocides (i.e. Chloroproper, ICT/MIT, PGH), were screened using C. elegans reproduction assay and zebrafish transgenic assay. The preliminary results showed ICT/MIT and BPA reduced fluorescence intensity of insulin gene on zebrafish, suggesting possible involvement of these chemicals on metabolic pathways. In brief, our results suggest multi-model approach could complement the limitations of a stand-alone model organism and thus more accurately identify chemical hazard on human health. Therefore, the outcome of the current study could be utilized for efficient chemical screening and better risk assessment of the chemicals. Acknowledgement: This work was supported by the Mid-career Researcher Program (2017R1A2B3002242) through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and Future Planning.

MO168

In vitro effects of two pesticides on the motility and viability of bovine spermatozoa

I. Bulhoisa, University of Aveiro / Biology department; M. Lopes, IC/BIAS-University of Porto / Department Veterinary Clinics; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

The use of plant protection products has exponentially increased in the agricultural sector over the past decades. Copper sulfate and glyphosate are two commonly used pesticides, the former as fungicide and the latter as herbicide. Farm animals may be exposed to this type of products through different ways: i) the drift of pesticides during their application may lead to inhalation or dermic exposure or ii) through the ingestion of plants. The above two exposure pathways may alter its mobility; velocity and/or viability; slight variations in the organism. The interaction between chemicals and sperm may affect reproduction of those animals. Actually, spermatozoa are extremely sensitive to this exposure. This exposure may lead to adverse effects in the reproduction and may result in the last generation of altered health effects. The results demonstrate that the decreasing $T_a$, with increasing $K_{ow}$ is caused by a rate-determining transfer-step of the electrphile from lipophilic compartments into the aqueous cytosol. Finally, chemovaiallity, as a trade-off between log $K_{ow}$ and log $K_{ow}$, is shown as a promising nonanimal tool to analyze the reactive aquatic toxicity. Therefore, exposure to reactive esters 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 molecular structure. This would enable screening with regard to their intrinsic toxicity potential. In this work, local electrophilicity parameters were developed based on the quantum chemistry. Their performance to describe electrophilic reactivity and reactive toxicity is 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 a,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.

MO170

Chemovaiallity of Organic Electrophilic - A Nonanimal Approach to Identify Candidates for Reactive Toxicity

A. Böhme, UFZ - Helmholtz centre for Environmental Research / Ecological Chemistry; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry

Organic electrophilics are important components within the exosomes 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 chemistry of the chemical with nucleophiles (i.e. EIs) and DNA. The toxicity enhancement $T_o$, which indicates the ratio of narcosis baseline (hydrophobic MIE) vs. experimental in vivo or in vitro bioassay toxicity, has been used as a measure for the reactive MIE for many years. However, very early studies already show that $T_o$ does not solely depend on reactivity, but also decreases with increasing hydrophobicity. This indicates that the relevant nucleophilic targets are located in aqueous compartments and that the hydrophobic and the reactive MIEs do not contribute independently to overall toxicity. In this communication, we employ our concept of chemovaiallity, to a set of S8 Michael acceptors, in order to analyze the impacts of reactivity and hydrophobicity on the overall toxicity as well as on $T_o$. To this end, reactivity was quantified by the second order rate constant for the reaction of the Michael acceptors with glutathione (GSH), a protein hydrolysing through the octanol/water partition coefficient and toxicity through the 48-h-effect concentration yielding 50 % growth inhibition of Tetrahymena pyriformis. The results demonstrate that the decreasing $T_o$ with increasing $K_{ow}$ is caused by a rate-determining transfer-step of the electrphile from lipophilic compartments into the aqueous cytosol. Finally, chemovaiallity, as a trade-off between log $K_{ow}$ and log $K_{ow}$, is shown as a promising nonanimal tool to analyze the reactive aquatic toxicity. Therefore, exposure to reactive esters 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 molecular structure. This would enable screening with regard to their intrinsic toxicity potential. In this work, local electrophilicity parameters were developed based on the quantum chemistry. Their performance to describe electrophilic reactivity and reactive toxicity is 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 a,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.

MO171

Local Electrophilicity Describes Experimental Glutathione Reactivity and Aquatic Toxicity toward Tetrahymena pyriformis

D. Wendt, This work is supported by the Mid-career Researcher Program (2017R1A2B3002242) through the National Research Foundation of Korea (NRF) funded by the Ministry of Science, ICT and Future Planning.; University of Porto / Department Veterinary Clinics; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro

The use of plant protection products has exponentially increased in the agricultural sector over the past decades. Copper sulfate and glyphosate are two commonly used pesticides, the former as fungicide and the latter as herbicide. Farm animals may be exposed to this type of products through different ways: i) the drift of pesticides during their application may lead to inhalation or dermic exposure or ii) through the ingestion of plants. The above two exposure pathways may alter its mobility; velocity and/or viability; slight variations in the organism. The interaction between chemicals and sperm may affect reproduction of those animals. Actually, spermatozoa are extremely sensitive to this exposure. This exposure may lead to adverse effects in the reproduction and may result in the last generation of altered health effects. The results demonstrate that the decreasing $T_o$, with increasing $K_{ow}$ is caused by a rate-determining transfer-step of the electrphile from lipophilic compartments into the aqueous cytosol. Finally, chemovaiallity, as a trade-off between log $K_{ow}$ and log $K_{ow}$, is shown as a promising nonanimal tool to analyze the reactive aquatic toxicity. Therefore, exposure to reactive esters 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 molecular structure. This would enable screening with regard to their intrinsic toxicity potential. In this work, local electrophilicity parameters were developed based on the quantum chemistry. Their performance to describe electrophilic reactivity and reactive toxicity is 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 a,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.

MO172

Using mechanisms of toxic action to classify and predict ester ecotoxicity

P. Bicheral, P. Bauer, KREATIS; P.C. Thomas, CHETRA SAS / Ecotoxicology and Risk Assessment

Even though esters are often used and released into the environment, little is known about their toxicity mechanisms to the aquatic system. Fish are considered to exert a specific narcosis, while some other esters can exert toxicity related to their potential reactivity. Therefore the critical step, before predicting the toxicity of an ester, is to determine its mechanism of toxic action (MechaS). For this purpose the classification of Baur et al. (2018) is used in combination with an accurate modelling approach which is derived from empirical data specific to the MechaS. The acute toxicity of esters to aquatic flora and fauna may be assessed against a hydrophobicity descriptor (i.e. log $K_{ow}$ or water solubility), and compared with similar regressions for non-polar narcotics. The similarity between these regressions confirms non-reactive esters are simple
narcotic compounds for algae but not for fish or daphnids. For the animal species, the regression 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, thereby preventing hydrolytic activity of esters being negligible. The di-esters appear to be 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. Thus, 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.

MOI73 Nanoendosc pulsed electric field incorporation technique to predict molecular mechanisms of teratogenicity and developmental toxicity on fish embryos
A. Arizono, Prefectural University of Kumamoto / Faculty of Env. Symbiotic Science; Y. Yamada, Prefectural University of Kumamoto / Faculty of Env. Symbiotic Science; 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 nanoendosc 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 the nsPEF technique is a powerful tool for assessing teratogenicity and embryonic developmental toxicity of chemicals and predict their molecular mechanisms in fish embryos.

MOI74 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 gut. Intestinal cell lines are a popular choice for studying developmental toxicity of chemicals and other responses in the intestine. The development of intestinal derived cell lines are useful Biological Sciences; AstraZeneca / Safety Health Environment; A.N. Jha, Plymouth University / Biological Sciences; L.M. Langan, Plymouth University / Biological Sciences; A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hydobiology, C. Cáceres-Martínez, Universidad Autónoma de Baja California Sur / The Mexican oyster is an introduced species from Asia, which is cultivated on 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 its 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 different concentrations of metal and their proportions in the mixture: Cd : Cr : Pb = 1:1:1. 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 (Ellman 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 metal mixture test concentration (0.2-5 µM) compared to PAHs indicating that their Kow is 6.5) industrial chemicals. Rainbow trout liver S9 fractions to predict the bioaccumulation potential of fragrance chemicals, K. Natsch, Givaudan Schweiz AG / Fragrances S &T; K. Jenner, Givaudan / Global Regulatory Affairs & Product Safety; G. Sanders, Givaudan International SA / Regulatory Affairs and Product Safety; A. Natsch, Givaudan Schweiz AG / Fragrances S &T

Bioaccumulation in aquatic species is a critical endpoint in the regulatory assessment of chemicals. The bioconcentration factor (BCF) is usually determined in fish (OECD TG 305). In vitro systems measuring biotransformation rates of chemicals to refine BCF model estimates have been established as alternative methods to refine predictive models which are based on hydrophobicity (i.e. log Kow). Fragrance chemicals frequently contain different isomers complicating its analysis especially at low concentrations. Thus, they have been commonly tested at 1 µM. Results reported recently indicate that first order depletion rate constants (kdeg) measured at test concentrations of 1 µM could underestimate the in vitro intrinsic clearance resulting in overestimation of the BCFs. However, these observations were mainly reported for substances from one chemical class (polyaromatic hydrocarbons, PAHs). For pyrene, chrysene and benzo[a]pyrene, kdeg determined at lower concentrations were 4- to 12-fold higher than kdeg measured at 1 µM. However, the effect of test concentration of industrial chemicals is lacking. The goal of this study was to compare kdeg values using different concentrations (e.g. 0.2, 1 and 5 µM) for four fragrance chemicals. These chemicals represent a diverse class of high log Kow (4.3-6.5) industrial chemicals. Rainbow trout liver S9 fractions from different sources were used and their enzymatic activity characterized using commonly used fluorescence assays (EROD, p-nitrophenol glucuronidation and CDNB-glutathione conjugation) and substrate depletion assays with testosterone, 7-hydroxycoumarin, pyrene and Cyclohexyl salicylate as reference chemicals. Decrease of the percent of each chemical was analysed by GC-MS or LC-MS and kdeg values determined. For the lowest concentration (0.2 µM) ca. 2-fold higher kdeg values were observed for Polysantol, Ambrofix, Cyclohexyl salicylate and Karanal compared to kdeg values determined with 1 µM. Measured kdeg values were 2-fold lower with 5 µM except for a 4-fold lower rate for Polysantol compared to 1 µM test concentration. The biotransformation rates of the fragrance chemicals were determined at lower concentrations (0.2-5 µM) compared to PAHs indicating that their Kow is 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.

MOI75 Impact of test concentration on the in vitro intrinsic clearance using trout liver S9 fractions to predict the bioaccumulation potential of fragrance chemicals
H. Laue, Givaudan Schweiz AG / Fragrances S & T; L. Hostettler, Givaudan Schweiz AG; K. Jenner, Givaudan / Global Regulatory Affairs & Product Safety; G. Sanders, Givaudan International SA / Regulatory Affairs and Product Safety; A. Natsch, Givaudan Schweiz AG / Fragrances S &T

Bioaccumulation in aquatic species is a critical endpoint in the regulatory assessment of chemicals. The bioconcentration factor (BCF) is usually determined in fish (OECD TG 305). In vitro systems measuring biotransformation rates of
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 Mi Thars mg-1 and show a direct dose-response relationship, since when increasing the time of exposure to DVPV increased the degree of lipid peroxidation in the tissues. A decrease in AChE activity was observed in percentages between 22 and 45% and fish from 22 to 35%. The results of this study indicate that the effects of the pesticide DVPV are likely irreversible in some species.

MO178 Characterising estrogenic activity of arctic char tissue extracts in two fish in veterinary settings

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 of up to 8 times higher levels than the lowest observed effect level for egg mortality in temperate salmonid fish raise concern that organisms 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 fish livers from the following contaminants (PCBs 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 developed and used together with the established methods 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 estrogenic activity in response to the F3 fraction, vitellogen production was observed in rainbow trout 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 preformed to identify potential contributors to the observed effects in knowledge. 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. Elendir, University of Saskatchewan / Veterinary Biomedical Sciences; Y. Palagi, ISD-Experimental Lakes Area; P. Borrett, University of Saskatchewan; L. Hreinshuk, 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 resource extraction. Higher Vtg induction 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 (Oncorhynchus 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 (m=0.56, 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 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 environmental monitoring programs. Our ongoing tool development project is aimed at providing empirical 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.

MO181 Divergent immunomodulatory effects of cadmium between two marine immune cell models in vitro, macrophages and mast cells.
I.M. De Ligney, Wageningen University / Department of Aquatic Toxicology; L.H. van den 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 differential impacts on physiological functions, depending on the cell type. The pury of the proposed BN model is to integrate information from large and varied ecotoxicological and physico-chemical databases, 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.europa.eu).

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.
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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 utilized. 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 new non-destructive and less invasive methods of exposure assessment 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 exposure and extraction methods and aimed to investigate the effects of time and dose on global protein expression of primary green sea turtle (Chelonia mydas) skin cells were exposed to two contaminants known to accumulate in sea turtles - a polychlorinated biphenyl (PCB153) and perfluoroanonic acid (PFNA). The exposure was performed over 24 or 48 hours to three environmentally relevant concentrations (1 μg/L, 0.1 μg/L, and 0.01 μg/L). Global protein expression was then measured using quantitative LC/MS resulting in over 5000 unique protein identifications. Our results show that a large number of proteins, over 700, were significantly differentially expressed by cells under exposure conditions and that time and concentration had significant effects on overall differential expression as well as on the expression of individual proteins. Most significantly, a biomarker of PCB exposure that has previously been identified in sea turtles (superoxide dismutase) was expressed by cells exposed to PCB153 indicating that these methods can potentially reflect biomarkers measured in whole organisms. Overall, the results from this study provide insight into the effects that time, dose and treatment have on global protein expression of green sea turtle cells, as well as preliminary evidence for the usefulness of non-targeted proteomics for biomarker discovery. This indicates the potential of the methods described here to support higher throughput confirmation of biomarkers of exposure and effect while reducing the need for invasive sampling on threatened wildlife.

MO183 Baseline vs. Reactive Toxicity toward the Nematode C. elegans as Alternative Bioassay
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MO184 Oxidative Activation of Pro-Electrophiles Mediated by an Fe-loaded Zeolite - A Nonanional Tool for Mimicking Phase I Metabolism
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The electrocatalytic activity 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 adduct formation is the molecular initiating event (MIE) of a complex adverse outcome pathway. Kinetic chemosyssays, 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 substrutures 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 chemosyssays 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-electrophilic phenol and dihydroxynbenzene derivatives into their reactive form. These reactive intermediates are then trapped by coincubation with the tripeptide WCG (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 oxidation pathways causing the reactive toxicity of pro-electrophiles. The authors acknowledge the EU-funded project OSIIRIS (GOCE-CT-2007-037017) and the BMBF-funded project ProHalTox (FKZ 031A22A and 031A22B) for financial support.


MO185 Integrated assessment of aquatic ecotoxicity for regulatory purposes
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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 ecotoxicity part of the Toxicity, we developed six continuous QSAR models for acute and chronic aquatic 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 ggdslv and VSURF to select the DRAGON descriptors and the tree ensemble (random forest) method to derive the models, obtaining good performance (R2 up to 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.vegalhub.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 applied 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 7 - 6 · 80 710/20 - 3716 414 0) by Umweltbundesamt (UBA) and LIFE COMBASE (LIFE15 ENV/E5/416) for the financial support.

MO186 An integrated testing strategy to fill data gaps for environmental risk assessment of isooalcohols
G.E. Bragin, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Sciences; B. Hedggett, ExxonMobil Biomedical Sciences, Inc.; C.A. Sutherland, ExxonMobil Biomedical Sciences, Inc / Toxicology and Environmental Science; B. Kelley, D. Letinski, ExxonMobil Biomedical Sciences Inc / Bioassay; A. Butler, 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 isoosotoc and isoosodecanol. 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 isospecies models. 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
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Glyphosate-based herbicides are widely used in agriculture. When these products are applied in the field, they are used in high quantities and have a potential impact on non-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. Nonanoic acid (a.k.a. pelargonic acid) is a biologically derived substance considered as an environmental friendly herbicide. Its toxicity level 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 against pelargonic acid and a pelargonic acid-based herbicide on aquatic systems using zebrafish as a model organism.

To our knowledge so far there are no available data for a neurotoxic effect of pelargonic acid on aquatic organisms. Hence, this outcome has to be further investigated. Financial support from the City of Vienna project Ökotoxikologie (MA 23 - Project 15-06) is gratefully acknowledged.

MO188
Chemoassay Profiling of Salicylates to Assess Their Reactive Toxicity
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Salicylates are widely used as fragrance additives or UV light absorbers in many consumer products. However, in ca

MO190
The Xenopus Embryonic Thyroid Signalling Assay (XETA) for assessment of effluents contamination in thyroid active molecules.
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The Xenopus Embryonic Thyroid Signalling Assay (XETA) was designed as a scientific tool 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) way 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 quan
tities. 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 sludge, and industrial effluents. 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 defined 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 endocrine effect 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 thyroid effect in a wastewater is linked to ecological load and rainfall; 2) Some WWTPs effluents still contains thyroid active molecules, results from chemical analysis performed on the same samples indicated a correlation between the total micropollutant load, and the thyroid effect 3) A minor part of the thyroid effect removal occurs during and decarboxylation process. The major removal of the thyroid active molecule occurs during the nitri
tation step of the water treatment.

MO191
Advances in locomotion detection of Daphnia magna, Artemia franciscana and Paramecia caudatum
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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
MO192 Validation of the in silico prediction tool for toxicity of Algae by pharmaceuticals in environment
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There are some concerns for environmental impacts of the pharmaceuticals due to the unintended environmental effects, which may be different from biological medicinal effects. Therefore, medical regulatory agencies require the assessment reports of environmental impacts by new drugs before marketing. It would be useful to predict the ecotoxicity of the new drug at the developmental stage, because the ecotoxicity studies are usually conducted at the final drug developmental stage just before submission. To validate the current in silico prediction tool, we evaluated the EC50 values for acute toxicity of the ECOSAR software, which is one of the few in silico prediction tools. In the last year, we evaluated the prediction performance of Daphnia magna and reproduction 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 out of efficient plates can be implemented on behavioral and ecotoxicological studies on small-sized aquatic invertebrates and planktonic organisms in any lab with an access to a tracking system. Financial support from the City of Vienna project Ökotoxikologie (MA 25 - Project 15-06) is gratefully acknowledged.

MO193 SeqAPASS to Evaluate Conservation of High-Throughput Screening Targets Across Species
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). Similarly, the Sequence Alignment to Predict Across Species Susceptibility (SeqAPASS) tool was developed to focus on the extrapolation of targets being evaluated as part of the Endocrine Disruptor Screening Program, including the androgen receptor, enzymes involved in steroidogenesis, and proteins in the PI3K pathway. This study demonstrates 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
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The alignment of the Endocrine Disruptor Screening Program, including the androgen receptor, enzymes involved in steroidogenesis, and proteins in the PI3K pathway. This study demonstrates 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.

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 to aquatic species. To create a universal set of rules – incubation time, chorion/no chorion, analysis timing, type of endpoints, formats, analysis procedure, etc. – that can be applied by all the zebrafish toxicity 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, at 20 zebrafish concentrations (Level 3 of the protein target of a chemical in a known sensitive species to species 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 edysone receptor (E2R) to investigate 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, while 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 E2R for more than 90 % of investigated species, but also identified dramatic species-specific differences in chemical susceptibility that align with results from standard toxicity tests. 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 reducing screening level 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.

SETAC Europe 28th Annual Meeting Abstract Book
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'-hexafluoroisopropylidenediphenol, 3-lodo-2-propyl-n-butylcarbamate, diethyldithiobromel, hexachlorophene, methylmercury chloride, rotenone and tetraethylthiuram disulfide.

MO196
MPA - an alternative for the standard procedure of Ames Test
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The Salmonella/microsome assay ( Ames Test) is the most widely used mutagenity 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 5X 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 15 known more or less potent mutagenic compounds. Six were tested only without 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)

MO198
The necessity of OASIS bead and polyethersulfone membrane extraction for the Polar Organic Chemical Integrative Samplers (POCIS) calibration: a case study for alkanephenol monitoring in produced water
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Produced water (PW) is one of the largest discharges from the oil and gas industry and includes formation and injected water. It contains several toxic compounds such as polycyclic aromatic hydrocarbons (PAHs), alkylphenols (APs), heavy metals, etc. PW is usually treated on the platform and then directly discharged into the sea. Despite the low content of toxic compounds that remain in PW after treatment, the large volume of PW lead to high total amounts of toxic compounds discharged every year into the sea; thus an effective tool for monitoring the hydrophilic organic compounds (HPOCs) is necessary. Passive sampler devices (PSDs) are the most common tools for monitoring a wide range of organic contaminants in water. By this regard, several PSDs have been used to monitor hydrophilic organic compounds (HOCs) in PW including semipermeable membrane devices (SPMDs). However, SPMDs are not suitable for monitoring HPCs in PW owing to the nature of these chemicals. It is therefore necessary to develop and standardize a passive sampler for HPCs, such as APs. Polar organic chemicals (POCs) IS is one of the most widely used passive sampler to monitor a wider range of contaminants. It allows the time weighted average (TWA) concentration to be measured and thus assess fluctuation in discharge concentrations. POCIS is composed of a sorbent (OASIS beads), two polyethersulfone (PES) membranes and two stainless steel rings. POCIS is calibrated by evaluating the sampling rate (R0), which is correlated with the contaminant concentration in the water and in the sampler, and is usually assessed by extracting the OASIS beads alone. We evaluated the effect of the PES membranes on AP uptake and, for the first time, calculated the R, following the extraction of both the sorbent and the PES membranes. This study demonstrated that there was a lag phase in uptake for APs, and that APs with log Kow>5 were accumulated more efficiently in the PES membranes. The extraction of both the PES membranes and the OASIS beads is thus needed when working with the POCIS in order to capture low contaminant concentrations and allow the detection of the less hydrophilic APs. This can be very useful in environmental applications because it may justify the use of only one passive sampler to monitor a wider range of contaminants.

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
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Bioavailability studies can be used to improve risk assessment and legislation relating to soil and sediments contaminated with 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 (Cfree). The Cfree 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 HOC in microsuspensions and are accounted for in PS methods for providing promising results to measure Cfree 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 infertile and two fertile field soils. The oil fields were located in peat bogs and consequently 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 annals 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
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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-cage experiments (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 data was further revealed with SOM chemical composition 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 (earwomans 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 non-sterile 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-sterile and sterile soils. Sterilization appeared to increase uptake rates and reduce the influence of p/p -DDE-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
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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 performed simultaneously under fields 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 Gold®) 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 Gold® 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 field conditions and highly heterogeneous rates in laboratory. However, the ratio of available/total concentrations showed the same trend of rate 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
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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 PELMO) 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 predicting the effect of pesticides on their bioaccumulation and toxicity depends on the availability of results from experimental studies. 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 procedures 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) “C” 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.

**MO293**
LFE Models for Partition Coefficients of Environmental Concern
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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 (K<sub>ow</sub>). Recently, more sophisticated prediction models have been developed and applied, including LFER approaches. Such approaches allow distinguishing between separate uptake descriptors. 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 K<sub>ow</sub>, the more sophisticated LFER equations, as known Abraham models, are preferred for such predictions. This and the respective presence of more such equations were put, 29% to 70%, 46% to 64%, 14% to 23%, 28% and 0.31%. The results of sediment characterization showed that the material, composition, surface area and adsorption capacity were significant different among sediments with different particle size, and adsorption capacity increased with decreasing particle size. In addition, the desorption rates of cypermethrin measured by Tenax extraction decreased with decreasing particle size. The development of the models was based on new experimental data, as determined by the authors. Possible sources of the required Abraham parameters are examined, compared and discussed. Particular attention is given to the environmental domain of the models. Acknowledgment: This study was financially supported by the European Union 7th Framework Programme SOLUTIONS (FP7-ENV-2013) of the under grant agreement no. 603437.

**MO284**
Influence of grain size on the bioavailability and bioaccumulation of sediment-associated cypermethrin to benthic invertebrates
H. Li, J. You, Jinan University / School of Environment Sediment particle-size distribution is an important factor influencing the bioavailability and toxicity of hydrophobic organic contaminants (HOCs) in sediment. Cypermethrin, a pyrethroid was used as an example in the current study to investigate the effect of particle size on the desorption kinetics and bioaccumulation potential of sediment-associated HOCs. Bioaccumulation test with oligochaete Lumbriculus variegatus and two chemical techniques, namely Tenax extraction and matrix-solid phase microextraction (SPME) were applied in the current study. A field sediment was collected and wet sieved to obtain five particle-size fractions: i.e., < 20 μm, 20-63 μm, 63-180 μm, 180-500 μm and > 500 μm. The toxic effects of the five size fractions were 49%, 86%, 64%, 74% and 84%, respectively. The relative effects of PAHs in zebrafish excluding digestive tract were lower after two day bioaccumulation. The difference may be caused by the efficiency of digestive tract in the later bioaccumulation; because the bioaccumulation factors of PAHs associated with particles in the digestive tract. When PAHs on suspended particles to fish is not well understood. In this study, a passive dosing system of spray was designed and two chemical techniques, namely Tenax extraction and matrix-solid phase microextraction (SPME) were applied in the current study. A field sediment was collected and wet sieved to obtain five particle-size fractions: i.e., < 20 μm, 20-63 μm, 63-180 μm, 180-500 μm and > 500 μm. The toxic effects of the five size fractions were 49%, 86%, 64%, 74% and 84%, respectively. The relative effects of PAHs in zebrafish excluding digestive tract were lower after two day bioaccumulation. The difference may be caused by the efficiency of digestive tract in the later bioaccumulation; because the bioaccumulation factors of PAHs associated with particles in the digestive tract. When PAHs on suspended particles to fish is not well understood. In this study, a passive dosing system of spray was designed and two chemical techniques, namely Tenax extraction and matrix-solid phase microextraction (SPME) were applied in the current study. A field sediment was collected and wet sieved to obtain five particle-size fractions: i.e., < 20 μm, 20-63 μm, 63-180 μm, 180-500 μm and > 500 μm. The toxic effects of the five size fractions were 49%, 86%, 64%, 74% and 84%, respectively. The relative effects of PAHs in zebrafish excluding digestive tract were lower after two day bioaccumulation. The difference may be caused by the efficiency of digestive tract in the later bioaccumulation; because the bioaccumulation factors of PAHs associated with particles in the digestive tract. When PAHs on suspended particles to fish is not well understood. In this study, a passive dosing system of spray was designed and two chemical techniques, namely Tenax extraction and matrix-solid phase microextraction (SPME) were applied in the current study. A field sediment was collected and wet sieved to obtain five particle-size fractions: i.e., < 20 μm, 20-63 μm, 63-180 μm, 180-500 μm and > 500 μm. The toxic effects of the five size fractions were 49%, 86%, 64%, 74% and 84%, respectively. The relative effects of PAHs in zebrafish excluding digestive tract were lower after two day bioaccumulation. The difference may be caused by the efficiency of digestive tract in the later bioaccumulation; because the bioaccumulation factors of PAHs associated with particles in the digestive tract. When PAHs on suspended particles to fish is not well understand. 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 burdens 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 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 bioaccumulation 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 zebrafish increased by 16.4% - 109.3% for pyrene and 21.8% - 490.4% for fluorenanthene during the first 8-d exposure. The findings from this study indicate that PAHs on suspended particles are partly bioavailable to zebrafish 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 Bioavailability Data**

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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 bullets 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 shell targets were commonly prepared using coal tar as a binding agent. It was hypothesized that the nature of the coal tar pitch/limestone matrix of the shell fragments reduces the oral bioavailability of PAHs compared to that seen in animal studies using pure benz(a)pyrene in solution. 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 ratio of 5% in the diet for fourteen days. For benz(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 the animals treated with extract 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 can be determined and averaged, but the more robust way to determine a site-wide RBAF from multiple samples is to determine a linear regression of metabolite excretion rates versus daily dosing rates. The FUE produced coefficients of determination (r²) that were typically greater than 0.95, showing that the rate of BaP metabolite excretion was directly proportional to the daily dose rate of BaP. RBAFs were determined using Monte Carlo simulations to calculate the 95% upper confidence limit on the ratio of the soil and soil extract FUEs. The site-wide RBAF was equal to 14% for BaP. Part of the RBAF 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 contaminants - from experiment to result evaluation**

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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 to 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 that 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=Kf² / (msoil/msolution); note: msoil/solution after phase separation. If p<0.3, reliability of obtained Kf values is given according to “EFSAA, 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 Kfoc from isotherms are derived. By significance of the adsorption coefficients, 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 Kfoc from isotherms are derived. By significance of the adsorption coefficients. Finally, fit quality as well as upper and lower 95 % confidence intervals of Kf and Kfoc from isotherms are derived. By significance of the adsorption coefficients. Finally, fit quality as well as upper and lower 95 % confidence intervals of Kf and Kfoc from isotherms are derived.

**MO208 Evaluation of the swimming behavior and tactic response to atrazine of the Pseudomonas sp. strain ADP**

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Atrazine is a herbicide used to control grassy and broadleaf weeds in sugarcane, wheat, corn, sorghum and other crop plants. 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 (photolyis 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 invertebrate 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 related to swimming pattern of the herbicide (the site was non-parametric, i.e. it was analyzed using Kruskal-Wallis). The physiological relevance of the chemotactic response to atrazine 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**

N. Khan, University of the Free State / Zoology and Entomology; P.M. Leeto, P. Voua Oromo, 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 toxicants. 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, i.e. it was analyzed using Kruskal-Wallis ANOVA followed by Dunns’ test. The level of significance was set to 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 Chlordecone elimination kinetics in ewes**

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Chlordecone (CLD) is an organochlorine pesticide used from 1972 to 1993 against parasites, e.g. on banana weevil, Simościopsis invicta. After CLD usage terminated in 1993 and is persistent in the soils (concentrations are above 1 mg kg⁻¹ of dry matter). Consequently, animals can be directly contaminated by involuntary soil ingestion. Previous studies showed a CLD absorption of 100% in goats and its metabolization in humans, gerbils and pigs CLD is reduced into chlordenol (CLDEN). Then CLD and CLDEN can be conjugated. No data are available about CLD metabolism and excretion. In ewes, CLD was usually consumed in the French West Indies. The objective of this study was to characterize the CLD elimination in ewes (linearity of the toxicokinetik, half-life in serum, metabolism, excretion forms and excretion routes). Three groups of 5 ewes received an intravenous single dose of CLD (0.04, 0.2 or 1mg/kg body weight (BW)). Blood, urine and feces samples were taken at defined times up to 84 days after CLD administration. CLD analysis in serum (analysis for each dose) was performed at the CART (Belgium) and CLD and its metabolites were analyzed in urines and feces (for the 1 mg/kg BW dose) at ANSES (France). For 1 mg/kg BW, 0.2 mg/kg BW and 0.04 mg/kg BW the half-life was respectively of 28.5 ± 3.0 days, 24.0 ± 6.3 days and 27.7 ± 5.0 days. These three
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 ewes is dose-dependent with the dose. In consequence, the different result obtained in this study is that CLD-DOH is not the main metabolite and that CLD is the main pesticide in interstitial water. The model study demonstrates that 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

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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 tested 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 glucuronyltransferase. 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 results were based on a former extraction method developed in 1990 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 a more sensitive method, a new development was carried out with this work. The extraction was based on 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 were set up and validated in its full extent. 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??

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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 concentrations of these contaminants and their bioavailability. Moreover, the chemical concentrations of SOCs differ 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 researches 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 apicultural matrices (honey bees, wax and pollen)

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Acaricides used in beekeeping such as coumaphos, chlorfenavinphos, amitraz and fluvalinate 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 acaricidal substances were detected in the analysis of the honey samples. These results clearly indicate the CLD elimination kinetic in ruminants and will help to decontaminate exposed animals in the French West Indies.

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 TROPHE project, the transfer of PCBs and PCD/DFs to plants and invertebrates has been studied. BCF in several plants and in earthworms has been measured and different models have been developed with this purpose. In earthworms, BCF values have been calculated by different models, but BCF values in plants are very different. The conclusion drawn is that there is no match between available guidelines to produce measured BCF in terrestrial organisms and the BCF needed with the REACH regulation guidance for ecological risk assessment. This guidance states that the exposure concentration for terrestrial predators can be calculated in taking in account the quantity of soil contained in the earthworms guts and the contaminant fraction metabolized in the earthworm, which is in its flesh. 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.

MO214 Adaptation requirements for the use of measured BCF for a realistic risk assessment of organic chemicals.

N. Puchaux, INERIS; S. ANDRES, INERIS / Toxicological Ecotoxicological 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 TROPHE project, the transfer of PCBs and PCD/DFs to plants and invertebrates has been studied. BCF in several plants and in earthworms has been measured and different models have been developed with this purpose. In earthworms, BCF values have been calculated by different models, but BCF values in plants are very different. The conclusion drawn is that there is no match between available guidelines to produce measured BCF in terrestrial organisms and the BCF needed with the REACH regulation guidance for ecological risk assessment. This guidance states that the exposure concentration for terrestrial predators can be calculated in taking in account the quantity of soil contained in the earthworms guts and the contaminant fraction metabolized in the earthworm, which is in its flesh. 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?

F. Jackson, University of Bradford, Environment Agency / Environment & Business; M. Gardner, Atkins Ltd; P. C. Banks-Jackson, Environment Agency (England and Wales) / Chemical Assessment Unit; P. Whitehouse, Environment Agency / Evidence

The Water Framework Directive (WFD) requires waterbodies to be at ‘good ecological status’ by 2015. There are currently three main methods to assess whether this standard is met. These are (1) measuring the chemical concentrations. A screening method according to REACH. The Water Framework Directive (WFD) requires waterbodies to be at ‘good ecological status’ by 2015. There are currently three main methods to assess whether this standard is met. These are (1) measuring the chemical concentrations. A screening method according to REACH. The Water Framework Directive (WFD) requires waterbodies to be at ‘good ecological status’ by 2015. There are currently three main methods to assess whether this standard is met. These are (1) measuring the chemical concentrations. A screening method according to REACH. The Water Framework Directive (WFD) requires waterbodies to be at ‘good ecological status’ by 2015. There are currently three main methods to assess whether this standard is met. These are (1) measuring the chemical concentrations. A screening method according to REACH. The Water Framework Directive (WFD) requires waterbodies to be at ‘good ecological status’ by 2015. There are currently three main methods to assess whether this standard is met. These are (1) measuring the chemical concentrations. A screening method according to REACH. The Water Framework Directive (WFD) requires waterbodies to be at ‘good ecological status’ by 2015. There are currently three main methods to assess whether this standard is met. These are (1) measuring the chemical concentrations. A screening method according to REACH.
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 which were not used in the decision making. The results were 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 solution before washing to achieve better cleaning. Some components of detergent are toxic (HERA, 2013; Chuku 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 routine method 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 proportion 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, N., Adeniyi, J. et al. (2015). Effect of washing carrot with Omo detergent on the nutrient composition, sensory characteristics and microbial count. J. Food Sci. Tecnol. A process-based population model for algae L. Azzevedo, BASF SE, Agrarzentrum Limburgerhof / Global Toxicology; M. Habekost, 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) non-growing (biomass) loss due to predation and grazing, (2) growth due to nutrient supply, and (3) recovery following exposure. The prediction performance of the model is demonstrated via model validation on field and laboratory data from several hydroecological sites across Europe. The model setup might serve as a basis for the development of a standardized model for algal population dynamics in aquatic ecosystems and can serve as the basis for a regional to continental scale model for the risk assessment of edge-of-field aquatic organisms. In this poster, the modelling approach will be presented and a comparison of the model results with the EFSA’s guidance document will be shown. The differences will be discussed in terms of potential future developments of the model. Furthermore, we will present results from the application of the model to data from 19 hydroecological sites in Europe and will discuss the impact of different exposure scenarios on the recovery of populations of cyanobacteria. This is the first attempt to apply a process-based algal biomass model to data from real-life situations, and the results will be discussed in terms of its potential for future modelling applications.

MO222 Population dynamics of a soil arthropod simulated using an individual based population model and established fate model data D. Nickisch, T. Wittwerk, Rifcon GmbH and Research Institute gaiac / gaiac, Germany 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 conflicts have been raised in the past, but the predictive power of chemical fate modelling has not been challenged so far. Here we present a population model of the soil arthropod (Dermaptera, Potamidae) Heteronymphe aegilops. The model was parameterised using fate model data from literature, to take into account the species specific fate of the arthropods. We made the assumption that a terrestrial arthropod can be described using a single species model. The species specific model structure allows for the investigation of the population dynamics of the arthropod, and the identification of species specific factors. The population model can then be used to estimate the potential for pesticide-leaching into groundwater and to predict the exact population size and fluctuations for this species. Because of the lack of fate model data on other species of arthropods and soil invertebrates, we are working on the development of a standardised species specific population model.
Therefore, it is necessary to prepare for possible chemical accidents of phenol. The organisms and its exposure can cause ecological and economical damages. 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 temperature series which represent the winter-summer different. These trends were not caught by the model predictions as well as the contact time (non exogenous DOC incremented mobility (up to a indicated that equilibrat (25 °C vs. 15° C) and in saturated vs. pseudo field capacity conditions. Results water vs. a solution prepared with commercial humic acid), at different temperature impacted procedures of glyphosate products. Therefore, we consider it necessary to develop an extension of the risk assessment to evaluate the indirect effects of specific 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 the 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 inffeld. 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).

MO225 Assessing and managing food-web effects of Plant Protection Products
K. Kwarsnawsky, 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) also acknowledge this aspect by mentioning indirect effects to be considered in the assessment of the impacts of PPPs on the environment. The results of a risk assessment of PPPs has been well documented and recent scientific opinions of the European Food Safety Authority (EFSA) confirm the need for their inclusion in the environmental risk assessment of plant protection products. As a first step towards this direction, the currently renewed approval of glyphosate includes an obligation to the EU Member States to assess and manage the risk to diversity and abundance of non-target terrestrial arthropods and vertebrates via trophic interactions in the course of authorization procedures of glyphosate products. Therefore, we consider it necessary to develop an extension of the risk assessment to evaluate the indirect effects of specific 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 the 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 inffeld. 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).

MO226 Compensating for ecological risks of pesticides
S. Matezki, K. Kwarsnawsky, 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. Although scientific communities already mentioned the importance of compensatory measures, the relevance of indirect effects of pesticides has not escaped our notice that our proposal could also make作者是setac欧洲28届年会摘要书
MO228
Historical control data of the optimized Zebrafish Embryonic Development Toxicity Assay (ZEDTA)
D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobar-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beckhuijzen, H. Emmen, Charles River Laboratories Den Bosch / GET; 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 96h. Exposure medium was renewed after 48 hours. Development were 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 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 (ZEEDA)
D. van den Oetelaar, Charles River Laboratories Den Bosch / GIT; M.A. Tobar-Kaplon, Charles River Laboratories Den Bosch / GET; M. Beckhuijzen, H. Emmen, Charles River Laboratories Den Bosch / GET; 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 development and growth 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 Environmental Agency; J. Schwaiger, Bavarian Environment Agency / Aquatic Toxicology and Pathology

Field 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 - are 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 EQSs. Even though several reporting and evaluation criteria for ecotoxicological studies have been published (e.g. Klimisch, 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 statistical significance of results, decreasing the specificity of endpoints 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 inhabiting 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 Ryukyus / 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 1980s (i.e. 50-100% Cu in river water in 1897). Although the heavy metal concentrations remarkably decreased since 1960s, the concentrations are still higher than in a 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 heavy metals 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 6-aminohexanoic acid deaminase, 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.
the objective of this study was to determine the toxic and genotoxic effect of the metals Cd, Cr, Cu and Pb which are present in the freshwater systems of the valley of Mexico, on juveniles of D. rerio, to evaluate the use of these fish as biosensors in environmental monitoring studies. Static bioassays were carried out with a duration of 48 hours, with each metal. Five toxic concentrations were used in duplicate, plus a non-toxic control. The L<sub>50</sub> was determined and with the surviving organisms the evaluation of genetic damage was carried out, by means of the evaluation of frequency of micronuclei in blood cells (1000 cells). The results obtained showed that the toxicity of metals and their mixture, based on the L<sub>50</sub> calculated was: Cu> Pb>Mix > Cr > Cd. The Kruskal-Wallis test indicated that there are significant differences between the degree of genetic damage in exposed organisms to different metals and controls (0.05%). The metal with the highest genotoxic effect was lead (0.05%), followed by cadmium (0.06%). Copper showed the lowest genotoxicity (0.37%). The metal mixture had a microuneculour frequency of 1.23%. The juveniles of D. rerio had deleterious effects in concentrations of metals lower than the LMP (Maximum Permissible Limits) that marks the NOM 001 Semarnat for water discharges to natural systems, so it is possible that they can be used as biosensors in the studies of environmental monitoring.

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-hydroxyphenylpropion 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, 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 axis (HPG) axis were investigated. The estrogenic (increase in 17β-estradiol/testosterone [E2/T] ratio) and anti-androgenic (decrease in T) effects were commonly observed in zebrafish exposed to 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 steriodogenic 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 the key structural component responsible for the estrogenic and anti-androgenic 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 DWH subacute exposure D. Wetzel, Mote Marine Laboratory / ELF, R. Medvecky, C. Miller, K. Main, T.A. Sherwood, Mote 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 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, DWH 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 disrupt 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, including: 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 comparing multiple pathways of exposure, and resulting impacts in terms of biological and ecological implications.

MO235 Impact of PAH/oxyster-PAH mixtures on heart development in zebrafish V. Cunha, 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/oxyster-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), oxyster-PH (the ketones 4H-cyclopenta[a]phenanthrene-4-one (4H-CPO), benzo[a]fluoranthene (BF) and 6H-benzo[c]pyren-6-one (6H-BPO)) 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 exposure to 6H-BPO 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 ZFE exposed to 6H-BPO 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 4H-CPO in mixture with BP. Gene expression analysis showed significant up-regulation of genes in vivo and in cardiac tissue development (tbx5), especially for ZFE exposed to the combination of oxy-PAHs with BP. Notably, the up-regulation of these two genes correlated with the formation of string heart. In summary, the binary mixtures were more potent then oxyster-PAHs alone in inducing cardiototoxicity, except in the case of 6H-BPO which seems to be a very potent oxyster-PAH. The oxyster-PAHs and PAHs interact and thereby increase the either effect 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 shows 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. Electrophysiological and blood flow exposure for retene caused a decrease in growth or energy consumption by day 14. 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 cypla). In addition, cep1 and celp and traf-like-domain expression were found similarly changed across all treatments but not at all sampling occasions. Using overrepresentation analysis revealed several biological processes affected, such as blood vessels and heart development following mixture treatment. Proteomic 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 metabolic pathways were found significantly changed by day 14. Through bioinformatic and computational methods, our study discovered several pathways affected by PAH exposure, together with phenotypic alterations, highlighting the unique Moa of different PAHs and as a mixture.

MO236 Induction of developmental cardiotoxicity in rainbow trout (Oncorhynchus mykiss) following PAH mixture exposure - new insights using an integrated OMICS approach A.N. Eriksson, C. Rigaud, 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 altered endocrine expression 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 aryl-hydrocarbon receptor agonists that up-regulate CYP1a expression and thereby induce their own metabolism, while other PAHs like fluoranthene directly inhibit CYP1a activity. ’n We exposed newly hatched rainbow trout fry (Oncorhynchus mykiss) semi-statically to retene and fluoranthene 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 shows 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. Electrophysiological and blood flow exposure for retene caused a decrease in growth or energy consumption by day 14. 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 cypla). In addition, cep1 and celp and traf-like-domain expression were found similarly changed across all treatments but not at all sampling occasions. Using overrepresentation analysis revealed several biological processes affected, such as blood vessels and heart development following mixture treatment. Proteomic 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 metabolic pathways were found significantly changed by day 14. Through bioinformatic and computational methods, our study discovered several pathways affected by PAH exposure, together with phenotypic alterations, highlighting the unique Moa of different PAHs and as a mixture.
includes detoxification enzymes induction (CYP1A), hemorhaging, 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 phloroglucinol can also induce cardiovascular defects (e.g., arrhythmia) via unknown AhR-independent mechanisms. In this study, we explored to explore the mechanisms of toxicity of individual PAHS in the rainbow trout (Oncorhynchus 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 genotoxic and nongenotoxic mechanisms 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 mainly within the GO terms. Exposure to 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.I Ezennweye, University Benin / Animal and Environmental Biology; N.O. Ezennweye, 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 μg.L⁻¹) of the drug in triplicates and observations of embryo development were made at different developmental stages. Morphological, physiological and behavioural responses were observed. Exposure to acetaminophen significantly altered the morphological and behavioural properties of the fish. The effects were observed to be dose and time-dependent, as more poisonous 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.


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 enzymatic 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 produced by the presence of reactive oxygen species (ROS) and relative modulation of scavenger molecule/enzymes, seems to be the crucial event influencing the expression of some biochemical markers related to toxicity, inflammation, cell cycle control, angiogenesis, indicating the possible stimulation of pathways responsible of 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 estimation of affinity constants for perfluorinated compounds in rainbow trout (Oncorhynchus mykiss) proteins. D. Dejii Esposit, Sirstea / UR RIVERLY Laboratoire Ecotoxicologie; A. Vidal, Sirstea; R. Casadio, University of Bologna / Department of Biotechnology and Environmental Biology; I. Tongo, University of Benin / Laboratory of Developmental Toxicology of a Non-Industrial Chemical Substance. Irstea Lyon; R. Casadio, University of Bologna / Department of Biotechnology and Environmental Biology.

Expression of genes related to cell cycle, stress, biotransformation, apoptosis and oxidative stress, were analyzed by enzymatic 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 produced by the presence of reactive oxygen species (ROS) and relative modulation of scavenger molecule/enzymes, seems to be the crucial event influencing the expression of some biochemical markers related to toxicity, inflammation, cell cycle control, angiogenesis, indicating the possible stimulation of pathways responsible of cancer promotion. Acknowledgements: the project CISAS “Centro Internazionale di Studi Avanzati su Ambiente, Ecosistema e Salute umana” (CUP B62F15001070005) is funded by CIPE- MIUR.

MO241 Impact of metformin on zebrafish (Danio rerio) embryos. S. M. Schlegel, University of Heidelberg / Aquatic Ecology and Toxicology; T. Brauneck, University of Heidelberg / Centre for Organisational Studies

The biguanide metformin is an insulin-sensitising agent through its characteristics to increase peripheral glucose uptake and to decrease hepatic gluconeogenesis and insulin secretion. Through its antihyperglycemic effect, metformin is one of the most commonly prescribed drugs for patients with type II diabetes mellitus. At the same time, metformin is also used as therapy agent for women with polycystic ovary syndrome (PCOS), a reproductive abnormality disease, and is being screened as a potential anti-cancer drug. Therefore, just in Germany Burton usage has almost tripled in the last 10 years to 1,100 tons (2010) and it is still increasing. As a consequence of the high consumption, the pharmaceutical is detectable at relatively high concentrations in both waste water treatment plant effluents and surface waters around the world, even though most of the substance gets removed during conventional active sludge treatment. Since most of its active form (up to 100%) gets excreted through urine and faeces, the poor metabolisation of pathways responsible of cancer promotion.

MO242 Pyrrolag and its structurally related compounds on animal cytotoxicity c oxidative activity. Y. Kim, K. Kim, H. Jeon, H. Kim, Y. Choi, S. Lee, Kyungpook National University

Pyrrolag is a benzenetriol being a brownish solid, and is used for hair dyes after mixing with copper sulphate. A recent report on mutagenicity of pyrrolag-containing hair gels has demonstrated that there was no 2-fold increase in revertors relative to the controls. However, it still needs to be determined its safety to the living organisms, when it is introduced to the environment. In this study, we evaluated its inhibitory effect on cytotoxicity and oxidative activity (COX) activity,
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 three, with an EC50 value of 0.96 μM and an inhibition of 70.8% at 10 μM. Gallic acid and 1,2,4-benzenetriol showed potent inhibition on the COX activity with the concentration of 100 ppm. At a 10-times diluted concentration, these three compounds showed moderate inhibition on the enzyme activities. These phenomenon were applied all of the tested animals. Pyrocatechol, caffeic acid, quinic acid, and chlorogenic acid did not show any inhibitory effect on the COX activity. Taken together, benzenetriols including pyrogallol may be caused 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.

Triclosan (TCS, 5-chloro-2-(2,4-dichlorophenoxy) 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 (WWTWs), 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 US. 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. Bouaicha, UNIVERSITE PARIS 13.

Microcystins (MCs) are hepatotoxins produced by several groups of cyanobacteria and are present in water bodies throughout the world. Their mechanism of toxicity consists of a potent inhibition of protein phosphatases 1 and 2A, which causes disruption of the cytoskeleton and consequent cell death. They can also alter the antioxidant system and induce oxidative stress in various organs of many species. Microcystin-LR (MC-LR) is the most studied variant due to its high toxicity and frequent occurrence in surface waters. In this study, we used a Microcystis aeruginosa bloom extract containing mainly the microcystin-LR congener. We compare the acute toxicity of this extract on two models: the common carp Cyprinus carpio, an omnivorous fish living in permanence in fresh waters in the presence of cyanobacteria and their toxins and the Wistar rat used usually as toxicological model. Two doses, 20 and 100 µg equivalent MC-LR/kg body weight (BW), were administered by gavage to male and female of both models weighing approximately the same mass of 200 g. Acute toxicity of the extract was evaluated regarding effects on kidneys, intestine, lungs and gills were been assessed by histological observations and analysis of oxidative stress biomarkers: lipid peroxidation (LPO), reduced glutathione (GSH) level, glutathione-s-transferase (GST) and glutathione peroxidase (GPx) activities. The results obtained showed that the two sublethal doses of MC-LR cause in both species remarkable histological abnormalities characterized by a hemorrhage and inflammatory infiltrate in all organs. The analysis of the oxidative stress biomarkers in all organs of both models have shown a very significant increase in the lipid peroxidation level and the activity of the GST with a significant decrease in the concentration of GSH and the GPx activity. In addition, the most affected organs in the rat are the lungs but for the carp are the kidneys. **Key words**: Microcystin-LR, acute toxicity, oxidative stress, histological study.

MO245  
**Subchronic toxicity of a Microcystis aeruginosa bloom extract containing mainly the microcystin-LR congener on the common carp Cyprinus carpio**  
R. Bordj, Z. Hadjer, H. Nasri, Laboratory of Biodiversity and Ecosystem Pollution, University of El Tarf, Algeria.; N. Bouaicha, UNIVERSITE PARIS 13.

The occurrence of harmful cyanobacterial blooms in surface waters is often associated by a production of variety of cyanotoxins that represent a hazard for human and animal health. Microcystins (MCs) are the most common cyanotoxins and may be expected wherever blooms of cyanobacteria occur in surface waters with more than 100 variants have been characterized. Among these cyanotoxins, microcystin-LR (MC-LR) is the most studied congener due to its high toxicity and frequent occurrence in surface waters. The purpose of the present study was to investigate the effects of 12-week gavage of a Microcystis aeruginosa bloom containing mainly the congener MC-LR (95%), in male and female of juveniles (200 g) weight common carp (Cyprinus carpio). The fishes were been randomly assigned to three groups. Group I, the control group, received daily physiological serum (500 μL) containing 2 and 10 μg equivalent MC-LR/kg body weight (BW) for 12 weeks, respectively. The effects on the hepatopancreas, kidneys, intestine and gills have been evaluated by histology and determination of some enzymes activities. The occurrence of harmful cyanobacterial blooms containing the two doses of MC-LR resulted in a significant increase of lipid peroxidation and GST activity in both male and female group. However, a significant decrease in both GPx activity and the GSH level have been observed. In addition, the results of the histological study and biomarkers of oxidative stress have shown that male fish are much more sensitive to the bloom of cyanobacteria containing microcystins than females. **Key words**: MC-LR, Cyprinus carpio, oxidative stress, histological study.

MO246  
**Diluted bitumen vs. conventional crude oil: effects of developmental exposure on first- and second-generation zebrafish**  
D. Lyons, University of Alberta; D. Philibert, K.B. Tierney, University of Alberta / Biological Sciences.

The Canadian oil sands industry produces a heavy, viscous crude oil called bitumen. Due to its viscosity, bitumen must be diluted with natural gas condensates to create diluted bitumen or ‘dilbit’ to reduce viscosity and thereby facilitate pipeline transport. The composition of dilbit differs greatly in chemical composition compared to conventional crude oils and the impact of dilbit exposure on aquatic organisms has not been well characterized, despite its widespread transport across North America. In this study, the effects of developmental exposures on breeding success and next generation embryos were compared between dilbit and two conventional crude oils (mixed sweet, and medium sour composite). Zebrafish embryos were exposed to water accommodated fractions of these oils from 0-7 days post fertilization (dpf) and gene expression and DNA methylation were measured at 7dpf. Exposed 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 unexposed 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 these leaking conventional crude oils may 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.

MO247  
**Effect of skatole and its metabolites on piscine Phase I metabolism**  
V. Zlabek, University of South Bohemia in Ceske Budejovice / Faculty of Fisheries and Protection of Waters South Bohemian.

The occurrence of harmful cyanobacterial blooms in surface waters is often associated by a production of variety of cyanotoxins that represent a hazard for human and animal health. Microcystins (MCs) are the most common cyanotoxins and may be expected wherever blooms of cyanobacteria occur in surface waters with more than 100 variants have been characterized. Among these cyanotoxins, microcystin-LR (MC-LR) is the most studied congener due to its high toxicity and frequent occurrence in surface waters. The purpose of the present study was to investigate the effects of 12-week gavage of a Microcystis aeruginosa bloom containing mainly the congener MC-LR (95%), in male and female of juveniles (200 g) weight common carp (Cyprinus carpio). The fishes were been randomly assigned to three groups. Group I, the control group, received daily physiological serum (500 μL) containing 2 and 10 μg equivalent MC-LR/kg body weight (BW) for 12 weeks, respectively. The effects on the hepatopancreas, kidneys, intestine and gills have been evaluated by histology and determination of some enzymes activities. The occurrence of harmful cyanobacterial blooms containing the two doses of MC-LR resulted in a significant increase of lipid peroxidation and GST activity in both male and female group. However, a significant decrease in both GPx activity and the GSH level have been observed. In addition, the results of the histological study and biomarkers of oxidative stress have shown that male fish are much more sensitive to the bloom of cyanobacteria containing microcystins than females. **Key words**: MC-LR, Cyprinus carpio, oxidative stress, histological study.
Cytochrome P450 (CYP) enzymes are dominant players in metabolism of 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 animal feed related to its organort is due to its biological effects. To the best of our knowledge, no studies attempted to investigate the effect of skatole and its major metabolites on piscine CYPs. The aim of this study was to identify weather skatole and its metabolites, 2-aminoacetophenone, indole-3-carbinol, 3-methylindole, and 3-hydroxy-3-methylindole, can interact with fish CYP isoforms. Enzyme activities of CYP2A and CYP2O2A in rainbow trout hepatic microsomes were measured in the presence or absence of skatole and its metabolites. Following concentrations of tested inhibitors were used: 0.5; 5 and 50 µM. Skatole and indole-3-carbinol showed no inhibition potency on either CYP1A or CYP2A, 2-Aminoacetophenone, 3-methylindole and 3-hydroxy-3-methylindole reduced CYP1A enzyme activity by approximately 25-35%, whereas CYP2A activity remained unaltered. Physiological consequences of such 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.

MO248 Linkage of gene expression patterns with in vivo endpoints: gaining deeper insights A. Zenker, University of Appl. Sc. Northwestern Switzerland / Institute of Environmental Toxicology; 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 geneexpression patterns in the fish embryo acute toxicity (FET) test 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 malformations. The expression patterns of such 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. Cremen, Eawag - Swiss Federal Institute of Aquatic Science and Technology / Environmental Chemistry; C. Garoce, INERIS; A. Boulahfouf, INSERM / IRCM - U1914; F. Biron, INERIS / Ecotoxicology Unit; W. Bourgueit, CBS CNRS UMR5046 - INSERM U1050; A. Escaud, Université de Montpellier; M. Grimaldi, INSERM / IRCM - U1914; S. Ait-Aissa, INERIS / UMR SEBIO ECOT; P. Balaguer, INSERM / IRCM - U1914

In the context of contamination of aquatic ecosystems by endocrine disrupting chemicals (EDCs), this work aims to provide new insights on cross-species differences in the modulation of nuclear receptors (NRs) by dietary hydrocarbon receptor (AhR) by individual chemicals and environmental mixtures, in order to help further cross-species extrapolation in the frame of the environmental risks of EDCs. To this end, a panel of individual ligands and environmental mixtures from an urban waste water treatment plant (WWTP), were screened on a set of recently bioavailable zebrafish and human reference ligands of the hPXR. Compared to their mammalian equivalents, the zfPXR whereas the clotrimazole and fexofenadine were more potent agonists of the zfGR than the hGR. Also significant differences in selectivity were noted among h and zf ER subtypes. Finally, the in vitro profiling of an urban WWTP confirmed these cross-species differences in terms of level, type (agonist vs antagonist), distribution along the WWTP. For instance, h and zf estrogenic activity was differentially detected in the sludge and the suspended material. In the same way, strong zf anti-androgenic activity was detected in the effluent while no human one can be noted. Also, strong zf mineralocorticoid activity was detected in both human and fish whereas only h and zf aldosterone activity was detected.

MO250 Combining acute toxicity, toxicokinetics and metabolomics approaches to assess the effects of triclosan in zebrafish embryos D. E. Damagal, 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. Leonardus, VU University, Institute for Environmental Studies / Department of Environment and Health; N. S. Tholen, National and Kapodistrian University of Athens / Department of Chemistry

Triclosan (TCS) constitutes a common household product ingredient, 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 needed to evaluate the toxic potential of TCS to aquatic organisms. The zebrafish 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 biotransformation data could be used complementary to the concentration of the parent TCS to interpret the induced toxicity. The final 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 highthroughput testing strategy incorporating different data analysis approaches, 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:LFABP:GFP) was used, to evaluate TCS liver toxicity potential. Concerning the toxicokinetics and the metabolism 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, that is being a broad range database for the metabolomics part of the study.

MO251 Isoprostanes in fish muscle - a non-lethal biomarker for oxidative stress P. Bulloch, University of Manitoba / Chemistry; S. Schur, D. Muthumuni, Z. Xia, University of Manitoba; W. Johnson, University of Manitoba / Chemistry; V. Palace, ISID-Experimental Lakes Area; G. Tanny, Department of Fisheries & Oceans Canada; F. S. Grandjean, Department of Food Science; S. Schur, D. Muthumuni, Z. Xia, Agalou, Biomedical Research Foundation Academy 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. Leonardus, VU University, Institute for Environmental Studies / Department of Environment and Health; N. S. Tholen, National and Kapodistrian University of Athens / Department of Chemistry

Triclosan (TCS) constitutes a common household product ingredient, 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 needed to evaluate the toxic potential of TCS to aquatic organisms. The zebrafish 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 biotransformation data could be used complementary to the concentration of the parent TCS to interpret the induced toxicity. The final 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 highthroughput testing strategy incorporating different data analysis approaches, 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:LFABP:GFP) was used, to evaluate TCS liver toxicity potential. Concerning the toxicokinetics and the metabolism 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, that is being a broad range database for the metabolomics part of the study.
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 vertebrate tissues. 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 mammalians; therefore, it was proposed as an alternative model for epigenetic research. The focus of this study was set on the investigation of epigenetic effects in the Zebrafish Liver (ZF-L) cell line after 48 h of exposure to selected compounds. The cells were exposed to the LCO_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-methylocoumarin (DEM)), and to the metal selenium. In this study, two omics based tools focused on characterizing the rainbow trout intestinal region. These data represent the first thorough characterization of the rainbow trout intestine with annotated proteins varying from 3,100 to 3,899 dependent on the region. Significant differences in proteins changed markedly between the pyloric and pos

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 particular risk for changes in internal Se. This hypothesis is 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. Initially, the maternal transfer of dietary SeM and its effect on the F1 generation were characterized in a short-term fish species assay, all the embryos used were fed a 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 studying 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 walleye, brook trout and northern pike.

MO253 Preliminary characterization of the rainbow trout intestine using omics based approaches. L.M. Langan, Plymouth University / Biological and Marine Sciences; S. Owen, AstraZeneca / Safety Health Environment; A.N. Jha, Plymouth University / Biological Sciences

Intestinal function is central to the physiology, health and disease of numerous organisms. However, little is known about its gene or protein profile in trout, a widely studied and environmentally relevant model laboratory organisms. In this study, two omics based tools focused on characterization RNA and protein expression were used to establish the ontology of each intestinal region viz. the pyloric, anterior, mid and posterior region. RNAseq was carried out on intestinal regions and mapped back to the rainbow trout genome (84 %). Following filtering for transcript abundance using TPM and a p-value cut off, 23,635 – 25,435 contigs were identified over the 4 regions and included enzymes involved in metabolism of chemicals such as the cytochrome P450 family (CYPs). Differential expression of genes between regions did not vary significantly between the pyloric, anterior or mid intestine (~6 genes), however, most pronounced differences were seen in the pyloric and posterior region (~29) highlighting their differences. Proteomic characterization established over 3,899 proteins present in the intestine with annotated proteins varying from 3,100 to 3,899 dependent on intestinal region. Significant differences in proteins were observed between intestinal regions further confirming trends observed in the parallel transcriptomic study. These data represent the first thorough characterization of the rainbow trout intestine, and will allow the identification of enzymes present in this organ which may be responsible for xenobiotic metabolism.

MO254
Zebrafish responses to the fourth-generation progestin drospirenone exposures

C. Quintaniero, Department of Biology & CESAM - University of Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; M. Monteiro, Aveiro University / Biology

Synthetic progestins (PGs) represent an important class of active ingredients of hormonal medicines/pharmaceuticals. In addition to its endocrine activity, it is known that PGs can interfere with other physiological and biochemical processes such as reproduction and metabolism. The present work aimed to investigate the effect of drospirenone (DRP) on the zebrafish (Danio rerio) in both acute and chronic exposure. As a follow-up to the previous studies, the present work focused on the long-term effects of DRP on zebrafish. DRP was administered to zebrafish (Danio rerio) at different concentrations, including 10.0 µg/l, 100.0 µg/l, and 1000.0 µg/l. The results indicated that DRP induced adaptive stress responses in zebrafish, including increased levels of cortisol (CORT) and decreased levels of vitellogenin (VTG). The higher concentrations of DRP (100.0 µg/l and 1000.0 µg/l) led to significant changes in the expression of stress-related genes, such as hspa1a, hspa1b, and hsp70. Additionally, DRP exposure led to a decrease in the expression of VTG, indicating a potential impact on reproduction. Overall, the results suggest that DRP can induce adaptive stress responses in zebrafish, and further studies are needed to understand the mechanisms involved.
vtg-ir bands similar to those of females. Likewise, plasma E2 concentration in males was significantly increased but the opposite was observed in T levels. These changes were also reflected in E2/T ratio. Furthermore, E2 levels in treated males were even higher than those of females. Vtg and ERα gene expression was up-regulated both in liver and skin after E2 treatment. Potential impact in parental behavior is discussed. We conclude that vtg and ERα expression in skin are sensitive and non-harmful biomarkers of estrogenicity in this Sub-Antarctic fish.

MO261 Thyroid disruption and its effects on neuronal development of zebrafish A. Häger, Institute for Environmental Research, RWTH Aachen / Department of Ecosystem Analysis ESA; C. Di Paolo, RWTH Aachen University / Ecosystem Analysis ESA; H. Hollert, RWTH Aachen University / Institute for Environmental Research

The endocrine disrupting effects of estrogenic compounds on humans and different species in the environment are well studied. But despite the growing numbers of patients diagnosed with thyroid disorders, thyroid hormone disrupting effects of compounds are less investigated. Furthermore, it is estimated that many substances found in our environment can influence the thyroid system and act as thyroid hormone disruptors. Thyroid hormones play a critical role in brain development and it has been shown that a lack reduces cognitive development. But the connections between thyroid disruption and developmental neurotoxicity are rarely studied and the basic mechanisms remain unknown. Because the thyroid system is well conserved among vertebrates, effects observed in humans can also be expected in wildlife. Out of a series of fathead minnows (Pimephales promelas) larvae, 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 Imiprotrin 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 lipids (lipoperoxidation), the activity of the enzyme acetylcholinesterase (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 was carried out where zebrafish juveniles were exposed to 2 sublethal concentrations (LC\(_{10}\) and LC\(_{50}\)). 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 imiprotrin. 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 Imiprotrin tests and 81% in the Dichlorvos bioassays. The insecticides Dichlorvos and Imiprotrin 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.

MO265 Effects of Omeprazole on zebrafish embryos (Danio rerio) A. Sobrino-Figueroa, Universidad Autonoma Metropolitana Iztapalapa / Hidrobiologia; J. Salazar Hernández, Universidad Autonoma Metropolitana Iztapalapa / Biologia

Omeprazole is a proton pump inhibitor, it is used for the control of gastritis, for this reason it is one of the most prescribed drug, consumed by millions of people in the world. This drug has been associated with acid rebound hypersecretion, decreased calcium absorption, decreased gastric acid secretion and potentially increased risk of peptic ulcer disease. Its safety and efficacy have been extensively investigated in vitro and in vivo in a wide range of species, including humans. Omeprazole has been reported to affect the thyroid system. In this work was made an evaluation of the toxic effect of Omeprazole in zebrafish embryos. Bioassays were performed (OECD test 236) where the embryos were exposed to 5 concentrations of the drug (200, 100, 50, 25, 12.5 mg L\(^{-1}\)) plus a negative control, to determine the LC\(_{50}\) (24 hours). The embryos were subsequently exposed to the LC\(_{10}\) and LC\(_{50}\) to evaluate the degree of exposure, by means of the evaluation of THs (Buege and Aust, 1978), the activity of the enzyme AChE as an indicator of effects neurotoxic (Ellman et al., 1961) and the frequency of malformations (OECD test 236). In the lethality tests, the LC\(_{50}\) value of 193.87 ± 18.48 mg L\(^{-1}\) was obtained. In the sublethal bioassays at 72 hours of exposure it was observed an increased in the degree of lipid peroxidation (52%) in 3 embryos exposed to LC\(_{10}\).

The evaluation of the AChE activity, significant differences were obtained between the control and the embryos exposed to omeprazole (p < 0.05), in the concentrations LC\(_{10}\) and LC\(_{50}\); a decrease in the activity of this enzyme was observed. The percentage of inhibition of AChE varied from 9 to 66.7%. A higher frequency (22%) of deformed embryos was observed in the LC\(_{50}\) concentration. The results of this study showed that omeprazole has a neurotoxic and possibly genotoxic effect in sublethal concentrations in zebrafish embryos.

MO266 The neurotoxic effects of Venlafaxine on zebrafish larvae - Omics technologies in the focus of global environmental challenges M. Fenske, Fraunhofer Institute for Molecular Biology and Applied Ecology IME, Germany / Department of Ecosystem Analysis ESA; C. Di Paolo, Instit for EnvironmentResearch RWTH Aachen Univ / Department of Ecosystem Analysis; J. Legradi, Vrije Universiteit Amsterdam; A. Haigis, Institute for Environmental Research RWTH Aachen University; H. Hollert, RWTH Aachen University / Institute for Environmental Research; I. Werner, Eawag, Swiss Federal Institute of Aquatic Science and Technology; M. Fenske, Fraunhofer Institute for Molecular Biology and Applied Ecology IME

The identification, analysis and evaluation of neurotoxic chemicals are a worldwide challenge. 'The societal costs for neurological disorders caused only by endocrine disrupters in Europe was 'estimated to amount to hundreds of billions euros per
year. Considering the ecosystem services/inputs, effects on single species, communities and whole ecosystems would increase that up to hundreds of times, similarly to when considering other chemicals such as neuroactive pharmaceuticals. Antidepressants such venlafaxine are of increasing environmental neurotoxic concern. Venlafaxine is one of the most prescribed antidepressants in Europe and the U.S. and a known aquatic pollutant. 5-HT is a serotonin-norepinephrine reuptake inhibitor, increasing serotonin and norepinephrine concentrations in brain regions. It was also shown to affect monoamine levels and cause behavioral alterations in zebrafish. The aim of this study was to analyze the neurotoxic potential of Venlafaxine on zebrafish larvae by evaluating transcriptomic profiles and behavioral alterations. The locomotor activity in zebrafish larvae was measured in 5 dpf larvae exposed to 24 h to 1, 10 nM, 100 nM and 1000 nM venlafaxine using DanioVision® and EthoVision. A significant difference in the swimming behavior concerning the different concentrations could be detected. Effects on the transcriptome were verified in zebrafish chronically exposed to Venlafaxine at 1 nM, 100 nM up to 120 hpf. RNA was extracted from pooled samples of 25 fish and submitted to a flow cytometry real-time quantitative real-time polymerase chain reaction (qPCR) using a target gene set and a database of targets involved in circadian rhythm regulation, muscle processes and responses to abiotic stimuli. Behavioral results indicate decreased swimming distance and increased thigmotaxis with 1000 nM exposed fish, in agreement with previous own data for continuous venlafaxine exposure. Results from qPCR indicated modulation of some of the pre-selected target genes such as sklh5 and currently unconfirmed qPCR being evaluated. Furthermore, in vivo zebrafish models were used to assess proteome and metabolome analysis. This study is expected to be a part of a bigger overview and understanding of the different effects of chemicals and pharmaceuticals on neuronal development.

Years of exposure to FLX in the environment have a significant impact on aquatic ecosystems and fish behavior. FLX, a primary ingredient of antidepressants, is commonly found in water bodies and can affect fish behavior and metabolism. This study aimed to determine the acute effects of FLX on zebrafish behavior, specifically focusing on locomotor activity, feeding, and swimming behavior. The effects of FLX were measured in 30-day experiments, and the results showed that exposure to FLX significantly affected fish behavior, with a decrease in locomotor activity and an increase in thigmotaxis. The study also investigated the transcriptomic changes in zebrafish exposed to FLX, using qPCR to analyze gene expression. The results indicated that exposure to FLX altered the expression of genes involved in circadian rhythm regulation, muscle processes, and responses to abiotic stimuli. These findings highlight the need for further research on the long-term effects of FLX exposure on fish and aquatic ecosystems.

MO267 Acute effects of the ayahuasca infusion (Banisteriopsis caapi and Psychotria viridis) on zebrafish and rodent models
T.S. Andrade, Universidade de Brasilia / Laboratory of Genetics and Toxicology
W. Melo Junior, University of Brasilia; R. Oliveira, State University of Campinas / SCHOOL OF TECHNOLOGY - UNICAMP; A. P. SADIO, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; M.L. da Silva, Universidade de Brasilia / genetic toxicologic; J.A. Morais, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; C. Koppe Grisolia, University of Brasilia / Department of Genetics and Morphology; I. Domingues, University of Brasilia / Department of Toxicology, Faculty of Health Sciences; Ed. Caldas, University of Brasilia / Laboratory of Toxicology, Faculty of Health Sciences; A. Pic-Taylor, University of Virginia / Laboratory of Embryology and Development Biology; A. J. Legradi, RWTH Aachen University / Institute for Environmental Research

The study aimed to analyze the neurotoxic potential of Venlafaxine on zebrafish larvae by evaluating transcriptomic profiles and behavioral alterations. The locomotor activity in zebrafish larvae was measured in 5 dpf larvae exposed to 24 h to 1 nM, 100 nM and 1000 nM Venlafaxine using DanioVision® and EthoVision. A significant difference in the swimming behavior concerning the different concentrations could be detected. Effects on the transcriptome were verified in zebrafish chronically exposed to Venlafaxine at 1 nM, 100 nM up to 120 hpf. RNA was extracted from pooled samples of 25 fish and submitted to a flow cytometry real-time quantitative real-time polymerase chain reaction (qPCR) using a target gene set and a database of targets involved in circadian rhythm regulation, muscle processes and responses to abiotic stimuli. Behavioral results indicate decreased swimming distance and increased thigmotaxis with 1000 nM exposed fish, in agreement with previous own data for continuous venlafaxine exposure. Results from qPCR indicated modulation of some of the pre-selected target genes such as sklh5 and currently unconfirmed qPCR being evaluated. Furthermore, in vivo zebrafish models were used to assess proteome and metabolome analysis. This study is expected to be a part of a bigger overview and understanding of the different effects of chemicals and pharmaceuticals on neuronal development.

MO268 Chronic exposure to fluoxetine affects growth, feeding, swimming behavior and tissue organization of zebrafish.
N. de Farias, University of Brasilia / Department of 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 do Diabo; C.K. Grisolia, University of Brasilia / Laboratory 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 morphological alterations such as decrease of 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
I. 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, Chlorodane (mixture), Heptachlor, Hexachlorobenzene (HCB), and beta-hexachlorocyclohexane (beta-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 µg/L by using Seahorse XF-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 CS), associated with mitochondrial metabolism, at 120 hpf. This comprehensive study could suggest the use 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. J. Hagedoorn, Vrije Universiteit Amsterdam; A. Haigis, 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; H. Hollett, RWTH Aachen University / Institute for Environmental Research

The societal impact of neurological disorders like Alzheimer’s disease or neurodevelopmental deficits like autism is immense. They are considered endocrine disruptors, 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 disruptors that lead to neurological disorders, costs society €150 billion per year. This does not include costs due to exposure to known neuroactive substances like pesticides and pharmaceuticals. Currently, testing for neurotoxicity is not required within the EU (REACH) as it is not clear how to assess neurotoxicity. Considering the low abundance of chemicals and the physiological and morphological complexity of the nervous system, it is a major challenge to test all substances for their neurotoxic potential, new advanced neurotoxicity assessment strategies need to be developed to fulfill these demands. The bmbf funded project NeuroBox (02WRS1419; coordination UBA, T. Grummt) aims to develop novel assessment strategies for neurotoxicity assessment in 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.
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 naturally occurring and transgenic strains, and the ability to study neurodevelopmental 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-CISC / Environmental Chemistry; M. Armstrong, University of North Carolina at Chapel Hill / Department of Environmental Science and Engineering; C. Postigo, IDAEA, CID-CISC / Environmental Chemistry; K. H. Libarore, K. Lamann, S. Kimura, A. Cutherford, 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; J. SEVERYNS, Catalan Institute for Water Research (ICRA)

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 iohexol (IHX), in the formation of different classes of DBPs during source water disinfection. The presence of ICMs in source water had no apparent effect on either the concentration or speciation of the formed DBPs and non-iodinated DBPs when present during chlorination and that IPAM, in particular, is a relevant iodine source in water undergoing chlorination or chloramination. Acknowledgments: CP acknowledges support provided by EU FP7 (No. 274379, Marie Curie IOF) and the Government of Catalonia and the COFUND programme (Marie Curie Actions, EU FP7) (2014 BP_B00064). This abstract does not represent EPA policy. This work was also partially supported by the National Science Foundation, under Award NSF124865 to SDR.

MO273 The use of a polymer inclusion membrane for the determination of arsenate by gas-diffusion flow analysis with spectrophotometric detection K. Vera, University of Girona / Chemistry; C. Fontas, University of Girona / Department of Chemistry; M. G. Almeida, The University of Melbourne / School of Chemistry; E. Antico, University of Girona / Department of Chemistry; R.W. Catrall, S.D. Kolev, The University of Melbourne / School of Chemistry

Arsenic is a naturally occurring toxic element, which is present in waters in different areas around the world, including South Asia, South America and to lesser extent Europe [1]. Therefore, the World Health Organization has set the guideline concentration for arsenic in drinking water at 10 μg L⁻¹ [2]. The most frequently encountered arsenic species in environmental and drinking waters is arsenate (As(V)). Therefore, highly sensitive analytical techniques are required for its determination in water samples. In the present work a novel flow analysis (FA) system has been developed for the determination of As(V) in environmental and drinking waters at the low μgL⁻¹ level. The system uses a polymer inclusion flow cell containing 2-[3-(2-thienyl)-3H-1,2,4-benzotriazin-3-yl]-1,4-dioxane/1H-pyrene poly(vinylidenefluoride-co-hexafluoropropylene) as the polymer and Aliquat 336 as the extractant, for the on-line 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. Then the flow 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% HClO₄ 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 exhibited a linear range of 0.08–40 μgL⁻¹ with a detection limit of 0.01 ngL⁻¹ and a sampling rate of 2.5 h⁻¹ and a repeatability, expressed as RSD of 1.8% (n=5, 25 μgL⁻¹) and 2.8% (n=5, 50 μgL⁻¹). The FA method has been successfully applied to the determination of As(V) in tap water in the μgL⁻¹ concentration range. Strong References [1] Villaescusa I, Bollinger JC. 2008. Arsenic in drinking water: sources, occurrence and health effects (a review). Rev Environ Sci Biotechnol 7:307–323 [2] Bold H. 1995. Aqueous phase microextraction of As(V) in environmental samples by poly(vinylidene fluoride-co-hexafluoropropylene) membrane extraction followed by graphite furnace atomic absorption spectrometry


Balancing environmental quality standards and infrastructure upgrading costs for the reduction of microcontaminants loads in rivers

Balancing environmental quality standards and infrastructure upgrading costs for the reduction of microcontaminants loads in rivers

MO275 Cost of Iodine as a case study and diclofenac as the unregulated microcontaminant. The variability of each individual is 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)

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MO275
Calibration of passive samplers for the monitoring of drugs in French Catchment.
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Drugs are more and more consumed worldwide (ONUDC, 2017). The French Catchment 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-LCMS/MS was done in order to be able to analyze 17 compound as markers of drug uses (cocaine, heroin, amphetamine, cannabis, their main metabolites and some substitute products such as methadone) 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_day, T2_day, T3_day, T4_day, T5_day, T6_day. Water samples were also daily collected. The first result of the calibration show a good capacity of the POCIS to sample cocaine markers (cocaine, benzoyleggonine, cocaethylene, ecgonine methyl ester, benzoic acid) in WWTP. The POCIS were retrieved after 3 days over exposure time (3 to 5 days). The calculated sampling rate (Rs) vary from 0.004 for benzoyleggonine to 0.2 L/J for cocaine.

MO276
Passive sampling in surface water as an immission-based approach to extrapolate waste-water-related pressures and potential EQS exceedence in Luxembourg
T. Galle, Luxembourg Institute of Science and Technology; D. Pittois, M. Bayerle, Luxembourg Institute of Science and Technology LIST

The pressure on surface waters that is exerted by emerging pollutants depends on the water body, treated wastewater plume and the sampling point. 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 waterbody. Organic Chemical Integrative Samplers (POCIS) were used as an oxidizer in rockets, munitions, and fireworks since the middle of the 20th century. 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-LCMS/MS was done in order to be able to analyze 17 compound as markers of drug uses (cocaine, heroin, amphetamine, cannabis, their main metabolites and some substitute products such as methadone) 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_day, T2_day, T3_day, T4_day, T5_day, T6_day. Water samples were also daily collected. The first result of the calibration show a good capacity of the POCIS to sample cocaine markers (cocaine, benzoyleggonine, cocaethylene, ecgonine methyl ester, benzoic acid) in WWTP. The POCIS were retrieved after 3 days over exposure time (3 to 5 days). The calculated sampling rate (Rs) vary from 0.004 for benzoyleggonine to 0.2 L/J for cocaine.

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 the 1950s. It has been found to cause thyroid dysfunction, and has been linked to tumors in humans. 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 Electrospay Ionization/Mass Spectrometry is one of the most sensitive and robust characterization methods available for perchlorate determination (MS) providing detection limits in high-ionic-strength matrices than 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-inlet quadrupole 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 µL/L over the range of 125-5000 ng/L using the internal 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 TARGETED 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 Orbitrap GC-MS can be used to take the next step of our approach to 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).

MO279
HILIC workflow strategy for the hidden target screening of very polar compounds in surface waters
S. Veloutsou, Technical University of Munich; S. Bieger, Technical University of Munich / Chair of Urban Water Systems Engineering; S. Grosse, T. Letzel, Technical University of Munich; S. Veloutsou, Technical University of Munich; S. Veloutsou, Technical University of Munich

Passive sampling in surface water as an immission-based approach to extrapolate waste-water-related pressures and potential EQS exceedence in Luxembourg
T. Galle, Luxembourg Institute of Science and Technology; D. Pittois, M. Bayerle, Luxembourg Institute of Science and Technology LIST

The pressure on surface waters that is exerted by emerging pollutants depends on the water body, treated wastewater plume and the sampling point. 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 compounds over the whole hydrological network. Here we used passive samplers for the monitoring of drugs in French Catchment.

MO280
HILIC workflow strategy for the hidden target screening of very polar compounds in surface waters
S. Veloutsou, Technical University of Munich; S. Bieger, Technical University of Munich / Chair of Urban Water Systems Engineering; S. Grosse, T. Letzel, Technical University of Munich; S. Veloutsou, Technical University of Munich; S. Veloutsou, 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 newly 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 samples; upstream and downstream of a WWTP and wastewater effluent. The samples were analysed by the established
RPLC-HILIC-ToF/MS system. The analysis data was then processed following a non-target screening workflow for very polar compounds. After importing the data in STOFF-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. Anamal, T. Toleveli, T. Soisinski, Agilent Technologies, Santa Clara, CA, USA

Although the dwHA values are non-polar, children and adults, the MC dwHA values are 0.3 mg/L and 1.6 mg/L, respectively. Ultimately, 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: L. Tian, McGill University; J. Reining, Université du Québec à Montréal / Département des sciences biologiques; J. Verreault, Université du Québec à Montréal / Département de Biological Sciences; M. Houde, Environment and Climate Change Canada / Aquatic Contaminants Research Division; S. Baven, 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 relevant small signals 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 group of 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.

MO285 Prioritising site-specific emerging contaminants in surface water based on LC-HRMS nontarget screening data: M. Krauss, C. Hug, Helmholz Centre for Environmental Research UFZ / Effect-Directed Analysis; R. Bloch, Helmholz Centre for Environmental Research GmbH / UFZ; T. Schulze, W. Brack, Helmholz Centre for Environmental Research UFZ / UFZ; T. Sosienski, Agilent Technologies, Santa Clara, CA, USA

HRMS screening data based on automatically retrieved information and a rarity score derived from signal intensity and frequency of occurrence. The approach was applied to a set of 31 sites in different sub-basins to detect 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 benzoazines from 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. These pharmaceuticals are unique pollutants because of their special characteristics and behaviour that cannot be simulated with other organic pollutants. The untreated wastewater effluent that contains pharmaceuticals from various substances of interest (e.g. PFOS) was investigated through the RPLC-HILIC-ToF/MS system. The analysis data was then processed following a non-target screening workflow for very polar compounds. After importing the data in STOFF-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.

MO283 Monitoring and drinking waters for Microcystis 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-dependent drinking water Health Advisory (dWA) for the natural freshwater toxins, microcystins (MCs). For pre-school age children and adults, the MC dwHA values are 0.3 mg/L and 1.6 mg/L, respectively. Although the dwHA 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 detection curves from 0.5–500 ppt 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-RR, 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 study on MCs needs to be conducted in the USA. Finally, our LC/MS/MS method reduces sample preparation, chemical usage, and instrument and preparation time while meeting EPA quality assurance criteria.
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; J. Schrlau, Oregon State University / Environmental and Molecular Toxicology; S.L. Moody Simon, 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 the United States Environmental Protection Agency (US EPA) to list 16 PAHs as priority pollutants. PAHs can be metabolized by mammals and some microbes to form hydroxylated PAHs (OH-PAHs) 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) is a possible solution to this problem. Data available showed that TPs in complex environmental samples. An HPLC-HRMS method was developed for analysis of phenanthrene TPs detected in bioremediated water. Cs0, phenyl-hexyl, and fluoro-phenyl HPLC columns were evaluated for their ability to resolve hydroxypheanthrene (OH-P) isomers. Baseline resolution of 2-, 4-, and 9-OH-Ph was achieved with the Cs0, and phenyl-hexyl columns using a gradient of water/acetonitrile (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-P 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 biotic and abiotic processes. Data available showed that TPs can 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 toxicokinetic challenges of TPs, which include slow transformation by degradation 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 malathion 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 remain 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 it 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 10 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 signals of some ECs and TPs. We also characterized the transformation products 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

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 (PN/A) pilot plant towards five pharmaceutically active compounds (ibuprofen, sulfamethoxazole, metoprolol, venlafaxine and carbamazepine). Batch experiments were performed under different experimental conditions by selecting different microbial groups: i) regular PN/A operation, ii) aerobic (optimal for nitriﬁcation 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 metoprolol 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 activation of different microbial groups in combination with alternating operational parameters can actually enhance the removal of some of the studied micropollutants.

MO290
Removal of pharmaceuticals in a bioﬁlter 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. EI-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 detected in environmental samples. Non-targeted screening based on high-resolution mass spectrometry to identifying chlorinated transformation products of aromatic emerging contaminants in wastewater. Presently, the water 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 acetone 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 0.08 mg/L at 300 mg C/L acetate addition. However, the oxygen levels in the effluent increased always 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 two pharmaceuticals. Briefly, atenolol and isoproterenol removal was attributed to co-metabolism (enhanced with acetate). Metoprolol, isopropenol, diclofenac, propranolol and sulfamethazine removal were reduced 1) at lower acetate concentrations by co-metabolic degradation dependent on aerobic turnover, and 2) at higher acetate concentrations limited by suboxic conditions. Moreover, sulfadiazine, sulfamethoxazole and trimethoprim were removed independently of acetate concentration, which could be interpreted as catabolism. Biofilm reactors can be employed for polishing treated wastewater, and the addition of primary carbon source can enhance the biofilm’s performance.

MO291
Investigating inhibitory effect of anti-inflammatory pharmaceuticals on aerobic sludge biodegradation
M. GREEN, E. Topuz, G. Yusuke, E. Ubay, Cogok, 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 micropollutants regularly, focusing on priority manual and catabolism biodegradation is more relevant. Due to the fast metabolic degradation of pharmaceuticals, 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 8192) (600 mg COD/L) and without any supplementary acetate. To assess the acute inhibition of the micropollutants, respirometric assays were conducted with pharmaceutical mixture (PMs) as dissolved in MeOH (10, 50, 75g/L of each; Naproxen, Diclofenac, Ketoprofen, Mefenamic Acid, Ibuprofen, Indomethacin). Modelling studies were performed using modified Activated Sludge Model No.1 and AQUASIM 2.0 software. Pharmaceuticals were quantified with LC-MS/MS. Culture amendment with 10µg/L PMs 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 maximum hydrolysis rate of slowly hydrolysable COD (kS) decreased from 0.84 to 0.72 1/day when the concentration of pharmaceuticals increased from 10 to 50g/L. When the concentration of PMs 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 carbon mass balance. Metabolism rate (kM) can be biologically characterized constant (kS) available for biodegradation purposes. The results of this study 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-GEIP 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. Kostanjčevski, Rudjer Boskovic Institute; J. Curko, Faculty of Food Technology and Biotechnology; M. Matotic, Faculty for Food Technology and Biotechnology; M. Abel, S. Terzic, Rudjer Boskovic Institute

Since the conventional wastewater treatment process has proven to be ineffective for a number of pharmaceutical compounds, there is 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 filtration, are necessary. Overall, a decrease in BTEX levels and/or to minimize the possible overall ecotoxicity of the effluents. Therefore, the aim of this work was to examine the removal of two opioid analogs, 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 of opioid analogs was systematically studied as a function of ozone concentration, pH and matrix used to dissolve target compounds. The determination of the remaining concentration of selected compounds as well as identification of transformation products formed during the experiment were performed 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. Caimi, SETAC Europe 28th Annual Meeting Abstract Book

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 by wastewater treatment processes. Two of the most relevant contaminants are pharmaceuticals and personal care products (PPCPs), which are not removed by current wastewater treatment processes. Therefore, the aim of this work was to examine the removal of two opioid compounds, 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 of opioid analogs was systematically studied as a function of ozone concentration, pH and matrix used to dissolve target compounds. The determination of the remaining concentration of selected compounds as well as identification of transformation products formed during the experiment were performed 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.
Evaluation of Rainwater collected from Concrete underground tank and other storage tanks in Owerri Imo State, Nigeria

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 and harvesting for drinking water 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 general populace in Owerri (Metal drum tank, concrete underground tank, PVC tank and coated basin for rainwater). The physicochemical and microbiological analysis of these rainwater samples were carried out using standard method. The trace metals in the water samples were relatively below the maximum permissible limit by WHO standard except for lead which was present at low concentration with the level of 0.05 mg/L. The metal drum tank based on the heavy metal content. For bacteriological analysis, the concrete underground tank recorded the presence of pseudomonas which exceeds the WHO standard stipulated for portable water. The results further explained that concrete underground tank and metal drum tank were more contaminated in terms of physicochemical and microbiological compositions. However, the study shows that harvested rainwater may not be suitable for direct drinking without treatment, but could be used for domestic purposes.

Keynote: Harvested Rainwater, microbiological analysis, physicochemical analysis, storage facilities, trace metals

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 213M kg of phthalates are produced globally each year with end use products including food packaging, paints, tubing 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 DDEHP 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 meta-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: benzylbutylphthalate (BBP), butylbenzylphthalate (BBzBP), di(2-ethylhexyl)phthalate (DEHP), di(n-octyl) phthalate (DnOP), di(nonyl)phthalate (DnNP), and bis(2-ethylhexyl)adipate (DEHA).

Evaluation of Rainwater samples were collected from four different storage facilities commonly used by general populace in Owerri (Metal drum tank, concrete underground tank, PVC tank and coated basin for rainwater). The physicochemical and microbiological analysis of these rainwater samples were carried out using standard method. The trace metals in the water samples were relatively below the maximum permissible limit by WHO standard except for lead which was present at low concentration with the level of 0.05 mg/L. The metal drum tank based on the heavy metal content. For bacteriological analysis, the concrete underground tank recorded the presence of pseudomonas which exceeds the WHO standard stipulated for portable water. The results further explained that concrete underground tank and metal drum tank were more contaminated in terms of physicochemical and microbiological compositions. However, the study shows that harvested rainwater may not be suitable for direct drinking without treatment, but could be used for domestic purposes.

Keynote: Harvested Rainwater, microbiological analysis, physicochemical analysis, storage facilities, trace metals
extreme of phthalate contamination within Ireland, and the impacts on human health, are unknown.

MO300
Poly- and perfluoralkyl substances (PFASs) in the sewage system of the Bordeaux city: high contribution of unidentified precursors of perfluoralkyl acids

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This study proposes to identify the origin of 30 poly- and perfluoralkyl substances (PFASs) found in effluents of a French city (Bordeaux Metropolis). 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 Metropolis 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-C₇ PFCAs and 6:2 FTSAs. High levels of 6:2 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 ΣPFAS 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.d⁻¹ for the sum of targeted PFASs; concerning removal in WWTPs, only the C₆-C₁₂ PFCAs, the PFOS 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 perfluoralkyl 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 PFCAs 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 micropolutants such as pharmaceutical residues, ingredients of personal care products and estrogenic endocrine disrupting compounds (EDC) in wastewater streams. In order to give insights into the potential effects of these compounds into the aquatic ecosystems, we investigated the occurrence of antibiotics and EDCs in 4 WWTPs of Rome. The majority of the compounds were found at ng.L⁻¹ concentrations ranging from ng l⁻¹ to few mg l⁻¹. Among the emerging compounds, antibiotics are of peculiar interests due to their potential adverse effects on aquatic ecosystems diversity and function and because they can act as a potential driver for dissemination of resistance genes. Previous studies show that classes of synthetic antibiotics, such as quinolones, sulfonamides, tetracyclines, betalactams and macrolides, widely used in human and veterinary medicine, are rather resistant to microbial degradation, providing an indication as to why these compounds might persist within wastewater treatment plant (WWTP), Nonylphenol ethoxylates (NPEOs), commonly used as detergents, wetting agents, emulsifiers and dispersants, are precursor of nonylphenols (NPs) by the loss of the ethoxy groups. Nonylphenol is known, as one of Endocrine Disrupting Chemical is the degradant product of Nonylphenol ethoxylates being used as nonionic surfactant. NPs have been included in the European list of priority hazardous substances unknown. 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 Metropolis 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-C₇ PFCAs and 6:2 FTSAs. High levels of 6:2 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 ΣPFAS 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.d⁻¹ for the sum of targeted PFASs; concerning removal in WWTPs, only the C₆-C₁₂ PFCAs, the PFOS 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 perfluoralkyl 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 PFCAs in all the matrices representing 32 % (in runoff water) to more than 90 % (in domestic wastewaters) of the total PFAS molar concentrations.

Mo302
Mass flows of antimicrobial compounds in Swedish sewage treatment plants

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Antimicrobial biocides are used in numerous applications such as soaps and detergents, personal care products, clothes and textiles, in order to prevent unwanted microorganisms. In the same manner as antibiotics, they are entering our sewage system and passing on to the sewage treatment plants. Sewage treatment plants has been suggested as a possible high-risk environment when it comes to development of antibiotic resistant bacteria. Concerns has been raised that biocides might promote antibiotic resistance via co- and cross-resistance mechanisms. It is therefore important to quantify and understand the fate of these compounds within the sewage treatment plants to be able to design and construct more efficient future plants, as well as an aid in risk assessment of these chemicals. The aim of this study was therefore to determine detailed mass flows of eleven antimicrobial compounds within three Swedish sewage treatment plants. In total, the three plants were sampled for nine days for samples representing the major flows in respective plant i.e. import wastewater, treated effluent, and wastewater after the primary clarifier, primary sludge, surplus sludge, digested sludge. All samples were analysed by liquid chromatography tandem mass spectrometry (LC-MS/MS). The compounds included different quaternary ammonium compounds (QACs), such as 12-BAC, 14-BAC, DDMAC, CPC and CTAB as well as other compounds such as chlorhexidine, benzoctrazolate, ciprofloxacin and fluconazole. QACs and AC and CTAB in the learned reported. The study provides not only new scientific understanding also important knowledge to e.g. sewage treatment plant operators and law- and policy makers.

MO304
Hercides and fungicides in watersheds of agricultural regions of Ontario

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Hericides and fungicides are widely used in agriculture to control weeds and fungal diseases that can reduce crop yields. There is potential for these compounds to be transported from treated fields into surface waters via agricultural runoff. The objective of this project was to evaluate the distribution of selected current-use fungicides and herbicides in 5 major rivers and 13 smaller streams within regions of intense agriculture in southern Ontario, Canada. The Polar Organic Chemical Integrative Sampler (POCIS) was selected as a principal monitoring technique, although grab samples of surface waters were also collected throughout the POCIS deployment periods. The sampling rate (Rs) for each target compound reduction was determined in the laboratory with synthetic water over 14 days at 15°C. The sampling rates were adjusted for the influence of environmental factors (e.g. temperature, flow) by measuring the loss of Performance Reference Compounds (PRCs) spiked into POCIS deployed in the field. Extracts from POCIS and grab samples were analyzed by liquid chromatography with tandem mass spectrometry (LC-MS/MS) for water solvable and lipid solvable herbicides and fungicides and deconjugation coupled with an Agilent 1100 HPLC. Among the six herbicide target compounds, the highest maximum concentrations were observed for atrazine (1,070 ng/L), dicamba (845 ng/L) and 2,4-D (691 ng/L). The highest maximum concentrations of fungicides were for oxozaxin (959 ng/L), myclobutanil (86 ng/L) and boscalid (74 ng/L). The rest of the fungicides and herbicides were detected at concentrations below 60 ng/L. There was no correlation between the watersheds that had the highest levels of fungicides vs the highest levels of herbicides. This may reflect differences in crops grown across the region, or differences in the timing of application of the pesticides. Overall, this study indicated that selected current-use fungicides and herbicides are widely distributed at ng/L concentrations in agricultural watersheds in Ontario, Canada.

MO305
A Study on the Distribution and Behavior of Nonylphenol in the Suyeong River, Korea

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Nonylphenol is known, as one of Endocrine Disrupting Chemicals is the degradation product of Nonylphenol ethoxylates being used as nonionic surfactant. Nonylphenol is classified as an endocrine disrupter capable of interfering with the hormonal system of numerous organisms. In order to understand the current contamination and behavioral characteristics of Nonylphenol by measuring the concentration of Nonylphenol in the surface water in the downstream of Suyeong
River of Korea, and based on that, estimating the material balance. During the survey period, the range of Nonylphenol concentration in estuary of Suyeong River had the range of 142.0 ~ 569.6 ng/L and the average of 271.0 ng/L. The target area was divided into 3 regions to estimate the material balance of Nonylphenol in the downstream of Suyeong River. The dissolved Nonylphenol of 282.3 g/day occurred in region 1 of Suyeong River, and Nonylphenol influx load occurred in particulate suspended solids of 122.6 g/day. The dissolved Nonylphenol output and discharged toward the region 2 was 192.5 g/day, while the adsorption to the particulate suspended solids was 89.8 g/day. In the case of Nonylphenol within the particulate suspended solids, the outflow to the region 2 was 1,250.0 g/day and the amount of settling toward the sediment was estimated to be 422.7 g/day. The adsorption from the dissolved Nonylphenol to the particulate suspended solids in the region 1 and region 2 was 31.8% and 54.9%, respectively. In the region 3, the desorption rate was 8.8%.

MO306 Drugs of abuse distribution in Turia River based on geographic information and ecotoxicological assessment
M. Andrés Costa, R. I. Juan, O. I. Pardo, J. M. Valdés, National University of Singapore / Civil and Environmental Engineering; L. Vinagre, ATLL Concessionària de l'Agua del Túria del Riu de València / Environnement Food Safety Research Group; J. Pascual-Aguilera, V. Andreu, CIDIE-CSIC UV GV; Y. Pico, 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 series of organic compounds (ORPs) were investigated in 2012 and 2013. The analysis was performed using a GC-MS/MS spectrometric system. The results show that the most abundant drug was the amphetamine up to 102.4 ng/L. The sediments also show a contamination of benzoylcegonine (BECG), and the concentration value of 9.9 ng/L was detected. The main metabolite of amphetamine was methamphetamine (PMA) and found in 3 or 4 sampling points at concentrations < 70 ng/L in 2012. In 2013, BECG was detected in a different sampling point of 2012 at a concentration of 14.03 ng/L.

MO310 Formation of N-nitrosodimethylamine during water treatment for potable use: an update
B. G. B. Slencu, University of Medicine and Pharmacy Grigore T. Popa Iasi / School of Pharmacy; L. Avăsiliăci, I. D. Morariu, Grigore T Popa University of Medicine and Pharmacy of Iasi / School of Pharmacy

Nitrosamines can form in water in specific conditions. N-nitrosodimethylamine (NDMA) and some anion exchange resins constitute the main source of NDMA precursors. More research is required in order to establish ways to avoid NDMA and other nitrosamines formation. The presence and environmental hazard of psychoactive pharmaceutical compounds in coastal waters and biota from North-Western Spain. J. Pascual, N. Ruiz-Rey, J. R. Rodríguez, J. J. Rodríguez, L. Rodríguez, Department of Biology; N. Mastroianni, Institute of Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry; C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. López de Alda, Institute of Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry; C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. López de Alda, Institute of Environmental Assessment and Water Research IDAEA-CSIC / Department of Environmental Chemistry; B. Huerta, Catalan Institute for Water Research ICRA / Water Quality; S. Rodriguez-Moraza, Institute for Water Research (ICRA) / Water Quality; M.E. Valdés, Catalan Institute for Water Research ICRA / Water Quality; D. Barcelo, IQAB-CSIC / Department of Environmental Chemistry; Y. Valcàrrec, Research and Teaching Group in Environmental.
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 in Spain has been limited. Our work represents the first attempt at monitoring these compounds 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 PPAs (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 cilupram (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 cilupram (92.50 ng/L). Only 3 PPAs (alprazolam, cilupram and venlafaxine) were present in the collected biota samples (zooplankton, clam, clam and octopus) in concentrations up to 14 ng/g d.w. (cilupram), 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, cilupram, and sertraline. The venlafaxine concentration by glyphosate in the AMPF (FE) was shown to be 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 fish and frozen for further analysis. Then, 100μL of bile was taken to prepare a 2μg/μL of each standard (3μL-AMPF, 1μL-Alprazolam, and 13C-Alprazolam) added before extraction with milliQ 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 AMPF. 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 still detectable after glyphosate degradation. Given these facts, it makes sense to look for ways in which to adequately reuse wastewater thereby reducing freshwater demand. One such solution is the reuse of wastewater for agricultural irrigation. Benefits of this practice include the reduction in fertilizer use due to the high nutrient content of wastewater, the environmental benefits of reusing an unwanted resource and the economic advantage for farmers who have to pay little or nothing to use the resource. Furthermore it has been shown that wastewater pollutant load can be reduced as it goes through the environment through processes such as photolysis, biodegradation and adsorption. Using these natural processes to our advantage can reduce the costs of treating wastewater. However it has been shown that treated and untreated wastewater contain emerging pollutants (e.g., pharmaceuticals, personal care products, antibiotics, hormones, etc.). When reusing wastewater for irrigation we are creating a pathway for these pollutants to enter the environment and possibly the human and animal food chains. Therefore to adequately assess this practice it is necessary to have a clear understanding of the presence, fate and prevalence of emerging pollutants from (source irrigation water), through soil and finally in plant tissue. Therefore this paper presents a method 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 mussels: analytical method development and occurrence assessment E.L. García, IDAEA-CSIC / Department for Environmental Chemistry; C. Postigo, IDAEA, CID-CSIC / Environmental Chemistry; M. López de Ala, Institute of Environment 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, it is relevant not only to identify their occurrence in coastal waters but also to evaluate concentrations at which organisms are usually exposed but also their bioaccumulation potential. In this context, the objective of this work was to investigate the occurrence of different classes of psychoactive substances and metabolites in mussel tissues, and to assess the bioaccumulation potential of these compounds in these organisms. To this end, an analytical method based on a “quick, easy, cheap, effective, rugged, and safe” (QuEChERS) extraction and subsequent determination by means of liquid chromatography–electrospray–tandem mass spectrometry (LC–ESI-MS/MS) was developed and validated for analysis of over 40 psychoactive compounds and metabolites, including various illicit drugs (opioids, amphetamine-type stimulants, cannabinoids, and hallucinogens) and therapeutic drugs (anxiolytics, antidepressants, sedative/antihistamines and stimulants) in mussels. 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 standards. Freshly collected and frozen mussels were used. The method was applied to mussels sampled from different coastal areas of Spain. Results showed that most psychoactive compounds were detected in fresh samples with the highest concentrations found in eastern coastal areas. Although, venlafaxine was the most frequently detected compound, other analytes were also found in several samples, including benzodiazepines and anxiolytics (e.g., alprazolam, lorazepam, and quetiapine), which are frequently used in the treatment of pain and anxiety disorders. The analytical results obtained further monitoring of venlafaxine and citalopram in coastal waters is of particular importance as it forms the basis for the Spanish Ministry of Economy and Competitiveness FIS (PI14/005156) and the European Regional Development Fund (ERDF).

MO312 Determination of glyphosate and AMPA in fish bile from the Marne River, France H. Blanchoud, EPHE UMR 7619; T. Ferreux, F. Alliot, EPHE / UMR Metis; A. Goute, 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 considered to cause chronic effects in exposed organisms, as well as the presence of these compounds in biota inhabiting the area. Based on the obtained results further monitoring of venlafaxine and cilupram in coastal waters is recommended. It was possible thanks to the Spanish Ministry of Environment and Competitiveness FIS (PI14/005156) and the European Regional Development Fund (ERDF).

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. Dedworth, 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 demand of water for drinking, sanitation, municipal, industrial and agricultural uses. At the same time the amount of wastewater generated is unprecedented. Given these facts, it makes sense to look for ways in which to adequately reuse wastewater thereby reducing freshwater demand. One such solution is the reuse of wastewater for agricultural irrigation. Benefits of this practice include the reduction in fertilizer use due to the high nutrient content of wastewater, the environmental benefits of reducing an unwanted resource and the economic advantage for farmers who have to pay little or nothing to use the resource. Furthermore it has been shown that wastewater pollutant load can be reduced as it goes through the environment through processes such as photolysis, biodegradation and adsorption. Using these natural processes to our advantage can reduce the costs of treating wastewater. However it has been shown that treated and untreated wastewater contain emerging pollutants (e.g., pharmaceuticals, personal care products, antibiotics, hormones, etc.). When reusing wastewater for irrigation we are creating a pathway for these pollutants to enter the environment and possibly the human and animal food chains. Therefore to adequately assess this practice it is necessary to have a clear understanding of the presence, fate and prevalence of emerging pollutants from (source irrigation water), through soil and finally in plant tissue. Therefore this paper presents a method 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.

MO315 Determination of glyphosate and AMPA in fish bile from the Marne River, France H. Blanchoud, EPHE UMR 7619; T. Ferreux, F. Alliot, EPHE / UMR Metis; A. Goute, 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 considered to cause chronic effects in exposed organisms, as well as the presence of these compounds in biota inhabiting the area. Based on the obtained results further monitoring of venlafaxine and cilupram in coastal waters is recommended. It was possible thanks to the Spanish Ministry of Economy and Competitiveness FIS (PI14/005156) and the European Regional Development Fund (ERDF).

New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (P)
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. In this way, the spectra 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 correlation results can be further refined to define particles. Boundaries. 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 Pimpmke 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 being used in the JPI Oceanic Plastic in the Baltic Sea (JIPAS). Results show a high variability between rivers and due to the lower size fraction measured relatively high concentrations compared 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. Frecheg, Leibniz-Institut I. Polymerforschung Dresden / Analytics; 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 due to the well-defined sampling procedures and sampling locations. Next task is the sample preparation procedure to remove organic and inorganic parts in such a manner, that the microplastic particles will not be destroyed. A further important point is the subsequent loss free transport to an analytical lab and the use of blind samples from the sampling location through all further steps until the lab. Starting from this point our poster describes the following practical steps to identify and quantify the microplastic particles in environment samples. All operations and analyses are performed in dust-free rooms in flow boxes and all equipment is plastic-free. First procedure is a three-step vacuum filtration to divide the particles in four fractions, above 500 µm, from 500 to 50 µm, from 50 to 10 µm and below 10 µm. After filtration the particles of the different fractions are on silicon filters made from wafers from 50 to 10 µm and below 10 µm mainly by Raman. However, several samples of the fractions above 10 µm are measured also with both methods since a combination of both delivers complete microplastic particles analysis. Further parameters, as the integration time, the number of accumulations, the magnification of the objectives and the lateral resolution, which influence the results concerning measurement time and locating and identification of mainly smaller particles will be discussed.

MO318
Using pyrolysis GC-MS in combination with multivariate tools to identify and differentiate polymer type and weathering of microplastics
T. Storslett, L. Sørensen, K. Almaas, SINTEF Ocean / Environmental Technology; M.O. Høyes, 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 their underlying FTIR spectra (A. van Oyen, Plastic Partnerships). Manual interpretation of the data, which requires a high level of competence and is time-consuming. Pyrograms obtained from environmental samples are typically complicated by the presence of naturally occurring organic compounds and the presence of multiple polymer types. Furthermore, weathering processes such as oxidation and biodegradation may alter the chemical composition of the polymers, especially at the surface. An automation of the pyrolysis GC-MS analysis approach was first used to classify pristine and environmental MP samples. Multivariate tools were then applied to classify the samples based on the global pyGC-MS derived composition of the polymers, and to compare pristine materials with samples from the environment. The technique shows promise where manual techniques fail or have difficulty due to the lack of visual resolution of chromatographic peaks with important diagnostic mass spectral features.

MO319
Marine Microplastic: Production and characterisation of realistic test materials for studying ecosystem impacts
Reported studies investigating the possible effects of plastic litter on marine biota have almost exclusively utilised pristine plastic materials that are homogenous in polymer type, shape, size and composition. This is particularly the case for microplastics (marine litter < 5mm), as collecting samples of such material from the marine environment in quantities sufficient for use in laboratory impacts studies is simply not feasible. Crucially, weathered plastics collected from the marine environment show considerable physical and chemical differences to pristine and post-production consumer plastics. In the current study, we describe the preparation and characterisation of a more environmentally realistic marine litter-derived 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 miscellaneous plastic materials) from the cleaning process and sieving 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 microplastic reference 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 sub-sample was analysed and 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 macroplastic mixture was also determined by GC-MS analysis 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. H. Lee, H. Lee, 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 environment-friendly, at least 20% of HDPE pellets 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 approach, 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 samples. To prepare a standard of HDPE microplastics 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 of plastic per cubic meter in the Arctic pole 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 Korean survey vessel (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, 12 m) for surface water, bongo net (330 mm; n=16) for subsurface water, sea-ice (n=27) by ice-corer, and snow (n=6). MPs were detected in all samples with average concentrations of 0.41 nm³ (surface water in 2016), 0.55 nm³ (subsurface water in 2016), and 1.20 nm³ (in sea-ice core). We are progressing the analysis for sea-ice core samples, with the data will be added later. It is generally known that plastics are light and floating in oceans, and are frequently detected in the order of PP > PE > PET. This is a gap, because PP in terrestrial environment 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 objective 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 with macroplastics contamination in high density polyethylene (HDPE) microparticles 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.

MO322 Microplastics in the Chukchi Sea

J. Kim, Incheon National University / Department of Marine Science; C. Kim, Graduate East Asia; S. Kim, Incheon National University / Department of Marine Science

Araon Expeditions. Here, we present the results observed in 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 Korean survey vessel (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, 12 m) for surface water, bongo net (330 mm; n=16) for subsurface water, sea-ice (n=27) by ice-corer, and snow (n=6). MPs were detected in all samples with average concentrations of 0.41 nm³ (surface water in 2016), 0.55 nm³ (subsurface water in 2016), and 1.20 nm³ (in sea-ice core). We are progressing the analysis for sea-ice core samples, with the data will be added later. It is generally known that plastics are light and floating, 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.
immune function was observed in exposed shrimp (p=0.8). We also conducted
shrimp (present study was to investigate the toxicity of wet prepared TWP in adult grass
J.E. Weinstein
Microparticles: Occurrence, Effects and Sources of Releases.
Lassen, Microplastics: Occurrence, Effects and Sources of Releases.
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 wealth of research on the impacts of microplastics (MPs), there is little on micronized tire rubber (microrubber, MR). Recent reports 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) and a variety of metals and salts. The derived particle size fraction was determined by sieving and the remaining MR samples were ground to pass through a 75µm sieve. The ground rubber was then divided into microplastic and leachate samples. The microplastic samples were used in acute and chronic toxicity tests, and the leachate was used for ecotoxicological assessment.

**MO327**
Acute and chronic toxicity of micronized tyre rubber to Hyalella azteca
F. Khan, L.L. Halle, Roskilde University / Science and Environment; A. Palmqvist, Roskilde University / Department of Science and Environment
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 to the particle. The effects of MR particles to *Hyalella azteca* were significantly impacted at the higher exposure concentrations of MR. Both acute and chronic exposure to MR reduced growth of *H. azteca*. The acute toxicity of MR was significantly higher than the chronic toxicity of MR. This indicates that acute toxicity may be more important than chronic toxicity for MR.

**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
I-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
Rubber and tire and related materials are a group of non-biological persistent contaminants that are widespread in the aquatic environment, and have been classified as emerging pollutants. Despite the growing body of knowledge about the potential effects of rubber on aquatic organisms, little is known about the acute toxicity of rubber to aquatic species. In the present study, the acute toxicity of rubber to the crustacean *Hyalella azteca* was studied. The acute and chronic toxicity of rubber particles was assessed using the *Hyalella azteca* test. The results of the acute and chronic toxicity tests showed that rubber particles were toxic to *H. azteca*. The acute toxicity of rubber particles was significantly higher than the chronic toxicity of rubber particles. The chemical analysis of the rubber particles showed that rubber particles contained a variety of substances, including polycyclic aromatic hydrocarbons, metals, and other contaminants. The results of the chemical analysis of the rubber particles were consistent with previous studies suggesting that rubber particles can release a variety of toxic substances into the aquatic environment. The results of the present study suggest that rubber particles are a significant source of contamination in the aquatic environment. The potential environmental impacts of rubber particles are largely unknown, and further research is needed to determine the long-term effects of rubber particles on aquatic organisms.

**MO329**
Applying nuclear techniques to study the biokinetics and toxicodynamics of...
Among pollutants widespread in the environment, mercury (Hg) is well recognised for its bioaccumulation capacity and high toxicity. Among these two routes, inhalation by humans is the most important. The direct contact of aquatic life with a polluted environment is also a significant route. Despite the potential of mercury to bioaccumulate in living organisms, only a few studies have been performed to quantify the metal’s bioaccumulation in aquatic ecosystems. This study was therefore aimed at understanding the bioaccumulation of mercury (Hg) in the Versoix River (Switzerland). Hg exposure and bioaccumulation were assessed in two sets of biofilms. The first set was exposed to IHg (~0.1-100 pM), the second set was exposed to DHg (~0.1-1000 pM). The biofilm biomass was measured before and after exposure to Hg. The biofilm composition was also measured, including the EPS composition. The results showed that the biofilm biomass increased significantly after exposure to Hg, and the EPS composition changed significantly. The biofilm’s ability to bind Hg may be related to the EPS composition. This study provides new insights into the bioaccumulation of mercury in aquatic ecosystems.
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 evasional fluxes, as gaseous elemental mercury (GEM), at the water-air interface. A CEM (Continuous Emission Monitor) system coupled with a sampling device using the Lunes-Ro (Lunes-Ro 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 measurements through the background GEM levels 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-IA); F. Spovernier, A. Macagnano, E. Zampetti, P. Papa, G. Esposito, CNR Institute of Atmospheric Pollution Research Italy; P. Nicola, Institute of Atmospheric Pollution Research (CNR-IA)
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 arrangements for providing itself with comparable monitoring data that enables the assessment of mercury status in 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-IA) 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 analyses in humans and in the environment. The experience made within the project suggests that there is an 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 (OSM)”. The OSM project aims to support the policy process in relation to the Minamata Convention implementation. CNR-IA 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 l'environnement et de leau; F. Pierron, Université de Bordeaux / UMR EPOC CNRS 5805; C. Moniecour, Université de Genève; G. Daffe, University of Bordeaux / UMR EPOC CNRS 5805; A. Boullémant, RioTinto
Mountain rivers are high order headwater catchments in which mercury fluxes are a main driver of its biogeochemical cycling in the uppermost 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.}

MO337
Mercury Photo-reduction and Total Photoreducible Mercury Dynamics in the Lakes of Keijmijuk National Park, Nova Scotia
N.J. O'Driscoll, Acadia University / Department of Earth and Environmental Sciences; T. Christensen, Acadia University; E. Vesel, Nova Scotia Department of Natural Resources; S. Klapstein, E. Mann, Acadia University
Photo-reduction and photo-oxidation are fundamental mechanisms controlling mercury volatilization and accumulation in freshwaters. In all water surfaces dissolved gaseous mercury (DGM) is produced as a net result of the reduction of redox mercury, which is believed to be primarily divalent mercury (Hg(II)) bound to specific carbohydrate ligands and the oxidation of elemental mercury (Hg(0)). These two processes control the amount of DGM available for evasion across the water-air interface; however, determination of the fundamental rate constants and mechanisms of these reactions in freshwaters are still areas that require more research. In particular, the total amount of photoreducible mercury is emerging as a key variable that requires more exploration. Here, we review the processes that control mercury through the water-air interface during three seasonal campaigns in total reducible mercury derived from two recent projects that examined water samples from a series of freshwater lakes in Keijmijuk National Park, Nova Scotia, Canada. We examined the hypothesis that gross photoreduction and photooxidation 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 rate constants and batch experiments were used to derive net reduction rates (and gross reduction rates) by difference. These results showed that the net photo-oxidation rates for freshwaters 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
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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). Ongoing avian (gruid) groundwater biovectors for mercury – including mercury – and nutrients, which may indirectly affect metal speciation (Choy et al. 2010). The site 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 biodiversity, a group of herring gulls and avian biovectors was selected. The preliminary study showed that the mercury speciation in the Big Meadow Bog with similar geological and hydrological characteristics. The filtered samples were analyzed for total mercury, methyl mercury, and water chemistry (pH, conductivity, anions, cations, and dissolved organic and inorganic carbon). Results show significantly higher nutrients (nitrate, phosphate, and sulfate), total mercury, and methyl mercury concentrations when compared to the reference bog that is minimally impacted by avian biovectors. This elevated availability of methyl mercury could potentially pose a threat to the local ecosystem and wildlife population due to methyl mercury’s toxicity to living organisms (Akearok et al. 2010, Singh et al. 2011). Citations: Akearok J et al. 2010. Science of the Total
MO339 Organohalogen and mercury residues in fish from the Western Mediterranean Sea: concentrations, bioaccumulation and dietary exposure
E. Junqué, Institute of Environmental Assessment and Water Research (IDAIA-CSIC); M. Gari, IDAIA-CSIC / Environmental Chemistry; R. LLull, General Direction of Public Health and Consumption; J. Grimalt, Institute of Environmental Assessment and Water Research IDAIA CSIC / Department of Environmental Chemistry
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 dimethylmercury (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 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 (R=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 ADI for Hg in seafood in 2012. 4 species showed the equivalent estimations for MeHg, involving provisional tolerable weekly intakes of 1.3 µg/kg bw were six and three times higher than these provisional tolerable weekly intakes in adults and children (7-12 years of age), respectively.

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Fish consumption is linked to the prevention of some human diseases, especially reduced 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 (Rd) as recommendations to Hg intake. Some studies have associated the fish muscle for fish species captured in the Azorean Exclusive Economic Zone, and the consumption of this seafood by the Spanish population that only consume Mediterranean fish, the estimated weekly intake for Hg (4.42 µg/kg bw) exceeded the ADI for Hg in seafood in 2012. 4 species showed the equivalent estimations for MeHg, involving provisional tolerable weekly intakes of 1.3 µg/kg bw were six and three times higher than these provisional tolerable weekly intakes in adults and children (7-12 years of age), respectively.

MO341 Mercury concentrations in black from the Gippsland Lakes, Victoria, Australia.
L. Magri, 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 in black 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 Hg in flesh from sea bass (Dicentrarchus labrax), tilapia, red emperor and other 1990s 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 mercury in fish caught over time in the Lakes. This result is supported by a comprehensive range of results. 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.

MO342 Mercury health risks due to the substitution of fish meat with shark meat.
P. Ramirez Romero, U.A.M. Iztapalapa / Hydrobiology; L. Elizalde Ramirez, Universidad Autonoma Metropolitana Iztapalapa / Hydrobiology; H. Herrera Villa Zevallos, UAM Iztapalapa / Hydrobiology
A previous three years study of mercury content in a variety of edible marine fish from sea bass, codfish, tilapia, red emperor and other species was conducted. The concentrations of organochlorines universal polychlorinated in CRP were used to analyze the samples. 777 samples were applied to obtain information regarding fish consumption habits, portion sizes and other characteristics of the population of the Mexico City metropolitan area. Shark mercury content was taken from the previous study. Hg average daily dose, lifetime average daily dose and total dose were calculated for two concentrations: 0.3 mg Hg/Kg and 2.7 mg Hg/Kg. 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 (Isogomphodon oxyrhynchus), silky (Cararcharhinus falciformis). With regards to the health risk, when considering the lowest Hg concentration, children may only eat 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. When considering the average Hg concentration, the number of portions/month is drastically reduced to less than one portion/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.

MO343 Mercury in trophic webs of estuaries in South-Eastern Brazil.
T.H. Trevizani, Universidade de Sao Paulo / Oceanografia Quimica; M.C. Vedolin, Instituto Oceanografico da Universidade de Sao Paulo / Oceanografia Quimica; R.C. Figueira, Instituto Oceanografico da Universidade de Sao Paulo / Instituto Oceanografico; C. Domit, Universidade Federal do Parana / Centro de Estudos do Mar
The estuarine regions of Brazil are susceptible to anthropic pressures due to urban,
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 these estuaries the status 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 ($\delta^{15}N$) in the trophic web composed by benthic invertebrates, benthivores fish (Stellifer rastrifer, Paralichthys brasiliensis and Isopisthus parvipinnis) and marine mammals (Sotalia guianensis and Pontoppordia blainvillii), to understand the trophic dynamics of Hg and compare these estuaries. Samples were taken in the summer of 2015; analyses of $\delta^{15}N$ 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- VGA), in the muscular tissue of the organisms. The results of $\delta^{15}N$ varied from 6.4 to 13.8 % in Paranaguá and from 7.1 to 14.3 % in Cananéia, with a continuous enrichment among the trophic levels. Concentrations of Hg were significantly higher in Paranaguá (0.02 to 5.8 mg kg$^{-1}$) than in Cananéa (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 $\delta^{15}N$, 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 this estuary presents higher phi values from anthropic activities than Cananéa, 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.

MO344 Biological and Geochemical Drivers of Mercury Toxicity in Yellowknife, NWT, Canada
M. Ardagh, E. Yuvvihoe, A. J. Poulan, J. M. Blais, University of Ottawa / Biology

MO345 Use of green tea to reduce mercury and methylmercury bioaccessibility in raw and cooked fish
V.F. Barbosa, Portuguese Institute of Sea and Atmosphere IPMA / Division of Aquaculture and Seafood Upgrading; P. Anacleto, Instituto Português do Mar e da Atmosfera (IPMA) / Division of Aquaculture and Seafood Upgrading; R. Alves, King Abdullah University of Science and Technology (KAUST); A. Mauvalt, Instituto Português do Mar e da Atmosfera / 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 Atmosphere IPMA / Division of Aquaculture and Upgrading

MO346 Importance of a tidal flat-saltmarsh system as a source-sink of mercury in a contaminated coastal lagoon environment (northern Adriatic Sea)
E. Petranich, University of Trieste / Dept. of Mathematics & Geosciences; L. Terrilli, University of Trieste; S. Covelli, Dipartimento di Matematica e Geoscience / Dept. of Mathematics and Geosciences; A. Acquavita, ARPA FVG; E. Pavoni, University of Trieste
Saltmarshes are important constituents of marine-coastal transitional environments that provide several services to the ecosystem. Due to anthropogenic activities, several contaminants are increasingly introduced into these environments where are distributed with biota. Mercury (Hg) is a pollutant that bioaccumulates in aquatic and terrestrial foodwebs as monomethylmercury (MMHg). Microbial activity is the main driver of MMHg production, with sulfate reducing bacteria being a major contributor. The roasting of arsenopyrite at Giant Mine in Yellowknife, NWT, has created strong environmental gradients of sulfate in lakes surrounding the area with distance from the mine. Whereas total Hg levels remain constant with increasing distance from the mine, MMHg concentrations show a relative increase in the riverine system. We hypothesized that high sulfate in lakes near the mine may be responsible for elevated MMHg concentrations in those same areas. To test our hypothesis, we sampled water and sediments from lakes spanning a range of distances from the Giant Mine. We determine simultaneous methylation and demethylation rates using stable isotope analysis and characterized the microbial communities responsible for these processes. By analyzing methylmercury production and microbial community composition, we have identified sulphate as being the main driver of both final concentrations of methylmercury and microbial community structure.

MO347 Main sources of mercury releases in Armenia
A. Aleksanyan, Hazardous Substances & Waste Policy Division / Head of Division; A. Saghatelyan, Center for Ecological-Nonooch Studies NAS RA; G. Tepanosyan, Center for Ecological-Nonooch Studies NAS RA / Environmental geochemistry department

MO348 Spatial and temporal variation of mercury accumulation in Thalcphterus

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 Parque Nacional Natural del Cañón del Pital, Cali, Colombia, is a site of 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 Roto and El Pato, during the dry season, dry-rain transect and rainy season. Using non-parametric statistics (Kruskal Wallis), significant differences were found in the HgT concentration of the DH (≤0.05), 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.

M.0349
Temporal integration of diurnal variations of metals and mercury concentrations by passive sampling method in a highly polluted site on the Deûle River, northern France
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Due to several metallurgical plants along the river, the Deûle 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 Deûle River, in the city of Auby, 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 ammonium (< 0.02 µg/L to 0.38 µg/L) and SPM concentrations (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 Hg⁰²⁺ and CH₄Hg⁺. Finally, the interpretation of DGT measurements will show how well DGT integrate variations of inorganic contaminants concentrations during the exposure period.

M.0350
The effect of activated carbon amendment on mercury methylation in contaminated sediment
E. Sermo, G. Cornelissen, L. Silvani, E. Eek, Norwegian Geotechnical Institute: H. Veitveig 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 Gunnneckel fjord (GF) and Bergen Harbour (BH) – two heavily contaminated locations having lowing DGT measurements. Bulk concentrations in the sediment samples were 25.5 and 9.5 mg/kg total mercury (ThG) for GF and BH respectively. Two treatments were investigated: Activated anthracite char (AC) and activated biochar (BC). Treatments were set up for time series of 0, 1, 3 and 6 months in sealed glass jars, stored dark at room temperature. At each time series sediment and pore water was sampled. An anoxic sediment in glass jars with a high frequency data acquisition (Superville et al., 2014) was added to simulate a sediment 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 Deûle River, in the city of Auby, 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 ammonium (< 0.02 µg/L to 0.38 µg/L) and SPM concentrations (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 Hg⁰²⁺ and CH₄Hg⁺. Finally, the interpretation of DGT measurements will show how well DGT integrate variations of inorganic contaminants concentrations during the exposure period.

M.0351
Bayesian Human Health Risk Assessment of Almaden Mining Area
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Almaden, with the largest and richest known mercury deposit is located in the southwest 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 for human health can be considered an environmental problem. The study was conducted on 15 August 2017. As Minamata Convention on Mercury entered into force in August 2017, efforts have been made to implement an environmental and health monitoring program to assess the human health risk associated with mercury exposure in areas affected by the mercury mining site. The work described in this paper is part of such an initiative.

M.0352
Concentrations of mercury in two offshore skates: sandy ray and shagreen ray
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S. Cuero Salazar, Centro de Diseño Tecnológico Industrial - Ingeniería y Administración, Departamento de Ingeniería; P. Cogua, Universidad de Castilla la Mancha / Geology and Mining Engineering; L. Canoira, Universidad Politecnica de Madrid / Energy and Fuels
Almaden, with the largest and richest known mercury deposit is located in the southwest 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 for human health can be considered an environmental problem. The study was conducted on 15 August 2017. As Minamata Convention on Mercury entered into force in August 2017, efforts have been made to implement an environmental and health monitoring program to assess the human health risk associated with mercury exposure in areas affected by the mercury mining site. The work described in this paper is part of such an initiative.

M.0353
EMPIR project "MercOx - Metrology for oxidised mercury"
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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 methodological support and development. The overall goal of the EMPIR – MerOx project (Oct 17 – Sept 20) is to develop SI traceable measurements, for monitoring and characterization 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 (Hg⁰) and oxidised Hg concentrations originating from different Hg sources. Furthermore, methods for measuring oxidised Hg⁰ and for accurately comparing the Hg⁰ 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-compartment 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

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Waterborne and dietborne exposures of freshwater fish to inorganic mercury (Hg⁰) affect their growth and reproduction. However, a mechanistic model to predict the impact of Hg⁰ on freshwater fish is lacking. The purpose of this study is to develop a physiologically-based toxicokinetic/toxicodynamic (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 body weight. The output of the model and physiochemical 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-compartment 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/organ, 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 Hg(II), indicating that Hg(II) was more toxic to gill, liver, and kidney, intestine and body weight than muscle. The current PBTK model could be used for predicting the bioaccumulation rate and concentrations of Hg(II) in freshwater fish.

**MO356**

Ring-test of different implementations of the General Unified Threshold model of Survival (GUTS)

R. Ashauer, University of York / Environment; T. Jager, DEBtox Research / Dept of Theoretical Biology

The additional information and insight gained through the application of toxicokinetic-toxicodynamic 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 scenarios with toxicity and dose. The GUTS ring-test could also help to 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

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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 or test species to untested ecological scenarios or exposure situations, which will improve the quality of ERA as well as saving time and resources. Toxicokinetic-toxicodynamic (TKTD) models for lethal effects have already proven the ability to identify patterns in effects across compounds and species. The Dynamic Energy Budget (DEB) theory may have the potential to provide a general modelling framework for sublethal effects. However, DEB theory has been used in ecotoxicology for decades, and these models are currently under discussion as standard approach for risk refinement at the level of tier-2. Models based on DEB theory allow for mechanistic interpretation of effects on feeding, energy expenditure, growth and reproduction. The same modelling framework can be used for all organisms, which is crucial for across - species extrapolation of effects. Many compounds, especially those that target the nervous system, act on the ability of the organisms to feed 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 for both sets of test conditions, fish do not change their assimilation 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 incorporate effects of temporary low food levels. We suggest the 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 macrophyte and chlorotoluron as a case study
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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 obtain representative long-term data for changing exposure scenario, 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 various factors such as light conditions and temperature. The substance-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 criteria 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 characterized by 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 demonstrate 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. Gabis, Rifcon GmbH; T. Preuss, Bayer AG / 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) values for various scenario were investigated for 4 fish species using the toxicokinetic/toxicodynamic (TK/TD) model for survival GUTS. The GUTS model was parametrized 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 inputs for the SSD calculations. The SSDs were derived by fitting probability distributions to the LC50 data, and the corresponding HC50 were determined. The analysis was performed separately for two compounds. Results with both toxicants 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 HC50. These findings infer that SSD strongly depends on the exposure scenario, and reveal the unreliability 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. Niskich, O. Jakobi, A. Medianec, Rificon GmbH
GUTS (General Unified Threshold model of Survival) is one of the most commonly used models 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’, and also EasyGUTS as a functional tool was tested in internal and external 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 provides the user who uses 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. Bruns, 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 population assessment for plant protection products for aquatic organisms in edge-of-field surface waters, states TK/TD 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 dataset. Particularly, test conditions like exposure for short periods 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 experimental 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 TK/TD 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.
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 tests 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. Apparent toxic efficacy scores, such as the LC50s, have been reported to depend on ambient temperature and particle size in aquatic invertebrates and algae and 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, such as GUTS, for different temperatures. We use GUTS to extrapolate toxic effects across temperatures and investigate the impact of temperature on a species sensitivity distribution (SSD) with aquatic invertebrates regarding Chlorpyrifos.

MO363

**Lemma toxicokinetic and toxicodynamic (TK/TD) modelling - Impact of the ecological scenario on the risk assessment**

S. Heine, Bayer AG / Effect modelling; E. Bruns, Bayer AG, Division Bayer CropScience / Ecotoxicology; 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) is responsible for the harmonized toxicokinetic and toxicodynamic (TK-TD) models for aquatic organisms in edge-of-field surface waters, states TK/TD population modelling as an approach for the aquatic risk assessment. Although, the EFSA aquatic guidance states TK/TD population modelling as a method for the risk assessment, there is a lack of guidance’s and practical experiences for this new technique – especially to what extent the environmental scenario in which a TK/TD population model is applied influences the outcomes of the model. Unfortunately, it is not obvious which environmental scenario is a conservative one, e.g. a high or a low level of nutrient or temperature. In this contribution, we analysed the sensitivity of a *Lemma* model (Schmitt et al., 2015) to changes in environmental conditions in a risk assessment case study. For this case study we considered exposure to a toxicant and conducted several simulations with the *Lemma* model. While the exposure situation was kept equal in all simulations, the environmental conditions were changed. Results demonstrate that population dynamics are altered the most in cases where the exposure occurred in phases with strong growth of *Lemma*. This analysis can be the basis to set a conservative ecological scenario for environmental risk assessment for *Lemma* TK/TD modelling approaches.

MO364

**Defining ecological lake scenarios for population modelling as part of the Ecological Risk Assessment of chemicals**

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The ecological risk assessment of chemicals (ERA) aims to minimize adverse ecological effects on populations and ecosystems. This assessment strongly depends on the scenario modelled as the underlying ecological scenarios and the species sensitivity to anthropogenic stressors. This also applies to the populations of planktonic species and fish in standing waters (lentic systems), many of them being focal species in ERA. For use in population modelling, we suggest a classification of ecological scenarios of lentic systems based on the EU Water Framework Directive (WFD). As a result of the European intercalibration process, a list of general lake types has been defined which includes many of the aspects that are important for lake modelling. Besides abiotic characteristics, the German lake classification system for the national implementation of the WFD additionally makes use of biocenotic and trophic descriptors, and provides short characterizations of typical characteristics for relevant lake types. For the German lake types, data on e.g. phytoplankton biomass and nutrient concentrations are available from natural reference lakes which can serve for model validation. As case studies, we have chosen three lake types from this list of general lake types, which differ in relevant lake properties such as morphometry, trophic state, water depth, stratification regime during summer, and food web structure of the pelagic food web. We additionally considered common anthropogenic lakes and ponds (e.g. in urban and suburban areas) as well as coastal and marine lakes which are relevant for the ERA of chemicals in Europe. For the simulations of these ecological scenarios, the biogeochemical lake model StoLaM was used, in which several phytoplankton and zooplankton groups as well as fish are implemented. Additionally, the one-dimensional vertical structured hydrodynamic model HyLaM as part of the StoLaM allows high resolution of the lake internal physical environment which is required for simulating the nutrient and plankton dynamics in detail. Based on scenario analyses, simulations of typical planktonic dynamics in lake systems will be presented and discussed.

MO365

**The use of population models in copper risk assessment: a case study with *Acioperus transmontanus***

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Current metal risk management consists of assessing single-species data on metal toxicity and constructing 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 effects 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 (*Acioperus 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 NeLog. 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 (ECx, values) for population as alternative tools in ecological risk assessment. In this context, lethal and sublethal 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) modelling. *Daphnia magna* is an aquatic invertebrate model for *A. transmontanus* containing 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**

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Modelling 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 more ecologically-relevant tools in metal 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) modelling. *Daphnia magna* is an aquatic invertebrate model for *A. transmontanus* containing 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.

MO367

**Developing predicted no-effect concentrations for perfluoroalkyl acids in the Po river ecosystem through a novel methodology based on the AQUATOX ecosystem model**

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Health and environmental risks posed by perfluoroalkyl acids (PFAAs) have been elevated in several European countries through several scientific and policy-related activities as well as international organizations. One of those is the Northern Italy, because of its high industrialization and population. Nevertheless, the real risk connected to PFAAs 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, through 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 methodology 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. Chu, Western Washington University / Environmental Science; M.E. Harris, Western Washington University; L. Wallis, Western Washington University / Institute of Environmental Toxicology; G. Young, Advisian WorleyParsons Group / Aquatic Sciences; W.G. Landis, Western Washington University / Institute of Environmental Toxicology; K. von Stackelberg, NEK Associates LTD / Department of Environmental Health

Population viability analysis is useful tool for assessing the environmental risk of toxics 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 (Oncorhyncus tshawytscha) and coho (Oncorhyncus 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-RM links concentrations of OPs to % Acetylcholinesterase (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 primary results of this model development suggest that environmentally realistic concentrations of OPs may slow the growth of salmon populations, underlining 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, URAFPAPA INRA / URA FPAPA INRA; F. Desor, C. Cakir Kieffer, Université de Lorraine UL / URAFPAPA INRA; M. Delannoy, URAFPAPA INRA; A. El Hajj, T. Oster, C. Malaplate, Université de Lorraine UL / URAFPAPA INRA; N. Tran, Université de Lorraine UL / École de chimurgie, Faculté de Medecine de Nancy; F. Yen-Poton, C. Feidi, Université de Lorraine UL / URAFPAPA INRA

Chronic low dose exposure and possible cumulative effects of various pollutants could affect consumer health and may contribute to the development of neurological pathologies. Due to the highly complex and long exposure, a clear link between pollutants and neurodevelopmental disease is often 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 chloroacetaldehyde (CLD) as proof-of-concept of our strategy. Several concentrations of CLD were used to treat a variety of mouse primordial 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 CLD from a 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, CEHTA SAS / Ecotoxicology and Risk Assessment

A mechanism of the action of (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 MechoAs covering hundreds of molecules, we developed a set of structural alerts associated with specific MechoAs. Consequently, a new method to predict MechoAs with high accuracy and with simple rules was developed. Using a new classification model, 6 general MechoAs including 23 detailed MechoAs. The MechoAs 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 MechoAs 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 method that 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 used in future-optimized 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 recocurring emissions U. Boßmann, Aarhus University / Environmental Science; D. Fernández-Calviño, K.K. Bramdt, 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, algaeicides 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 (T1/2 < 10 d) to compounds with higher persistence (T1/2 > 120 d). For two selected biocides (terbutryn and octylisothiazolinone) 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 all transformation products for octylisothiazolinone was not closed, as six transformation products were degraded as well. However, Microtox tests revealed reduced toxicity of transformation products towards Aliivibrio fischeri than the
respective 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 (sub)urban 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. Botho, 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 façade coatings to protect the materials against biological deterioration. In- and can as well as film preservatives are used for this purpose. Nevertheless, these biocides leach to the environment when the façade 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 transformation and fate of biocides were studied. The latter is based, inter alia on an Emission Scenario Document (ESD) providing methods for release estimation of active substances from biocidal products to the environment. In case of rodenticides (product type 14 of BPR), the current available ESD for Rodenticides (2003) has been reviewed to be taken account of realistic biocidal product applications as well as worst-case environmental exposure assessment. The German Environment Agency (UBA) has commissioned Dr. Knoell Consult GmbH for drafting a revised ESD for PT 14 (rodenticides) on the basis of European Competent Authorities experiences gained during active substance approval and product authorisation, experiences from a workshop on risk mitigation measures for anticoagulant rodenticides, knowledge and common practice of trained pest operators, rodenticides associations, experiences from awarding public and private authorities and furthermore. New scenarios or sub-scenarios have been developed in case of application of rodenticides in sewer systems (with reference to the different types of pipe systems) and of application in and around buildings (distinction between direct applications on paved and unpaved soil; integration of an indoor baiting scenario). A new scenario for bank slopes of water courses has been established, whereas the waste dumping scenario of the terrestrial compartment from the original ESD for PT14 has undergone minor adaptations. When exposure of the terrestrial compartment is considered the transport of biocidal active substances to aquifers and groundwater has to be allowed for. In case of rodenticide application an appropriate approach for estimation of local concentrations in groundwater is newly included in the revised ESD for PT14. The risk assessment for primary and secondary poisoning of non-target organisms was revised in order to provide a more generic approach, i.e. identifying focal non-target organisms. Furthermore, guidance already provided for plant protection products has been considered. The presentation aims at providing an overview of current developments in environmental emission and exposure estimation of rodenticides as biocidal products.

MO374
New Developments in Environmental Emission Scenarios of Biocides - Preservatives for products during storage
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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 existing 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 in 6 sub-categories was defined. 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 uses of the end-product (application and service life) within a subcategory have to be considered. To reduce the workload and to minimize 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. On 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 emission 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
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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
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Under the Biocidal Products Regulation, applicants can apply for authorisation of biocidal product families (BPFs), which consist of products with similar uses, the same active substances, similar compositions within specified variations and similar levels of risk and efficacy. Especially when consortia are formed and products of multiple companies are grouped into one single dossier, building a dossier to demonstrate safe use for all products may become burdensome. Hence, there is a strong need to reduce the amount of risk assessments required to support the BPFs, in the interest of the applicants as well as the competent authorities. BPFs are typically subdivided into subfamilies called ‘meta SPCs’. The subgrouping in meta SPCs considers a.o. the composition, formulation type, product type (PT), risk mitigation measures (RMMs), classification and labelling (C&L) and shelf-life of the related products. The scenario comparison can be used to simplify environmental risk assessments, however, most often do not coincide with the factors that determine the meta SPC structure. Instead, other grouping strategies are more fit for purpose. The risk envelope approach is a strategy routinely applied in
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 BPF 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 BPF at a later stage. The benefits and potential difficulties of this approach will be discussed in detail.

MO376

Are biocide emissions into the environment already at alarming levels? Recommendations of the German Environment Agency (UBA) for an approach to study the impact of biocides on the environment

K. Pohl, German Environment Agency (UBA) / Section Biocides; C. Meier, German Environment Agency (UBA) / Biocides; M. Ahting, I. Noeh, German Environment Agency UBA / Biocides

More than 40,000 biocidal products were registered on the German market, including disinfectants, preservatives, pest control and anti-fouling products. All biocides act as intended on living organisms and the use of these biocides can result in alarming impacts on the behavior of both human beings and environment, their individual findings of only a few substances, particularly in surface water. However, a comparative picture of the actual pollution of the environment with biocides – one that goes beyond such individual findings – is not available, since there is no biocide-oriented, systematic environmental monitoring in Germany to date. To tackle this problem, the German Environment Agency (UBA) has developed recommendations for an environmental measuring programme for biocides based on the results of a research project and two international workshops. These recommendations contain a prioritization concept for biocidal substances as well as a proposal for a systematic monitoring programme. At first, we established a database containing information relevant for the environmental risk assessment according to the Guidance on Biocidal Products Regulation (BPR) for all biocidal substances currently available on the market. A multi-criteria prioritization approach was applied to prioritize substances based on their 1) emission relevance, 2) environmental effect data, and 3) environmental persistence. Thereby creating lists of high-prioritized biocidal substances and relevant transformation products that are of particular concern for the environment. Instead of monitoring individual entries at endpoints, our approach aims at monitoring the entry pathway of relevant biocidal substances. Therefore, we developed different entry path scenarios (work packages), which represent the different use pattern and entry paths of particular biocidal products. Based on the obtained prioritised substances and the different entry paths a systematic monitoring strategy is suggested for a German wide inventory of biocides in the environment. This will provide on one hand better knowledge about the behavior of biocidal substances in the environment and their impact on the environment. On the other hand, these monitoring data could help to support a more comprehensive risk assessment of biocides by providing a basis for risk mitigation measures or for the exclusion and substitution of environmentally hazardous active substances.

MO378

A case study on exposure assessment of biocides in PPCP using exposure assessment models

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Several accidents caused by the use of chemical products created a need for risk assessment of chemicals used in Pharmaceuticals and Personal Care Product (PPCP) in Korea. CMIT/MIT which is a mixture of 5-chloro-2-methyl-2H-isothiazol-3-one and 2-methyl-2H-isothiazol-3-one is used in PPCPs as preserving active and preservative. Despite of its high toxicity, this mixture has been used as humidifier contaminated from the 1990s without considering its exposure route and caused a lot of victims to suffer from its adverse effect. In contrast, CMIT/MIT was detected in toothpaste and the products containing the mixture were recalled in 2016 even though its toxicity via oral route is not known. The aim of this study is assessing the exposures of CMIT/MIT in PPCP and comparing discussed with two different levels of consumer exposure tools. ECETOC TRA.A.3 was used as tier 1 model which is basic and simple but conservative calculations and ConsExpo was used as tier 2 as it can be more precisely redefined and covers more specific estimations. The gap of estimated exposure values which have been derived from these two different model was identified. It is concluded that the difference between exposure calculation equations and input values affects the results. And each level of model has its strengths and weaknesses. Several improvements are needed to apply European models assessing in reflection of Korean exposure scenarios.

MO379

Hazard evaluation of biocides and its metabolites for the aquatic compartment

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The ECETOC COMBASE 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, half life, ECETOC TRA.A.3, and derived aquatic chronic toxicity data for fish, invertebrates, algae and WWTP microorganism. 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 ≤ 10 mg/L), 3) (10 > 100 mg/L) and 4) (> 100 mg/L). Most of the found data was related to toxicity in fish, followed by invertebrates and algae, marine microorganisms being the least studied. There was not reported data for around 8(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% 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.

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MO380

Synchronous decreasing levels of imposex and tributyltin (TBT) in dogwhelk (Nucella lapillus) from Norway, 1991-2015


Imposex is TBT-induced malformation of male gonads in female dogwhelk (Nucella lapillus). This biological effect is quantified by the Van Deferen 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 ambient level regulations on industrial chemicals when these 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 organotin like tributyltin (TPTT). The VDSI values were calculated as (3.3 µg kg⁻1 wet 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 Karmusundet, 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 *N.lapillus* 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 algaeicides 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- 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 in the realistic worst case to ensure assessing the leading behaviour. 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 algaeicide applied in swimming pools. The poster will be based 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 environment including new studies and risk management measures

**MO382** Could a spatially distributed modelling approach enhance post approval considerations for veterinary medicines?

C. McMillan, G. Hughes, J. Carnall, Cambridge Environmental Assessments

Tiered chemical risk assessment framework adopted in Europe for assessing the surface and groundwater risk from veterinary medicines used to treat livestock follows a tiered approach. The initial exposure assessment is a simplistic approach, with the FOCUS suite of models (FOrum for Co-ordination of pesticide fate models and their USE) often subsequently required for higher tier surface and groundwater refinement. Standard FOCUS scenarios defined within the guidance are intended to represent realistic worst-case scenarios for assessing the leading behaviour. In the case of veterinary medicines, only 42 are currently assessed using a tiered approach to calculate PECsoil and PECgw of VMPs from livestock to water. However, this approach does not help inform post approval considerations such as identifying the regions most vulnerable to groundwater contamination or surface water risk. In this presentation we consider how this could be achieved for groundwater assessments by using the current Okehampton scenario and comparing it to a spatially distributed model of PEARL at the EU scale. Key factors include: 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 environment including new studies and risk management measures

**MO383** Are currently-adopted European guidelines on veterinary medicine product and feed additive risk assessment sufficiently cautious?

A. Di Giuanda, 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 or 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 manure. 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 kg/Ha 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, NVZ 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 surface water. In particular, this study was aimed at investigating the potential contribution of active substances 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 in the realistic worst case to ensure assessing the leading behaviour. 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 algaeicide applied in swimming pools. The poster will be based 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 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 and a quick scan we investigated the potential contribution of the veterinary medicines to environmental occurrences of veterinary medicines in Dutch waters to feed possible policy measures. For this, we gathered information from detected compounds in both groundwater and surface 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 42 are measured, and in total 23 substances actually detected. These detected involved 15 antibiotics, four anti-parasitic resources, three anthelmintics and one painkiller. 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. We further noted that the origin of a detected compound cannot always be properly traced back to a specific veterinary use only. We noted that 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 of 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. Castelan, PlasticsEurope / LCA; P. Saling, BASF SE / Sustainability Strategy

The steam cracker process turns fossil hydrocarbon feedstocks into several different main products, such as ethane, propylene, and ethylene. 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 uncertainty 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 products have slightly different LCI results depending on 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. Bellizario, 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. Yoshida, Institute for Technological Research IPT

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 discuss 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 effect might be underestimated. 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 errors in uncertainty assessment, such as impact overestimation. Uncertainty modelling can be improved in the database by allowing the input of different amount uncertainties, 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 decades. 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 regions of Europe. On the scope of this study, 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 recently 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-NH) and Fe3O4-based (FeO4@SiO-NH-NH) composites, which function with a similar thiol group for Hg(II) removal are compared at 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 the latter. However, a significant enhancement of negative environmental impacts. A “what-if” perspective was applied to address the uncertainties of using lab-scale data for parameters including amounts of acid (HCl + H2SO4), ammonia, ethanol, methanol, DCC (N,N'-dicyclohexylcarbodiimide), NHS (N-Hydroxysuccinimide), water recovery, and electricity. The results of a test comparing the impacts between MGO-NH-NH and FeO4@SiO-NH-NH estimated respectively 37%, 34, 40, 31, and 26% more climate change, water use, 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 showering

S. ShahMohammadi, Radboud University / Environmental Science; Z. Steinmann,
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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 output of LCAs, the variability in consumer behaviour is generally ignored in LCAs, which use the average behavior as a basis for estimating the environmental impacts. The goal of our study was to demonstrate how the data on consumers’ reasoned choices, consumers’ 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 of household water showers, which 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 process and indicator considered. Sensitivity 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.

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 impact on the environment. 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. Subsamples 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, while there was no effect at the lower Ag-NM concentration. The long-term toxicity and ecotoxicity 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 Site-specific N-emissions of rapeseed cultivation in Germany

H. Stichnoth, Thünen Institute / Agricultural Technology; J. Augustin, ZALF; R. Fuss, H. Flessa, Thünen Institute of Climate-smart Agriculture; R. Ruser, University of Hohenheim; H. Kage, University of Kiel

Globally growing population increases the demand for food, which should be produced as efficiently but also environmentally friendly as possible. Simultaneously climate change requires the reduction of greenhouse gases (GHG) in order to keep the global temperature increase below 2°C. Germany has defined ambitious goals to reduce its GHG-emissions. The reduction targets are 40% by 2020, 55% by 2030, 70% by 2040 and 80-95% by 2050. Within the last 15 years, GHG emissions from agriculture have not decreased. Simultaneously the European Water Framework Directive requires a good status of water bodies, which is in particular regions in Germany not achieved. Winter oilseed rape (Brassica napus L., WOSR) is the major oil crop cultivated in Germany. Nitrogen field emissions are usually estimated using IPCC-emission factors that are not specific for the crop and associated with strong uncertainty. N2O field emissions are controlled by N-fertilization and dominate the GHG balance of WOSR cropping due to the high global warming potential of N2O. The same applies for nitrate emissions that dominate the Eutrophication potential or ammonia emissions for the Acidification potential of WOSR when organic nitrogen fertiliser is applied. To address these issues and support decision makers, our project aims to reduce specific emissions effectively and their accuracy that can be achieved. In addition to a life cycle assessment studies for WOSR cultivation. Thus, field experiments were conducted to increase the data basis and subsequently derive WOSP-specific emission factors. Furthermore, the project strives to develop robust but also generalisable statements about nitrous oxide emissions and ammonia volatilisation due to returning digestate from biogas plants to the field using state-of-the-art application technology. The results of this project aim to improve understanding of trade-offs in the environmental assessment of WOSR production including additional aspects such as fertiliser use efficiency.

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

MO393 Site-specific N-emissions of rapeseed cultivation in Germany

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The environment as a reactor determining fate and toxicity of nanomaterials (P)
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 Ag$_2$S, and bulk Ag$_2$S were added with an influent concentration of 1 mg/L and AgNO$_3$ with an influent concentration of 0.5 mg/L into the denitrification of a simulated STPs continuously for 10 days. The sewage sludge of each treatment was dewatered and the biosolids were mixed with soil. After 0, 60, 180 and 360 days, the metals were analyzed in the leachate and the biomass. The highest metal concentrations were found in the leachate at 360 days, and the lowest were found at 0 days. The metal concentration in the biomass did not change significantly between 0 and 360 days. This indicates that the metal concentration in the biomass is not a good indicator of the metal concentration in the leachate. To distinguish the signal from metal ions, this also enables to predict the fate of the metal in the environment. 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 digestible gland and distinguish the signal from metal ions. This also enables to proof whether NPs are formed secondary in the organisms after ingestion of metal salt solution. We present a study where terrestrial isopods 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 invertebrate digestive juice and assessed the dissolution rate using (sp-) ICP MS. The preliminary data show that there are mostly major Ag in the digestive glands, but NPs were also detected when the metal was exposed only to the 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 isopods 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 andrei after exposure to zinc in nanoparticle or ionic forms**

Z.M. Swiatle, Institute of Environmental Sciences, Jagiellonian University / Institute of Environmental Sciences; 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 earthworm Eisenia fetida, two Zn forms (Ag$_2$S NPs and of Ag$_2$S) were used. While lowest availability was expected in the soil with the highest cation exchange capacity (CEC), this indeed was the case for Ag$_2$S. Where lowest availabilibity was expected in the soil with the highest cation exchange capacity (CEC), this indeed was the case for Ag$_2$S and Ag$_2$S NPs to earthworms (Eisenia fetida) and springtails (Folsomia candida). The results suggest that the earthworms are able to regulate internal Zn concentrations efficiently, regardless of its form and concentration, and any serious impact on their energy reserves. Sugar content was the only energy reserve component which was significantly lower in 1000 ZnO-NPs than control (p<0.03) in the uptake phase. The total available energy reserves (Ea) and protein contents did not differ significantly between treatments but significant effect of day of exposure was found (p<0.0003). Neither treatment nor the exposure day affected the lipid content in the uptake phase. In the elimination phase, no treatment or time of exposure had an effect on Ea or protein content (protein content). Two treatments (1000 ZnO-NPs, ZnO-NPs (250 and 500 μg Zn) and ZnO-NPs (500 and 1000 μg Zn) g dry soil), corresponding to EC$_{50}$ and EC$_{90}$ for reproduction, plus control without added Zn. The results show that the earthworms are able to regulate internal Zn concentrations efficiently, regardless of its form and concentration, and any serious impact on their energy reserves. Sugar content was the only energy reserve component which was significantly lower in 1000 ZnO-NPs than control (p<0.03) in the uptake phase. The total available energy reserves (Ea) and protein contents did not differ significantly between treatments but significant effect of day of exposure was found (p<0.0003). Neither treatment nor the exposure day affected the lipid content in the uptake phase. In the elimination phase, no treatment or time of exposure had an effect on Ea or protein content (protein content). Two treatments (1000 ZnO-NPs, ZnO-NPs (250 and 500 μg Zn) and ZnO-NPs (500 and 1000 μg Zn) g dry soil), corresponding to EC$_{50}$ and EC$_{90}$ 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 any serious impact on their energy reserves. Sugar content was the only energy reserve component which was significantly lower in 1000 ZnO-NPs than control (p<0.03) in the uptake phase. The total available energy reserves (Ea) and protein contents did not differ significantly between treatments but significant effect of day of exposure was found (p<0.0003). Neither treatment nor the exposure day affected the lipid content in the uptake phase. In the elimination phase, no treatment or time of exposure had an effect on Ea or protein content (protein content). Two treatments (1000 ZnO-NPs, ZnO-NPs (250 and 500 μg Zn) and ZnO-NPs (500 and 1000 μg Zn) g dry soil), corresponding to EC$_{50}$ and EC$_{90}$ for reproduction, plus control without added Zn.
Mo401 Determining the comparative ecotoxicity of CdTe quantum dots with three different functional groups in three species of soil dwelling organisms

T. Botha, North-West University / School of Biological Sciences; S. Bosch, D. van Rooyen, G. Bouwer, North-West University / Unit for Environmental Science and Management; M. Mabota, North-West University / Unit for Environmental Sciences and Management; V. Wepener, North-West University / School of Biological Sciences / School of Biological Sciences

Soil is a natural resource that is important for a number of ecological reasons relating to ecosystem and biosphere processes. These processes include plant production, nutrient cycling of organic matter, storage of water and carbon, and richness of pathogens in agricultural crops. Pore water is the interstitial water found between sediment and soil. Soil acts as a biological habitat and gene reserve for a variety of species which are involved in all the soil ecosystem health. Therefore, contaminants released into soil can affect the organisms which dwell in them directly affecting soil richness. As nanomaterials are being released into the environment they are able to form complex structures with organic material and soil particles. In order to address the fate and behaviour of CdTe QDs three different functional groups (COOH, PEG, NH$_2$) were used for soil ecotoxicity studies. The earthworm Eisenia andrei, pot worm Enchytraeus albidus and soil nematode Caenorhabditis elegans were used following OECD and ISO protocols to determine comparative ecotoxicity. The nanomaterial distribution is soil was determined by using a flow through system combined with microwave digestion and ICP-MS where nanomaterials were poured onto soil as well as homogenously mixed and eluted using ultrapure water. It was found that a predominant amount of metals were found within the eluted interstitial water and that NH$_2$-functional groups had a higher binding affinity to the soil. There was no mortality seen for both earthworms and pot worms exposed up to 500 mg/L over 21 and 28 days respectively. Significant stimulation in reproduction was seen at 5 mg/L for NH$_2$ and 5 and 30 mg/L in the COOH for earthworms. Pot worms showed an insignificant bimodal response but a significant decrease in reproduction was seen at 5 mg/L in the NH$_2$ group only. The nematodes showed a significant decrease in reproduction rate, biocume accumulation and mucus production in all functional groups. A dose dependent nanomaterial uptake was seen within the tissue of both the pot worms and nematodes but was only observed in the PEG group of the earthworm group. As nanomaterials are released in to the soil environment they exhibit a high mobility within pore water, this mobility is dependent on the functional groups of the nanomaterials release. Soil nematodes show the highest ecotoxicological response compared to earthworms and pot worms and should be used as an indicator species for nanomaterial release.

Mo402 Toxic Effects of Silver Nanoparticles and Its Transformation Product in Soil Applied with Biosolid

F. Topuz, I. Koyuncu, Istanbul Technical University / Environmental Engineering Biodegradables, which are produced as a result of biological wastewater treatment, need to be managed as a separately managed waste. Land spread of 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 nanomaterials 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 EC50 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 residuals 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 on the nematode Caenorhabditis elegans which has been broadly used due to its sensitivity to different soil, water and air. Silver nanoparticles (AgNPs) have the highest degree of attention in recent years due to their potential ecological risk in soil, water and air. Silver nanoparticles (AgNPs) have the highest degree of commercialization due to their high thermal and electric conductivity, high catalytic activity, and powerful antimicrobial properties. Caenorhabditis elegans 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 in vitro study was to understand the effects produced by AgNPs (5.08±22.82 ng/mL and PVP-PEI coated) in comparison with the soluble form of the metal (AgNO$_3$) at molecular level in coelomocytes of *E. fetida* at different exposure times. *E. fetida* was used in vivo exposed to different concentrations of AgNPs and AgNO$_3$ (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 detoxification (MTs-metallothioneins) were determined in coelomocytes extruded from exposed earthworms. In addition, the enzymatic activity (Catalse) and protein content (MTs) were quantified. The response 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 AgNO$_3$ 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 coelocytes that preceed other responses at higher levels of biological organization. The responses in transatlantal 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
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The majority of nanomaterials (NMs) used in commercial applications are likely to enter the wastewater stream and reach wastewater treatment plants. In many countries, wastewater effluent and sewage sludge are discharged in aquatic environments or applied on agricultural land, however, the transformation of the particles and the potential effects on aquatic organisms are still poorly understood. Recent studies have shown high association of NMs with sewage sludge, therefore soils can be a sink for NM pollution making terrestrial organisms vulnerable. The main aim of the study is to understand the transformation of NMs during wastewater treatment processes and to evaluate the potential environmental hazard of aged particles compared to pristine ag. In this study, coelomocytes (primary immune cells) isolated from the epigeic earthworm Denudrobauna veneta are used as a model to assess the effects of Ag and TiO$_2$ NPs. Initial investigations focus on Ag (PVP coated, 25 nm, nanoComposix) and TiO$_2$ particles (uncoated, nanoscale primary size of 5 nm, 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 TiO$_2$ 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 microscope (sp-TEM), while the responses of daphnids exposed to Ag and TiO$_2$ NPs are determined by using tripan blue assay and comet assay respectively. The responses of daphnids suggested deleterious effects of dispersant to daphnids, especially for higher concentrations (25 and 75 µg/L) and ASTM (125 µg/L). The dispersant used in ASTM (4% w/w of each Tagat® TO and Tweener® 20) showed both significant decreases (AChE, GST, CAT) and increase (LDH) of enzymatic activities in dispersant-control comparatively to ASTM-control, thus suggesting induction of oxidative stress by effluent. The dispersant used in ASTM (4% w/w of each Tagat® TO and Tweener® 20) showed both significant decreases (AChE, GST, CAT) and increase (LDH) of enzymatic activities in dispersant-control comparatively to negative-control, suggesting deleterious effects of dispersant to daphnids. Biomarker responses to NM-300K were more marked when added to effluent sequentially to wastewater treatment plant (WWTP) effluent. Effluents include both dispersant-control and negative-control, with a different concentration of dispersant (0.5% w/w). The results showed a significant decrease of AChE activity 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 increase of LDH activity at 75 µg/L in effluent 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 in 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. In

MO408
Outlining the behaviour and ecotoxicology of biomedical nanoparticles in natural waters
G. Grassi, M. Cuperio, 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 NPs employed in novel cutting-edge applications as nanomedicine. In this study we investigated five biomedical NPs, namely polyethylene glycol- and polystyrene-based polyurethane (PSNH), europium-doped-cerium oxide (CeO₂@Eu), carbon dot-doped silica (Si@C), barium and polystyrene glycol-functionalized silica (SiO₂-B and SiO₂-PEG, respectively), and we assessed their behaviour and biological impacts in natural river- (NRW) and seawater (NSW). Hydrodynamic 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 SiO₂ NPs. In fact, SiO₂ NPs dispersions were found to be stable in NRW, while an immediate instability was observed in NSW. PS₁NH, CeO₂@Eu and Si@C 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 ecotoxicity of suspended NPs in both media. SiO₂-B and SiO₂-PEG NPs remained suspended in NRW until 10 days, while in NSW the sedimentation regime was steeper and hardly any signal was collected from suspensions after 24 h. On the contrary, no such difference was observed for PSNH, CeO₂@Eu and Si@C NPs, which completely settled within 24 h. NPs structural integrity was monitored as well over 30 days by means of spectrophotometric assays. SiO₂-based NPs bioaccumulation studies were examined in brown trout, which were conditioned before use with the test solution/dispersion to be filtered. Membrane filters (0.45 µm) and centrifuge filters were conditioned before use with the test solution/dispersion 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 asymmetric Flow-Field-Flow-Fractionation (4F) coupled to ICP-MS (for the silver nanoform 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, ingestion test of particulate Ag and/or bioaccumulation 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, which had no direct contact to the test samples containing Ag NMs. The study was carried out with five replicated test vials with two groups of amphipods 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 27 (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 corelle microscopy. The derived accumulation factors and the results of the TEM investigations allow to evaluate the contribution of particulate and dissolved ionic Ag to the accumulation of Ag from STP effluent.

MO412 Ecotoxicity of silica and silver nanoparticles (ENPs) on hyphoric copepods as a function of their bioavailability by dissolved organic matter (DOM) and water hardness of environmental samples

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 NPs employed in novel cutting-edge applications as nanomedicine. In this study we investigated five biomedical NPs, namely polyethylene glycol- and polystyrene-based polyurethane (PSNH), europium-doped-cerium oxide (CeO₂@Eu), carbon dot-doped silica (Si@C), barium and polystyrene glycol-functionalized silica (SiO₂-B and SiO₂-PEG, respectively), and we assessed their behaviour and biological impacts in natural river- (NRW) and seawater (NSW). Hydrodynamic 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 SiO₂ NPs. In fact, SiO₂ NPs dispersions were found to be stable in NRW, while an immediate instability was observed in NSW. PS₁NH, CeO₂@Eu and Si@C 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 ecotoxicity of suspended NPs in both media. SiO₂-B and SiO₂-PEG NPs remained suspended in NRW until 10 days, while in NSW the sedimentation regime was steeper and hardly any signal was collected from suspensions after 24 h. On the contrary, no such difference was observed for PSNH, CeO₂@Eu and Si@C NPs, which completely settled within 24 h. NPs structural integrity was monitored as well over 30 days by means of spectrophotometric assays. SiO₂-based NPs bioaccumulation studies were examined in brown trout, which were conditioned before use with the test solution/dispersion to be filtered. Membrane filters (0.45 µm) and centrifuge filters were conditioned before use with the test solution/dispersion 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 asymmetric Flow-Field-Flow-Fractionation (4F) coupled to ICP-MS (for the silver nanoform 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, ingestion test of particulate Ag and/or bioaccumulation 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, which had no direct contact to the test samples containing Ag NMs. The study was carried out with five replicated test vials with two groups of amphipods 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 27 (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 corelle microscopy. The derived accumulation factors and the results of the TEM investigations allow to evaluate the contribution of particulate and dissolved ionic 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 nanoparticles, especially in the presence of high concentrations of DOM. These such as the humic substances found in water, sediment, and soil, are ones 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 nanoparticles are able to regulate their toxicity 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 streambed that integrates surface and groundwater. Its location is central to biogeochemical linkages between the riparian zone, dissolved nutrients, and benthic biota. Even if 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 gracilis 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. Arvanitidou; F. Androu, I. Manarioti, 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 microalga. 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 0.081mg/L of ZnO NPs. The cultures were grown in modified Blue-Green 11 medium (BG-11). The effects on the growth rate was associated with aging seawater (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), ultraviolet–visible 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 for at least 4 hours under stirring conditions. After 4 hours, the microalgae was exposed during 7, 14 and 28 days. After exposure, the haemolymph was collected individually into a plastic container (100 mL of reconstituted saline water) and fed to the

Silver nanoparticles affect the early development of Tisbe battagliai: pristine vs aged particles
A. Georgantzopoulos, Norwegian Institute for Water Research NIV; K. J. Farkas, SINTEF Ocean Technology; K. Andreou, 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, bioavailability, toxicological potential and chemical composition. Our preliminary results then showed a different toxicity for pristine and transformed particles on the marine organism Tisbe battagliai. In this study the harpacticoid copepod Tisbe battagliai 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 (PVP coated 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), ultraviolet–visible 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 for at least 4 hours under stirring conditions. After 4 hours, the microalgae was exposed during 7, 14 and 28 days. After exposure, the haemolymph was collected individually into a plastic container (100 mL of reconstituted saline water) and fed to the

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 uses considerably. Silver nanoparticles (AgNP) tend to agglomerate in the aqueous phase and settle to sediment surfaces exposing deposit feeding organisms. Amphipods, like Parhyale 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 food containing AgCl. Silver nanoparticles < 100nm (Sigma Aldrich) were incorporated into formulated fish feed pellets in a concentration of 0.081 mg/L of ZnO NPs 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.

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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 bivalve organisms**

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The use of carbon nanomaterials (CNMs) has increased rapidly in the last years, namely due to their important properties such as electromagnetic, optical, catalytic, mechanical, thermal, and pharmacokinetics. Currently, carbon nanotubes (CNTs) are one of the most important and commercially used CNMs. CNTs are hollow graphene cylinders that are microns to millimeters in length and can be divided in single-walled (SCWNTs) with a diameter of 0.7 to 3 nm, and multi-walled (MCWNTs) with a diameter of 10 to 25 nm. CNTs are engineered with a wide variety of core structures and surface functionalizations that change their chemical and physical properties to enhance their suitability for different industrial applications. However, despite of the large array of available CNT configurations, their impacts on aquatic organisms, especially on invertebrate species, are still limitedly known. To our knowledge, no information is available on how surface chemistry alteration (functionalization) of CNTs may impact the toxicity of these CNMs to aquatic environments. For this reason, the exposure (28 days) to two types of MCWNTs (Ni-MCWNTs) in comparison with functionalized MCWNTs (f-MCWNTs), by introducing polar groups such as carboxyl groups (-COOH) in order to achieve better dispersibility in water, were evaluated in the Manila clams Ruditapes philippinarum, one of the most dominant bivalve of the estuarine and coastal lagoon environments. Alterations induced in clams’ oxidative status, neurotoxicity and metabolic capacity were performed. The results obtained clearly showing that both MCWNTs and f-MCWNTs were able to generate oxidative stress in the exposed clams and were also responsible for changes in organisms’ metabolism (expressed in alteration of energy reserves) and neurotoxicity induction in R. philippinarum, however greater impacts were caused by f-MCWNTs. As the field of nanotoxicology matures there is a call for the research focus to probe from hazard identification to more eco-relevant assessments of nanomaterials 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 ENMs have on freshwater bivalve species. 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 (CeO₂NP) and silver nanoparticles (AgNPs) we investigate the routes these sediments pass through as these materials in the freshwater sediment dwelling worm Lumbriculus variegatus.
the sediment and lack of dissolution (< 1% of spiked cerium was extractable with water). Transdermal uptake of AgNPs 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 be conducted in these environments to examine the colloidal properties of these NPs, which may be important for both transport and toxicity. Together, our research will provide mechanistic insight into the potential of TiO2 NPs to influence environmental processes.

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. Kaegi, Eawag - Swiss federal Institute of Aquatic Science and Technology
Once released to the aquatic environment, engineered nanomaterials (ENM) 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 ENM. In this study, we have extensively optimized for the characterization of TiO2 NPs in this study include methylene blue dye degradation (photocatalytic activity), rose bengal dye photolysis (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.

MO423 Evaluating spICP-TOF-MS for Exploring Environmental Nano-scale Processes
M.D. Montejo, University of Vienna / Environmental Geosciences; B. Gerstmann, A. Laycock, N. Tepe, T. Hofmann, F. von der Kammer, University of Vienna / Department of Environmental Geosciences
The advent of single particle ICP-MS (spICP-MS) has helped advance the field of nanometrology, specifically at concentrations and in matrices that are environmentally relevant. However, the concentration of naturally occurring nanoparticles (NNPs) and nanominerals far outweigh the expected released concentrations of engineered nanoparticles (ENPs), making their detection by single element spICP-MS and their subsequent risk assessment a challenge. The introduction of ICP-time-of-flight mass spectrometry (ICP-TOF-MS) has the potential to overcome these challenges, as elements are detected quasi-simultaneously at dwell times of 4µs, covering nearly the entire atomic mass range (7-250 amu). By examining differences in the chemical composition on a particle-by-particle basis, NNPs and ENPs can be differentiated, and geochemical processes occurring at the nano-scale can be explored on an individual particle basis. In order to establish this technique, different spICP-MS and spICP-TOF-MS configurations have been tested and compared, with a focus on instrumental parameters, detection limits, and detection efficiencies. The results will provide a basis for further research towards applying single particle detection for ENPs in the aquatic environment.

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; J. Morgan, The 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 methyl barrier) facilitating the diagnosis of diseases occurring at 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 Analytics; L. Hilber, Agroscope / Environmental Analytics; T. Hüffer, 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 digestate (BCsub), greenhouse tomato waste (BCwaste) and from durian shell (BCshell), 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’ toxic, carcinogenic, teratogenic 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 concern because commercial HCH is used as a remnant in several parts of the world. 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 (BCsub), from greenhouse tomato waste (BCwaste) and from durian shell (BCshell), 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 same 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 isomers and between 5 and 2000 μg L⁻¹ (total concentration) in the mixture isomers. Polyethylene (PE, 26 mm thick) and flock (2 cm high, 0.01 g) were used as a passive sampler for assessing the HCHs concentration in water. The sorption performance of the biochars is related to their physicochemical properties. Preliminary results have shown the adsorption processes 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. Reminigmann, RWTH Aachen / Biogene; S. Parkerton, ExekumMobil Biomedical Sciences Inc. / Toxicology & Environmental Science; G. Witt, HAW Hamburg / Department of Environmental Engineering
Recently, the total PAH sediment concentration reported for a sample a report is 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 parental 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 for investigating 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 matrices (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 and ex-situ measurements with corresponding laboratory derived measurements using sediments collected from the same stations.

MO430
Spatial Distribution of DOCs 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 manufacturing 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 that eat fish from this area. Hydrophobic organic contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freely dissolved contaminants are most directly related to concentrations of freedom 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 lab and field. This approach describes the testing of the approach in-situ and ex-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 the first 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 PRCs, 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.

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. Fuchte, 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 measuring bioavailable concentrations of waterborne hydrophobic pollutants in the environment. Often, silicone samples 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 lab and field. This approach describes the testing of the approach in-situ and ex-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 the first 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 PRCs, 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 hexachlorocyclohexane sorption: a mechanistic approach
L. Silvan, g. comelissen, s.e. half, Norwegian Geotechnical Institute
Hexachlorocyclohexanes (HCHs) are halogenated compounds composed of 4 main isomers: α-HCH, β-HCH, γ-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’ toxic, carcinogenic, teratogenic 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 concern because commercial HCH is used as a remnant in several parts of the world. 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 (BCsub), from greenhouse tomato waste (BCwaste) and from durian shell (BCshell), have been used as sorbent materials for the HCHs removal from water. The BCs used cover a wide range of surface area (5.4 -
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 CIMAR LA; J.L. Dores-Sousa, VUB / Department of Chemical Engineering; C. Cruzeiro, CIMAR CIMAR LA, Porto, CEF ICTUC U.Coinbru; E. Rocha, ICBAS U.Porto, CIMAR CIMAR LA The study shows the occurrence of 16 priority compounds (PAHs) in surface waters from the Douro River estuary and nearby Atlantic seaboard. 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 (Σ16PAHs) were extremely high in both analysed matrices and at all sampling sites. In fact, average concentrations attained ≤ 52 μg/g dry weight (dw), indicating an overestimation of the risk if only total initial concentrations in soils can be measured. The leachable fraction was generally greater for more hydrophilic PACs, such as NOSO-aromatic compounds (NSO-Aromatic), indicating low availability of the compounds in soils. The aim of this study was to investigate the occurrence of 77 PACs including PAHs, alkyl PAHs and heterocyclic compounds (HAPs) in surface waters from the Douro River estuary and nearby Atlantic seaboard. 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 (Σ16PAHs) were extremely high in both analysed matrices and at all sampling sites. In fact, average concentrations attained ≤ 52 μg/g dry weight (dw), indicating an overestimation of the risk if only total initial concentrations in soils can be measured. The leachable fraction was generally greater for more hydrophilic PACs, such as NOSO-aromatic compounds (NSO-Aromatic), indicating low availability of the compounds in 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. Cameron, ExxonMobil and P. van Hees, Orebro University / Department of Chemical Engineerin

Petroleum substances are examples of UVCBs (substances of Unknown or Variable Chemical Structure) and complex mixtures of biocides or Petroleum. Due to their complex chemical composition, such data will vary depending on, amongst other things, the source of crude oil, the refinery processes 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 a well-established method consisting of creating data gaps and to reduce unnecessary testing, and has been applied to available aquatic toxicity data of 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 information, predicted EL50 and toxic unit (TU) values calculated using PETROTOX, and results from biomimetic extraction solid phase microextraction (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.

MO443 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 Centre de Recherche; M. Kingwall, Orebro University / Man-Technology-Environment research centre (MTM)

Polycyclic aromatic hydrocarbons (PAHs) are common contaminants in agricultural soils, 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 weathering processes in the environment. In this study, the occurrence and potential for bioaccumulation and toxicity of PAHs and total AhR agonists were investigated in agricultural soils. The occurrence of PACs was 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 commonly high relative to the saturation level. Both approaches avoid direct contact with the pure substance 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

MO436 New approaches for determining solubility of volatile liquid chemicals

H. Birch, DTU Environment / Department of Environmental Engineering; L. Thomsen, Technical University of Denmark / Department of 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

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 Insibria; K. Knudsmark Sjøholm, University of Copenhagen / Dept. of Plant and Environmental Sciences; A. Di Guardo, University of Bari, 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_free) 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.

MO437 sorbent/water systems and sorption coefficients for selected pollutants. A review.

J. Engerer, University of Malta / Department of Chemistry

A review of sorbent/water systems and sorption coefficients for selected pollutants. The review summarizes the 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.

MO438 New approaches for determining solubility of volatile liquid chemicals

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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. Smedes; 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 alkanes 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 a(+)-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) 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. Comendador, 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 this study, CONCAWE has initiated a comprehensive analytical program 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 toxicity. In this study, the extractions of HOCs followed by lipid extraction of HOCs followed by lipid extraction of HOCs followed by lipid extraction of HOCs followed by lipid extraction of HOCs 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 cytoxicity, 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 active in 2012, the period during which the extraction was done. The AhR, AhR and cytochrome P450 (PPAR) receptor gamma (PPAR) and ERa. The activation of the AhR was by far the 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 Cmed vs. Cmed will enable assessing the actual risk (Cmed vs. the potential hazard of those chemicals that might be released in future scenarios (Cmed) biota. The present 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 bioaugmentation (uptake + metabolism). This shortcoming obstructs correct 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 compartments. Passive Sediment Diffusion Samplers (PSDs) are proposed as a means to address this shortcoming. These PSDs are based on the premise that HOCs dissolve in the water in the vial for subsequent solvent extraction. Total sediment concentrations (Csed) were determined using equilibrium with thin coatings of silicone on the inner walls of glass jars with subsequent 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 cytoxicity, 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 active in 2012, the period during which the extraction was done. The AhR, AhR and cytochrome P450 (PPAR) receptor gamma (PPAR) and ERa. The activation of the AhR was by far the 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 Cmed vs. Cmed will enable assessing the actual risk (Cmed vs. the potential hazard of those chemicals that might be released in future scenarios (Cmed) biota. The present 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.

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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 bioaugmentation (uptake + metabolism). This shortcoming obstructs correct 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 compartments. Passive Sediment Diffusion Samplers (PSDs) are proposed as a means to address this shortcoming. These PSDs are based on the premise that HOCs dissolve in the water in the vial for subsequent solvent extraction.
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 equilibrium approaches have been considered. The 7 indicator PCBs (28, 52, 101, 118, 138, 153, 180) have been selected as target compounds, covering a KOC range from 5.66 to 7.15. Relative reference [1] Rusina TP, Carlsson P, Vrana B, Smedes F. 2017. Equilibrium passive sampling of POP in lipid-rich and lean fish tissue: Quality control using performance reference compounds. Environ. Sci. Technol., DOI: 10.1021/acs.est.7b03113.

MO442 Widespread occurrence of 4-Nonylphenol, BHT, and 2,4-DTBP in blue crab, Callinectes sapidus, malapoeae 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 these compounds in one third of the blue crab megalopae that were live and dead al cells and examine the cell performance reference compounds. Environ. Sci. Technol., DOI: 10.1021/acs.est.7b03113.

MO443 Real-time visualization and quantification of perylene bioaccumulation at single cell level x. gu, 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 unknown, and is considered a marine pollutant, but exhibits low toxicity. All these 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 should be re-evaluated to mitigate potential sub-lethal effects of exposure to blue crab populations.

MO445 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 (surface water 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. Phthalates were the most abundant chemicals, with concentrations in fish muscles in the range 10,000-150,000 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 Marine hydrographic network. Surprisingly, chubs infected by the acanthocephalan Pandorina multifida had less NP and phthalate accumulation. This study is the first time that NP and phthalate contamination has been measured in free-living chubs. Future validations are needed to confirm the transfer of these pollutants from host to parasites and to investigate the potential benefits of this detoxification pathway for parasitized chubs.

MO446 Is Lake Como a “uniform lake”? Information from its inhabitants (zooplankton and fish) M. Montomoli, University of Insubria (Como) / DiSTA; A. Bufo, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNR; R. Perma, University of Insubria; S. Polesolo, Water Research Institute- CNR / Water Research Institute; S. Valsecchi, Water Research Institute - Italian National Research Council IRSA-CNR; R. Bettinetti, University of Insubria / DiSTA Lake Como, a subalpine lake (Northern Italy), is an oligolimnic 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
MO448 Kinetic Sorption and Bioaccumulation of Hydrophobic Organic Chemicals in Marine Plankton Food Chain


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 (A. excavatus) cultured in a gas purging system with a steady supply of PAHs for 7 days in this study. The result shows that PAH accumulation in plankton can be roughly divided into three sections: 0.2-1 hours, 1-2 hours, and 24-168 hours. The PAH concentrations in plankton varied greatly over the 0.2-1 and 1-24 hour time intervals, then approached steady-state at 24-168 hours exposure. The low molecular weight PAHs (ACN, AC) were found at significantly higher levels compared to other PAHs in phytoplankton. 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, demonstrating that PAH composition in plankton might be affected by trophic levels. All PAHs demonstrated significantly linear relationships between bioconcentration factor (BCF) and PAH hydrophobicity (Kow) in plankton, however the linear regression slopes of log BCF and log Kow 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 triclocarban in a sediment-water system?

L. Benne, J. Politowski, M.P. Hennig, H. Hollert, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, RWTH Aachen University / Center of Aquatic and Chemical Toxicology.

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 ofCNT-containing products might increase Likewise. Weathering processes like radiation can alter nanoparticle properties and lead to changes in their environmental behavior. The study objective is to investigate whether weathered MWCNT in the water phase may be altered: due to agglomeration and aggregation processes they probably settle down in sediments, which represent a potential sink for carbon-based nanomaterials. Nevertheless, during their stopover in the water phase they may interact with water dissolved xenobiotics, and thus alter 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 are investigating 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 monitored, i.e. pH, oxygen level and conductivity. For each of the measured compounds multiple regressions are being constructed to establish the links between the concentration of compounds in biota and in sediment. The interpretation will take into account dissolved concentrations (where feasible) as well as general water and sediment characteristics. Identification of robust links between the extent of bioaccumulation and sediment and/or water concentrations would strengthen the basis for use of surrogate monitoring methods.

MO450 When technical limits triggers risk assessment for non-biodegradable insoluble pharmaceutical molecule

B. Journel, E. Beltran, CEHTRA SAS; P. Adrian, CEHTRA.

The assessment of substances in the environment is driven by numerous factors. Among them, substance's properties such as Henry's constant (i.e. water solubility and volatility) and hydrophobicity (in terms of Kow and adsorption) have a non-negligible impact on how substance's behaviour is modelled in the different compartments (soil, water, sediment, air), to predict exposure levels in risk assessments. Pharmaceuticals represent a specific category of substances as they are often difficult to analyse due to their experimental results more subject to imprecision. Due to analytical difficulties, parameters such as water solubility and Kow are often expressed as “lower than” or “higher than” and have no defined value. Additionally, model softwares such as EUSES impose maximum value for Kow 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 Kow 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 system 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

E. Peñuelas, University of Antwerp; C. Belpaire, Research Institute for Nature and Forest INBO; R. Blust, L. Vboerts, 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 measured 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 are investigating 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 monitored, i.e. pH, oxygen level and conductivity. For each of the measured compounds multiple regressions are being constructed to establish the links between the concentration of compounds in biota and in sediment. The interpretation will take into account dissolved concentrations (where feasible) as well as general water and sediment characteristics. Identification of robust links between the extent of bioaccumulation and sediment and/or water concentrations would strengthen the basis for use of surrogate monitoring methods.

MO452 Personal care products (PCPs) in the southeastern coast of Brazil: Determination of the method and environmental occurrence

A.C. da Silva, T. Combi, Instituto Oceanográfico da Universidade de São Paulo / Instituto Oceanográfico; R.C. Montone, Universidade de Sao Paulo / Oceanographic Institute.

The use of large amounts and a broad variety of chemicals that are potentially harmful to the environment (including persistent organic pollutants (POPs)), personal care products (PCPs), and pharmaceuticals (i.e. non-functional compounds as well as general water and sediment characteristics) are among the most complex and current issues in environmental chemistry. Possible adverse effects related to some groups of PCPs, such as potential to accumulate through the trophic food chain and in human adipose tissues, endocrine disruption and hazard to coral reef conservation

Argenio), 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 C. mas 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 perfluoroalkyl substances (PFAS).

The work that receives funding from the FP7 ERA-NET SIINN.
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 EHMC) and fragrances (tonalide and galaxolide). The next steps of this work include testing additional extraction methodologies, extraction solvents 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. Łapczyński, 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) 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 Environment 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 essential to rank them for risk assessment refinement. This 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 Fahd 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-Hadj-Ahmed, King Saud University / College of Science, Chemistry Department; R. Hull, University 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 polymeric 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, tidal 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 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 tidal 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)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, benzo(b)pyrene.

**MO455**
Pt/Ti modelling of super-hydrophobic chemicals

W. Latrach, 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 Pt/Ti 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 both 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 uptake 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-Ellsberry 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. Sakurataki 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/kr_csa_r11_pbt_peg_en.pdf/ddac9031-d4a4-4995-8efc-3738162ba4e8

**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. Cronin, 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. Odino, 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. Saab, BASF SE; J. Roembke, S. Jaensch, ECT Oekotoxikologie 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 under the assumption that repeated observations 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 which results are from the single mesocosm study 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 selection and 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 sensitivity. To accomplish these goals, the initial steps entailed 1) validating the chemicals within ECOTOX 2) mapping species to NCBI taxids and 3) mapping all relevant ECOTOX codes to corresponding ontological terms so chemical effects can be turned into computable phenotypic ontology classes. To semi-automate the code mapping, a Java-based lookup tool was developed using the ontology browser BioPortal (https://bioportal.bioontology.org) of the REST API to conduct batch code mapping. This tool was designed to make use of BioPortal’s annotator and recommender functions so that all ontological class identifiers relevant to a particular ECOTOX term would be returned and specific ontologies recommended. Using this approach, the majority of the 2000+ ECOTOX codes were mapped to ontological class identifiers; some terms required multiple identifiers to properly describe them. Further, manual curation was necessary using the results of a single code mapping. The results of the automated code mapping approach were evaluated against a set of manually annotated prototypes as induced by exposures to ten well studied chemicals (aztrazine, bishphenol A, cadmium chloride, chlorpyrifos, copper sulfate, cypermethrin, dioxin, EE2, malathion, or Tris(1,3-dichloro(isophoropyl) phosphate) in six vertebrate species (carp, zebrafish, fathead minnow, mouse, rat, trout). The content of this presentation neither constitute nor necessarily reflect US EPA policy.

**ECOTOX Knowledgebase: New tools for data visualization and database interoperability**


The ECOTOXicology knowledgebase (ECOTOX) is a comprehensive, curated database of aquatic and terrestrial toxicity 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, taxonomic 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. The new features and tools will be available in ECOTOX Knowledgebase version 5.0, to be released in FY18.

**TU005**

Edaphostat - A web application for automated and interactive meta-analysis of environmental data from the Edaphobase datawarehouse.

J. Hassler, RWTH Aachen University; R. Scholz-Starter, 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 merge 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 analysis tools, which are customized for certain data warehouse applications, can be 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 many sources, e.g. museum collections, field data, literature and unpublished results. Edaphostat performs 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 functionality of the Edaphobase datawarehouse, which contains hundreds of data selected by e.g. area, time period or study design. It performs automated analysis of environmental 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.

E. Saouter, EU Commission JRC / Sustainable Assessment Unit; F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; A. Gissi, European Chemicals Agency; P. KARAMERTZANIS, ECHA European Chemicals Agency / ProBost, European Chemicals Agency; ECHA; S. Proenca, EU Commission Joint Research; D. Versteeg, EcoStewardship LLC

Product Environmental Footprint (PEF) and Organisational Environmental Footprint (OEF) form a core part of the Commission Recommendation “on the use of environmental footprinting methods 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. The new features and tools 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 taxonomic group 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. The calculation of Chronic and Chem­i­cal geometric 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 data set for thousands of chemicals using R-Studio program

F. Biganzoli, EU Commission Joint Research / Directorate D Sustainable Resources Bioeconomy Unit; S. Proença, 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 (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). 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. These parameters mean for cancer and no-cancer effects. For PEF/OEF, 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 tests results, as of March 2017) available in the IUCLID 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 biodegradation; 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 Klimasch 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

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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 commuter groups (highest trophic levels), this approach is not exhaustive enough for each species. 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 used 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 matrices. 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 TIB 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 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

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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, which can influence both humans and ecosystems. However, 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 electronic 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 potential errors in the indicated dosage or field size. 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 utilise handwritten data, but use the digital data after that. This trend resulted in a unique 44 year time series of PPP use in apple orchards. 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. This poster presents 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 linear 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, with NNs being hypothesised (directly or indirectly) to cause negative effects on species 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

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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 as linear covariates 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. Sørfjord in western Norway) for mercury, zinc, cadmium and lead. Highest concentrations of PAHs and PCBs were found close to densely populated industrial regions, i.e. in the North Sea and in the Kattegat and Skagerrak. The spatial pattern of the PCBs suggests the secondary and diffusive 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 oil gas platforms discharging produced water
A. Tomsenby, ISPRA / Nat species (Vibrio fluvialis; Donaliella teres; Tecto. Tigriopus fulvus) were considered. Moreover a battery of biomarkers at different biological levels together with bioaccumulation of some organic and inorganic 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 physiological parameter photosynthesis inhibition and bioaccumulation in marine invertebrates were exposed to different PCBs, PAHs and HCHs exposures. In this study, we used a photosynthesis inhibitor herbicide: diuron, one of the priority substances of the trophic chain in aquatic environments and considered as an excellent bioindication or monitoring along with more traditional indexes. We undertook 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 IRP application periods in two decapoda, six fish and two amphibian species. Biomarkers of exposure (cytochrome P450 and acetylcholinesterase) and effect (catalase, superoxide 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 (i.e. tigerfish - Hydrocynus vitulus and Mugil chloride) displayed a higher DDT bioaccumulation there were no distinct biomarker responses evident. When exposure data of another banned OCP, γ-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 ecotoxicology in environmental risk assessment and ecosystem monitoring (P)

TU014
Identifying bacterial indicator taxa along an urbanization gradient in stream ecosystems
M. Simonin, Duke University / Biology; K.A. Voss, Regis University; B.A. Hassett, J.D. Rocca, 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.

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 as linear covariates 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. Sørfjord in western Norway) for mercury, zinc, cadmium and lead. Highest concentrations of PAHs and PCBs were found close to densely populated industrial regions, i.e. in the North Sea and in the Kattegat and Skagerrak. The spatial pattern of the PCBs suggests the secondary and diffusive 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.

TU013
Utilising biomarkers in a multispecies approach to relate organochlorine pollution for produced water discharges.
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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 size analysis and bioaccumulation on native mussels. In this study, a multidisciplinary approach including chemical analyses, grain size analysis and bioassays on marine sediment, together with bioaccumulation and biomarker investigations in polychaetes exposed to sediment, is applied to assess potential impact due to offshore platforms and produced water (PFW) discharge. PFW is a complex mixture of contaminants and is the main discharge of gas/oil platforms. Marine sampling in the Adriatic regions (Central Adriatic region) were phys-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 physiological parameter photosynthesis inhibition and bioaccumulation in marine invertebrates were exposed to different PCBs, PAHs and HCHs exposures. In this study, we used a photosynthesis inhibitor herbicide: diuron, one of the priority substances of the trophic chain in aquatic environments and considered as an excellent bioindication or monitoring along with more traditional indexes. We undertook 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 IRP application periods in two decapoda, six fish and two amphibian species. Biomarkers of exposure (cytochrome P450 and acetylcholinesterase) and effect (catalase, superoxide 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 (i.e. tigerfish - Hydrocynus vitulus and Mugil chloride) displayed a higher DDT bioaccumulation there were no distinct biomarker responses evident. When exposure data of another banned OCP, γ-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.

TU015
Diuron sorption in freshwater biomats: determination of isotherms
B. Chalinet, Iriste; J. Rocca, M. Simonin, University Montpellier; J. D. Hassett, Duke University; B. Roux, Iriste

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 Kjellnerup 2013) because of its high capacity to integrate contaminant exposure displayed along the watercourse. 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 absorption in biofilm was dependent on the cell density 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

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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 capacity of 210 µg.g⁻¹ dry weight, an equilibrium 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 constant and 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 organism behaviour and impact in periphytic microorganisms.

TU016
New insights into the biotransformation of sulfurluramid: role of ammonia oxidizing bacteria and community shifts

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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 perfluoroctane sulfonamide (N-ETFOA), 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 its degradation kinetics and pathways in activated sludge, marine sediments and soil. However, little information is available on the contributions of different microbes to the biotransformation of N-ETFOA. This study used Alillythiourea (ATU), an inhibitor of ammonia monooxygenase (AMO), to investigate the relative contributions of ammonia oxidizing bacteria (AOB) and other microorganisms to the biotransformation of N-ETFOA degraders by analysing the microbial community shifts. In the reactors with ATU addition, N-ETFOA was degraded faster with an apparent half-life of 1.3 days, which indicated that ATU had actually enhanced the biotransformation of N-ETFOA. This implied that AMO was probably not involved in the biotransformation of N-ETFOA, 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 Proteochlamydiu increased significantly in the ATU-treated sample, which suggested that this genera could be a potential degrader for N-ETFOA. Future work needs to determine the genes involved in the biotransformation process using metagenomics and metatranscriptomics.

TU017
How can three herbicides impact the fatty acids of the freshwater diatom Gomphonema gracile ?

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Metal discharged from different anthropogenic sources. This study aims to investigate the effects of ZnO nanoparticles on soil microbial communities via herbicides (Biolog). BiologEcoplate 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. The main hypothesis is that the addition of ZnO nanoparticles to soils can modify microorganisms along with decomposition of different fertilizers under the same conditions in different fertilizers (F1 and F2). The fertilizers were added with ZnO Bulk, ZnO NPs and zinc oxide (ZnSO₄) at 230 mg Zn/kg. Then, the fertilizers with Zn compounds were added to the farm soil. After 15 days of soil exposure to fertilizers with ZnO Bulk, NPS and ZnO, the eluates were obtained. Different elutions on the metabolically active soil fraction were performed. The different response of microorganisms was tested using Biolog Microplate with 96-well plates at 30°C in the dark. A mixed culture of 100 µg.L⁻¹ of diuron and 100 µg.L⁻¹ of metolachlor which inhibits elongases. Concerning diuron and glyphosate, the decrease of SFA and MUFAs can reflect an indirect effect, which can be explained by the mode of action of these two pesticides which respectively blocks electron transfer in photosynthesis, and inhibits the synthesis of aromatic aminocids.

TU018
Effects of Nickel on cell cycle progression, growth and antioxidant enzymes of green algae C. reinhardtii

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Freshwater ecosystems received industrial and domestic sewage discharged and natural chemical compounds as a result of anthropogenic activities. Heavy metals released in the environment have increased over the last decades causing environmental and human health problems worldwide. The known biological adverse effect of metals include growth disorders, decrease in photosynthesis and pigments synthesis pathways, induction of oxidative stress, mutagenic effects, among others. Among aquatic organism, microalgae have an important role in aquatic system as they are a key component of food chains. So that, it is crucial to has early assessment tools to evaluate effects of metals at the cellular level. In the present study effects of Nickel was evaluated on cell cycle progression, growth and antioxidative enzymes kinetic of the green algae C. reinhardtii. Synchronized cultures of this multiple fission dividing algae were used for the study. Aliquot from growing cultures were taken hourly during 36 hours. The attainment of commitment points (CP) was evaluated by transferring hourly aliquot into aerated tubes at 30 °C in the dark. Analysis of cellular division, nuclear division (DAPI stain) changes in cell size, were performed. The proportion of mother cells and daughter cells was assessed at the end of the cell cycle. Ecotoxicity of metal was assessed by algal growth inhibition test, estimating toxicity endpoints, growth rates, protein, antioxidant enzymes activities of catalase, guaiacol peroxidase, ascorbate peroxidase, glutathion reductase and concentration of chlorophyll a, chlorophyll b and carotenoids at the end of 96 hs of exposition. Nickel provoked a block of cell cycle at the highest concentration tested. At lower concentrations, cell cycle progression was observed with different pattern of attained CP, depending the exposure concentration. Antioxidant enzyme activities were inhibited at concentration above 0.05 and 1 mg/L. The effects of metal on pigments concentration was less evident than the effects on growth rates, indicating a lower sensitivity of these parameters. Nickel provoked severe damage on algal cell division and cell cycle progression in kinetic pigments, as well as inhibition of antioxidant enzymes activities. An integrated analysis is done discussing the consequences on population performance in natural environment after metal discharged from different anthropogenic sources.
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

TI02/02 Environmental factors-regulated disease dynamics of tilapia lake virus (TILV) transmission in farmed tilapia ponds

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BACKGROUND: Outbreaks of tilapia lake virus (TILV) have caused substantial mortalities of farmed tilapia, posing a significant threat to worldwide tilapia industry. Environmental factors controlling TILV 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 TILV 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 TILV dosage were fitted by two-parameter Hill model to estimate median lethal dose (LD50). To explore the TILV highly artificial environmental conditions, sacrificing some of the susceptible-infectious-mortality (SIM) model was applied to describe cumulative mortality data to estimate mortality rate (\( \alpha \)), transmission rate (\( \beta \)), and basic reproductive number (\( R_0 \)) for Nile tilapia posed by TILV under treatment of cohabitation.

RESULTS: In toxicity assessment, LD50 estimate of Nile tilapia infected by I.P. injection with different TILV dosage was 57127.5 TCID50 mL\(^{-1}\). TiO\(_2\) NPs did not significantly inhibit Fv/Fm of any species in exposure after 15 days. After 30 days no difference was observed in terms of Fv/Fm between control and TiO\(_2\) NPs treatments.

CONCLUSIONS: TILV transmission could be affected by environmental factors such as temperature and aquaculture density. Results of toxicity assessment and disease epidemics could provide insights into aquaculture management of TILV disease by controlling potential factors in tilapia ponds.

Keywords: Tilapia lake virus; Toxicity assessment; Susceptible-infectious-mortality model; Aquaculture management

TI02/03 Impact of the antihistamine fexofenadine on structure and functioning of leaf-associated microbial communities

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The antihistamine fexofenadine is used as a broad-spectrum antihistamine drug. Here, we monitored the changes in microbial community structure and function in two plant substrates (i.e., black alder leaves and hay). Biodegradation of fexofenadine was observed in both substrates, with higher degradation rates in the black alder leaves. The differences in microbial community structure and function were attributed to the differences in plant substrate composition, which could provide insights into the potential impacts of drugs on the environment.

Keywords: Fexofenadine; Environmental effects; Microbial community structure; Functionality

TI02/04 Innovative tools and metagenomics for the monitoring of rivers and lakes: the Europan project iNTEGRATCh

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Microbial communities provide a large range of ecosystem services such as primary production, nutrient recycling, pollutant degradation, and are 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 future research directions 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
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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 hydrodynamics. Even though the interactive effects of stressors can potentially affect the structure and function of biofilms, 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 PCR approach. Focusing on the protostatic aquatic hyphomycete biofilm 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.

TU028 Does fungicide exposure alter interspecific relationships of aquatic fungi during leaf-decomposition? - A case study using species-specific qPCR assays
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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 inferences on species-specific abundance and performance under stress. Therefore, we performed a microcosm experiment in which we related the interaction of a model fungal community with different leaf decomposition to individual species’ abundances quantified via species-specific quantitative real-time polymerase chain reaction (qPCR) assays. Using a factorial design, every possible single, binary and quaternary species combination of four different aquatic hyphomycete species (Alatospora acuminata, Heliscella stellata, Neocentria lugdunensis and Tetraludium marchalianum), was exposed to the model mixture composed of four substances with different modes of toxic action (four sum concentrations, ranging from 5 to 2500 µg/L and a fungicide-free control, n=5, N=275). In monocultures, aquatic hyphomycetes exhibited different fungicide tolerance levels, with concentrations ranging from 500 to 2500 µg/L resulting in significantly reduced abundances. Interestingly, only the two tolerant species (i.e., N. lugdunensis and T. marchalianum) were capable of decompising leaf material to a significant degree. Moreover, abundances of single species within the model communities as well as their functioning were governed by dominance interactions (e.g., one species outcompeting the other), probably as a result of competition for leaf substrate. Depending on the species composition, interactions
resulted in an up to 99% reduced abundance of the inferior species. Species interactions were largely unaffected by fungicide exposure as dominant species shown as tolerant towards fungicide exposure. However, qPCR results reveal that one of the two 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 ecological and functional effects on soil as well as 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: Characterisation of Microbial Communities by Metagenomics analysis
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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 depuration region of the lake at 30 m column depths, 0.5 m from surface 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 EPI and 2.5x SECCCHI. The results showed that a peak of cyanobacteria was observed around 14.9/21.9 in the EPI (E) samples consistent with the high observed concentration of chlorophyll a. The lowest abundance of the cyanobacteria was in the SECCCHI (S) samples. In the early stages of the bloom, a cyanotoxin composition was also observed for proteobacteria and actinobacteria. Our result suggests that the major differences in bacterial community composition during the bloom are concentrated in the SECCCHI depth region while composition of the EPI 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 cyanotoxin data although compounds very 18S genomic composition should be recommended in order to discard a possible contribution of potosynthetic eukaryotes.

TU030 Following copper bioaccumulation and internalization during freshwater biofilm development using stable Cu isotope
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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, we investigated the role of EPS and the corresponding Cu/EPS in the bioaccumulation of two Cu isotopes in different biofilm fractions throughout biofilm growth and maturation. During the early stages of its development (0 to 20 days), biofilm was grown on glass slides in water spiked with natural dissolved Cu (PICT) using photosynthesis as the endpoint. Periphyton was exposed to five copper concentrations, between 0.01 and 10 µM, in a semi-static test. The corresponding 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 eukaryothic community structure at concentrations as low as 0.01 µM. The protokaryotic community structure was changed at slightly higher concentrations (0.06 µM). A total of 23 taxa, including species within the Proteobacteria, Bacteroidetes, Stramenopiles 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 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, we observed that copper was 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.
induced community tolerance in exposed communities. Taken together, these findings indicate that negative impacts from copper might be common in coastal ecosystems.

TU/033
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 petrodiesel, however, currently which biodiesel is more microbial friendly than petrodiesel is inconclusive. Previous studies of soil microbial community on contaminated sites failed to reveal 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. Biolog 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 should not be automatically considered 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, SO\textsubscript{4}, O\textsubscript{2} 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 \textit{S}-triazines, terbutylazine and their metabolites. At last, the pharmaceuticals benzoylecongine and carbamazine/ibresartan/valsartan induced growth stimulation of \textit{N. palea} and \textit{P. pellucida}, respectively. Same records for pharmaceuticals were observed for the other three sites, excepted Bidiaso. 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)

TU/035
Can post mortem data be used to monitor population health in response in the barn owl?
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The Predatory Bird Monitoring Scheme (PBMS; http://pbms.ceh.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 fluctuating asymmetry) that may be an indicator of stress. 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 these values could indicate a problem. For the mussels and whelks bioaccumulation friendly 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 (287 g vs 258g) but there was extensive overlap in the prediction intervals for the two sexes. Prediction intervals for the percentage of birds with low fat depots were 23-65% and 28-75% for females and males, respectively. The level of kurtoisis 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.

TU/036
Identifying suitable marine bioindicators in South Africa: Mussels vs Whelks
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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 bioaccumulation between mussels (\textit{Mytilus galloprovincialis}) and whelks (\textit{Bursupena lagenaria}) as well as measure imposex prevalence in \textit{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 concentrations of metals (Al, Cu, Zn, Fe, Cr, Mn, Co, Ni, Mo, Mg, Cd and Pb) were measured in intertidal sediment, \textit{M. galloprovincialis} and \textit{B. lagenaria} imposex prevalence recorded in \textit{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 bioindicators 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 \textit{B. lagenaria} along the South African coast, which is not the case for \textit{M. galloprovincialis} that only occurs on the west and south east of the country, the proposal is made that \textit{B. lagenaria} could be considered as alternative bioindicators of ecotoxicity in contaminants in the region.

Recent developments in environmental risk assessment for pollinators (P)

TU/038
Behavioural effects of imidacloprid, a neonicotinoid insecticide, on bumblebees (\textit{Bombus terrestris})
J.S. Paus-Knudsen, University of Oslo / Department of Biosciences; H.A. Sveinsson, University of Oslo / Department of Physics; K. Borgia, Department of Biosciences, University of Oslo / Department of Biosciences; M. Grung, A. Nielsen, University of Oslo / Department of Biosciences

Bees 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 sub-lethal effects of neonicotinoids on bees (including Apis mellifera and non-\textit{Apis} species. Bumblebees were exposed to three different dosages of imidacloprid through artificial nectar (water syrup), 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 first objective of this poster is to summarize all available industry data, for active substances and formulated products on honey bee larvae testing, according to e.g. OECD 237 and OECD 239, in order to gain an overview of these results and the selectivity of different product groups. As a first step in the risk assessment, EFSA requires a screening step which includes the calculation of risk quotients (ETRs) for honey bee larvae. This considers exposure routes for the compound and its metabolites through on- and off-field (PPPs and as seed treatment and granules) scenarios. Where a substance or use should not pass one of the screening level risk quotients, EFSA offers 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* I. Hug, Rifcon GmbH; R. Becker, BASF SE Agrarzentrum Limburgerhof; S. Schmitzer, IBACON GmbH; B. Szcześniak, Eurofins Agrosciences Ecotox GmbH *on behalf of the ICPPR Non-Api working group and the Bee Working Group of the German AG Bienenschutz Based on EU Regulation 1107/2009/EC the current regulatory risk assessment on bees has to address the risk on honeybee larvae. According to the new document on the risk assessment of plant protection products on bees (Apis mellifera, Bombus spp and solitary bees) (EFSA 2014), both, the Oomen brood feeding test (Oomen et al., 1992) as well as the OECD Guidance Document 75 (2007; OECD GD 75) are given as the two higher tier options to refine the risk on honeybee brood if concern is raised in tier 1. Both methods focus on the brood termination rate (hereafter BTR) as the key endpoint. While the Oomen brood test investigates an artificial and worst case acute or chronic oral exposure scenario with a test item spiked feeding solution administered inside the hive (Lückmann & Schmitzer 2015) brood studies according to OECD GD 75 under semi-field conditions rely on a realistic contact and oral exposure scenario to bees comprising contaminated nectar and pollen after overwintering of a bee attractive crop. As the evaluation of historical data from different semi-field studies according to OECD GD 75 showed a strong variability of the control BTRs (Becker et al., 2015), the performance of OECD GD 75 bee brood studies under field conditions was regarded as an option to get more reliable BTR data (Becker et. al 2015, Giffard & Huart 2015). The present poster compares control BTRs from Oomen feeding studies with BTRs obtained from OECD GD 75 semi-field and field trials and case evaluations for observed variances. Moreover, the possibilities and limitations of three of the methods will be discussed.

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. Borgen, G. Gonisour, M. Kienzheng, B. Szcześniak, Eurofins Agrosciences Ecotoxicology Ecotox GmbH; S. Knaebe, AES Ecotox GmbH / Ecotox 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 a percentage) brood development rate (an indicator for 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 define a 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 sexuals is essential for the maintenance 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 how 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.

TU042 Ecotoxicological studies with bumble bees - latest developments and method improvement L. Franke, Eurofins Agrosciences Ecotox GmbH / Ecotoxicology Field; O. Klein, Eurofins Agrosciences Ecotox GmbH / Ecotox Field; J. Fricke, Eurofins Agrosciences Ecotox GmbH / Ecotoxicology Field; J. Sorri, TRIALCAMP SLU; T. Vollmer, Eurofins Agrosciences Ecotox GmbH / Field Ecotoxicology; S. Knaebe, AES Ecotox GmbH / Ecotox 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 biology is well-known, they can be used for ecotoxicological semi-field and field trials to provide data on environmental effects of pesticides, and consequently impacts of pesticides on bumble bees have already been tested for years. Currently, 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 sexuals is essential for the maintenance 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 how 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 bee species in the field - is the well-known 'focal species' concept a suitable approach? J. Lueckmann, M. Faulp, J. Ludwigs, Rifcon GmbH According to EFSA (2013) bumble bees and solitary bees have to be considered in acute and chronic oral solitary testing) or under development (e.g. chronic oral solitary testing) trials. Also, they provide important pollination services, e.g. in greenhouse cultures, and consequently impacts of pesticides on bumble bees is well understood. For bird and mammal risk assessment it has not been yet applied for bee species. 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 2012 testing (Oomen testing, acute contact solitary testing) or under development (e.g. chronic oral solitary testing) trials. Also, they provide important pollination services, e.g. in greenhouse cultures, and consequently impacts of pesticides on bumble bees have already been tested for years. Currently, 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 sexuals is essential for the maintenance 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 how 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.
solitary bees. Here, we present the idea of a ‘focal species’ concept for solitary bees, its needs, refinement options, advantages and limitations.

TU044 Non-Apis (Bombus) versus honeybee (Apis mellifera) acute oral and contact toxicity - Preliminary results of ECOPA company data evaluation

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A preliminary data evaluation was conducted by ECOPA 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 insects, fungicides, herbicides in about equal numbers plus a few other substances. The preliminary ECOPA evaluation of LD50 valuing 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. Overall, the ECOPA company data evaluation indicates that bumblebees are not more sensitive than honeybees based on acute toxicity assessment.

TU045 Bumblebee (Bombus spp.). 10 day feeding laboratory test design: First results from an ICP-PR testing

N. Exeler, Bayer AG, Crop Science Division; N. Hanewald, BASF SE / Ecotoxicology; C. Jenkins, Environ, H. Krueger, EAG Laboratories; A. Zicot, SynTech Research / Ecotoxicology; E. SOLER, TRIALCAMP SLU / Ecotoxicology; A. Molitor, Eurofins Agroscience Services GmbH; S. Vinall, Mambo-Tox Ltd; K. Amsel, BioChemagrar 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 changing 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 bumble bees, the recently developed Non-Apis Non-Api working group designed a rating test protocol to develop a first-tier chronic feeding test for bumblebees. Based on the recently published honeybee 10 day chronic feeding test guideline OECD 245 and the bumblebee acute oral toxicity test 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 Dimethoate EC400 (Perfektion) was evaluated with 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 trophallaxis and need to be fed individually. Furthermore, single housing prevents the contamination of the test set with adults of other species. The endpoints calculated were: LC50 (median lethal concentration) and LD50 (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.

TU046 Standardization of method to test toxicity on stingless bees

The UNESD Univesad Estaulal Paulista Jôlo de Mequita Filho / Biology; R. Roccetti, UFSCar / Departamento de Ciências da Natureza Matemática e Educação; O. Malapina, UNESP Universidade Estadual Paulista Jôlo de Mequita 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, Collettidae, Melittidae, and Megachilidae, with 9 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 testing 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 used the following technical standard: The test insects were kept in 250 mL cages (ten bees were placed per cage, such that each treatment contained thirty bees from three colonies), fed in groups through microtubes (1.5 mL) punched in extremitities, and kept in a chamber of biochemical oxygen demand (BOD) at 29 ± 2 °C, relative humidity of 70 ± 10% and in constant darkness. The diet used was composed of 50% (w/v) aqueous sugar solution. Our observations showed that with this method reproducible results were obtained. The mortality in 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.
termination rate during the larval development as well as the success of emergence of their progeny (Fl-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.

**TI049** Predicting wild bee sensitivity to Acetylcholine Esterase (AChE) inhibitors utilizing a trait based phylogenetically controlled approach

T. Panninger, BASF SE; Agrarzentrum Limburgerhof / Ecotoxicology; N. Holzer, BASF SE / Ecotoxicology; C.W. Schneider, BASF SE; I.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 model species in pollen and nectar, 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 of exposure routes to residues. Method fanasies used in this data set was comprehensive, with information on bee bodyweight, 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 confirming for A. mellifera is particular sensitive to this class of PPPs. In contrast, many stingless bee species, are comparatively resilient to AChE inhibitors, especially when controlling for bodyweight. We discuss the consequences of these findings in the context of the global non-Apis bee risk assessment debate in Europe and the Americas.

**TI050** New approaches in testing of pollinator exposure under realistic conditions - Methods and recent experience

M. Persianzehl, 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 recently, new methods have been developed to accurately determine residual concentrations of residues as part of (semi-) field studies with bees in pollen, nectar and honey. Studies on foraging behaviour as well as methods to adequately determine residues for non-standard uses, such as home garden uses, ornamentals and granules with a slow release formula. The different methods are compared and advantages and potential pitfalls are illustrated.

**TI052** Normative Instruction 02/2017 - Brazilian risk assessment of pesticides to bees

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Recently, Normative Instruction 02/2017 (NI 02/2017) has been published in February 2017 by IBAMA 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 substance, we will show how the 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.

**TI053** How the new Brazilian risk assessment framework for bees works

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The Environmental Assessment of pesticides to bees in Brazil is performed by the Environmental Institute (IBAMA) and comprises two aspects: Environmental 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 with some 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 single substance, we will show how the 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.

**TU045** An epidemiological study about an effect of neonicotinoids residues on honey bee colony survival in Japan

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Neonicotinoid insecticides are widely used in Japan. Seven neonicotinoid insecticides such as Imidacloprid, Acetamiprid, Thiacloprid, Clothianidin, Dinotefuran, Thiamethoxam and Nitenpyram 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. Neonicotinoid pesticides in foods are much higher than those in EU and the US and that science news that loss of honey bee numbers occurred frequently in Japan. The aim of this research is to reveal ecological risk assessment of honeybees including colony survival in Japan by ELISA analytical methods. The exposure assessment is conducted by neonicotinoid 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 of honey bee samples than those reported by previous reports in Europe, Canada and America.

**TU055** Thiamethoxam Honey Bee Large Scale Colony Feeding Study - Design and Interpretation

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Colonial feeding studies were originally developed to directly assess the insect growth regulating properties of neonicotinoids 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 temporal differences for pollen stores, overall colony strength and overwintering survival returned to the control, confirming the NOEL of 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 residues 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
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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 Elav (Down syndrome cell adhesion molecule) and Dscam (Down syndrome cell adhesion molecule) genes, which have an important role in the formation of nervous system. Elav encodes proteins commonly used as neuronal markers in metazoans, which has action on post-transcriptional regulation and is required for differentiation and maintenance of the nervous system. Whereas that, Dscam gene can suffer alternative splicing from a high variable region and can be able to generate more than 38,000 isoforms and it is important for growth and connection of mushroom bodies, a center of learning and memory, for the expansion of dendritic fields. Based on this, we injected 2 µL of each of the pesticides (0.01 mM Thiamethoxam, 2 mM Carbendazim, 47 mM Glyphosate) to the abdomen of forager bees. After 24 hours, the brains were dissected for RNA extraction. We analyzed alternative splicing of Elav and Dscam in three treatments: normal control bees and two foragers per treatment, with one P32 γ-ATP radioactively labeled primer 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: 2015/22368-5).

TU057 Non-uniform distribution of treated sucrose solution via trophalaxsis by honeybees affects variability of homing success rate, gene expression and mortality among replicates
L. Jeker, 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 (Brodtschneider, R., et al. 1995) 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 homing 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/bees, 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/bees, 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/bees, was significantly lower with ten bees compared to the two bees approach. A large variability of success rates and gene expression during treatment 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 (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 discussed and considered 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 clear="all" />

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 they 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 explicitly 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 95th 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
A. Görlich, WSC Scientific GmbH; M. Wang, WSC Scientific GmbH / Dept Efate Modelling
For honeybee semi-field and field studies EFSA defined 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 goals formulated in the recently published honeybee guidance. In honeybee field studies EFSA recommended in its latest guidance that field studies should ensure that the 95th exposure percentile is met. Practically, it is challenging to confirm where honeybees actually foraged. For honeybee semi-field and field studies EFSA defined in its 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 goals formulated in the recently published honeybee guidance. For honeybee semi-field and field studies EFSA defined in its 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 goals formulated in the recently published honeybee guidance.
test power refering 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

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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 before progression 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

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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 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 West African dwarf goats. Raw and cooked samples were digested and analysed using the method described by the Association of Official Analytical to determine the levels of the metals by Atomic Absorption Spectrophotometric technique. Results show that there were significant differences (<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 in more of the various parts of meat than in bull meat from both the two cattle species. There was, however, no significant difference at 0.05 in the amount of these metals accumulated by both the buck and Doe. There was a major reduction in the results obtained for cooked samples when compared with raw 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. Robidoux, 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 antioxidian system (catalase [CAT] and superoxide dismutate [SOD] activity), an enzyme of detoxification cation 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 to 2-28 days, whereas effects on other enzymatic markers were low and temporarily inconsistent. NRRT also was significantly decreased after 28 days exposure to all soils currently to the control. However, little information is available on the environmental fate and ecological effects of Bi. This paper also summarizes the acute toxicity (LC50=416 mg Bi/kg) and biacciessibility of Bi, and describes bioavailability and chronic effects of bismuth on the earthworm Eisenia andrei. In reproduction tests, adult earthworms were exposed to natural sandy soil spiked with Bi citrate. Results indicate that Bi fraction 0.005 mg bioaccessible Bi/kg had little effect on phagocytic efficiency of adult earthworm coelomocytes. After 28 days,Bi concentrations in earthworm tissue increased up to 21.2 mg Bi/kg and reaching a stationary state at 212 mg Bi/kg of soil.

**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. Uren, INRS-ETE / Centre Eau Terre Environnement; S. Jacob, P.G. Campbell, P. Robidoux, Université du Québec, INRS / Centre Eau Terre Environnement; Z. Omouri, AGAT Laboratories, Ltd / Specialty services Division; Z. Omouri, AGAT Laboratories, Ltd / Specialty services Division; Z. Omouri, AGAT Laboratories, Ltd / Specialty services Division

Metal exposure may lead to accumulation and toxicity in aquatic species. Once metals enter living organisms, they can penetrate into their cells and cause deleterious effects. Alternately, metals can be detoxified by binding to molecules designed to sequester them and prevent them from exerting their toxic effects, such as metallothioneins (MT) and metalloproteinlike like peptide (MTPL). MT and MTPL are mainly found in the cytosol of white suckers collected in a river in front of two petrol stations. In this study, the concentrations of As, Cd, Cu, and Se were measured in the heat-stable fraction of the exposed fish than in the reference fish, but overall, metal-binding strategies did not vary between the reference and exposure fish, with the exception of As. For Cd and Cu, a major peak was observed after a retention time of 15 minutes, corresponding to the retention time of MT, suggesting that these two metals were reasonably well detoxified and regulated in these fish by binding to MT. In contrast, for Se, a major peak was observed at 27 min indicating that Se was not bound to MT but rather to a biomolecule with lower molecular weight. Finally, regarding As, two major peaks were observed in the reference fish (25 and 27.5 min), whereas in exposed fish a major peak was identified at 29.5 min, suggesting the potential induction of a specific ligand to bind As in exposed white suckers. For future work, the identification of the Se and As binding biomolecules would be of great interest to determine if these metals are detoxified or if, conversely, the biomolecules are metal-sensitive and their binding to Se or As represents a threat for the health of fish.

**TU065**

Assessment of Toxicological Impact of Anthropogenic activities on Onitha Stretch of River Niger in Southeastern Nigeria

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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 Onitha 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>Cr>Ni. The HPI and MI values were far above the critical values. Results also showed EDCs to include PAH, phthalates, PCDDs, PCDFs, PBDEs, bisphenol A and PCBs. This study established that Onitsha 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
Bioaccumulation, DNA damage and metallothionein expression in plants grown on heavy metal contaminated soil supplemented with sewage sludge
M. Jaskulak, Czestochowa University of Technology / Institute of Environmental Engineering; A.O. Murtuza, Czestochowa University of Technology / Department of Infrastructure and Environment; A. Grobelak, M. Kacprzak, Czestochowa University of Technology / Institute of Environmental Engineering

Many anthropogenic activities have contributed to a release of contaminants, including heavy metals, into the environment. Since plants cannot leave polluted areas, it is, therefore, essential to possess a vast range of defence mechanisms that can reduce the toxic effects of heavy metals (HM). Contamination of soil and water with HM not only decreases the growth of plants but since metals can be accumulated in plant tissues they cause a severe threat to animals and humans the food chain. Identification of plants response mechanisms to contamination is becoming a prime objective in research since this knowledge can provide a solution for soil contamination and metal accumulation in plants. Studies on plants have demonstrated the ability of specific proteins - metallothioneins (MTs) - to hyperaccumulate heavy metals, and play a significant role in their detoxification and overall oxidative stress. The physiological roles of MTs are not completely understood and much is still unknown concerning their characterization in many higher plant species. Many studies have been conducted to evaluate the effects of fertilization of contaminated with HM soil by sewage sludge on the genotoxicity levels and the expression of metallothioneins in plants shoots and roots. The toxicity assessment was conducted using selected measurement endpoints: germination index, roots length, the severity of DNA damage, chromosome aberrations and the expression level of metallothioneins. Sinapis alba L. was chosen as a model plant for this experiment. Plants were grown for 28 days in a growth chamber where they were exposed to soil contaminated by HM from metallurgical activities and to contaminated soil amended with different concentrations of sewage sludge. The study showed the effects of sewage sludge on the level of genotoxic effects caused by heavy metals as well as on MT expression. As such, a significant increase in the expression level of MT was observed in plants grown under metal stress. The results showed that the differences statistically significant changes between related conditions which means that presented assay can be used as a sensitive stress marker for phytoremediation process.

TU067
Chronic toxicity assessment of Ni contaminated rivers in Japan using Ceridaphnia dubia for development of biotic ligand model for Japanese surface waters
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Ni is one of industrial essential chemicals and have been widely detected in Japanese river, US and EU have already established the water quality standard/criteria for aquatic life protection; however, it is still under development in Japan. In metal toxicity assessment, bioavailability of metals is an important factor and Ni bioavailability models (i.e. biotic ligand model (BLM)) for both acute and chronic toxicity have already been available for plant, invertebrates, and fish. They were developed mainly based on data of fish, crustaceans, and snails on the freshwater waters (hard water in general), which have different water chemistry from Japan (soft water, in general). Since water chemistry parameter (e.g. Ca, Mg, Na, K, pH, and natural organic carbon) highly influence on metal toxicity, we should check applicability of the existing BLMs on Japanese surface waters or development of our original BLM based on the data of Japanese surface waters. To collect Ni toxicity data in surface waters, we collected 45 river water samples from Ni contaminated rivers all over Japan and conducted the daphnid reproduction test using Ceridaphnia dubia, which is one of the most sensitive species to Ni and recently came into use as test species to evaluate surface waters and industrial effluent in Japan. We used The Windermere Humic Aquatic Model (WHAM) for speciation calculation. Ni toxicity were predicted using the existing chronic Ni bioavailability model for C. dubia established by De Schamphelaere et al. (2006). Except for uncontaminated upstream samples, the daphnids demonstrated typical toxic symptom of Ni (delayed lethal toxicity) and reproduction inhibition levels were correlated with Ni concentration suggesting that Ni is the representative toxicant in the collected samples. However, in several stations, other metals (such as Zn) may also contribute the toxicity thus we should carefully interpret the mixture toxicity.

TU068
Comparing metallic elements in corals from South Africa and the Mascarene Basin
V. van der Schaff, North-West University / Unit for Environmental Sciences and Management; R. Choong Kwek Yive, University of Mauritius / Chemistry; H. Boulman, North-West University / Unit for Environmental Studies 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 the skeletal and tissues of the colonies. No knowledge exists on the state of metal and metalloid contamination in corals from the Western Indian Ocean (WIO). Fragments of four soft- and five hard coral genera were collected from five sites in the WIO. 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. They were built to analysing metalloids and metalloids of different trophic branches and different organisms in 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 WIO than in certain region 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.

TU069
Cytochrome P450, fat and ageing: new insights into metal toxicity
N. Rai, Oerobo University / The Life Science Centre, School of Science and Technology; P. Olsson, Oerobo University / The Life Science Center-Biology; L. Larsson, Oerobo University / The Life Science Center-Biology

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 age-related effects in different organism. 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 clear yet. CYPs and fatty acid metabolism are related since both the pathways are connected to life span of organisms. CYPs are very well conserved model to study stress response mechanisms induced by metals due to some fundamental 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 of C. elegans following metal exposure. C. elegans were exposed to metal contaminated environmental sample 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-53B2 genes on exposure to both the metal mixture and environmental sample exposure. Further, fatty acid metabolism related genes such as fasn-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 further 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
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Effects of culture medium on metal toxicity and new approach for toxicology assessment

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Pollution of aquatic ecosystems is a global problem affecting the biological continuity of living organisms. In this context, metals is a group of pollutants occurring naturally in the environment, however human activity increase its concentration in the environment. Therefore, for environment surveillance purposes, metals entering aquatic ecosystems are regulated by water quality guidelines. The last one is based on the results obtained in toxicology tests using aquatic organisms, nonetheless the reported medium Effective Concentration (EC50) of a tested metal in a species widely varies. Here, our first purpose was to study 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 as study metal species, in order to play an impact on human 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 (fluorimetric analysis). In the first experiment, the microalgae was exposed for 72 hours to each metal using three different types of culture medium, OECD modified OECD medium (mOECD) and Bold Basal Medium (BBM). In the second experiment, the microalgae was exposed in a simplified test medium (distilled 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, >1200 and 293 µg/L for Cu, Pb and Zn in OECD medium, respectively, in mOECD, they were 34, 219 and 134 µg/L, respectively and in BBM, they were >300 µg/L in all the cases. In the second experiment, the obtained EC50 after 6h were 150, 189 and 88 µg/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.

TU/073

Environmental diagnosis of water and tilapia Oreochromis niloticus of the Tenango dam, Puebla, Mexico.

M. Manoza-Najera, G. Barrera Escorcia, University Autonoma Metropolitana Iztapalapa / Hidrobiologia; P. Ramirez Romero, U.A.M. Iztapalapa / Hidrobiologia Human population has seen the deterioration of resources derived from overexploitation and contamination by anthropogenic activities, an example of this is the Tenango dam. Due to the growing demand for this resource, associated to population growth, industry, livestock, and agriculture, dams have been built to satisfy these needs. In Mexico, some of them were constructed in sites/areas that over time were declared protected natural areas. Population/in settlements on its banks to make use of the water, as well as of 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, Mexico, which is used for fishing, irrigation, recreation and electric power generation, among other purposes. The study was conducted to evaluate the water quality and fish quality. Five field/trips were made in 2015. Physicochemical parameters were recorded: pH, dissolved oxygen and temperature; as well as nutrients: nitrates, nitrites, phosphorus, total metals; cadmium, chromium, copper and lead were determined in both water and tilapia. Results indicated that the fish physicochemical parameters are within Mexican admissible ranges. Nitrates and phosphorus exceed the acceptable limit for urban use and protection of aquatic life. Lead and chromium in water exceeded 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 of 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 a protected natural area.

TU/074

Estimation of Target Hazard Quotients and Potential Health Risks of Some Heavy Metals from Lipsticks in Nigeria.

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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. The purpose of this paper is to evaluate the hazard quotients of heavy metals due to daily 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 metal 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 arsenium 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 560.59 and the lowest value was obtained in Arsenic with 1.43 × 10^4. However, target cancer risk (TR) was highest for Lead with the value of 2.903 × 10^9 mg/kg. This shows that some of these cosmetic 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
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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, unabated use of these chemicals has changed the pressure over 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. Some changes in copper concentration and the interactions with other metals are still unknown. Nowadays, bivalve species are used in ecotoxicological biosassays 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 exposed under laboratory conditions to copper sulphate to determine lethal concentration; at a second phase, it was conducted experiments to the nutritive value of the two species and the inclusion of a resuspension event. We conducted a series of laboratory evaluation, which includes the assessment of Rapid Degradation (greater than 70% in 2.903 h), partitioning, speciation and resuspension. It is important to understand this initial fate process in regards to resulting biological effects. In addition, current OECD method 29? what sediment characteristics affect metal removal and which metals significantly faster than non metals? How do various test method conditions affect metal removal, using OECD method 29? What sediment characteristics affect metal removal and which show a reasonable worst case (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, dissolved 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 d tests. 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 removed 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.

TU074 High selenium-lentils offer a nutritional solution to combat arsenic poisoning in Bangladesh
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Background: Worldwide, the major chronic environmental threat to human health affecting over 100 million people, is daily exposure to naturally high levels of arsenic through drinking water and food, notably rice. Malnutrition increases the toxicity of arsenic. Low blood selenium specifically, increases the risk of arsenic-induced skin lesions and other manifestations of arsenic poisoning. Selenium, an essential element that interacts antagonistically with arsenic in the body, has been shown to decrease body burdens of arsenic and reduce arsenic-induced atherosclerosis in animals fed high selenium diets. Objectives: To reduce genotoxic absorption, and therefore arsenic-associated toxicity in highly exposed people, through a dietary intervention with naturally high selenium lentils. This treatment is especially practical for populations already consuming lentils on a daily basis, as in the region notorious for chronic arsenic poisoning, the Indagogenic plains of northeast India and Bangladesh. Methods: For six months in a double-blind study, 400 participants with tube well As levels from 10 to 1200 µg/L based on atomic absorption spectroscopy (AAS) analysis (WHO limits: 10 ppb for the west and 50 ppb in other regions) ate the same variety of lentils with high (0.854ppm) or low (0.029ppm) selenium because of the soil where they were grown. Urine, stool and hair samples were collected before, during, and at the end of the study, to determine arsenic levels and other physiological responses. Major outcomes: Mixed model statistical analyses determined that people consuming the high selenium lentils excreted significantly more arsenic though their urine (p<0.05) than those on the low selenium lentils, but there were no differences in stool As concentrations. Considering females only, there was a trend towards a difference in hair As on the 2 diets. Hair As decreased by 0.20 ppm in the high selenium lentil group, whereas it increased by 0.49 ppm in the low selenium group (p=0.07). Summary: This study indicates the potential effectiveness of a simple, whole food solution of consuming lentils naturally high in selenium to reduce absorption of arsenic from water and food.

TU076 Metals removal from water for hazard classification
Garman, NiPERA / Ecotoxicologist
Metals usually enter aquatic ecosystems in an oxic environment and associated with particulate organic matter. It is important to develop methods to determine the metals that are released into the water column. The Transformation/Dissolution Protocol (OECD 29) is an established method that was modified to examine metal removal from the water column under oxic conditions. The modifications include the addition of a small amount of sediment, and the inclusion of a resuspension event. We conducted a series of laboratory evaluations to address the following questions: Are copper (Cu) and nickel (Ni) removed from the water column of freshwater systems and if so, what is the rate of removal? How do various test method conditions affect metal removal, using OECD method 29? What sediment characteristics affect metal removal and which show a reasonable worst case (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, dissolved 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 d tests. 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 removed 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
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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 evaluated 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 Column Studies
C. Heise, Hamburg University of Applied Sciences/University of the West of Scotland; S. Heise, Hamburg University of Applied Sciences / Life Sciences
REEchangeE focuses on the anthropogenic release of the rare earth elements (REE) lanthanum and gadolinium to the environment and their potential risk within ecosystems. REE are increasingly applied e.g. in green technology, and consequently also emitted to the environment. But there is a diversity of potential poisoning sources of which little is known, and no regulatory environmental framework for immissions exists so far. In addition, a review by Herrmann et al. (2016) demonstrated the considerable lack of reliable data for La toxicity in the aquatic environment. Considering their future use, release, and environmental fate, an evaluation of environmental risk from lanthanum and gadolinium will have to be based on information on exposure pathways, exposure and effect concentrations. The project REEchangeE addresses these topics in the following ways: (1) by studying the toxicity to aquatic organisms. Results on ecotoxicity responses obtained for Aliivibrio fisheri and Rhaphiodocells subcapitata so far are in the same range as literature data, and show a higher toxicity of Gd compared to La. Effect concentrations are of the same magnitude as for cadmium. (2) by substance flow analysis (SFA) for La and Gd, exemplarily performed for Germany. Information has been collected from published work for a variety of potential sources for La and Gd in rivers and lakes. Additionally, water and sediment samples have been analysed at specific locations. Current data point to wastewater and specialised industries as prominent sources of emission. (3) by investigating the impact of changes in environmental conditions (pH, redox, salinity) on the bioavailability of particle bound La and Gd. In a microcosm, a battery of miniaturized biotests was applied to monitor the toxicity responses in overlying water and sediment. This includes tests with Aliivibrio fisheri, Vibrio proteolyticus Archaeobacter gholfris and especially Daphnia magna. Additionally, speciation and bioavailability of the La and Gd are examined following a procedure by Simpson et al. (2014), applying a cascade of different filters and a chelating resin. The presented poster will depict the results of the microcosm experiments along with the information on bioavailability based on biotests and speciation data.

TU082
Sediment characteristics of natural and anthropogenic origin and their possible association with benthic macroinvertebrates in a minimally affected river in South Africa.
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Sediment characteristics generally entail metals, minerals, organic content, elements, particle size, particle size distribution and the pH. The pH of sediments may originate from anthropogenic activities including mining, industries, agriculture as well as aseptic deposition. Limited attention is however given to the contribution that natural occurring phenomena play in the concentration of metals in the sediment. Weathering of minerals originating from the primary lithology can on the one hand add to the metals in sediments and on the other hand to the particle size composition. Although it is well known that chemical pollutants, due to anthropogenic impacts, act as a major determinant for the macroinvertebrate composition in surface waters the influence of the above mentioned components in a pristine river is less known. The aim of this investigation was firstly to determine the sediment characteristics and secondly to establish which of these characteristics have a significant impact on the macroinvertebrate community structure in the Marico River, South Africa. Sediment characteristics (metal concentrations, pH, electrical conductivity and both diversity and abundance of macroinvertebrates) Forty two families of which the vast majority associated with particles >2000µm, were found. Sediment particle sizes <2000µm had a detrimental effect on the biodiversity. No significant correlations was demonstrated in the relationship between metals and both diversity and abundance of macroinvertebrates. Although relatively high concentrations of selected metals were present in the sediment, it was largely from geological origin and most probably not bioavailable. Therefore, it can be concluded that, under these conditions, sediment particle size, played the decisive role on the distribution and abundance of macroinvertebrate taxa.

TU083
The effect of copper sulphate on the antioxidivs enzymes activity of two size classes of Cerastoderma edule
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Anthropogenic activities, such as agriculture or industrial activities are the main source of copper pollution continuing to the degradation of aquatic ecosystems affecting the living organisms of the aquatic systems. Copper is often released into the aquatic systems, and may affect these ecosystems and its communities. Copper sulphate is a copper-based formulation, used in the agriculture practices to control pests. The main aim of this study is to determine the effects of copper in the antioxidant defence system of an important commercial bivalve species, Cerastoderma edule in two size classes. In this work was observed the behaviour activity of the organisms during the exposure time to copper sulphate and subsequently it was determined the antioxidant enzymatic activities of GST, GRd and GPx in the muscle tissue (foot). Moreover, lipid peroxidation was evaluated
through thiosemicarbazide 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.

TU004

The impact of single metals and mixtures in nature: a microcosm experiment

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Even though ecological 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 Asellus 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 Asellus aquaticus, Daphnia magna. Cryptocaryon riparius with different Phrygia, Hyalella azteca. The obtained results showed a 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. natalii 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 metal at the end of the experiment, further research focused on sublethal factors or with a longer exposure duration is needed.

TU005

The influence of soil properties on lead bioavailability and toxicity to Enchytraeus crypticus

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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. Enchytraeus was 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 days 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. pHCaCl2 and pHporewater decreased with increasing total Pb content. Enchytraeus, however, did not decrease more than much stronger for the soils with lower CEC and OC content. Surfact per 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 enchytraeids 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 3392 mg Pb/kg dry soil. LC50 on the basis of total Pb concentration increased linearly with increasing CEC (R² = 0.70-0.90) or pHporewater (R² = 0.87-0.94). The differences in Pb toxicity among soils could be associated to the Pb extractable 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 pHporewater (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 effecting LC50, EC50 and internal Pb concentrations in enchytraeids, 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.

TU006

Toxicity evaluation of soils sampled in the vicinity of an Aluminum smelter in Montenegro using the Ames, Biotest LABeco Biosays

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This study conducted as a part of the national project ECOTOX that main topic was testing applicability of several biosassays 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 high level of Pb in soil and massive industrial activity is also reached 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 city communities, 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 by bioluminescence in the potency Biofisher and concentrations of possible dioxins present in the samples by DR-Luc test on rat H4IIE 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 of 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)

TU007

In silico approaches to screen and design safer chemicals

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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 undesired 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 QSARINS-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 SbD 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.

TU008

Application of chemometric methods and QSAR models to support pesticide risk assessment starting form ecological toxicological datasets

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Recently the International Center for Pesticides and Health Risk Prevention (ICPS) – European Food Authority (EFSA). The aim of the project was investigating 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 EC50 or EC20 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. We therefore report their 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 EC50, EC20, and EC10 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
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In the framework of a Project GUIDEnano we investigated the effect of different metal nanoparticle (NP) coatings (synthesized from PlasmaChem GmbH, Germany) on 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 uncoated and coated with citrate or polyelectrolyte 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 hepatosomatic 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 uncoated NP for which Ti levels in the fish were higher than for the other coated NPs. Ti levels reached basal values already in the first day of depuration indicating the uncoated NP for which Ti levels in the fish were higher than for the other coated and no differences in fish growth or in the hepatosomatic index among groups were considered more appropriate since they take into account the whole transport 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 complicated 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 FP7 project NANO-2010 NANOARD, we are developing 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 NMs and the biological medium, in these 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. Quil, RIVM / DMG; E.A. Bleeker, W. Brand, RIVM / VSP; C. Som, EMPA Technology & Society Lab

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-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 take into account the whole transport 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 complicated 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 FP7 project NANO-2010 NANOARD, we are developing 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 NMs and the biological medium, in these 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).

TU092 Safer-by-Design framework for supporting Small and Medium Enterprises early in sustainable innovation for nanomedicine
M. Schmutz, C. Somi, EMPA Technology & Society Lab

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 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, might allow them within a short time to reach 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 complicated 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 FP7 project NANO-2010 NANOARD, we are developing 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 NMs and the biological medium, in these 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).
risks and having batch-to-batch uniformity. Finally, notifying bodies are behind development because of the uncertainties arising from this field. Therefore, it seemed important to include in the framework the following aspects: safe material's design, human health and environmental risks, manufacturing, storage and transport and the regulations related to the topic at hand. At the end of the project, the Safer-By-Design framework will be used as a structural backbone for creating nano-specific guidelines and十几年前. These guidelines aim to facilitate the communication among the different stakeholders in the value chain and with regulators for safe and sustainable innovation.

TU093 Review of the applicability of early-stage sustainability methods integrating toxicity and environmental assessments
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The chemical industry strives for the development of bio-based alternatives for present fossil-based chemicals driven by the transition to a bio-based economy. Key in this transition is “safe and sustainable by design”, which means safety and sustainability are taken into account at the earliest possible development stages. 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 address 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 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 neither 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.

TU094 Liquid organic hydrogen carriers (LOHC) - comparative hazard assessment
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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 (IPC-81), bacteria (Vibrio Fischeri), algae (Raphidochelis subcapitata), freshwater plants (Lemna minor) and invertebrates (Daphnia magna) were investigated. Test set included LOHC systems based on quinoline, ethyl-, propyl-, butyl- or butyric acid and LOHC systems based on H2, H2-rich and partially hydrogenated. Low to moderate (eco)toxicity of automotive diesel fuel, was observed for the quinoline LOHC system. No effect occurred in aquatic tests for H2-rich alkylcarbazoles due to unstable exposure. The H2-rich forms were moderately cytotoxic. High cytotoxicity was observed for partially hydrogenated alkylcarbazoles, with the effect increasing with the chain length. Alkylcarbazole LOHC systems were generally more toxic than diesel oil. None of the LOHC chemicals showed appreciable biodegradation except quinidine. Further biodegradability test under less stringent conditions are needed to investigate potential persistence. Additionally, hydrophobicity of H2-rich and intermediate forms of alkylcarbazoles (log D 3.6–4.8) indicates that they might be bioaccumulative. Nonetheless, additional socioeconomic benefits come from the fact that LOHC energy systems can operate on renewable energies. Moreover, this LOHCs are more favourable in the terms of handling and transportation safety. The composition of LOHC is much better defined than it is in case of fossil fuels, which facilitates standardisation or quality control. This study also showed that many of the standard (eco)toxicity testing approaches are not well suited for LOHC systems showing moderate to high hydrophobicity as it is the case for diesel oil.

TU095 1-Octanol and 2-Butanone as biofuel candidates - Using “Green Toxicology” for biofuel development
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The 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)toxicalogical bioassays can be applied as screening tools during the early developmental phase of biofuels for obtaining information on potential hazardous properties. These biochemical 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-Octanol 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 "Butanone as biofuel candidates” funded by the Excellence Initiative by the German federal and state governments to promote science and research at German universities.

TU096 Investigation of the toxic effects of new mixtures of deuterium of eucalyptus solvents (DES) on the environment and human health
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The development of environmentally benign and green synthetic protocols, due to the concern over carbon dioxide, has been accompanied by the necessity to find greener, readily biodegradable and low cost solvents. This new concept of green chemistry has recently led to the synthesis of Ionic Liquids (ILs), from which have evolved in few years the deuterium eutectic solvents (DESes).[1] These compounds are obtained mixing two components: a quaternary ammonium salt (e.g. ChCl) with different hydrogen bond donors, in such a ratio that the resulting substance has a significantly lower melting point than that of each individual component. DESes have proved to be environmentally sustainable and alternative to the conventional organic solvents in synthetic chemistry, able to increase efficiency of organic transformations. These solvents have attracted widespread academic and industrial interests, and have found almost unanimous worldwide approval. Cosmetics has been one of the most profitable industries. The majority of cosmetics are composed of chemicals generally as emulsions. Given the ease of use and cost, cosmetics are composed of chemicals generally as emulsions. Given the ease of use and cost, cosmetics are used as pesticides, meaning of the importance of their presence in our daily life. Toxicological studies on ChCl+Glycerol and ChCl+Levulinic Acid (never studied before) on algal species of the genus Symbiodinium clade B, known to be highly sensitive to environmental stress, for all the tested mixtures. Algae growth and Reactive Oxygen Species (ROS) production, a general indicator of stress, is indeed not affected by all the tested compounds in the order of 1L. Results from the present study indicate an expected safer

New frontiers in Life Cycle Inventory data collection and modelling (P)

PREDICTING ENVIRONMENTALLY BENEFICIAL PRODUCTION PATHWAYS FOR CHEMICALS WITH NEURAL NETWORKS
J. Klundt, R. Thomsen, Aachen University. Institute of Technical Thermodynamics

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. This 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.

A STUDY ON THE DEVELOPMENT OF FOOD LCI DB AND PCR FOR ESTIMATING ENVIRONMENTAL FOOTPRINT IN SOUTH KOREA
S. Choy, 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, 195 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 regulations of developed 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 2008 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 data registration in each country. However, Korea’s agricultural and livestock LCA DB does not meet the quality environmental information on foods. As a result, the registered data in the ILCD- EF transition phase can be resumed as following: - 1242 obsolete or wrong environmental flows have been deleted /mapped - 560 new environmental flows have been created - 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.

NEW TOOLS FOR ENVIRONMENTAL FOOTPRINT DATA CHECKING AND SHARING: SODA4LCA, ILCD VALIDATOR AND REGISTRY FOR THE NODE MANAGEMENT
S. Fazio, E. J. R. E. C.; R. Diaconu, JRC European Commission; O. Kusche, OkowX; R. Pant, European Commission / Institute for Environment and Sustainability; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit

Several tools for Life Cycle Inventory data development, validation, sharing and registration to the Life Cycle Data Network (LCDN) have been released by the EC since 2013 and improved after the official launch of the LCDN (2014). All those tools were originally meant for the International Life Cycle Data (ILCD) scheme. Since 2013 after a specific EC Communication (COM(2013)/0196) the Environmental Footprint (EF) scheme has been developed and led to significant changes in the structure of the ILCD/LCDN. During the development of EF compliant data, the tools had to be adapted and improved to fulfill new requirements. Particularly the following tools and software have been changed: - ILCD validation tool: software for the compliance assessment of datasets (format syntax, archive structure, nomenclature, links and orphaned items, categorization, etc.) - soda4LCA: software for distributing data based on the ILCD data format, with search and management functions, including the data registration in the LCDN - ILCD registry: online registration facility that can store data from nodes running on soda4LCA, and meant to make available only fully compliant data (while the nodes can host also intermediate data) The changes that have been applied can be summarized as follows: - ILCD validation tool: additional validation profiles added for EF scheme. Checks against different parameters for Elementary Flows, location IDs, new LCIa methods, Flow Properties, Unit Groups and schemata, according to the changes made in the DB structure - soda4LCA: new access profiles are available for data stocks. The developer can now select entire data stocks and restrict the access only to authorized users. The entire data stock can be now downloaded directly, while before it was possible only at the single dataset level. The registration form includes a statement for the use of data within the EF framework. Declaration of compliance in the registration phase and possibility of multiple registration in more than one registry at once (a dataset can be both ILCD and EF compliant and therefore registered in two registries with different compliances declared). - LCDN registry: a dedicated registry has been developed for EF, with new functions. The compliance scheme is now visible (before was implicit since only ILCD was possible), possibility to register entire batches of data at once (before each single dataset had to be registered manually). Search interface improved.

TRANSITION FROM ILCD TO ENVIROMENTAL FOOTPRINT: CHANGES IN THE DATABASE STRUCTURE, FORMAT, NOMENCLATURE, METHODS AND OTHER ADAPTATIONS.
S. Fazio, E. J. R. E. C.; O. Kusche, Karlruhe Institute of Technology; E. Diaconu, JRC 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, nomenclature and communication of 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) of major production pathways for the same product and 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.

IMPROVING THE CONSISTENCY AND THE ACCURACY OF WATER INVENTORIES OF CHEMICAL SITES IN PLASTICS EUROPE LCIS IN THE PERSPECTIVE OF THE APPLICABILITY OF THE IMPROVEMENT METHODOLOGY TO OTHER SITES
M. Baird, 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 inconstancies in its eco-profile procedure, where use and consumption sometimes were confounded. This short term action, in perspective of enabling the application of the latest consequential water 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

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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 water use in a chemical plant and the link to the life cycle inventory phase and ILCD flow name. This framework is a 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 gate LCA. The presentation aims to attack LCIA 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 / LISPB; Y. Pigned, Université de l’Havre; T. Navarrete-Gutierrez, LIST; N. SCHIOPU, A. Lebert, CSTB; T. Gibon, Luxembourg Institute of Science and Technology (LIST)/ Environmental Research and Innovation

The aim of this study is to investigate the environmental performances of 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 SimPro 8.02 with ecoinvent 2.2 to calculate the conventional LCI. The calculated technological and environmental interventions distributed in time, was then used for climate change impact calculation in function of time. Two indicators were calculated in function of time: mean temperature change and radiative forcing. The new method allows considering fossil and biogenic carbon for climate change proposes without clashing on to fixed characterization factors and time horizon and without compensation as done in conventional method. The use of dynamic processes in operational and end life cycle 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 use of dynamic processes in operational and end life cycle results.

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 is well known in the input-output analysis and in the LCA literature. Authors tackle the influence of spatial variability by capturing differences in agricultural practices, transport options and industrial processing sites in the life cycle inventory (LCI). This information is, however, incomplete when quantifying impacts of agricultural commodities that are produced in large amounts and traded worldwide, e.g. soybean. Despite the efforts from the Input Output community to understand these impacts, this is usually requires the use of aggregated resource consumption and emission data for environmental extensions, which provides little detail on the technological and logistic factors contributing to overall ecological footprints. From the LCA perspective, total nation’s supply is made of thousands of individual life cycles from farm to gate, for which LCI data is not frequently available. The Trase platform allows for real-world pathways of several internationally traded commodities to be annually mapped, from producing regions to destination countries. In view of its great potential for LCA purposes, our goal is to implement a carbon footprint module able to deliver results on CO2eq. emissions associated, on the one hand, to annual production of soybean supplied from Brazil for the period 2010-2015; on the other hand, to every individual supply chain embodied in the whole supply of seed, oil, and cake to the international market. These include 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 relevance of the method approach that added up the further up the 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 Asia-Pacific 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 existing database for Japan does not normally also include the dynamicism 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 CO2eq. 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 Y. Ichisugi, VTT Technical Research Centre of Finland; M. Mlynska, 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 process description. Therefore, the results are sensitive to the choice of methods. 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 tests and see the impact of these actions, e.g. on material choices or manufacturing methods both locally and at the network level. This feature is also beneficial for policy planners who want to see the big systemic picture and formulate their action plan based on the observed data. The data needed for the life cycle assessment can be provided via a web form, which has certain built-in features to speed up the data gathering process. The web form supports predefined parameter lists and it is also possible to add new parameters to the existing lists. Also the compatibility with impact categories such as impact on greenhouse gas emissions or resource depletion is hereby ensured.
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 flows (known as “technosphere”) flows according to ISO 14044 (ISO 14044 2006).

Elementary flows or intermediate flows are of energy, or space that are used directly from the environment or released directly back into 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 fluxes in LCA data. INT J LIFE CYCLE ASS. http://dx.doi.org/10.1007/s11367-011-01354-3 [3] ISO 14044 (2006) ISO 14044: Environmental management--Life cycle assessment--Requirements and guidelines. International Organization for Standardization, Switzerland

TU106

Tissue specific 32P accumulation and consequent biological effects in bivalve molluscs

E. Verouci, The University of Plymouth / School of Biological & Marine Sciences; J.T. Smith, University of Portsmouth / School of Earth and Environmental Sciences; A.N. Jha, Plymouth University / Biological Sciences

1. Introduction

The aquatic environment is not only the natural recipient of anthropogenic contaminants, including radionuclides. Despite the growing concern over presence of radionuclides in the aquatic environment, there has been only limited studies to determine potential biological responses in aquatic invertebrates following exposure to environmentally realistic levels of radiation doses. This integrated 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 days 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 mussel tissues were investigated in digestive gland and gill cells. This included the induction of DNA damage (Comet assay) and repair response (Gamma-HAX), 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 in 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 viable estrogenic inducer?

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Vitellogonadogenesis (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 estrogen 17α-ethinylestradiol (EE2) induces endocrine disruption 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 . 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 compared to the solvent control, although this increase was not statistically significant. In mussels exposed for 24 days to 100 ng L−1 EE2, Vtg levels were significantly higher than mussels exposed to a solvent control. These results suggest that EE2 does not induce Vtg in M. galloprovincialis. However, it is possible that Vtg synthesis was impaired by the fact that organisms were in negative energy balance. The results of the experiments done at a higher feeding regime (currently being analysed) will confirm this result. A significant correlation was found between Vtg levels and the maturation state of female mussels, indicating that maturation state is a confounding factor for the application of Vtg levels in gametogenesis studies.

TU110

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

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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. Gonçalves, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM; A.M. Soares, University of Aveiro / department of Biology & CESAM; F.J. Webre, 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 in 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 using behavioral and morphological effects on the offspring and the population dynamics derived from four different sources in regional rivers (SP, ATB, STB and ELLs). All ecotoxicological results were complemented with the chemical analysis of metals, naphthenic acids (NAs) and polycyclic aromatic hydrocarbons (PAHs) to understand the possible effects that this material will induce when in contact with aquatic systems. All tested organisms responded negatively to the presence of oil sands material through the decrease in liquid medium or through sediment contamination with solid oil sands material. A pattern of toxicity was also observed, where the SP source material was the less toxic and ELLs material being more toxic. These results corresponded with the chemical analysis which showed the ELLs sample having high levels of PAHs and NAs. In summary, tests revealed that oil sands material affected model organisms under laboratory exposures, especially in samples with more NAs and PAHs content.

**TU11**

**Genomic DNA methylation level : a stress molecular marker in the species Gammarus fossarum**


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 in 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 using behavioral and morphological effects on the offspring and the population dynamics derived from four different sources in regional rivers (SP, ATB, STB and ELLs). All ecotoxicological results were complemented with the chemical analysis of metals, naphthenic acids (NAs) and polycyclic aromatic hydrocarbons (PAHs) to understand the possible effects that this material will induce when in contact with aquatic systems. All tested organisms responded negatively to the presence of oil sands material through the decrease in liquid medium or through sediment contamination with solid oil sands material. A pattern of toxicity was also observed, where the SP source material was the less toxic and ELLs material being more toxic. These results corresponded with the chemical analysis which showed the ELLs sample having high levels of PAHs and NAs. In summary, tests revealed that oil sands material affected model organisms under laboratory exposures, especially in samples with more NAs and PAHs content.

**TU113**

**Ecotoxicological effects of the insecticide Imidacloprid on amphipods along pollution gradient in a river**

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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 also the case of an amphipod species Gammarus pulex (Crustacea, amphipoda), which can be 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 (Saxony-Anhalt, Germany). Sites were characterized with respect to pollution burdens 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**

**Antennae 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 Parhyale hawaiensis is a marine amphipod of worldwide circumtropical distribution. An ecotoxicological tests for P. hawaiensis is able to regenerate its appendages, limbs and tissues after an injury or lost during the entire course of their life. Regeneration can be used as an ecotoxicological endpoint to assess potential teratogenic compounds and their impact on stem cells. Studies suggest that P. hawaiensis has local progenitor cell in each part of body It was already been demonstrated that P. hawaiensis has a fast regeneration of thoracic limbs, within a week, but no information on antennae's regeneration was found. Thus, the aim of this study was to obtain data on regeneration of antennae of P. hawaiensis to determine the viability this endpoint on toxicity tests. On day one left antennae of six months old organisms were amputated with sterilized tweezers, each
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 fed 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 daily until all of them undertook full regeneration. At the end of each experiment, another pictorial data set to determine the difference between the initial length (n=8) before and after full regeneration. Another regeneration 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 determine their absorption process in the developed experimental conditions. Acknowledgement: 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 Rampaço Magalhães for technical contribution.

TU115

**Added value of community approaches in environmental risk assessment**

M. Hammers-Wirtz, T. Strauss, Research Institute gaiac / gaiac - Research Institute for Ecosystem Analysis and Assessment; A. Toschki, Research Institute gaiac

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 of pollution can be identified. The applicability of such approaches is higher in Marine and Estuarine ecosystems due to the lower environmental 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 mesocosms 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 applied as a low tier tool for testing of non-standard species that 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 MDD categorization 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 cur-rent 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 assessments to improve the higher tier testing as well as the lower 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 products which passed risk assessment to check up on community level effects; 4) as monitoring tool for typical sequence scenarios of 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 assessments to improve the higher tier testing as well as the lower 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. Struyman, Cape Peninsula University of Technology / Biodiversity and Conservation; J. Odenaal, 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 polluted and run the risk of irreversibly losing their ability to support ecosystems. To address this, the Fraunhofer-Institute for Environmental, Safety and Health Technology (Steinwiesen, Germany) has been involved in a project on 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 studies concerning the relationship between water quality and the natural function of freshwater 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, km 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**

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QWATER: Towards a complete, cost-effective and quick 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 requires for chemical and ecological evaluation of water ecosystems, combining or multiple 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 cur-rent 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 assessments to improve the higher tier testing as well as the lower 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.

TU118

**Chronic testing of mayfly and stonefly species - Development of a new approach**


Aquatic organisms, especially lotic invertebrate species originating from running waters, are exposed to releases of plant protection products which are mainly used in agriculture. Since lotic invertebrate species are regarded to be very sensitive but are hardly considered in chronic ecotoxicity testing, we developed a test system in order to investigate chronic effects on mayfly and stonefly species. After developing the test system for steelyard larvae Psephenus sp., the next step was the establishment of a method for testing of mayfly species Ephoron sp. In the developed test system, contrary to usual indoor stream systems, not the water body itself, but test vessels inside test containers are circulated, thereby creating a target flow. The test containers are filled with medium and contains ten replicates each. Each replicate is a small cage, which serves as individual compartment for individual testing of one test organism. The surrounding are adapted to the natural habitat of the test organisms. As endpoints growth, emergence and mortality are observed during a 21 day exposure period. For the studies we use field collected larvae which are adapted to laboratory conditions.
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 snailfly 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 snailfly testing, the green alage Desmodesmus subspicatus was used for feeding of mayfly larvae. To avoid adaption of mayfly larvae to cladoceran 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 snailfly species will be presented.

TU119

Toxic effects of a carbamate insecticide on a non-target freshwater gastropod: active ingredient versus commercial formulation


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 drainage 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 12.68 µg L\(^{-1}\), and the equivalent to 126.86 µg L\(^{-1}\) CAR of a formulation (dissolved in dechlorinated tap water) with 85% of the active compound. The concentrations used were chosen so as to have the same molarity as previously used in our laboratory. In bioassay 1, eight glass vessels per treatment were used with five 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 (ChEs), carboxylesterases (CEs) with two substrates, glutathione S-transferase (GST), glutathione (GSH), superoxide dismutase (SOD) and catalase (CAT). In bioassay 1, five treatments per compound or formulation, does not affect their toxicity. In bioassay 2, the results of the performed tests as well as a comparison between testing of mayfly and snailfly species will be presented.

TU120

Toxicity of lanthanides to freshwater microcrustaceans

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Lanthanides are still insufficiently understood. The toxic concentrations reported in the literature, e.g., for Daphnia magna, noticeably vary presumably due to different test conditions. For this study, acute test toxicity of La, Ce, Pr, Nd and Gd nitrates 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 (iii) tested chemical element. Therefore, nominal concentrations were used for toxicity calculations. Acute toxicity of investigatedLn to both crustaceans was similar: E(LC50) values ranged from 18.5 to 18.5-31.1 mg L\(^{-1}\) for D. magna. Gd was the most toxic to both species, however, difference between E(LC50) values for Gd and other Ln was statistically significant (p < 0.05) only in T. platyurus. In the lake water, bioavailability of Ln was much lower: mortality of exposed organisms did not exceed 25% at the largest tested concentration (50 mg L\(^{-1}\)). In contrast to acute assays, the 21 day chronic test performed in the lake water showed high Ln toxicity to D. magna (0.2 to 0.5 mg L\(^{-1}\)). It was revealed that mortality was a more sensitive endpoint than reproduction. Differences between LC50 of individual Ln were not statistically significant. Thus, our results support the hypothesis that different lanthanides have a similar mechanism of toxicity in crustaceans. This work was supported by Estonian Research Council grant IUT23-5.

TU121

Relevance and suitability of invertebrates swimming behavior as sub-lethal endpoint to be considered for ecotoxicological investigation

s. morgana.; 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 toxic effects at early stages of toxicant levels. At the CNR-ISMAR laboratory, it has been developed an innovative automatic recording system, namely Swimming Behavioral Recorder system (SBR system), coupled with an advanced image processing software. Nowadays, the SBR system has been used to record and track the swimming speed of different marine invertebrates, including carnivorous, crustaceans, rotifers and echinoderms. 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.

TU122

Benefits of Using Ecologically and Economically Valued Invertebrate Species for Ecotoxicological Analyses: Potential Phototoxic Effects Comparing a Freshwater Vertebrate and Invertebrate

E.N. Vekbrosky, Louisiana State University / Department of Environmental Sciences; W. Xu, Louisiana State University AgCenter / Renewable Natural Resources; J. McGuffin, Louisiana State University AgCenter / Renewable Natural Resources; K. Ambrust, 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 areas, such as Louisiana, where an invertebrate species is of such importance, incorporating that species into ecotoxicology testing may benefit the overall risk assessment for the chemical in question and any potential effects to the organism itself. For example, dicloran is the active ingredient in the fungicide Botran™, which is used throughout Louisiana on rice fields. The toxic and phototoxic impacts of dicloran were analyzed using a vertebrate and invertebrate species (fatehed minnows, Pimephales promelas, and red swamp crayfish, Procambarus clarkii). Fathead minnows showed negative impacts at concentrations as low as 0.1 mg/L and >90% mortality at 0.75 mg/L and red swamp crayfish showed negative impacts at concentrations ranging from 0.50-1.0 mg/L; the effects at similar concentrations show that P. clarkii is a useful, nontraditional organism to be used for ecotoxicological analyses in areas such as Louisiana where they are of such high importance. The use of crayfish, or other valued invertebrates, in ecotoxicology testing are additionally beneficial as they do not require IACUC approval and can likely be spawned in labs.

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.

sets the performance of Daphnia magna bioassays, 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 snailfly testing, the green alage Desmodesmus subspicatus was used for feeding of mayfly larvae. To avoid adaption of mayfly larvae to cladoceran 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 snailfly species will be presented.
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 a specific and bioactive activity, reaching the freshwater aquatic systems mostly untreated, where their fate and behavior is little understood. Anti-cancer drugs are among of the ECCs of concern due to their high cytotoxicity and increasing usage. The administration of drugs in coral reef zones, 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 sub-lethal concentrations of a non-antibiotic (5-Flourouracil, 5FU) and a cytotoxic antibiotic (Doxorubicin; DOX) alone and in mixtures. The results showed that 5-Flourouracil 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 interaction that both drugs have different antioxidant pathways and an 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

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Quantification of acetylcholinesterase (AChE) and general 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 _in vitro_ and _in vivo_ in the two aquatic invertebrate species: _Daphnia magna_ and _Chironomus riparius_. The aim of this comparison is to ensure the efficiency and selectivity of the four methods, 1) to compare _in vitro_ and _in vivo _measurements and 3) to compare the inherent esterase activities of _D. magna_ and _C. riparius_. The four assays were: 1) _AChE-assay_ using acetylthiocholine iodide (ATCI) as substrate, 2,5′-dithio-bis-(2-nitrobenzoic acid) (DTNB) as chromogen, measuring the production of 5-thio-2-nitrobenzoic acid; 2) _AChE-assay_ using acetylthiocholine iodide as substrate, measuring resorufin 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-methylumbelliferyl fluorescence. Michaelis-Menten curves were created for all substrates, where it was possible. The results showed that the _AChE-assay_ using 4-MUB measured general esterase activities well both in _in vitro_ and _in vivo_. The _GE-assay_ using 1-NA and _AChE-assay_ using ATCI substrates with 24-hour exposures 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 _in vitro_ of _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±2.4±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 _in vivo_ measurements, the _GE-activities_ were 49.1±17.4 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_ 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_.
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 transcriptional phase of I (CYP1-like, CYP2-like, CYP2A1U 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 lipohilicity of pyrene, facilitating its influx through the plasma membrane into the intracellular compartment and enzymes involved in the biotransformation. This study contributes to the identification of new biomarkers of PAHs contamination in *C. brasiliana*. Moreover, a possible participation of these genes and enzymes in pyrene biotransformation metabolism is suggested. In addition, it suggests the participation of CYP2A1U gene in the biotransformation process of PAHs in gills of *C. brasiliana*.

**TU128 BIOCHEMICAL AND CELLULAR RESPONSES OF THE CRAB CHIRGYPACHYGRAPUS MARMORATUS TO EVALUATE THE ENVIRONMENTAL CONTAMINATION OF THE LIVORNO HARBOUR (ITALY) AND OF AN ADJACENT MPA**

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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 *Chirygachypaurus 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 develop cross-borders 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 “Secche della Meloria”, located just a few miles from 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, IDH; lactate dehydrogenase, LDH), oxidative stress (lipid peroxidation, LPO; glutathione S-transferase, 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 specimens collected at Livorno harbour and the samples coming from the MPA. The average values of LPO were about three times higher in crabs sampled in Livorno harbour in comparison with that sampled in the MPA. The results trends are not influenced by the sex and the female showed higher values of biomarkers in comparison with the males. The crab *P. marmoratus*, used for the first time as a bioindicator to investigate the toxicological status of a port and an MPA area by the use of a multi biomarker approach, was found to be a good sentinel species to monitoring coastal marine environment.

**TU129 Toxicity of titanium on the mussel Mytilus galloprovincialis**

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Titanium (Ti) is at forefront of research related to nanomaterials. Due to their physical and chemical properties, Ti nanoparticles (nTiO\(_2\)) are widely used in aquatic environments and industries, such as additives in pharmaceuticals and food colorants, toothpastes, solar cells, sunscreens, cosmetics and boat paints. With the increasing production and use of nTiO\(_2\), it has been inevitably released into aquatic systems through wastewater treatment plants, surface run-off, direct inputs and atmospheric deposition. The increasing input of nTiO\(_2\) in the aquatic environment has raised concerns about the toxicity of Ti to inhabiting organisms. Once in the aquatic environment, nTiO\(_2\) interacts with the surrounding water components, including other contaminants, which may change the availability of Ti to organisms, namely the ability to penetrate into cells which may result in toxicity. In the present study the mussel species *Mytilus galloprovincialis* was used to evaluate the impacts caused by the exposure of Ti (II) solutions with the initial concentrations of 5ng/L, 50ng/L, 100µg/L of Ti (II) (\(10^{-9}\)). Biochemical (oxidative stress related biomarkers, metabolic capacity and energy reserves) markers, after 96 hours and 14 days exposure periods, were evaluated. The obtained results revealed significant alterations in contaminated mussels, varying with the concentration and time of exposure. Mussels exposed to Ti presented lower metabolism, represented by lower electron transport system (ETS) activity, which decreased along exposure time. Moreover, nTiO\(_2\) decreased their metabolism by lowering the glycerol (GLY) and protein (PROT) contents. Moreover, contaminated individuals activated their antioxidant defences increasing the activity of superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx) and glutathione S-transferases (GSTs), which still were not enough to prevent cellular damages (revealed by the increased of lipid peroxidation in mussels exposed to Ti).

**TU130 Comparing interspecific Artemia responses to chronic zinc exposure**

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The invasive species Artemia franciscana is displacing native Artemia (A. salina and A. parthenogenetica) from eastern Atlantic coasts and across the Mediterranean region. The showed higher survival rates was significantly safer and higher mortality when exposed to Zn, but not significant effects were found in final size. Reproductive parameters, Zn exposure increased offspring production of both Artemia species when compared to control conditions. However, native *A. franciscana* showed increased growth and higher reproductive performance (higher number of broods and offspring production; lower % non-viable nauplii) than *A. franciscana*. These results of the work highlight the 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*, potentially leading to the theory of local adaptation. Keywords: Artemia species; Local adaptation; Sublethal exposure; Zinc contamination.
values obtained exposing ephyrae jellyfish to different toxic compounds and materials such as nanoparticles and microplastics with those obtained with other marine invertebrates, highlights that ephyrae 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

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In the last few years it has become increasingly important the contribution of ecotoxicological assays to the environmental monitoring, as a fundamental indication 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 echinoderm Paracentrotus lividus, as a new end-point. In detail, we 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.

TU133

Application of sea-urchin embryo test in the effect directed analysis approach for the evaluation of WWTP effluent in an estuarine media

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Since aquatic and chronic tests are often insufficient to clarify 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 Bilbao). The set-up was extracted using a sequential LC-UV fractionation methodology based on two different columns: a Nucleodur C18 column (21 fractions were collected) and an aminopropyl column (15 fractions). Two endpoints were used to determine the toxic effects after 48 h: the growth rate of the larvae and the rate of skeletal malformation. 6 levels (n=3) of dose-curve were prepared in units of relative enrichment factor (REF, final volume of 3 mL of filtered seawater with 0.1 % of DMSO). Non-target analysis was performed by means of UHPLC-Qxactive Plus MS in positive and negative modes with a C18 column. Toxic compounds were identified using MS2 spectra, Metfrag and Compound Discoverer (Thermo) interfaced to MZmine. Among the collected C18 fractions, only fraction 13th (F13) showed a clear toxicity and, therefore, it was tested separately to establish the concentration-response model. The curve-dose response of the raw sample (EC50 = 10 REF and EC50=19 REF) could be explained by the contribution of active F13 (EC50=14 REF and EC50=39 REF). Regarding the chemical analysis, among the final candidate list (20 compounds), mendenzalone (an antihelmintic agent) was confirmed chromatographically with standards. Nevertheless, a sequential fractionation of F13 was also carried out with an aminopropyl column, which showed a different orthogonality compared to C18 column, and the resulting 15 fractions were also submitted for further bioassays and data-dependent analysis. Overall, the results of this work suggest the possibility of addressing a kind of specific toxicity in sea-urchin embryos owing to the determination of only one toxic fraction and the contaminants identified in that fraction. Acknowledgement. This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. L. Mijanos is grateful to the Basque Government and H. Ziarrusta to the Spanish Ministry for their predoctoral fellowships.

TU134

Plausibility of Daphnia magna model to evaluate eicosanoid pathway related toxicity

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Eicosanoids are biologically active, oxygenated metabolites of C20 polyunsaturated fatty acids and are synthesized through cyclooxygenase, lipoxigenase or cytochrome P450 epoxygenase 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 toxicant or drugs such as ibuprofen and aspirin. However, an 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 transcriptional 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 plaq2, cox, pgd2a and pge2, was identified. After that, Daphnia magna was exposed to the eicosanoid pathway targeted drugs, i.e., ibuprofen, indomethacin, celecoxib and acetylaminothen at 0.25, 2.5 and 25 μM. Then, we analyzed transcriptome. To evaluate the activity, 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 of two monophyletic species. In this study, the 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.

TU135

Responses to single chemical and pulse exposures of two monophyletic Daphnia species under a multi-generation approach

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Placoplankton human activities are considered to be 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 duration acute and chronic tests. To ensure toxicity, 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 daphnids) to the fungicide mancozeb were also accomplished. Organisms from Pb were changed to a clean media for recovery for three generations. To monitor acclimation, statistically significant acute immobilization tests to K+2CO3- (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, except 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 ECoC). 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

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Since bisphenol A (BPA) can act as a weak estrogen agonist and disrupt steroidogenesis, 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-isopropoxynphenylsulfone (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 (<p < 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. Acknowledgment: 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

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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 2008/105/EC it is mentioned that endpoint of MEHP as acts as a carcinogenic 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?

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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 adequacy criterion. The EU regulation 2008/105/EC concluded that endpoint of MEHP acts as a carcinogenic disrupting chemical in aquatic organism such as Daphnia magna and Chironomus riparius. Therefore, we conducted a test protocol on both species using different concentrations of MEHP in both acute and chronic toxicity tests. The results indicate that acute toxicity of D. magna is lower than C. riparius and Chironomus riparius is more sensitive to MEHP. MEHP is highly persistent and bioaccumulative in environment and living organisms. Therefore, it is necessary to conduct chronic toxicity tests on this compound in order to understand the long-term effects of MEHP on aquatic organisms.

TU140 Genetic variability in tolerance to microbial insecticides in Chironomus riparius

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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 to current environmental conditions and their 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 sexually reproducing organisms, based on the sensitivity of inbred families (sib 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 invertebrate 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 developmental weight were used as response variables. 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

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Amitraz is a very effective formamidine insecticide used in agriculture to control a wide range of pests like fruit trees and cotton pests. Due to its widespread use and high toxicity levels, there is an elevated risk of contamination of adjacent aquatic ecosystems. However, the information of amitraz toxicity to aquatic non-target invertebrates is scarce. In this study, the toxicity of amitraz to the midge Chironomus riparius (Meigen) was assessed in terms of life history responses using standard ecotoxicological tests and biochemical endpoints using oxidative damage, antioxidant defenses, energy metabolism, and neuromuscular toxicity biomarkers. Chronic exposure to amitraz contaminated waters (28 days; 10, 20, 40, 80, and 160 µg L⁻¹) resulted in impairment of Ch. riparius emergence and developmental rates (reduced larval growth and delayed emergence), with male development time being prolonged.
the most sensible endpoint (LOEC of 40 µg L^{-1}). Short-term exposures (48 h; 0, 10, 40, and 160 µg 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 amitraz, while there was a significant decrease in DNA damage levels at 10 and 40 µg L^{-1} treatment. The main 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-MAG/1302/2014), co-financed by COMPETE (POCI-01-0145-FEDER-16773).

TU142
Multigenerational exposure of Folsomia candida to copper agrochemicals: conventional and nano-pesticides
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Agricultural practices include the use of agrochemicals for crop maintenance and enhanced productivity. Although soil contamination may result, inorganic agrochemicals, like copper pesticides, have been used in a range of agricultural applications, which may result in environmental problems. More recently, nanopesticides were introduced in the market with the intent to improve efficiency and decrease environmental negative effects. However, the chronic ecotoxicological effects of nanoparticle exposure on soil biota are not well known since related environmental hazards are most often assessed using only the active ingredients. Moreover, the multigenerational effects of long-term, chronic exposure of soil organisms to agrochemical applications are unknown. The objective of this study was to evaluate the impact of long-term, multigenerational exposure of the soil collembola Folsomia candida to conventional and nanoparticle formulations of copper pesticides. Two formulations were assessed: Kocide® 3000 (nano form) and Champion® WP (conventional), as well as the pure active ingredient Cu(OH)_2 in spiked LUFA 2.2 soil. The effects of multigeneration exposure to the Cu pesticides were assessed using two soil treatments: 1) Cu spiking performed only at the beginning of the experiment and collombolan responses (survivorship, reproduction) measured for three generations (i.e., aging soil exposure); and, 2) Cu spiking performed at the start of each new cohort (three generations i.e., renewal reproduction). After three generations in both soil treatments, the surviving collombola were moved to uncontaminated soil for three generations to assess their recovery potential. Similar response patterns were observed in the two soil treatments for all three Cu formulations. Exposure to aging soils revealed an increasing tolerance across generations of F. candida. In contrast, in treatments with renewed Cu spiking, the collombolan populations showed ongoing sensitivity to Cu exposure. In both treatments, after being moved to clean soil, all treatment populations showed some recovery by displaying increased reproductive output. Copper forms presented different effects between them in the long term exposure. This study further emphasized the importance of using multigenerational approaches to obtain 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


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 the 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 against predatory mites on apple (Ariadna c. andrei) and vine (Cyathus porrectus 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 (Albuch, ATR 80), low-drift nozzles (Albuch, TV1 800015 green), and high-drift nozzles with an anti-drift adjuvant (rapeseed 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 (P)

TU149

Freshwater organism can recognize microplastics as microorganisms
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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 the present study, we observed the behaviour of freshwater organisms and evaluated whether they recognize and response 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±0.0, 2.8±3.1, and 0±0.4, respectively. Ingestion rate of diving beetle on control group was calculated as 0.63±0.02 zebrafish wet/mg. 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) during 591±85 seconds. On diving beetle, the MP were only 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 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
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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-effect 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 analyses textiles (PA, PBT, polyester/cotton blend and PES/CO) that were functionalised with durable water repellent (DWR) treatment. The chemical treatment consists of polymers that are based on per- and polyfluoroalkyl 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 nature of the fiber fragments generated 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
We demonstrate that based on current data concentrations of MPs measured in the environment are not high enough to elicit the effects reported from laboratory studies. There is however a mismatch between the size ranges and types of MPs used in laboratory ecotoxicity tests and those detected in the environment. There is an urgent need to address this mismatch by performing better quality and more holistic monitoring studies alongside environmentally relevant effects studies. Only then will we be able to determine whether these materials are having real impacts or not.

TU153
A cost-effective methodology for separation of microplastics from freshwater systems
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The past ten years has seen increasing scientific and public concern over the occurrence of microplastics (MPs) in freshwater systems. This is due to the fact that MPs are ubiquitous and persistent in freshwater systems, and can interact with biotic and abiotic environment. Currently, there is a mismatch between the size ranges and types of MPs detected in freshwater systems and those used in laboratory ecotoxicity tests and those detected in the environment. This result in inaccuracy data that differ 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 method. 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 different 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 multienzymatic detergent (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, the total mass recovered (recovered), the 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 monitoring 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
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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-mobile plankton or non-mobile sediments, we tested the hypothesis of a co-occurrence of microplastic and specific water parameters. In situ water parameters, microplastic concentrations, chlorophyll a or colored dissolved organic matter were determined. In situ derived spectral reflectance measurements (ASD 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 peroxide 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 samples and ocean current modelling

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Plastic pollution in inland waters and the open ocean is a long recognized problem for marine wildlife, 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 number countless 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 food 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 sampling at 9 beaches (averaged particle size range: 1.5 - 5 mm). 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 wind 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

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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 is 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 most is done 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 aquatic systems and subsequently in the marine environment. Beaches surrounding estuaries are heavily polluted with macroplastics which calls for greater prevention and clean-up efforts. Much effort is spent corporately to reduce South Africa’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 countrys largest drainage basin flowing through industrialised 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

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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 water bodies. The MPs were extracted from 5-L 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 in MP 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 micromicrons 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

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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. Therefore, it is important to study the effect of the weathering of MP particles to better understand how microplastics disperse in the environment. The UK-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: Biofilm (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 bioassays 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 bioassays, covering i) cytotoxicity; ii) acute effects of metabolic toxins, e.g. via binding to water soluble carbon receptor; 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.

Occurrence and characteristics of fine microplastics in seaweage water, domestic water, sewage treatment water and river water by coagulation and FT-IR microscopy method

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The occurrence of Microplastics (MP) is of great concern in aquatic environment, especially ocean. Many current studies evaluate MPs ranged from 100 μm to 5 mm. However, MPs used in personal care products and other industrial processes are expected to be much smaller, 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 water bodies. The MPs were extracted from 5-L 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 in MP 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 micromicrons 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.
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 water, sewage treatment waste, wastes in aquatic environments and so on. This research shows occurrence and characteristics of MPs originating from sewage treated in wastewater treatment plants in the arid climate with hot and dry summer, low rainfall (about 450 mm per year) in size. 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 scanning electron microscope. MPs by FT-IR were microplasty and FTIR, MPs are characterized by materials, size, color and multi-regression analysis by FT-IR spectroscopy. 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

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Microplastic (MP) pollution is nowadays recognized as a global concern affecting both marine, freshwater and also the terrestrial environment. Beside microplastic pollution, also micro-paint particles (MPP), originated by the coating degradation and abrasion of painted surfaces (buildings, ship-paint materials) have been reported in some recent studies. As many paints also contain organic compounds and heavy metals used as biocides aimed to inhibit the method of biota on painted surfaces, these particles could be even more harmful to the environment and wildlife than microplastics. Here we present some results obtained from the analysis of soil samples collected in a recreational boat facility in the North of Denmark. A “Microplastic-based” approach has been used, extracting the particles from the soil matrix using air-assisted density separation followed by FPA-μFTIR-Imaging analysis. This approach allows to identify and quantify microplastics and micro-paint particles down to 10-20 µm in size. Surficial soil samples were collected along three transects located in different areas of the shipyard. The samples, previously sieved (500-50 µm and 500-10 µm) were submitted to flotation using ZnCl₂ followed by sample cleanup using enzymes and H₂O₂ oxidation 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 was 222,500 particles Kg⁻¹, while the estimated mass was 17.1 mg Kg⁻¹. The most abundant polymers/paints detected were polyester (30%), acrylic coating (20%), water-based polyurethane (16%). 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 analysis procedure including multiple-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

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More than 90% of microplastics (MPs) present in raw wastewater are captured by wastewater treatment plants and removed in the course of the sludge phase. Therefore, the use of sludge as a fertiliser for agricultural soils may be a relevant source of MPs in the terrestrial ecosystem and, through runoff, in surface waters. The fate of MP applied with sludge is strongly dependent on weather conditions (rain, temperature, etc.). The objective of this study was to determine the fate and distribution of MPs in the agricultural soil-water system. The study was performed in a semi-arid environment in the Henares River basin (province of Alcalá de Henares, Madrid, Spain), located in central Spain, in an area characterised by semi-arid climate: hot and dry summer, low rainfall (about 450 mm per year) which is concentrated in spring and autumn. Suitable devices for runoff collection (modified Pinson collectors) were placed on three different plots with different MPs treatments: (i) soil never treated with sludge (control), (ii) soil treated with sludge in the past (in 2013), and (iii) soil treated with sludge at the start of the experiment (November 2017), according to usual agricultural practices. Besides sludge application, soil characteristics (composition, texture, etc.) were comparable in the three plots. Sludge was applied early November and the plots were sown with barley. After each relevant rainfall event, runoff water was collected and filtered in-situ and to isolate the MP fraction. Soil samples were taken in all plots at the start of the experiment, as well as 3, 6 and 12 months after the start of the experiment. To determine the vertical MP transfer within the soil, soil cores were divided into three fractions (0-5, 5-10, 10-15 cm). Separated plots receiving the same sludge treatments and soil conditions were used to sample earthworms and to ascertain the MP contribution of WWTP effluents. The study was carried out in the Henares River watershed (Central Spain). Five WWTPs with different dimensions (population equivalents between 10,000 and approx. 400,000), different influent types (domestic, industrial, or both mixed), and different treatment processes were selected. Wastewater inflow, outflow, and sludge (humid and dried) were sampled 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 µm). 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 matrix using FTIR microscopy. Finally, the most satisfactory charectistics of the MPs were selected. Microplastics occurrence and composition in drinking water from a Norwegian urban area

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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 fractures of MPs in different polymers; limited information is available on the chemical compartments of marine, freshwater and terrestrial ecosystems; others point out the accumulation of micro- and nanometric sized plastic particles through the marine and terrestrial food webs posing the risk of marine and terrestrial life and ultimately the human health. According to the WHO tips, the studies point out the occurrence of micro plastics in freshwater systems including surface and groundwater basins, very little in knowledge about occurrence of microplastics in the drinking water and their implications on human health. The research tasks of the present work were: Map published and available literature, develop and optimize a standardised fast, sensitive protocol for sampling and quantification of 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.

**TU164**

Macro and Micro(plastics) in the Environment of Some French rivers

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It is now known that the vast majority of microplastics found in the seas and oceans originate from land. In such a process freshwater environment (rivers and riverbanks) play a major role. It is therefore necessary to imagine the scenario that a used plastic, becoming a waste after use, will be found in the environment if it has escaped to a waste treatment stream. Its stay in the environment can persist for a very long time and this waste will then be exposed to a set of environmental constraints (UV, rain, wind, mechanical erosion, ...), which will continue and amplify its degradation, leading to its fragmentation. The work we have undertaken consists of: 1. Mapping of plastic litter in the territory and environmental cross-section over time of macromolecules present on the banks of an experimental site of the Allier River, and linking it to the density of the vegetal area. 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 babylge sampling net [3,4], which makes it possible to multiply samples and analyzes. 1 Occurrence of plastic litter in the Allier river in France, Vincent Verney, Gaëlle Bissagou Koumba, Alexandre Garreau, Florence Delor-Jestin, Erwan Roussell, Olivier Voldoire, Jean-Luc Peiry; To be published 2- https://www.researchgate.net/project/PLASTICSCAGES 3- Promise cycity, the case of babylge, Max Liboiron, Engaging Science, Technology and Society 3(2017), 499-527 4- http://lapagialiaueavauge.org/laboratoirebecquen/

**TU165**

Spatial and temporal trends of microplastics in an urbanized Canadian river

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Microplastics are ubiquitous contaminants in the marine environment, but quantification of their occurrence in the freshwater environment is sparse. This study investigates the occurrence, composition, and potential sources of microplastic contamination in the North Saskatchewan River, an urbanized river flowing through the city centre of Edmonton, Alberta, the fifth largest city in Canada. Surface water samples were collected monthly during the summer of 2017 using plankton nets with 53 µm mesh. Samples were collected from seven sites throughout the river, with four being in the downtown core of the city and three potential point sources (i.e., a wastewater treatment plant, WWTP). Microplastics were found in all samples, and at some sites concentrations exceeded those reported in other urbanized rivers. Various coloured fragments, films, beads, and fibers were identified, with the majority of microplastic contamination being in the form of fragments. Both the total concentrations and the proportion of each type of plastic varied with distance downstream and size class, suggesting changing inputs as the river flows through the city. No differences in either concentration or composition were found between sites upstream and downstream of the WWTP, suggesting a lack of significant input to the river. Moving forward, the chemical composition of suspected microplastics will be investigated using Raman microspectrophotometry. The work represents one of the first studies on the occurrence of microplastics in the freshwater environment in Western Canada and will provide a baseline for future monitoring studies.

**TU166**

A Historical Sediment Record of Microplastics in an Urban Lake, London, UK

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A historical record of microplastics extracted from a radionuclide (210Pb and 137Cs) dated sediment core from a London lake provides novel data on the long-term deposition of microplastic waste in freshwater systems. Microplastic particle abundance and calculated accumulation rates are indicative of plastic usage in the 20th century. Concentrations of microplastics extracted from the sediment, by sieving and floatation using dense liquid separation range from 30 to 880 particles per kg of dried sediment. Fibres dominate the assemblage of microplastic particles identified in the time-resolved sediment samples. Polyethylene microplastic particles were identified and are found in post-1950s sediment and up to the present day. An increase in microplastic concentration is evident in recent sediments (post 2000) but a peak in concentration is also observed in late 1960s-1970s age sediment. Raman spectroscopy of selected particles and fibres provides compositional data on the fibres and particles found in the sediment. The size and nature of microplastic particles found in the sediment is key to understanding the potential sources of microplastic transport to the lake. Microplastic analysis of temporally well-resolved lake sediment sequences will greatly assist in quantifying the historical flux of microplastic waste into the environment and should be included in future analyses to enable calculation of catchment-based budgets of microplastic contamination.

**TU167**

Microplastics from sewage treatment works and storm water outfalls discharging into the Victoria Harbour, Hong Kong SAR

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We conducted surveys of microplastic pollution in the surface waters and sediments from Deep Bay, Tolo Harbour, Tsing Yi, and Victoria Harbour in HK SAR. 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 27,909 particles per 100m2 and 49.0 to 5.048 particles per kg of dried sediment. The highest concentration of micro-plastics (coastal water) was recorded as 35,642 particles per 100m2 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 (SWOs) (Kwan Tong Ferry Pier, New Yau Ma Tei Typhoon Shelter, which are potential microplastic pollution sources entering into the Victoria Harbour. Effluent samples from each of these sites were collected from three weekdays per month and different seasons (December, March, June and September) to determine spatial, temporal (seasonal) variations of microbeads in treated sewage and stormwater discharges. The average concentrations of microbeads present in effluents from STWs and SWOs respectively ranged from 137,239 to 1,081,597 particles per 100m2 (December 2016 to March 2017) that consider as moderate emission level. Biological samples (fishes and mussels) are also collected in both two SWO for the assessment of microbeads 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 microbeads 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 vitellogenin 1(VTG1) studies. Our objectives in microbeads exposure experiments in zebrafish adult (Danio rerio) are 1) the upper and lower size boundaries for microbeads ingestion (ingestion range:10 to 600µm), 2) amount of microbeads accumulated inside the digestive tracts, and 3) expression profile of oxidative stress-related gene (CYP1A1) and endocrine-related gene (VTG1).

**TU168**

Models for Data Synthesis, Sampling Design and Scenario Analysis: Some using the INCA-MP model of microplastic fate and transport in soils and surface waters

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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 demonstrate that an INCA-MP, the Integrated Catchments model for Micro Plastics, the first published model of microplastic terrestrial fate, riverine transport and contaminant co-transport can be used to synthesis 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 spatial, may be used as proxy data to constrain modelled predictions of microplastic transport to the lake. Microplastic analysis of temporally well-resolved lake sediment sequences will greatly assist in quantifying the historical flux of microplastic waste into the environment and should be included in future analyses to enable calculation of catchment-based budgets of microplastic contamination.
Influence of environmental conditions on the sorption of organic pollutants to microplastic particl

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The ubiquitous contamination of all environmental compartments with microplastic particles is 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 micropollutants 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 different pH conditions (4.7, 7.0, 9.2). The investigated compounds showed a wide variety in their physico-chemical properties, e.g. a log $K_{ow}$ 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 $K_{ow}$ 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 predominantly dominated by the neutral fraction, while the charged...
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 polystyrene 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 most-manufactured polymers that is found in the terrestrial environment, used in many different sectors, including agricultural mulches, composites and packaging material [3]. To date, microplastics have been mainly studied in marine and freshwater systems, while 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 in 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 chemistry, because they can interact [5]. In order to characterize and investigate the influence of microplastics on the transport of organic contaminants in a soil under varying aqueous conditions, [1] K. Duiis, A. Coors, Environ. Sci. Eur. 2016, 28, 2 [2] M. Rillig, Environ. Sci. Technol. 2012, 46, 6453. [3] M. Beg, S. Kornim, B. Jirajmani, H. Zaman, Adv. Polymer Technol. 2015, 35, 2152. [4] A. Bakir, S. Rowland, R. Thompson, Mar. Pollut. Bullet. 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 Physiological Ecology; H. Schmiege, Tubingen University / Animal Physiological Ecology; E.E. May, University of Tübingen / Animal Physiological Ecology; R. Triebkorn, University of Tübingen / Animal Physiological Ecology. Despite the long and vast usage of plastic products during the last decades, the quantity of globally produced synthetic polymers rises continuously in high amounts of plastic debris of all sizes in the environment. Very small-sized particles and fibers (< 5 mm) which are defined as microplastics result either from degradation of macroplastics or are produced as primary microplastics which are contained e.g. in cosmetics. Microplastics are of particular interest in ecosystem research, because they can migrate like pesticides or pharmaceuticals, transport them into food chains and modulate their toxicities. In addition, they can mechanically affect exposed organisms. Whereas in the past, most of the studies on microplastics have focused on the marine environment, there is still little knowledge about the occurrence and impacts of microplastics in freshwater ecosystems. The aim of this study is to examine possible influences of polystyrene particles in combination with different organic pesticides on the behavior and biochemical responses of the giant rams-horn snail (Marisa cornuarietis). Snails were exposed to 10,000 polystyrene particles per liter (cmedogenetically milled, < 100 µm) in combination with different concentrations of the pesticides cypermethrin, methiocarb and thiocarb. In order to quantify the observed behavioral responses, five categories of behavior were defined, which are “crawling”, “attached to the wall”, “attached above the water surface”, “inactive on the ground” and “retracted with closed operculum”. All snails were individually categorized twice a day for nine days. The results make evident that snails exposed to cypermethrin significantly changed their behavior between the first (day 1-4) and second (day 5-9) observation period, independent of the test concentration. In the first period, they were often categorized as “attached to the wall” or “attached above the water surface”, whereas in the second observation period, these snails were mainly classified as “inactive” or “retracted”. As biochemical endpoints we study oxidative stress (lipid hydroperoxides, superoxide dismutase), proteotoxicity (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: 02WRS1378).

TU176 Effects of artificial weathering on polypropylene microplastics V. Fernández-Gonzalez, Universidade da Coruña / Grupo Química Analítica Apostila Aplicada (QANAP); G. Guineo-Noche, Universidade da Coruña / Grupo Química Analítica Apostila Aplicada (QANAP); J.M. Andrade-Garda, Universidade da Coruña / Grupo Química Analítica Apostila Aplicada (QANAP); P. López-Mahía, Universidade da Coruña / Analytical Chemistry Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química Analítica Apostila Aplicada (QANAP); S. Muniategui, Universidade da Coruña / Analytical Chemistry

Microplastics are defined as plastic materials or fragments with diameter below 5 mm. These microplastics occur due to the release of manufactured (primary) microplastics in various products and the breakdown of larger plastic litter (secondary microplastics). The time required for plastic to degrade under natural conditions is estimated to be hundreds to thousands of years, being photo-oxidation by UV light its primary degradation pathway. The small fragments of microplastic created by weathering are detrimental to ocean ecosystems for multiple reasons. In the frame of the BASEMAN project (JPI Oceans) 9 natural microplastics of different polymers materials, in two size presentations (100-500 µm and pellets ≤1 mm) were artificially weathered. A pilot-scale simulated weathering system (dry conditions and simulated marine conditions), using UV/Vis metal halide lamps, was deployed. This study focuses on the characterization of the changes that an accelerated artificial weathering process produces in polypropylene microplastics using ATR-FTIR. This could be useful to identify real plastics and microplastics found in marine environment, and understand how aging affects the surface and chemical structure of this material. New absorption peaks can be seen, that reveal changes in the main structure of the microplastics. Some indexes were calculated as the ratio of these IR bands to a reference peak that indicate oxidized carbon in the plastic hydrocarbon chain. It is worth to note that the direct identification of the type of polymer is usually not possible. Weathering-related changes in the IR spectra difficult the correct identification of the polymer when are compared with the IR polymer library. Moreover SEM microscopy was also done in order to study the characteristics of the microplastics. In addition, they can mechanically affect exposed organisms. Whereas in the past, most of the studies on microplastics have focused on the marine environment, there is still little knowledge about the occurrence and impacts of microplastics in freshwater systems. The aim of this study is to examine possible influences of polystyrene particles in combination with different organic pesticides on the behavior and biochemical responses of the giant rams-horn snail (Marisa cornuarietis). Snails were exposed to 10,000 polystyrene particles per liter (cmedogenetically milled, < 100 µm) in combination with different concentrations of the pesticides cypermethrin, methiocarb and thiocarb. In order to quantify the observed behavioral responses, five categories of behavior were defined, which are “crawling”, “attached to the wall”, “attached above the water surface”, “inactive on the ground” and “retracted with closed operculum”. All snails were individually categorized twice a day for nine days. The results make evident that snails exposed to cypermethrin significantly changed their behavior between the first (day 1-4) and second (day 5-9) observation period, independent of the test concentration. In the first period, they were often categorized as “attached to the wall” or “attached above the water surface”, whereas in the second observation period, these snails were mainly classified as “inactive” or “retracted”. As biochemical endpoints we study oxidative stress (lipid hydroperoxides, superoxide dismutase), proteotoxicity (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: 02WRS1378).

TU177 Freshwater microplastics and effect of conditioning on pollutant and chemical transfer potential K. Reilly, The University of Birmingham; J. Sadler, The University of Birmingham / Department of Geography and Environmental Science; I. Lynch, University of Birmingham / Geography Earth Environmental Science

The presence of microplastics in the environment has received increasing scientific and societal interest over recent years. Following this, there has been a range of scientific studies and discussions on impacts that microplastics are having in the environment and how we can mitigate this, leading to changes in legislation, although more is needed. Micro, and recently nano, plastics have been shown to have a range of detrimental effects on various organisms in both field and laboratory studies. Effects are typically dose-dependent and include reduced feeding and successful reproduction, change in organism’s behaviour and decreased survival. This study aims to build on current research on the effects of freshwater microplastics, focussing on the micro and nano plastics potential to transfer chemicals in the environment. The formation of a corona on plastic particles changes their surface characteristics which could lead to a change in how biologically active chemicals interact with these materials. In this study, we compared the effect that plastic conditioned under different scenarios can have on the interaction with Daphnia magna (a keystone species). We assessed this using several parameters including: (1) quantifying the proteins and polysaccharides secreted by the organism’s before and after exposure, (2) quantifying uptake of plastic in the individual organisms, and (3) observing changes in behaviour (reproduction and movement). We explored these effects for pristine plastics and plastics combined with chemicals commonly found in the environment, including 17α ethynylestradiol and detersgens. The effect that competitive binding of biomolecules naturally secreted by Daphnia have on both adsorption and desorption of the target chemicals on the plastic’s surface was a key element of this study, to assess how chemicals interact with microplastics during more complex pollution issue in the environment. This study could help to explore the issue of combined stressors using parameters that can be controlled in the laboratory. Through this, we can assess the impact of assumptions about test conditions, and the impact of over-simplification of standardised test media, on the resulting data regarding the Trojan-horse potential of micro and nano plastics. Based on this data we will be making recommendations to improve the environmental realism of the laboratory conditions to make more accurate exposure assessments for environmental modelling in the future.

TU178 Exposure to conventional but not biodegradable microplastics impacts fitness in Daphnia magna Z. Gerdes, Stockholm University / Department of Environmental Science and Analytical Chemistry (ACES); M. Puranen, Stockholm University; M. Ogonowski, E. Gorokhova, Stockholm University / Department of Environmental Science and
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 the 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 other plastics. PMP had a similar effect to the environmental impact on both polymer types. We compared effects of exposure to polystylic acid (PLA; biobased) and polystyrene (PS; oil-based polymer) on midgut gland tissues and therefore 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 effects induced by the polymer types using different biological endpoints. 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)


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 the intended purpose 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, diameter < 50 µm, up to 100,000 particles/L) 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 ferrous oxidative xylenol orange assay (FOX assay). In parallel, 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: 02WR51378).

TU180

Daphnids in distress? Acute and chronic effects of primary and secondary microplastics on three species of Cladocera
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G. Jakumar, CML Leiden University / CML; N. Brum, CML Leiden University / Conservation Biology; J. Baas, Centre for Ecology & Hydrology / Centre for Ecological Hydrology & Aquatic Ecology; H. Schmieg, Tübingen University / Animal Physiological Ecology; T. Bosker, CML Leiden University / Ceter for Environmental Sciences Microplastics (< 5 mm) 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 Cladoceran 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 and PMP had a similar effect on C. dubia, more toxic 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

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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 afterwards the degradation of microplastics. 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 millions/L of 10 µm MPs and 2 millions/L of 1 µm MPs, and MIX2, which contained 500,000/L of 10 µm MPs and 500,000/L of 1 µm MPs. Therefore, mussels were exposed for 7 days in static condition 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 in a 10% formalin solution for 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 control, 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 suggests that the toxicity of MPs could be modulated by other factors or MPs toward 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

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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 analyzed the effects of irregular polystyrene MPs (< 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 pM L−1 over 6 weeks at 16 °C. After the exposure, the mussels were analyzed for malondialdehyde concentrations in gill and midgut gland tissues as an indicator for lipid peroxidation (TBARS assay, thiobarbituric acid reactive substances) as well as for the remaining abundance of hydrophilic, non-enzyme 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 poly styrene 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 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.

TUI183 Tissue Translocation of Polystyrene Micro- and Nanoparticles in Daphnia magna
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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 faced by researchers in the realm of nanotechnology. Our understanding of 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 – the potential for plastic to translocate to other tissues in D. magna is not yet experimentally confirmed. 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 fractoscope-based clearing followed by investigation through confocal laser scanning 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 microplastics under conditions closely resembling those reported in the literature. This highlights that the replication of nano- and microplastics studies is important, especially if these have a high impact on the body function and research in the realm of nanotechnology.

TUI184 Do terrestrial organisms, isopods Porcellio scaber and earthworms Eisenia andrei, avoid microplastic contaminated soil?
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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. 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, the effects 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 cleanser was 0.137 ± 0.051 mm, while the plastic bag MP was larger 8.80 ± 5.05 mm (with 62% of particles smaller than 5 mm). Microplastic was mixed into the soil at environmentally relevant concentration 4 mg/L 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 polypropylene 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 covered 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, whereas they 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
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Microplastic particles (MP) are of concern in the aquatic environment because of their increasing amounts in production and release into the environment. Despite 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 MP could be a complex model for the experiment to be performed 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 μg MP/L. For two other treatment groups, the same concentration of MP was coated with nominal CPF concentrations of 0.5 μg/L (L) and 2 μg/L (H) in the water phase. After MP treatment, all 24 aquaria contained 16 L water and a 3 cm sediment layer, both taken from outdoor ponds. The natural plankton community got enriched by the amphipod Crangonyx pseudogracilis. After a pre-treatment period of five weeks, the experiment run for eight weeks. A chemical analysis of CPF in the water phase of the stock solutions and the treatment groups L and H (day 14) was performed. Since CPF could not be detected in neither of them, a strong sorption of CPF to MP is indicated. Abundances of Daphnia pulex revealed higher population increments in MPC than in C, L and H, indicating higher reproduction rates in the first two weeks after application. Furthermore, body lengths of juvenile D. pulex remained nearly constant during the test period in all MP treatments (MPC, L, H) while they increased in the controls (C). Interpreting these results, MP might have led to higher reproduction rates as a stress response which were lowered when CPF was present. In this case, CPF might have become bioavailable to D. pulex after ingestion of MP. For C. pseudogracilis, total abundances increased the most in MPC, whereas L and H developed similar as C. As for the cladoceran, MP might have led to higher reproduction rates that were lowered by CPF. The Trojan horse effect has probably not been the case in this experiment, as CPF was applied as an oral treatment of the organisms. Knowledge in this field is important to assess the potential hazard of microplastics studies is important, especially if these have a high impact on the body function and research in the realm of nanotechnology.

TU186 Microplastics exposures of fish: internalization and effects on behavior and growth
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Awareness of the presence of microplastics, i.e. plastic particles ranging in size from 1 μm to 5 mm, in marine and freshwater has recently risen but detection and quantification is challenging. Furthermore, whether they pose a risk to aquatic organisms is not yet clear. Interpreting these results, MP might have led to higher reproduction rates as a stress response which was made irrelevant by the lack of transparency in reporting methodology and results. We were able to adapt a fractoscope-based clearing protocol to the use with high amounts of Daphnia samples.

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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 complex 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
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Thames estuary 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, between 33-47% of fish ingested plastic, 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, benthi, 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 cladoceran Daphnia magna
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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 for microplastics (MPs), small plastic particles (dimensional range < 5 mm) on freshwater cladocera 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. 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 increased after 24 and 48 hours. In the gut of daphnids 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
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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 (Hollow, 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 (2.2-3.4 mm) to D. pulicaria (1.3-2.0 mm) which span a similar range of sizes as micro and nanoplastics, 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 10.0 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 SMZ2000) 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 gut 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
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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 microplastics (MPs < 5 mm) present in the ocean is caused 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 biomas, which can be destructive to the plastic particles and their surfaces and create interferences that were problematic for μ-spectroscopy-based analyses. 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 applied 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 of Consolidation and Structuring of Units of Competitive Investigation of the University System of Galicia (Xunta de Galicia) potentially co-financed by ERDF (ED431C-2017/28) and by the Ministry of Economy and Competitiveness (subproject PCIN-2015-170-C02-01, funded by FUNDACIÓN SABIAN (JPI Oceans) and project CTM2016-77945-C3-3-R (ARPA-AOU). 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. Filman, C. Halsband and T. S. Galloway, Scientific Reports 4, 4528 (2014) [3] J. Wagner, Z.-M. Wang, S. Ghosal, C. Rochman, M. Gassell and S. Wall, Anal. Methods, 9, 1479 (2017)

TU191
Microplastic contamination of the model system Weser-National Park Wadden Sea: an across-ecosystem approach
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For the first time worldwide, in the joint project PLAWES the pollution with microplastics of a large European river basin will be investigated on the example of the model system Weser-National Park Wadden Sea. PLAWES, as a pioneer study, is going to conduct an interdisciplinary and ecosystem overarching analysis concerning the contamination with microplastics from the headstreams to the North Sea, thereby considering exemplarily major point (e.g. wastewater treatment plants, combined sewer systems) and diffuse (drainage, atmosphere) sources and entry routes. The new insight is going to be included in a new modeling concept for the identification of primary transport mechanisms and accumulation zones of microplastics. Effects of microplastics on ecosystems of the Weser-Wadden Sea system will be investigated on both, aquatic invertebrates and the interaction of pathogens with microplastics in biofilms. The insights on ecologically relevant aspects are going to be used to assess the environmental effects of microplastics on the model system Weser-National Park Wadden Sea and to transfer these to other systems. Furthermore, the results will be used to develop novel teaching materials to provide an education platform for teachers, pupils and parents across Europe. Hence, PLAWES will generate unique data on the impacts of microplastics on a large European river basin and on environmental health. This will not only be instrumental for decision makers and stakeholders but also serve as focal point to develop science-based solutions.

TU192
Photochemical fragmentation of freshwater (microplastics under UV irradiations
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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 photocleaning of the material. This scenario is accompanied by a physical fragmentation into particles of increasingly smaller sizes, and this 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 (melting point, ion and liquid chromatography). The main result is that in all cases there is a formation and leaching of short chain (1C, 2C, 3C) carboxylic acids (acidic and formic acids, lactic and glycolic in the case of PLA) all known to be markers of polymer degradation. In the absence of light no transfer of any acid in the liquid is recorded.

TU193 Characterization and Environmental Risk Assessment of Polymeric Cosmetic and Personal Care Ingredients
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Polymers have been developed to perform a variety of functions that are central to modern living. Cosmetic and personal care products (CPPCs) 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 physichem properties. Solid polymers, such as plastics, are prioritized for assessment since they are routinely detected in the aquatic and marine environment and have the highest potential to contribute to environmental litter. The main result is that in exposure and hazard of priority polymers is then assessed. When a polymer poses an unacceptable environmental risk, risk mitigation options are considered. A polymer’s physichem properties provide insights into how environmental exposure and hazard can be assessed. A decision tree was developed linking physichem 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)
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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 are environmentally relevant (fragmented) 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. In Keywords: Microplastics, Sheepshead minnow, Behaviors, Gene expression/inv

TU195 Assessment of the microplastic contamination in sediments from the French Atlantic coast
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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 important accumulated 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 25 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 combined with centrifugation technic. After a filtration step, MPs were detected and identified directly on the membrane filters using µFTIR spectroscopy in reflection mode. Then, a test was performed in order to determine the replicate number required to obtain a reliable statistic representativeness of the whole sampled sediment. For the 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 per kg of dry sediment (N = 10; 250 g). Ten different compositions of MPs were defined by µFT-IR with a high proportion of PE and PP, 38 and 23% respectively. Five MP types (PE, PP, PVC, polystyrene and polyester) represented more than 90% of MPs. Interesting 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.

Derivation, Validation and Implementation of Environmental Quality Benchmarks (P)

TU196 Challenges in implementing legal frameworks for assessing water quality: the cases of the EU and Swiss approaches
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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 identified that non-sedimented/reach-related pressures, in particular temporal pressure, remains the most important single pressure. We developed a new methodology to measure the water quality of a river and to evaluate its ecological state. The original EQS was not derived based on available chronic ecotoxicity data but was set as 0.00046 mg/L in 1980, a value that was derived from a species sensitivity distribution (SSD) for crustaceans and insects using the concentration that 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 shared 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
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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) of CPF based on the current data and the WFD method for EQS derivation published in 2011. Both AA-EQS and MAC-EQS 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. bahia taken from the EESA authorisation dossier and was 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 HC, from a species sensitivity distribution (SSD) for crustaceans and insects using
The lowest eligible AF of 5. The SSD reveals branchiopoda and amphipoda 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 amphipoda. The original EQS dossier from 2005 contains no specific EQS derivation for sediment. It was concluded that “Protection of sediment [is] covered by the Q5 referring to the pelagic community”. The data sets for heavy metals in chronic and subchronic aquatic data for sensitive species in freshwater systems with effect data ranging from 0.324 mg/kg dw (acute) to 0.032 mg/kg dw (chronic). Acute data suggest that the amphipoda H. azteca might be as sensitive to CPY as the insects C. riparius and C. tentans but chronic data are available only for insect species. The resulting sediment EQS,\textsubscript{sed,AF} at 0.32 mg/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,\textsubscript{sed} from the revised AA-EQS. The application of this model including an AF of 10 that covers uptake by ingestion resulted in a EQS,\textsubscript{sed,AF} of 0.016 µg/kg dw. Without this AF, the EQS,\textsubscript{sed} would be in the same order of magnitude as the calculated EQS,\textsubscript{sed,AF}. Based on our EQS update we strongly recommend to revise the current EQS values for CPY.

TU199 Lead exposures in European Freshwaters; are they a risk? A regulatory assessment accounting for bioavailability

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Lead (Pb) is a chemical for which one EQS has been set and is applied across all countries. Pb bioavailability is assessed readily using the EQS(Bioavailable) (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\(^{-1}\) (EQS(Bioavailable)) was undertaken, with regulatory freshwater monitoring data from six European member states and FOREGS database. A tiered approach was adopted (Table 1) to determine if exposure concentrations should be accounted for, by correcting the measured dissolved metal concentrations in the water sample to a bioavailability-based concentration. There are relatively low across all regulatory datasets and FOREGS. At Tier 1, 3.9 % of sites assessed had a Pb concentration failing to meet the EQS, only 16 (2.0%) water samples of the whole dataset found Pb concentrations that are greater than the EQS of 1.2 µg L\(^{-1}\). 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 exceedances 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.

TU201 Modelling survival under chemical stress. A comprehensive guide to the GUTS framework

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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, focussing 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 central model framework: GUTS, the General Unified Threshold model for Survival. GUTS was conceived in 2010, and has subsequently 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.

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

Integrated approaches for ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling (P)

TU202 Dose response modelling in aquatic and terrestrial effect models

M. Wang, WSC Scientific GmbH / Dept Dafate Modelling; K. Billau, WSC Scientific GmbH

In recent years mechanistic effect models including GUTS and DEBTox have been successfully used in the aquatic and terrestrial risk assessment of pesticides. These models offer the advantage that results from laboratory studies, usually conducted with constant exposure, can be extended to time variable exposure, which is more typical under field conditions. At present these models consider a threshold beyond 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.

Integrated approaches in ecotoxicology: bridging the gap between experimental toxicology and mechanistic modelling (P)
which effects start to appear. Once this threshold is surpassed the amount of effect reflects the metal toxicity. Copper (Cu) plays an essential role in cellular metabolism. 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.

TI/206 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
Present study evaluated the effects of temperature (20 °C and 25 °C) on oxidative stress and life-history trait responses 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 and iron-superoxide dismutase (SOD) activity in elevated temperature conditions in the Baltic is 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.

TI/207 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 Biosafety and Environmental Sciences Engineering
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 ml g⁻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} h^{-1} was also significant greater than MAP 0.086±0.001 ml g^{-1} h^{-1}(p<0.001), it revealed that Cd was likely to bind on MDP in the low exposure concentration than that of MAP. This study concluded that Cd 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

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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 nucleic acids 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 biochemically 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 shown to slightly higher in exposed fish than in reference fish, with Cd (x10) 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 levels of stress, suggesting a trade-off with fish growth and oxidative stress. 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 brain 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 is 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, less resource-intensive programming as well as the development of adverse outcome pathways 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 tumor formation in the airway. 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.

TU211

A combined PBTK and qAOP-modeling approach to assess the impact of dioxin-like compound (DLC)-induced embryotoxicity on recruitment failure in European eels

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Discharges from metal mining operations may lead to metal accumulation and toxicity in aquatic species. Once metals enter cells, they can bind to sensitive fractions (MSF) and biochemically 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 shown to slightly higher in exposed fish than in reference fish, with Cd (x10) 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 levels of stress, suggesting a trade-off with fish growth and oxidative stress. 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.

TU212

Salmonid pituitary cells as a test system for identifying endocrine disrupting compounds

L. Harding, University of Washington / Aquatic and Fishery Sciences; G. Young, Advisian WorleyParsons Group / Aquatic Sciences; P. Swanson, NOAA-NWFS

The pituitary gland is a primary site of reproduction, producing two gonadotropins, follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which regulate gonadal development, sex steroid synthesis and gamete maturation. The pituitary gland is a central regulator of reproduction, producing two gonadotropins, follicle-stimulating hormone (FSH) and luteinizing hormone (LH), which regulate gonadal development, sex steroid synthesis and gamete maturation. Despite its central role in regulating reproduction, there are limited data on impacts of endocrine disrupting chemicals (EDCs) on the pituitary gland. We have previously observed that waterborne exposure of previtellogenic coho salmon to 17-ethynylestradiol (EE2) causes widespread effects on the pituitary transcriptome. Other in vivo studies with the selective serotonin reuptake inhibitor (SSRI) fluoxetine caused a decrease in FSH beta subunit (fsbh) mRNA levels. These results motivated us to expand our studies by developing an in vitro test
end-of-life (EoL) processes, this is increasingly relevant when comparing different electrochemical energy storage technologies. Thus, a thorough modelling of the EoL phase can be considered mandatory for a well-funded assessment. For evaluating this aspect we expand existing LCA studies on stationary batteries by a tentative modelling of their EoL processes (recycling) and compare the results. Three different battery technologies are considered for this purpose, an LFP-LTO battery (ramp-mounted supercapacitor), a hybrid aqueous ion battery (AHIB) and a vanadium redox flow battery (VRFB), all with the same capacity and lifetime. The results show that considering the end-of-life stage actually does change the outcomes of the results significantly and that cradle-to-gate assessments are not appropriate for comparing very different battery technologies. Highly integrated batteries like the LIB have advantages under a cradle-to-gate perspective (higher energy density and thus lower material demand per provided capacity), while less integrated systems can have significant advantages when it comes to recyclability. The AHIB and VRFB are easy to dismantle and all major components can be recovered by mechanical dismantling on a macro-scale. The highly integrated LIB require complex processes and obtain a commingled fraction of micro-size particles that are difficult to separate and require significant process inputs while only recovering a fraction of the materials originally contained in the battery. This can change the picture fundamentally towards an advantage of technologies easy to dismantle on macro-scale (AHIB and VRFB) in comparison with highly integrated cells (LIB). Thus, design for recyclability is highly important in terms of future circular economy and might easily outweigh the possibly reduced energy density or lower performance.

TU216 Battery recycling efficiencies and their influence on the life cycle impacts of circular economies
K. Boonen, A. Van der Linden, VITO

The EU Batteries Directive sets the minimum recycling efficiencies for waste batteries as a percentage of their average weight. In the light of the circular economy, it may be argued that, in addition to the quantity, it is important to consider the specific materials that are recycled, the quality of the recycled fractions and their potential use. The Public Waste Agency of Flanders (OVAM) asked VITO to assess the effect of these factors. In this study, the environmental impact of the end of life is compared for different battery recycling routes. Furthermore, the impact of the rest of the life cycle of disposables and rechargeable batteries is calculated to put the impact of the end of life into perspective. A number of potential improvement options, such as a higher collection rate, higher functional recycling and a shift to different types of batteries, are evaluated.

TU218 New and Reconditioned Electrical and Electronic Equipment. How does changing the environmental performance?
M. Pini, University of Modena and Reggio Emilia / Department of Sciences and Methods for Engineering; P. Neri, University of Modena and Reggio Emilia / Department of Sciences and Methods for Engineering DISMI; R. Gambierini, B. Rimini, F. Lolli, University of Modena and Reggio Emilia; A. Ferrari, University of Modena and Reggio Emilia / Department of Sciences and Methods for Engineering The scope of this study, carried out within the LIFE12 ENV/IT001058 WEENEModels, was to compare the environmental performance of the life cycle of new electrical and electronic equipment (EEE) and the reused one through the Life Cycle Assessment methodology. Both attributional and consequential LCI (Life Cycle Inventory) models are developed and implemented for each EEE category that has been considered for each EEE group, assuming that it generates the same environmental damage of the other products belonging to the same category. In particular, the following representative products have been selected: refrigerator (R1), washing machine (R2), cathode ray tube (CRT) (R3), laptop (R4) and fluorescent lamp (R5). In addition, lower performance of reconditioned EEE has been taken into account. Different set of replaced components have been evaluated in order to understand which determines the best solution. Scenario A represents the set of replaced components, which damage more frequently. Scenario B is just an alternative set of replaced components. The environmental comparison between new and reused EEE, adopting attributional LCI modelling, showed that Scenario B presents a damage decrease for all EEE categories. Moving on to the consequential LCI modelling, the environmental comparison highlighted for both scenarios a considerable damage reduction for the reused EEE respect the new one. Furthermore, for the reused R1, R2, R3 the analysis of results carried out environmental credits. This is due to the avoided burdens associated to the manufacturing of the new EEE, since the system boundaries have been enlarged understanding the avoided production of the not produced. Attributional and consequential LCI modelling performed different LCIA results. Following the methodology guidance for the identification of the most adequate LCI modelling framework presented by Laurent et al., 2014, it would recommend to adopt consequential LCI modelling. But we suggest to LCA practitioner to focus also the attention on the request of who commissioned the project, which often in the waste field are local administrations. Generally, they wants a snapshot of the real effects that waste management policies provoke on human health and environment. For this reason, attributional LCI modelling would be the proper LCI modelling to achieve this scope. Considering this LCI modelling the Scenario B determines the...
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. Hirsch, EMPA / Technology and Society Lab; S. Sala, European Commission - Joint Research Centre / Bioeconomy unit
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 greenhouse gas emissions within household appliances. The aim of this study is 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 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 has been evaluated with the ECOsix method and LCI data. The results show that the level of 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 show 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 the appliances. IRP (thanks to the assumed “phasing out” of nuclear power 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 HTP, FEPT, LUC and FRD – show a higher 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 this study, an ex-ante analysis with LCI 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 show 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 the appliances. IRP (thanks to the assumed “phasing out” of nuclear power 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 HTP, FEPT, LUC and FRD – show a higher 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.

TU222 Li-S batteries for electric vehicles, challenges for circular economy objectives
g. benveniste, C. Corchero, IREC; B. Amante, Universitat Politècnica de Catalunya
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 electric future, we are now in the short term, 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 possible 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.

TU233 ATISOL C2C - Life cycle assessment as a tool for the ecodesing of a “vapour and air barrier membrane - insulator” system, in a cradle to cradle approach
A. Léonard, Liège Université / Chemical Engineering; A. Dombrovskis, Liège Université / Mechanical Engineering; P. Vandenbulcke, Liège Université / Chemical Engineering - PEPS; M. Getlicherman, Derbigum; B. Colson, Sioen Felt & Filtration; I. De Vilder, Centexbel; A. Timmins, Belgian Building Research Institute (BBRI); A. Léonard, Liège Université / Chemical Engineering - PEPS.
The European directive on the energy efficiency of buildings requires the members of the EU to set up national energy performance standards (PEPs) for new buildings and refurbishment. A national energy performance standard (PEP) targets the energy efficiency of the envelope 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, punching resistance), and finally a low disassembly and re-use level. The ATISOL C2C project aims to develop a complete solution (ecological insulation + recycled materials), with the least environmental impact on its whole life cycle. The solution can be used in both new construction and during renovation. Compared to the state of the art, the solution that is developed is unique and innovative by its simplicity in terms of materials by integration of a vegetal self-adhesive binder to the spundbond reinforcement of the membrane, the latter being also made of renewable resources. The material is appropriate for application on all different wall covering systems by cats: it can be adapted and shaped for the specific 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 first step is already carried out: the Derbiskin®. 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 spundbond 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; F. Maffei, University of Firenze / Department of Engineering; U. Barbagelata, University of Firenze / Department of Engineering; P. Nobile, University of Firenze / Department of Engineering. Recycled materials and waste are increasingly used in road construction. This paper presents the life cycle assessment results of two alternative road mixes with high recycled contents. One of the mixes is a modified asphalt mix insulated with a vegetal binder and the other is a high asphalt mix insulated with a biodegradable 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 first step is already carried out: the Derbiskin®. 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 spundbond reinforcement to the manufacturing process. This project is supported by the GreenWin Competition Clusters and subsidized by the Walloon Region (BE).

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, that case seems a limitation. Due to the absence of processes that research has not explored to the perception of “real” environmental sustainability. The results of dynamic LCA are compared to the results of traditional static LCA, to see how the methodological development of dynamic LCA may have an influence on the final environmental evaluation for construction materials. Both dynamic and static LCA results show that the recycling of industrial residues to produce new construction materials has the potential to mitigate the climate change impacts of construction blocks, by substituting traditional OPC concrete. Although the dynamic LCA did not result in a shift in the ranking between the three materials compared with static LCA, it provides a clearer picture on emission flows and their effect on climate change over time.

TU226 Pursuing 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 drivers in this quest 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 studies. 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, material flow analysis or input-output analysis. The reviewed 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 of the consequential LCA
H. Helander, 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 and is said to be comprehensively studied so as 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 enables 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 an analysis of the cement industry in Europe. The CLCA tool will support cities in their local sustainability goals while approach circular economy within planetary boundaries. 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 drivers in this quest 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 studies. 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, material flow analysis or input-output analysis. The reviewed 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.
tool to direct future research. We performed the work using Simapro 9.0 software, method Recipe Endpoint (E) and the Ecovison 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 ones. Recognizing that flocculants from iron sludge can be applied 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 pre-treatment 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 waste water is required. A technical research into the efficiency of the VCD, to optimize compound removal from waste water, is recommended. In this study LCA has shown to be an effective tool to evaluate the direction of research within the water 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. Isasa, 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 bringing 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 options (develop etc. of different circular flow systems) and municipalities and wider geographical areas, act as accumulators of resources that in the current linear model create negative externalities. However, these 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 Felini de Llobriga and Gavà in the Barcelona 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 design of the indicators to establish relevant levels of circularity and benchmarks. The need to develop a tool to assist in the data inventory gathering, data visualisation and material flows 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 waste design and infrastructure to produce resources efficiently. 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 bioenergie 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 or secondary treatment plants). A feedback loop will be established between 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 managerial 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. Itten, R. Kelley, M. Stucki, Zurich University of Applied Sciences / Institute of Socioeconomics; M. Airoldi, Università degli Studi di Milano, Department of Economics, Business and Territory, which tools to use to decide on the most appropriate circular economy opportunities is also highlighted. Conclusion 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.

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. Isasa, CETAqua Water Technology Centre / MASE; Y. Lorenzo-Toja, CETAqua, Water Technology Centre; D. Marin, CETAqua, Water Technology Centre / Environment and Socioeconomics; M. Isasa, CETAqua Water Technology Centre / MASE; Y. Lorenzo-Toja, CETAqua, Water Technology Centre; D. Marin, CETAqua, Water Technology Centre / Environment and Socioeconomics; M. Isasa, 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 (WWTs) from being energy consumers to resource recovery sites. In the meanwhile, a huge effort is done in the field of anaerobic digestion to recover energy from the finite reserves of phosphate rock, that moreover, are located out of Europe. The LIFE NECOVERY 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 effluent 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 life cycle of innovative non-conventional technologies, if any; 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 to evaluate the cost incurred for 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.

TU234 Environmental, social and economic challenges towards a bio-economy: the STAR-ProBio project, Sustainability Transition Assessment and Research of Bio-based Products

F. Devesa, University de Castilla-La Mancha / Dipartimento di Chimica G Ciamianic; E. Tagliavini, Università di Bologna / Dipartimento di Chimica G Ciamianic; Alma Mater Studiorum EU wine production accounts for some 60% of worldwide output, with France and Italy being the largest wine producer countries in the world (Gaeta and Corsinovi, 2014). The wine industry influences the environment with the use of soil, water, energy, fertilizers and pesticides. In addition it produces liquid and solid organic waste that has to be managed in the proper manner in order to minimize environmental impacts. In recent years, some innovative technologies have been proposed for the valorization of winery waste and by-products (i.e. grape marc, grape seeds, vinification lees, etc.) (Devesa-Rey et al., 2011). VALSOVIT is a research project funded by Emilia Romagna Region (Italy) which aims to valorize wine industry by-products. Its focus is the development of an integrated strategy for the transformation of waste from the whole oenological supply chain into high added-value products such as polymers, base chemicals, and molecules for the nutraceutical, cosmetic and agrochemical industries. In this framework, a novel experimental process for the valorization of wine lees and sewage sludge is carried out. These winery residues are subject to anaerobic acidogenic fermentation in order to produce volatile fatty acids (VFAs), which in turn are used to feed a mixed microbial community (MMC) able to accumulate polyhydroxyalkanoates (PHAs) granules as carbon and energy intracellular reserve. The last step consists of PHAs extraction using dimethyl carbonate (DMC). Life cycle assessment is applied to calculate and compare the environmental impacts related to the production of one kg of PHA to that of analogous products of a fossilic origin. Polypropylene (PP), poly(lactic acid, PLA). PHAs produced from wine industry residues show mixed results. Four different scenarios which vary in terms of feedstock used and pre-treatment process are analyzed. Results show that system setup including pyrolysis pre-treatment allows to reduce both energy demand and GHG emissions more significantly than the most common way to process this type of biomaterial, i.e. with a classical composting process. On the other hand, is technically simpler and therefore less effort and cost consuming than the one including pyrolysis. No significant differences between the two feedstock used are found in the results. Gaeta and Corsinovi, 2014. Economics, Governance, and Politics in the Wine Market. Palgrave Macmillan, US Devesa-Rey et al., 2011. Waste Management. 31:2327-2335

TU236 CRADLE-TO-GATE LIFE CYCLE ASSESSMENT OF BIOMASS 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 a 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 assessment of the potential performance of POME-based biogas production 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 8.0.2 software. The present study demonstrates that the generation of electricity from biogas production is an 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.
Access to Chemical Engineering

González encouraging food with higher education and higher incomes. Although respondents had no clue on all food waste. It was found that the restaurant consumers had low ecological Weekend effect was also registered. Flour during the selected timeframe. Most of food was discharged in December, and in regions. This wastage has an enormous negative impact on the global economy and 39% of food is wasted at consumption level in developed

Ecoinnovazione / LCA and Ecodesign Laboratory; D. Tono, 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 need to close waste cycles 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, with 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 right technology to the right place, identifying the potential and limitations of the new technology and how the technology can provide 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 consumers say? R. Baghiute, Vytautas Magnus University / Environmental Science Department; A. Musteikytė, 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 residues have major environmental impacts. EU programme "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 households indicates, 61% of wasted food could be consumed if it would be better handled. Hence, changes in consumption patterns are in importance to reach these 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 amount of the restaurant waste, we conducted a questionnaire (174 in total). Results show 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 discarded 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 the respondents express their willingness to take-away leftovers. Most of restaurant guests 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 encourage 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, University of Santiago de Compostela / Chemical Engineering; J. Garrido, Universidad de Santiago de Compostela; E. González-García, University of 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 agenda. In addition, 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 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 detailed 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 valid for a first step in understanding the impacts of an 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. Chau, 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 preventing waste and reducing energy consumption. EU initiative “Towards a circular economy: a zero-waste programme for Europe” is 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 detailed 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 valid for a first step in understanding the impacts of an 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 (RVC-2014-14984).

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

TU241 Effects of plant growth and organic carbon addition on DDE degradation in soils: The use of Solanum lycopersicum in 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 (RVC-2014-14984).

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. Patrocéleo, Water Research Institute-National Research Council / Water Research Institute; N. Ademollo, F. Spataro, National Research Council of Italy / Water Research Institute; K.S. Miglioranza, University of Mar Del Plata / Laboratorio de Ecotoxicología y Contaminación Ambiental; Instituto de Investigaciones Marinas y Costeras; M. Gonzales, University of Mar Del Plata; P. Gnreni, National Research Council of Italy (CNR) / Water Research Institute; A. Barra Caraccioli, National Research Council / Water Research Institute After the use of DDT was banned in numerous Countries several years ago, owing to its high lipophility 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 polluted soil microbial community and on DDE biodegradation ability were evaluated 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 synergistic interaction between poplar and soil microorganisms in the planted soil promoted a reduction of overall PCBs concentration under the Italian legal limit (D.Lgs. 152/06) of 60 mg/kg (Ancona et al., 2018). A further sampling was performed four year later in order to assess the PCB residual concentrations at different depths and distance from poplar tree trunks inside the planting area. At the same time, microbial analyses were carried out to evaluate the total microbial abundance, cell viability and dehydrogenase activity. Moreover, nucleic acids were extracted from soil. The hypervariable regions V4-V5 of the 16S rRNA gene were amplified and sequenced by MiSeq (Illumina). The structure of the microbial community in the planted and unplanted (control) soil was performed and compared and bacterial species involved in PCB degradation identified.

TU243 Plant-assisted bioremediation to recover multi-contaminated areas and provide biomass for renewable energy production
V. Ancona, Water Research Institute - Italian National Research Council / Water Research Institute; A. Barra Caracciolo, National Research Council / Water Research Institute; D. Borello, Università La Sapienza - Dipartimento di Ingegneria Meccanica e Aerospaziale (DIMA); M. Falconi, ISPRA Institute for Environmental Protection and Research / Soil Pollution Department - Geological Survey of Italy; A. Basile, Regione Puglia / Servizio Rifiuti e bonifica; A. Massacci, Italian National Research Council / IBAF; V. Uricchio, Italian National Research Council / Water Research Institute; B. Dorello, Università La Sapienza - Dipartimento di Ingegneria Meccanica e Aerospaziale (DIMA);

Phytoremediation is gaining popularity as a sustainable solution to contaminated soil remediation. In particular, plant-assisted bioremediation exploits synergistic action between plant roots and natural microbial community to enhance the degradation of organic contaminants in soil. This process is ecological, economically and environmentally 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 poplar clone for syngas gasification, 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; A. Barra Caracciolo, 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 (clone 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 hypoxxia (TMMA). Moreover, non-planted 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 grow, transform and bioremediate TCP 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 the capability to transform and degrade PCBs under different conditions. Consequently, the switching of aerobic and anaerobic conditions in rhizosphere can be a promising strategy to promote both the degradation of high/lower 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
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In the last two decades, rhizoremediation 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/greenhouse experiments and long-term field trials have been conducted to investigate the most suitable plant species and environmental conditions that stimulate and favour microbial activities in the degradation of Polychlorinated Biphenyls (PCBs). Recently, an attempt to extrapolate rhizoremediation half-lives (rho-PCBs) 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 rho-PCBs 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. aged) and experimental conditions (greenhouse vs. field), the experimental set-up, the use of appropriate controls and replicates as well as the analytical and microbiological techniques adopted. The present work aims to 1) list and discuss the main pitfalls in the experimental design of previous and current rhizoremediation experiments and 2) propose guidance to perform appropriate experiments to obtain comparable, accurate and useful data for rho-PCBs calculation. Moreover rho-PCBs will be presented and compared with those obtained with other approaches.

TU246 Effect of Organic and Inorganic Fertilizers on the Bioremediation of Used Motor Oil Polluted Soil
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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. Hydrocarbon-utilizing bacteria counts were high in all the poultry manure-amended soil ranging between 9.0x10^8 and 30x10^7 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-Cafaro site.

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Contaminants are strong ecological drivers steering the microbiome structure in polluted soils. Bioremediation relies on the residing microbial communities and their activity but 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 technologies. In this perspective, the Spatial Property Site SIN Brescia-Cafaro (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 100 soil samples were collected in the SIN Brescia-Cafaro 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-Cafaro. 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.

TU248

Laboratory-scale assessment of bioremediation of hydrocarbon-contaminated soil.

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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. Bioremediation using soil solution is a resource efficient, low cost and sustainable solution with both the size of the area and the economic/environmental costs of other technologies such as Dg&Dump. Biopiles will be built to treat the contaminated soil, air insufflation and nutrient addition will be considered to stimulate the aerobic biodegradation of hydrocarbons. In order to optimize this process, a lab-scale test was carried out and three different conditions were tested: natural attenuation (NA), addition of sawdust (SW), addition of rhamnolipid (R). Soil samples were collected at different times to evaluate the degradation rates and micro-biological/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 2600 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 bacteria in CO bioreactors. This 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

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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 porewater 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 effects of Brij-35 micellar surfactant and rhamnolipid biosurfactant at three concentrations (0.1X, 1.0X, and 10X CMC) and the bioaugmentation of Mycobacterium vanbaalenii PYR-1 in PAH-contaminated soil using 14C-pyrene as a model compound. Additionally, the bacterial community structure after the 50 day incubation was analyzed using 16S rRNA gene high-throughput sequencing and PAH-degrading genes were predicted using phylogenetic investigation of communities by reconstruction of evolutionary trees (PICRUSt). The results demonstrated that 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-Cafaro. 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 parameters were also selected in the investigated areas within the SIN Brescia-Cafaro. 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.

TU250

Italian field results of Emulsified Lecithin-based Substrate used as ERD treatment of Chlorinated Solvents in groundwater

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ELSMicroemulsion is a food-grade carbon that supports the treatment of a wide range of groundwater contaminants, including chlorinated solvents. ELS is the acronym for Emulsified 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 feed on the soluble carbon, they produce reducing equivalents and then follow the RED reactions. In this respect, MNP results showed a significant increase in the reducible carbon dioxide and aldehyde hydrogenase were greatest in bioaugmented soils treated soils compared to native soil treatments. Overall, the results of this study provided beneficial insights towards the abiotic and biotic processes as well as their complex interactions in the bioremediation of PAH-contaminated soils.
VOCs potentially migrating from beneath the former facility. A total of 4000 kg of ELS concentrate was emulsified and injected under pressure through 51 fixed 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 along with the reduction of the recognized catabolites, 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

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The Life Science Center

Biological reductive dechlorination of CE is contributed by dehalorespiration. The bacterial community marker. Specific genes were used for detection of ongoing reductive dehalogenation of the CE contaminants. Specific markers are still being monitored in the treated groundwater and will be discussed together with physico-chemical results.

TU252  
The Influence of Nanoscale Zero-valent Iron (nZVI) in Combination with Various Organic Compounds (Modifiers) on 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. Dolinova, Technical University of Liberec / Institute for Nanomaterials Advanced Technology and Innovation; J. Nosek, Technical University of Liberec. Among all the groundwater contaminants chlorinated ethylenes (such as trichloroethene (TCE)) can be transformed by combination of abiotic and biotic methods under anaerobic conditions. Currently, nanoscale zero-valent iron (nZVI) is used for the treatment of chlorinated compounds via its strong reducing property. Biological reductive dechlorination of CE is contributed by dehalorespiration. The influence of nZVI in combination with carboxyl methyl cellulose (CMC), molasses and detergent (anionic surfactant) on the specific dehalorespiring microflora was tested within this study. Groundwater contaminated with CE (1,2-cis-DCE and TCE) was collected from the chemical factory Spolchemie a.s. Batch tests with iron composite and various concentrations of CMC (0.25, 0.5 and 1 g/l), detergent (5, 10 and 20 g/l) and molasses (5, 10 and 20 g/l) were performed for periods ranging from 6 to 26 days. DNA was extracted after filtration of the tested water and used as a template for a real-time PCR amplification. 16S rDNA gene was used as a total bacterial community marker. Specific genes were used for detection of ongoing reductive dehalogenation (vcra, bvac, Dre DHC-R and Dsb) and to monitor denitrifying and sulphate reducing bacteria (apsA). CMC as the substrate for dehalorespiring bacteria was not confirmed. Detergent enhances nZVI subsurface migration parameters. Direct positive effect on bacterial populations only in denitrifying bacteria was observed. Detergent had even inhibiting influence on dehalorespiring bacteria. Molasses as carbon and electron source had positive effect on all studied groups of bacteria. Interestingly, in combination with nZVI molasses enhanced growth of dehalorespiring but not denitrifying and sulphate reducing bacteria. Molasses is suggested to serve as the substrate for fermentation which produces electrons utilised by dehalorespiration. Molasses as the substrate and nZVI with its pH buffering capacity presented the best conditions for dehalorespiring bacteria. The authors acknowledge the assistance provided by the project No. TF02000064 supported by TACR.

TU253  
Mechanistic insight into microbial reductive dehalogenation

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Microbiologically mediated reductive dehalogenation provides a promising approach to remediating and detoxifying halogenated aromatics. Despite extensive respective studies, the mechanistic understanding of the underlying chemical reactions is still limited. Interestingly, Dehalococcoides mccartyi strain CD1 and Dehalobacter strain 14DCB1 share a common substrate spectrum but yield different dehalogenation patterns, suggesting different sites of primary attack (chemically bound halogen vs. H) by the nucleophile cobalamin (vitamin B12). The latter was unravelled through quantum chemical analyses of respective electronic structure characteristics. Building on these recent results, a perturbational approach was used for modeling 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-coordinate e° orbital located at the carbon-halon bond mediates the dehalogenation step, and enables discriminating CD1-active from non-active substrates for 92%. In this way, highly efficient and cost-effective methods for including applications of the MO approach for predicting dehalogenation pathways and regioselectivity. Overall, the approach supports the view that the reductive aromatic dehalogenation proceeds through an inner-sphere electron transfer.


TU254  
Bacterial biosorption of PFOS from contaminated waters

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Per- and polyfluorinated alkyl substances (PFASs) have been extensively used for commercial and industrial products since the mid-1960s. Although they have been classified as bioaccumulative hazardous organic compounds (Stockholm convention 2009). 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 new strategies and alternative 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 deadbacteria were found to have high adsorption (286-3324 gg/g of bacterial pellet) whereas the live bacteria only had low amounts (0-4.26 gg/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 biocathodic microbial electrolysis cell

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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 included a set of technologies based on both biological 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 anabiotic biocathode in a Microbial Electrolysis Cell (MEC). The cathode was first inserted into the cathodic compartment of a dual-chamber Microbial Fuel Cell, and inoculated with autotrophic cultre originate 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 biofilm at the end of the electrodes was performed. The main source of variability resulted to be the kind of preculture and for the three components of MFCs (planktonic, biofilm and rod).

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.

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

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The present site comprises an urban site where a historical Chlorinated Compounds-CHC (mostly PCE) contamination has been released in aquifer before electrification and with non-return valves corresponding to thirty. 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 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 (Phase 1) 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 producing 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 point and after solid values corresponding to thirty. Conditionment 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.

TU257 Bioelectrochemical sulfide scavenging from hydrocarbon contaminated marine sediments

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Thermodynamically favorable electron acceptors (e.g. oxygen) are quickly exhausted in hypoxic and anoxic 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 shown the possibility to couple anaerobic hydrocarbons degradation to current production in Bioelectrochemical Systems (BES), in which an electrode (anode) can be used as a sole 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 bioelectrochemical stimulation is an effective strategy to promote both 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). Anodic polarized current (ABP) and anodic open circuit (AOCP) were measured and alternative 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 60% in AOCP compared to 5.5 mA (POL) and higher current was observed in ABP. Sulfate reduction was also observed indicating the involvement of the sulfur cycle in the process. Members of the families Desulforomonadaceae and Prolixibacteraceae dominated the anodic community.

TU258 Freshwater sediment enrichments to improve MFCs performance for in situ remediation application: a phylogenetic microbial characterization

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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 Firmicutes 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 precultures and at the MFCs level (p > 0.05). Enrichment with FeC decreased the relative abundance of EAM and the microbial diversity. Previous studies show the need of a heterogeneous community dominated by EAM to improve the removal 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.

TU259 Integration of molecular and isotopic analyses to investigate the potential of aerobic biodegradation at a site contaminated by Monochlorobenzene

conditions to simulate both natural attenuation and biostimulated degradation processes. Enrichment factors for $^{13}$C were determined by Compound Specific Isotope Analysis (CSIA). High-throughput sequencing (Illumina) and Ion Torrent analysis and quantitative PCR were performed to gain insights into the structure of the microbial community and to identify functional biomarkers. The investigation of the potential anaerobic degradation pathways is not shown because the obtained data are not relevant. However, during the biodegradation MCB was completely depleted up to addition of nutrient and CSIA results confirmed negligible C isotope fractionation under oxidative conditions. The catalytic toE gene, encoding for tolue dioxycnase, and Pseudomonas were identified as molecular and taxonomic markers, respectively. Recently, analyses of the identified molecular and taxonomic markers for the aerobic degradation of MCB were also applied to another area contaminated by MCB, and nearby the first site, to establish whether an aerobic approach for site reclamation from MCB would be successful in the extended area.

TU260

Isotopic and Molecular Biology fingerprinting of a complex contaminated industrial area

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Microbial ecology and ecosystem services: a key role for biotechnological approaches. Human kind is largely relying on microbiota and microbial activities impact on a planetary scale. They are ubiquitous and show remarkable biodiversity and soil quality. Despite microorganisms are of micrometric size (1µm), their metabolic activities are not consistent. On the other hand, interactions between the microbial components have an impact on the content and performance of the bioprocesses at stake. Disruptions in the AD processes 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.

TU262

Evaluation of bioremediation potential in groundwater using newly-developed software

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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 Novy Bydřov 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)

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Introduction: Despite the scenario of excess phosphorus in some aquatic ecosystems, there has been concern with the disposal of phosphorus-rich sludge, which can affect global food security. A possible solution to this contrast is the use of sawdust to remove the excess phosphorus 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 micromorph 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 using specific methods. 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 mg P g$^{-1}$ sawdust). The adsorption of estradiol and caffeine was not observed in sawdust. The concentrations of carbamazepine, diclofenac, paracetamol, ibuprofen, naproxen, propranolol, triclosan, estrone, 17-estradiol and 17-ethynlestradiol are below the limit of quantification (LOQ).

Conclusion: Sawdust is considered a biosorbent, of easy access and low cost, to use in the remediation of eutrophic environments. The possibility of phosphorus recovery is important to ensure water and global food security.

Acknowledgments: FAPESP (2016/00490-6)

TU263

REMEDIATION OF AQUATIC ECOSYSTEMS: ADSORPTION OF PHOSPHORUS BY SAWDUST

G. Pantano, T.C. Souza, P.S. Fadini, A.A. Mozeto, Federal University of Sao Carlos

Introduction: Despite the scenario of excess phosphorus in some aquatic ecosystems, there has been concern with the disposal of phosphorus-rich sludge, which can affect global food security. A possible solution to this contrast is the use of sawdust to remove the excess phosphorus 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 micromorph 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 using specific methods. 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 mg P g$^{-1}$ sawdust). The adsorption of estradiol and caffeine was not observed in sawdust. The concentrations of carbamazepine, diclofenac, paracetamol, ibuprofen, naproxen, propranolol, triclosan, estrone, 17-estradiol and 17-ethynlestradiol are below the limit of quantification (LOQ).

Conclusion: Sawdust is considered a biosorbent, of easy access and low cost, to use in the remediation of eutrophic environments. The possibility of phosphorus recovery is important to ensure water and global food security.

Acknowledgments: FAPESP (2016/00490-6)
Formation potential of trifluoroacetate and its estimation by means of the TOP assay

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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\textsubscript{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 high performance liquid chromatography coupled to tandem mass spectrometric detection (IC-MS/MS). The oxidative transformation of 10 precursors (pesticides: flufenacet, fluopicolide, fluopyram, flurtamone and teflubenzuron; pharmaceuticals: fluoxetine and sitagliptin; industry chemicals: 4:2 FTSA and 6:2 FTSA) led to substance-specific molar yields between 7.1% (6:2 FTSA) and 96% (sitagliptin). It is known from previous studies that TFA can be formed during wastewater treatment. Here, the potential formation of samples from six treatment plants (WWTPs) was 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.

A Challenge for pesticide regulators: The example of 1,2,4-triazol in groundwater - Overview of regulatory strategies in Germany, Denmark and France

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The substance 1,2,4-triazol is a known metabolite of several fungicidal active substances used in plant protection products. Modelled groundwater concentrations of potential uses of each 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 uses, e.g. as an inhibition inhibitor uses as additive to fertilizers, or even being 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 use, nitrification inhibitor uses or from biocide uses, nitrification inhibitor uses and sitagliptin; industry chemicals: 4:2 FTSA and 96% (sitagliptin). It is known from previous studies that TFA can be formed during wastewater treatment. Here, the potential formation of samples from six treatment plants (WWTPs) was 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.

Pesticide & Biodegradation Assessment (P)

Implication of microbial adaptation for the persistence of emerging pollutants

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Regulatory determination of the persistence 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-chloroanilines, 4:2 FTSA, N5805 CS-methylpiperazine and metformin. Two of these chemicals are considered as 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-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 metformin 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 persistence 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.

Prioritization of organic compounds based on their persistence in dissolved phase

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When considering the large number of chemicals potentially present in the environment, the scientific community seems to establish a pertinent list of priority compounds. Assessing the persistence of chemicals such as pharmaceuticals or polar pesticides represents a need in order to realize a better prioritization of compounds of concern. Persistence 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 persistence 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 using OECD ready biodegradability tests (RBTs). In order to compare relative compound persistence in dissolved phase, a persistence 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 persistence 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 compounds. Of those prevailing in transitional areas. This study focuses on the persistence 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 using OECD ready biodegradability tests (RBTs). In order to compare relative compound persistence in dissolved phase, a persistence 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 persistence 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 compounds. Of those prev.
TU269  OECD 308 tests to explore differences in persistence of pharmaceuticals and microbial diversity between two rivers
C. Coll Moro, 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. Soheik, 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 regarding 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-anoxicaric 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-stereotypes 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 acetaiminoephenn showing signs of degradation. Dissipation of pharmaceuticals in the sediment compartment is more relevant than the difficulty of 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
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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 test the water compartment, while 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, WST) and soil (Soil Screening Tool, SST) were developed based on the existing MITI test system (OECD TG 301C). The test systems MITI, WST and SST were applied to determine biodegradation data for a set of fifteen test compounds. The results demonstrate that the WST 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 (P0).

TU271  Persistance assessment of pesticides in Denmark
A. Gimsing, The Danish Environmental Protection Agency / Pesticides and Gentechnology; A. Aagaard, S. Marcher, The Danish Environmental Protection Agency / Pesticides and Biocides; V. M. Glasser, 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 pH2. 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 authorized 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 psychrophilic plant pathogens. The persistence of these fungus-specific fungicides under winter 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. Fungicides were applied three times at the recommended application rates and fungicide concentrations in the turfgrass leaf tissue were measured at several time points between December and March. At the study end, the fungicide concentration in the turf was measured in a controlled environment chamber using the psychrophilic 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 2015 and 10 cm diameter turfgrass cores were collected biweekly from the experimental area and refrigerated during the winter. Fungicide concentrations in the turf were measured 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
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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 wild strains of Bacillus circulans. The microbial levan can be used as a biocompatible, biodegradable, sustainable and eco-friendly fructose-based polymer. It can be produced from sucrose by wild strains of Bacillus circulans. The microbial levan can be used as a biocompatible, biodegradable, sustainable and eco-friendly fructose-based polymer.

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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 13C NMR Bruker AVANCE III 500 spectrometer. Biodegradation potential in aerobic conditions of obtained copolymer was investigated using Micro-Oxymax respirometer (Columbus Instruments, Ohio). O2 consumption of samples mixed with soil was measured in period of 28 days. The 13C NMR spectrum of copolymer showed the signals of two copolymer components: 13C-DMF and 13C-DMSO. The amount of CO2 in copolymer sample (705.0 L) compared to control (350.9 L) and polystyrene (499.5 L) after 673 h. The formation of levane and polystyrene graft copolymer was confirmed by 13C NMR analysis. Results after 28 days in aerobic biodegradation in soil showed 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

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The persistence of chemicals is assessed through their kinetics of 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 these tests is complex. Degradation (-14C) of 2,4- and 2,6-TDA was studied using different soils, 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 main metabolites, formation of non-extractable residues. In addition, the influence of the characteristics of the soils 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

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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, which are widely used in industry, personal care products and agriculture. In general, TDA degradation is complex because several parameters may influence the kinetic of degradation such as temperature, substance properties (e.g. solubility), environmental conditions, and others. The OECD Guideline Nos. 301B and 308, wherein their disappearance, formation of degradation products, and evolution of 14CO2 were measured from initial doses of 0.5 mg/L. The 301B test used an inoculum collected from a domestic sewage treatment plant, while the 308 test used water/sediment collected from two diverse tributaries of the Rhine River. Disappearance of TDAs in the RBT followed parent-first-order kinetics, and half-lives for the 2,4- and 2,6-TDA were approximately 43 and 17, respectively. For 2,4-TDA, evolution of 14CO2 was equivalent to 4% of the total radioactivity (AR) after 28 and 63 d, respectively, that while that from 2,6- TDA was 12 and 24% of AR, respectively. The TDAs were removed by >90% in the RBT, with the balance of AR associated with the biopolymers. In the 308 test, the TDAs were rapidly transformed from their fully-soluble state in water to a non-extractable residue (NER) in the sediments and biomass. After the first 11 d, radioactivity in the river water was reduced to < 10% of AR, several transiently-formed degradation products were detected (tentatively identified by high resolution LC-MS), and NER accounted for ≥ 79% of AR for both TDAs in both river systems. Disappearance of TDAs was fitted to a double-first-order-in-parallel kinetic model, with 50% depletion times (DT50) of approximately 0.4 – 1.0 d and 0.7 – 1.2 d determined for the 2,4- and 2,6- isomers, respectively, in both river systems. Yields of 14CO2 were ≤ 10.6% of AR for the 2,4-isomer and ≤ 8.3% of AR for the 2,4-isomer in both river systems after 100 d. In all cases, < 1.5% of AR could be freed from the sediment using vigorous solvent extractions. The results of both test types show that the TDAs are not persistent in the environmental conditions and are transformed by concurrent biodegradation and abiotic reactions. While the RBT gave a reasonably conservative approximation of the DT50 times and 14CO2 yields in aerobic surface water/sediment systems, it did not give a realistic representation of the fate mechanisms which result in formation of NER with natural organic matter in the environment.

TU276

Evidence for Anaerobic Microbiodegradation of PCBs and PBDEs in Sediment cores from an e-Waste Site, South China

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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 sediments, three sediment cores from an e-waste dismantling site, Shenzhen, China, were sampled (named #1, #2, and #3, respectively). A positive factorization model (PMF), compound specific isotope analysis (CSIA), and microbial analysis were used to trace the in-situ biodegradation of these pollutants. High levels of PCB (44-67800ng/g, dw) and PBDE (62-79200ng/g, dw) were found in all the samples and the concentrations were generally 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 cores, especially for PBDEs. This conclusion was supported by the microorganism analysis, substantial Dehalococcoidetes were found in the sediment cores. The range of the relative abundance of Dehalococcoidetes for three sediment cores (#1, #2, #3) were 1.50-0.91%, 1.47-5.24%, and 0.20-2.55%, respectively, which were significantly correlated with the ratios of factor 2 (biodegradation sources) to PBDEs (with the p-values of 0.02, 0.05 and 0.01, respectively). As for CSIA analysis, only the stable carbon ratios (δ13C) of BDE 28, BDE47, BDE85, and BDE99 in the top 20cm of the #3 sediment cores were obtained. An increase in the δ13C values for BDE 28 and a slightly decrease in the δ13C 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 δ13C values of BDE 47 and BDE 99 were obtained in the three 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 phosphine phosphate in aquatic environment

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Organophosphate flame retardants (OPFRs) in aquatic environment are concerned because they are latest alternative 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 its sensitivity to aquatic environment. TPHP was exposed to individual daphnia magna and each samples were 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 1 & 2 biotransformation mechanisms. Diphenyl phosphate (DPhP), 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 retention times. Parent compound (TPHP) and hydrolysis products (DHPH) were calculated by degradation ratios relative to control. Significant tendency were observed between TPHP and DHPH; as TPHP showed decreased, degradation product (DHPH) 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

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This study provides new data on the degradability and persistence of a selected group of silicon-organic compounds (p-MeOC6H4SiMe2, p-MeOC6H4SiMe2, p-MeNC6H4SiMe2, p-MeNC6H4SiMe2) with higher water solubility was investigated to provide new and reliable data on
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. After a period of 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 environmental 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: organozelolate and bentonite. Petroleum pollutants sorption was investigated in the batch tank. Sorption was conducted with sorbents (1g/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 with bentonite/diesel (BED) model and lowest biodegradation potential with organic pollutants, which present certain limitations to assess the biodegradability of complex mixtures. The UTOC method was proposed 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 in this assessment for substances of unknown 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 new xenobiotic. It appears that coupling ecotoxicological tests with UTOC 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 quantitatively estimate 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.

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 pollutants in natural systems. The biodegradability is a fundamental determinant of 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 is the only laboratory-based approach that can 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 such 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 Bergudnsjön 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 taken at 1 time point. After addition of a mixture of 9 stable standards, the samples 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

Development of a multi-sensors device to assess the biodegradation of chemicals

M. Cevezi, University of Nantes / GEPEA CNRS UMR CBC Laboratory; 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 for substances of unknown composition. This work is composed of three different studies to introduce and improve a new target approach, where the implementation of liquid chromatography 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.

TU279

Biodegradation of adsorbed oil pollutants: Research on a model system

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According to 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 achieving inherent biodegradability. This work is composed of three different studies to introduce and improve a new target approach, where the implementation of liquid chromatography 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.

TU282

A Ultimately Transformed Organic Carbon (UTOC) approach to assess biodegradability of complex chemicals

M. Cevezi, Brillet, University of Nantes / GEPEA CNRS UMR CBC Laboratory; C. Sweetlove, lOREAL SA / Research and Innovation; J. Chenèble, lOREAL Research / Research and Innovation; T. Gerald, University of Nantes / Microbiology

Ultimately Transformed Organic Carbon (UTOC) as a quantification tool for biodegradation of complex mixtures was compared and contrasted to evaluate the hypothesis.
modeling steps involving the use of different parameters such as \( \text{O}_{2}, \text{CO}_2, \text{pH}, \text{T}^\circ\text{C}, \) 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.

TI/283 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

Studies on 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 \( \text{CO}_2 \) 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 poster present 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 cytometric cell counting. As test compounds, selected reference chemicals were chosen from the ECETOC MCC/007 list suggested for method development for readily and non-biodegradable compounds. Alongside cell counting, several test compounds were analyzed in parallel for \( \text{CO}_2 \) and disappearance of parent compound, and comparison with results from standard screening tests will be presented.

TI/284 Challenges and Solutions of Ready Biodegradation Study with Difficult Substances
T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; T. Sasa, D. Tsumuraya, Kao Corporation / Safety Science Research; M. Yamane, Kao Corporation / Safety Science; D. Morita, 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 these problems with these test systems. Here challenges and solutions in ready biodegradation studies are presented with water insoluble or/and volatile substances, as examples of “difficult substances”. A hydrocarbon, 15-methylpentane, is insoluble in water and tends to stay on the water 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 aroma chemical, 3,5,5-trimethylhexanoic acid, is insoluble in water and tends to stay on the water surface and volatileize. An initial ready biodegradation study indicated that it was not ready 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.

TI/285 Influence of inoculum origin and adaptation on biodegradation of emerging contaminants
B.A. Poursat, University of Amsterdam/IBED Institute / Institut for biodiversity and ecosystem dynamics; J. Dalmijn, 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; M. Lamers, University of Amsterdam / Ibed

Assessment of microbial biodegradation is a key parameters for estimating adaptability of 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 an allow a better persistency 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-methylpyrropane 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 procedure. Therefore, sealed bottles with different inocula sizes were used for the incubation and elimination is monitored 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 inoculums 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.

TI/286 Investigations on the role of adaptation in OECD biodegradation screening tests
F. Miffon, C. Dick, Firmenich; K. van Ginkel, AkzoNobel; 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 Information Requirements and Competition 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 these compounds is to be used to develop a test concerning the environmental representativeness of positive results obtained from enhanced RBTs with adapted inocula.

TI/287 Use of Chemical Analysis to Enhance Biodegradation Testing: A Case Study with Two Gas-to-Liquid (GtL) Products
J. Dawick, G. Whale, 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 Baltic and North Seas. Chemicals covered under 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 results of standard biodegradation tests. Confidence in the assumed representativeness of lab results obtained 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 1. ECETOC Workshop Report No.34 – Improvement of the OECD 306 Screening Test. Published September 2017. Available online via: http://www.ecectoc.org/publication/workshop-report-no-34-improvement-oecd-306-screening-test/ 2. Hughes, C., Whale, G., Mead, C. (2015). Investigation into the
TU288
Organising an international ring test to improve the marine biodegradation screening test
A. Najera, T. Morgan, Newcastle University / School of Engineering; G. Whale, Shell Health / Risk Science Team; J. Snape, AstraZeneca UK Ltd. / AstraZeneca Global Environment; B. Rowles, Cefas Lowestoft Laboratory; R. Davenport, Newcastle University / School of Engineering
A series of international standardised tests have been approved by the OECD to measure the relative biodegradability of substances. Among these tests, beeswax biodegradation tests (BSTs) form the first tier of assessment, offering relatively simple and cheap characterisations of biodegradability. Most parameters in these BSTs are highly prescribed and conservative, but the microbial inoculum is the least controlled parameter. The resulting high levels of variation have been recognised as a limitation since the introduction of these tests up to today and are especially reported for the marine BST OECD 306. BSTs were designed over two decades ago and are not, in their current form, effective as screens for persistence. In recent years, regulatory emphasis has shifted from identifying chemicals that are rapidly biodegradable to identifying chemicals that are potentially persistent in the environment. Technical guidance documents, which have been prepared under the European chemicals regulation system known as REACH, have suggested several improvements to effectively assess persistence with BSTs. Within their nature, there have resulted in major enhancements also address a number of the commonly discussed reasons for high variability and poor reliability of BSTs. The Cefic LRI ECO11 project investigated and validated several enhancements for the marine BST. It was possible to represent the bacterial diversity in the sampled environment better by increasing the microbial inoculum to environmentally relevant concentrations through tangential flow filtration. This standardisation led to a significant decrease in variability between replicates in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test project was conducted from 2016-18 to validate these intra-laboratory findings from Cefic LRI ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented.
TU289
Tissue-specific accumulation of triphenyltin compounds in marine fishes in such locations as Hong Kong
R. C. Sham, K.K. Ho. The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science
The extensive use of organotin (OT) compounds in antifouling paints and other industrial uses (e.g. as fungicides, wood preservatives, and antibacterial textiles) has led to significant decrease in variability between replicates in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test project was conducted from 2016-18 to validate these intra-laboratory findings from Cefic LRI ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented.
TU290
POPs in the terrestrial environment of Schirmacher Hills, Antarctica: A preliminary study and implications for PCB degradation kinetics
s. katanak, IIT Hyderabad; A. Qureshi, IIT Hyderabad / Civil Engineering; P. Chakraborty, SRM University; A.K. Tiwari, NCAOR / Polar environment
We present preliminary results on the occurrence of Polychlorinated biphenyls (PCBs) and Organochlorine pesticides (OCPs) in the terrestrial environment [moss, and water] of Schirmacher Hills, Dronning Maud Land, Antarctica, n-HCH concentrations (4.48 ng/L) are particularly high in snow samples. This suggests that some localized sources of PCBs may still exist in the Schirmacher Hills region. It is possible that the old research stations, or tourism base, in the area may be one of those sources. While the observed congener distribution can be explained using congener distributions in known commercial PCB mixtures (Aroclors, Sovol and Clophen) in some samples, a post-deposition transformation in snow/moss (in glaciers) is required to explain the remaining observations. Box modeling exercise to reproduce congener distribution in our environmental samples suggests that degradation half-lives of PCBs in snow should differ by at least 20 times between penta-/hexa-/hepta- (1750 h) and octa- (35000 h) congeners, as against the uniform value of one year (8760 h) suggested previously. Different half-lives could be possible, either if the rate of actual photodegradation-dechlorination process is different for congeners other than penta-/hexa-/hepta-PCBs. The Cefic LRI ECO11 project investigated and validated several enhancements for the marine BST. It was possible to represent the bacterial diversity in the sampled environment better by increasing the microbial inoculum to environmentally relevant concentrations through tangential flow filtration. This standardisation led to a significant decrease in variability between replicates in comparison to the standard marine BST. By extending the test duration beyond the persistence half-life threshold, previously reported elongated biodegradation lag phases for chemicals in surface water were recognised. A ring test project was conducted from 2016-18 to validate these intra-laboratory findings from Cefic LRI ECO11 in 13 other testing facilities within Europe, North America and Japan. The test protocol, developed by academia, industry, CROs and regulatory bodies, together with information on the organisation and conduction of the ring test will be presented.
TU291
Degradation of crop protection products in Brazilian soils—An international ring test project
N. Basdin, S. Marshall, Syngenta Product Safety / Product Metabolism and Analytical Science; G. Bending, University of Warwick / School of Life Sciences; I. Bramke, M. Garrod, Syngenta Product Safety / Product Metabolism and Analytical Science; C. Mckillican, Syngenta Crop Protection LLC / Product Metabolism and Analytical Science
Recent CPPs become commercially available they are subjected to rigorous testing according to strict regulatory guidelines, including understanding the fate of these compounds in the soil environment. The global use of CPPs requires an understanding of their behaviour in a range of soils, including those from both temperate and tropical regions. Moreover, results from previous CPPs fate studies have shown fundamental differences in Brazilian soils compared to temperate soils. The aim of my project is to determine the major physico-chemical and biological properties controlling the degradation of pesticides in Brazilian soils. A set of 4 different soils, prescribed for regulatory testing to encompass the typical range of properties, such as pH, organic matter, clay content and cation exchange capacity (CEC), including an up crop version and a pristine version of these soils, was used in my study. My first experiment focussed on the rate of degradation and mobility of pentachlorothiabendazole in four different Brazilian soils and one temperate soil. Thiabendazole exhibited slow degradation due to its adsorption onto the soil solid surface, thus being unavailable to microorganisms in the soil pore water. Thiabendazole half-lives (DT50s) and distribution coefficients (Kow) were higher in some Brazilian soils compared to the temperate soil due differences in their physico-chemical properties. Further pesticides will be tested to determine which key physicochemical and biological properties are the driving force for a compounds fate in tropical soils.
TU292
Study of the Degradation of Bisphenol A by the basidiomycete fungus Trametes versicolor, via HPLC-DAD
C.E. Gracio, V. Bianchi, P.G. Silva, A.C. Montini, E.C. Lima, C.L. da Silva, UFABC / CNCHI
Biophenol A (BPA) is a compound widely used in plasticitants such as polycarbonates and resins. Its use has been increasing in the last years and researches point that it may be detected in the environment in great concentrations. Moreover, this substance is classified as a pollutant of emerging concern because of its persistance 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, it was evaluated the ability of the fungus specie 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 powder to it. After that, 2ml 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.

**TU 203**

**Soil dissipation of paraffin oils: Improvement of the microbial degradation and impact on soil dissipation.**

P. Adrian, A. Barret, CEHTRA SAS; G. Destreyker, 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 four sites in Germany and handled per the International Standards Organisation Standard ISO/DIS 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 not any substantial dissipation of Paraffin Oil CAS (72623-86-0) as produced by TOTAL Fluids. Dissipation of PAHs from Coal Mining Heap Samples from the Saarland region.

**TU 296**

**Impact of biofilm growth on mercury accumulation in Daphnia magna.**

J. Libbert, G. Vallina, P. Adrian, A. Barret, C. T. Holschuh, M. Schiemann, TOTAL Fluids.

After 250 years coal mining stopped 2012 in the Saarland, Germany. Ca. 80 mining heaps are located within the Saarland region. The mining operations mostly involved the open-pit extraction of hard coal. Special samples were taken from the Saarland region. A 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.

**TU 298**

**Multiple stressor effects on resource quality for consumers: a case study with Daphnia magna.***

M. Damer, K. Sanchez-Thirion, LIEC; C. Crenier, LIEC; Université Lille; M. Borel-Pichon, Centre d’Études pour l’Environnement; V. Felten, LIEC; CNRS; A. Bec, Université Clermont Auvergne; T. M. Ciesielski, Norwegian University of Science and Technology.

Multiple stressor effects on resource quality for consumers: a case study with Daphnia magna.*

**TU 302**

**When ecotoxicology meets trophic ecology (P)**

P. Mendez, Observatorio Pelagis; J. Spitz, Observatorio Pelagis; Université de La Rochelle/CNRS; F. Caurnat, Université de La Rochelle / LIENS.

In marine mammals, food is the main route of entry for contaminants. Their concentrations can largely vary among prey species, for that reason differences in bioaccumulation will arise from differences in predator diet. Among all the contaminant that marine organisms faced, metallic trace elements (MTE) are natural substances that have been present on the earth since its formation. MTE can be divided in essential and non-essential in function of their biological role in the organisms. Low concentrations of essential elements can lead to deficiency effects. On the contrary, excess of non-essential elements i.e. cadmium (Cd), mercury (Hg) and lead (Pb) can induce toxic effects. However, their long-term presence in to the environment has allowed to marine mammals and other marine organisms to develop mechanisms to mitigate the potential toxic effects of these non-essential elements. The best known detoxification process is the demethylation of Methyl-Hg by Selenium (Se) forming granules of tiemmanite (Hg:Se) in their liver. Today, anthropogenic activities induced a continuous increase of Hg concentrations in the environment, altering the organism’s metabolism as well as their interactions with other 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 phocaena*). 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 concentrations at the preferred diet can decrease because of its short-range transport different which exposure among marine mammal species depending on their diet, which means that some of them could be less protected against Hg toxicity. Thus, changes in prey quality could have cumulative effects in cetaceans (increase of toxic elements and deficiency in essential ones) impacting the efficiency of detoxification processes in the future.
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 each 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. Billoir, Université de Lorraine, CNRS UMR 7306; A. Cébron, LIEC CNRS UMR Université de Lorraine; S. Coq, CEFE, CNRS, Montpellier; V. Feiten, LIEC / LIEC UMR Université de Lorraine; J. Nahmani, LIEC-CNRM, Montpellier; F. Maumour-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 ditangeulate the potential mechanisms leading to this pattern, we evaluated 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 diploped 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 diploped physiology (in particular with an increasing oxidative stress when increasing Pb levels in non-supplemented goats were 2-fold higher than in supplemented animals (0.012 vs. 0.006 μg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagy by the animal. These supplements could serve as 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.

TU300
Decomposition rates and feeding activity of soil fauna in relation with stages of plant colonization in mine soils of a Mediterranean area

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Organic matter decomposition (tea bag index) and feeding activity of mesoofauna (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 (2-3) ≤≈2.5 m high, growing scattered (P); 3. Isolated *Betula pendula* trees > 5 m high, growing scattered (P); 4. Dense patches with several *P. halepensis* trees (≥5) ≤=≈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. Control forest not contaminated with *P. halepensis* trees > 5 m high and shrubs and herbs under the canopy (CP); 5. Polluted forest with *P. halepensis* trees > 5 m high and shrubs and herbs under the canopy (DP+MS). Rothoos and green tea bags were buried in 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 emptied after 20 days was recorded to calculate the % of holes fed upon. After ~50 days, the percentages 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%, roths tea=90%; - P: CF and P: green tea = 80-85%, roths tea =90%. These percentages were maintained until the day 110. The lower decomposition in CF and P 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 forest soils with little resources, sessile 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 (~) 5% of holes fed upon. CF =22%, P =38%, S =31%, P+MS≈21%. 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-Instituo 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. Durakcan, National Veterinary Research Institute / Department of pharmacology and toxicology; R. Mateo, IREC-CSIC- 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 still cause an environmental and health risk. Since Pb, unlike other metals, is known to bioaccumulate to high levels in many animal species, and the mobilities of Pb depend on the geochemical parameters of the soil, we aimed 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 in vivo 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 50% lower than in non-supplemented animals (0.014 vs. 0.006 μg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagy by the animal. The use of these supplements could serve as a cost-effective measure to reduce Pb exposure of livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is the reduced 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 pesticide 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 captured 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. Pesticide samples from common bussards (*Buteo buteo*), little owl (*Athene noctua*) and Gammarus fossarum (*Gammarus fossarum*), used as a model predator, 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 50% lower than in non-supplemented animals (0.014 vs. 0.006 μg/g wet weight). Based on our study, supplements enriched with Ca and P appear to decrease the Pb burden in the animals, likely through competition in intestinal absorption with the nutrient, Ca, preferentially absorbed over the toxic metal, Pb, and possibly through reduced geophagy by the animal. The use of these supplements could serve as a cost-effective measure to reduce Pb exposure of livestock and wildlife in areas contaminated with Pb. An assumed additional advantage is the reduced Pb exposure through milk consumption by the local human population.
Recent increases in terrestrially derived dissolved organic matter (tDOM) in water (surface and we characterized physicochemical conditions, lower food web structure and Hg contaminants such as mercury (Hg). While several studies exist on effects of terrestrial food webs. To better understand the bioaccumulation behaviour of chemicals in terrestrial food-webs, we aim to produce a food-web model to assess the biomagnification of POPs in an apex avian predator, the Cooper’s hawk. Over 100 samples were collected from various trophic levels of the food-web including halibut eggs, songbirds, invertebrates, and berries. All samples were analyzed for a number of contaminants listed as priorities for monitoring by the Chemical Management Plan of the Canadian federal government. Stable isotope analysis of δ13C and δ15N signatures of hawks, songbirds, invertebrates, and berries was used to estimate the trophic position of each organism. Legacy POP concentrations were expressed in terms of lipid equivalent concentrations to account for variability in the fractions of lipid and non-lipid organic matter measured in each sample. POP concentrations were expressed in terms of protein equivalent concentrations to account for the fraction of protein within each sample, which was estimated at the product of the percent of nitrogen measured in each sample and a nitrogen:protein conversion factor. Censored regression by maximum likelihood estimation was used to assess the relationship between the natural logarithm of each lipid or protein equivalent concentrations, and trophic position. Trophic magnification factors (TMFs) were determined as the antilog of the regression slope. TMFs of legacy POPs ranged from 0.61 to 38.40, indicating that most legacy POPs are biomagnifying in this terrestrial food-web. TMFs of PFCs ranged from 11.8 to 544.6, indicating that PFCs are also biomagnifying in this terrestrial system and potentially at higher magnitudes than legacy POPs. Overall, terrestrial TMF values for POPs were determined for several aquatic systems; whereas, terrestrial TMF values for the PFCs were considerably higher than TMF values found in aquatic systems.

TU306 Comparative trophodynamics of polychlorinated biphenyls and chlorinated paraffins in an urban river system

S. Schultze, University of Oslo; A. Ruus, NIVA/NIVA; K. Borga, Department of Biosciences, University of Oslo / Department of Biosciences; T. Andersen, D.O. Hessen, University of Oslo / Department of Biosciences; H. Veiteberg Braaten, O. Kaste, NIVA / Norwegian Institute for Water Research; A. Poste, Norwegian Institute for Water Research. Recent increases in terrestrially derived dissolved organic matter (DOM) in freshwater (“browning”) and marine systems (“coastal darkening”) have been noted in several studies in boreal areas. This leads to the question if high riverine input of terrestrial derived material will affect the food web dynamics of recipient brackish and marine ecosystems. The presence of DOM may affect light attenuation, primary production, and invertebrate production. Trophic and bacterial factors (TMFs) were determined as the antilog of the regression slope. TMFs of legacy POPs ranged from 0.61 to 38.40, indicating that most legacy POPs are biomagnifying in this terrestrial food-web. TMFs of PFCs ranged from 11.8 to 544.6, indicating that PFCs are also biomagnifying in this terrestrial system and potentially at higher magnitudes than legacy POPs. Overall, terrestrial TMF values for POPs were determined for several aquatic systems; whereas, terrestrial TMF values for the PFCs were considerably higher than TMF values found in aquatic systems.

TU307 Copper and mercury effective body residues in freshwater macroinvertebrates as related to benthic community metrics from a mining river basin.

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TU305 Spatial comparison of contamination and biomagnification profiles of triphenyltin compounds in sub-tropical marine environments of Hong Kong

R.C. Sham, K.K. Ho, The University of Hong Kong / The Swire Institute of Marine Science and School of Biological Sciences; X. Wang, Xiamen University / Department of Environmental Science and Technology; K.M. Leung, The University of Hong Kong / The Swire Institute of Marine Science. Biomagnification of lipophilic organic contaminants is one of the major pathways to accumulate xenobiotic substances in marine organisms. Interestingly, the magnitude of biomagnification is not necessarily consistent in organisms across the marine food chain. Triphenyltin (TPT) compounds, which is moderately lipophilic (log Kow = -3.5), are commonly used as antifouling paints on sea-going ship hulls and supports the marine macroleuca in Hong Kong, Japan, China, and Taiwan. Studies have suggested that TPT can be biomagnified along the lower part of the trophic food chain (i.e., among primary producers, invertebrates, and fishes), while their magnification potential has remained unclear among the higher trophic organisms, such as larger fishes, dolphins, and seabirds. To date, only two studies have investigated whether bioaccumulation of TPT occurs in marine organisms at higher trophic levels; however, their findings were contradictory. Therefore, we aimed to evaluate the biomagnification potential of TPT in high-trophic organisms across a spatial gradient from the more-contaminated western waters to the less-contaminated southern waters of Hong Kong. We have divided the western and southern waters into four sites, namely inner estuary (WI), outer estuary (WO), south of Lantau Island (SL), and southeast of Hong Kong Island (SE). Environmental (seawater and sediments) and biota samples (including molluscs, crustaceans, fishes and marine mammals) collected from the respective sites were analysed using gas-chromatography mass-spectrometry to examine the concentrations of six organotin compounds (i.e., mono-, di- and tri-butyltin; mono-, di- and tri-phenyltin). Preliminary results showed that seawater samples from WO had higher concentrations. This is partly due to the fact that TPT is more bioavailable from biota samples indicated a concentration gradient from the western to southern waters (WI > WO > 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).
TU308
Trophiic 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.

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Trophiic 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 metazooplankton 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 LC50 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 also an inhibition of GGE% (Aurelia sp.EC50: 3.82 mg/L). As regards ecotoxicological assays, immobilization was never affected (effect < 50%), while frequency of pulsations showed a significant decrease after each feeding treatment. These findings suggest a contaminant transfer from crustacean nauplii to ephyrae able to induce sublethal effects.

TU309
Tissular injuries in Crassostrea virginica as evidence of the trophiic transference of copper and cadmium via Chlorella sp.

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Essential metals in aquatic organisms in small quantities carrying out 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 trophiic chain of marine ecosystems. After contact with 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 'n was to evaluate the effects derived from the trophiic transfer of copper and cadmium from Chlorella sp. to C. virginica. Microalgae were used for 110 h at a sublethal dose of copper and cadmium (0.1 mg/L). A concentration of 30 X 10^6 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 'n 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 h of exposure to the contaminated food. However, lesions derived from cadmium exposure, a non-essential metal, in more than 50% of organisms/n could be observed on day 10 and those associated with more than 50% 'n 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 trophiic metal poisoning, and the prevalence of lesions with metal and exposure time.

TU310
Can microplastics save us? Effects of microplastic particles and particle-bound trace contaminants in an artificial aquatic food web

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Since 2015, studies dealing with toxic effects of microplastics in freshwater ecosystems come into focus. Still, little is known about vertebrate models as final consumers in food web experiments. The present study investigates the transfer of pristine microplastic particles and a model polycyclic aromatic hydrocarbon, along an artificial food chain with Artemia sp. nauplii and zebraschiff (Danio ririo). Therefore, cryogenically grinded microplastic particles, made of polystyrene (}

TU311
Toxicokinetics links predator-prey dynamics to assess zero-valent iron nanoparticles bioaccumulation in a Caenohabditis elegans-Escherichia coli ecosystem

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BACKGROUND: Zero-valent iron (Fe0) nanoparticles (NPs) are one of the most paramount NPs applied in environmental remediation that the potential impacts on the ecological dynamics and soil ecosystem health are of great concern. OBJECTIVE: The primary objective of this study was to simulate dynamic models linking bioinert and consumer-resource dynamics in the Caenorhabditis elegans (C. elegans)-Escherichia coli (E. coli) OP50ecosystem. METHODS: The bioinert parameters, uptake and deprecation rate constants of bacteria and worms were obtained from toxicokinetic experiments and related published literature. Biomass dynamics of bacteria and worms were estimated by employing the Lotka-Volterra model. Dynamics of FeNPs accumulations, bioconcentration factors (BCFs), biomagnification factors (BMFs) were simulated based on the consumer-resource dynamics. A sensitivity analysis was also performed to characterize the influence of consumer-resource-related physiological parameters. RESULTS: Results showed that biomass of worms increased steadily from 22.25–21.61 g L−1, whereas the biomass of bacteria decreased rapidly from 17.17–2.29 g L−1 and attained a steady-state after 2 h of the simulation in the scenario of 100 mg L−1 FeNPs exposure. We also observed that internal concentrations of FeNPs were estimated to be 67 and 1768.85 µg 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 BMFs of worms were maintained to be consistently smaller than 1 during 24 h exposure. Results also indicated that internal concentrations of FeNPs 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 FeNPs accumulations in bacteria and worms that the bioaccumulation kinetics and consumer-resource dynamics are likely to be dominated by the same physiological parameters.

Use of Effect Based Methods in the context of the national and european legislative framework for the protection of aquatic ecosystems (P)

TU312
INTEREST OF IN VITRO BIOASSAYS (YES/YAS) FOR THE SCREENING OF ENDOCRINE DISRUPTION IN SURFACE WATERS OF WALLONIA (BELGIUM)

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This study is part of the BIODIEN project. This project aimed at conducting, for the first time, a screening campaign of endocrine disruptors (ED) in waters of Walonia (groundwater, surface water and wastewater). Almost 200 substances were screened, including hormone estrogens, alkylphenols, phthalates, chlorophenols, etc.

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perfluorates, PBDEs, PCBs, HAAS and pesticides. In parallel with analytical methods, YES and YAS bioassays were conducted in order to quantify estrogenic and androgenic activities in surface waters. Antagonistic 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. Of the other hand, estrogenic and androgenic bioassay 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 estrogen concentration but also with other ED (e.g. bisphenol A, perfluorates). This study is, in a way, the first attempt in Wallonia to follow the recommendations for the use of effect-based methods (EBM) 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)

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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 Zebró, 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) heavy metals (Fe, Cu, Zn, Cd) and (iii) ecotoxicological endpoints, using biotestings representing different trophic levels (Vibrio fischeri, Thamnocephalus platyurus, Daphnia magna). In general, Zebró and Lucefécit presented concentrations of BOD (Zebró: 4.0-35.5 mg L⁻¹; Lucefécit: 2.3-7.5 mg L⁻¹) and total phosphorus (Zebró: 0.18-6.23 mg L⁻¹; Lucefécit: 0.02-1.92 mg L⁻¹) that compromise the support biological life, with regard to nutrient and oxygenation criteria. The concentrations detected were low, being benzotene the compound quantified at highest levels. Lucefécit was the tributary that presented higher concentrations of pesticides (with values of benzotene of 1.94 mg 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 Zebró 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

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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 alternative to the currently used water monitoring with, for example, 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. 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. The 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. Diporeia, Daphnia pulex and Chironomus) were not selected for monitoring, since they are already well proven with no detailed evaluation was required, however, they 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 with 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.

TU315
Innovative ecotoxicological monitoring strategies for the protection of aquatic ecosystems and the implementation of the Water Framework Directive (WFD)

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The Water Framework Directive (WFD, 2000/60/EC) regulates the European water basins, with the operation of EBM introduced as a strategic approach to protect aquatic ecosystems. Monitoring programs are designed to allow the implementation of the WFD. Over the last few years, the interest to incorporate new relevant bioassays once they have achieved a sufficient level of validation has increased. 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 Zebró, 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) heavy metals (Fe, Cu, Zn, Cd) and (iii) ecotoxicological endpoints, using biotestings representing different trophic levels (Vibrio fischeri, Thamnocephalus platyurus, Daphnia magna). In general, Zebró and Lucefécit presented concentrations of BOD (Zebró: 4.0-35.5 mg L⁻¹; Lucefécit: 2.3-7.5 mg L⁻¹) and total phosphorus (Zebró: 0.18-6.23 mg L⁻¹; Lucefécit: 0.02-1.92 mg L⁻¹) that compromise the support biological life, with regard to nutrient and oxygenation criteria. The concentrations detected were low, being benzotene the compound quantified at highest levels. Lucefécit was the tributary that presented higher concentrations of pesticides (with values of benzotene of 1.94 mg 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 Zebró 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.

TU316
Chemical and Ecotoxicological Monitoring of a marine coastal area in the Central Italy

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A monitoring campaign in Central Italy with the aim to characterize the chemical quality status of the coastal marine area in order to detect the possible impact of the emissions of a Coal fired power station and other sources of pollution in proximity of the city of Civitavecchia. The sampling has been carried out in two different seasons of the year along the marine coastal area and in a transitional surface waterbody (Saline di Tarquinia). The analysis has been performed on the water column and the first 20 centimeters of the sediments. The chemical substances analyzed included several priority substances of the WFD (water framework directive) and other chemical substances: Metals, Dioxins, PCB, PAH, Naphthalene. The Ecotoxicological assays have been performed with the use of algae (Phaeodactylum tricornutum) and crustaceans (Artemia franciscana and Tigriopus fulvus). The results have showed a diffuse light exceedance of the sediment quality guidelines and also environmental quality standards of the Italian legislation for some metals (e.g. arsenic, lead, chromium, mercury) and naphthalene. The data of the water column are in general below the environmental quality standards, but Uranium has been detected in surface water samples at concentrations above the available PNEC.
effects forms an innovative approach with potential for preventive product quality endpoints were analyzed for the EDA: cytotoxicity (MTT assay), endocrine water pollution. A LC IMS QTOF system was used to carry out the NTA. Different regularly over a period of one year in order to obtain an annual progression of the determination of organic micropollutants is needed. This project is an approach reason, it is necessary to initiate a proactive screening of contaminants and their surface water. On the other hand, there are Organic micropollutants p

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**TU317**

USE OF DIAGNOSTIC STRAINS OF THE SALMONELLA/MICROBE ASAY 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. Massé, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis; G. Umbuzeiro, School of Technology, UNICAMP / ALAE

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 the absence and presence of metabolic activation (S9). The strains used were: 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, a view was made of different types of mutagenic compounds 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 mixes that are thought to be responsible for the mutagenicity. The mutagenic analysis is currently carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals. ACKNOWLEDGMENTS The authors thank FAPESP Project 2013/16956-6. José Ricardo R. M. Zwarg thanks FAPESP Project 2015/1139-7 for the IC scholarship. Daniel A. Morales thanks CAPES for the PhD scholarship.

**TU318**

NTA meetsEDA: A practical example

J. Kuinke, V. Hinnenkamp, P. Balsaa, A. Simon, IWW Rheinisch-Westfälisches Institut für Wasserforschung gGmbH; T.C. Schmidt, University of Duisburg-Essen

The Coal fired power station.

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**TU319**

Imposex levels in gastropods from the Northern Adriatic Sea (Italy): a proposal of classification according to the Water Framework Directive F. Cacciatore, ISPRA-Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; R. Boscolo Brusà, C. Antonini, M. Femelevicz, ISPRA - Institute for Environmental Protection and Research; and Marin, University of Padua; A. Bocchini, M. Gabelini, 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 compound and it is generally recognized as a specific water quality and aquatic toxicity compound. 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. Nassaarius nitidus (Jeffreys, 1867) and Hydrobia ulvae (Linnaeus, 1758) are 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 Bad 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. Böndölkke Adamsen, P. Gåveson, A. Sahln, Rabiball 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 (WFD) requires that all abatement measures are demonstrated to be responsible for mutualistic 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 mixes that are thought to be responsible for the mutagenicity. The mutagenic analysis is currently carried out to test if it is possible to correlate the observed profiles with individual compounds or groups of chemicals. ACKNOWLEDGMENTS The authors thank FAPESP Project 2013/16956-6. José Ricardo R. M. Zwarg thanks FAPESP Project 2015/1139-7 for the IC scholarship. Daniel A. Morales thanks CAPES for the PhD scholarship. The SOLUTIONS project has received funding from the European Union's Seventh Framework Programme for Research, Technological Development and Demonstration under grant agreement no. 603437.

**TU321**

Impacts of methylmercury on growth, respiration and swimming in larval in a marine forage fish

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**Behavioural Ecotoxicology: Unravelling behavioural responses to chemical contaminants in the environment (P)**

Behavourial Ecotoxicology: Unravelling behavourial 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 measured behavioral effects of MeHg to a marine forage fish at the larval stage, the Sheephead 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 tend and 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 affected. To investigate this, we conducted additional experiments, and this could influence the success of populations in the wild through impairment of predation or avoidance of predators.

TU323

Effects of 17α-ethynylestradiol (EE2) on social behaviors of the false clown anemonefish, Amphiprion ocellaris
T. Chen, National Museum of Marine Biology and Aquarium / Department of Biology; C. Lu, National Dong Hwa University / Institute of Marine Biology; C. Chen, National Taiwan University / Institute of Environmental Health.

The synthetic estrogen 17α-ethynylestradiol (EE2) is extensively used in oral contraceptive pills, medication, cosmetics, and personal care products. It is also widely used in livestock and aquaculture systems via wastewater discharges and effluents of sewage treatment plants. EE2 is commonly detected in wastewater effluents and surface waters including coastal water. Coastal regions are often impacted by sewage discharges, no study has been done to address the effect of environmental estrogens such as EE2 in coral reef fish. Agonistic behavior is crucial for maintaining social hierarchy in many coral reef fish. Endocrine disrupting contaminants such as EE2 may interfere fish social structure via disrupting their agonistic behavior. In this study, we aimed to use the false clown anemonefish (Amphiprion ocellaris) as an experimental model to characterize endocrine disrupting effects of EE2 in coral reef fish, with an emphasis on social behaviors. For the exposure experiment, the fish were randomly distributed to separate tanks to form small colonies consisting of three individuals and were exposed to an environmental concentration of EE2 (30 ng/L) for 4 weeks. During this period, social behaviors including agonistic behavior, submissive response, and shelter utilization were videotaped and quantitatively analyzed once a week. Our results show that growth and survival were significantly affected by exposure to EE2 at concentrations of 10 and 30 ng/L whereas EE2 treatment did not affect appetite or swimming speed of fish at all EE2 concentrations. Social hierarchy was not altered, but social behaviors of the middle-ranked fish were significantly affected by EE2, suggesting that EE2 may cause different impact in different ranks.

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’Byran, Monash University / The Development and Stem Cells Program of Monash Biomedicine Discovery Institute and the Department of Anatomy and Developmental Biology, Monash University, Australia; B.B. Wong, Monash University / School of Biological Sciences.

Pharmaceutical contaminants are increasingly being detected in ecosystems and effluents of sewage treatment plants. EE2 is commonly detected in wastewater effluents and surface waters including coastal water. EE2 is extensively used in oral contraceptive pills, medication, cosmetics, and personal care products. It is also widely used in livestock and aquaculture systems via wastewater discharges and effluents of sewage treatment plants. EE2 is commonly detected in wastewater effluents and surface waters including coastal water. Coastal regions are often impacted by sewage discharges, no study has been done to address the effect of environmental estrogens such as EE2 in coral reef fish. Agonistic behavior is crucial for maintaining social hierarchy in many coral reef fish. Endocrine disrupting contaminants such as EE2 may interfere fish social structure via disrupting their agonistic behavior. In this study, we aimed to use the false clown anemonefish (Amphiprion ocellaris) as an experimental model to characterize endocrine disrupting effects of EE2 in coral reef fish, with an emphasis on social behaviors. For the exposure experiment, the fish were randomly distributed to separate tanks to form small colonies consisting of three individuals and were exposed to an environmental concentration of EE2 (30 ng/L) for 4 weeks. During this period, social behaviors including agonistic behavior, submissive response, and shelter utilization were videotaped and quantitatively analyzed once a week. Our results show that growth and survival were significantly affected by exposure to EE2 at concentrations of 10 and 30 ng/L whereas EE2 treatment did not affect appetite or swimming speed of fish at all EE2 concentrations. Social hierarchy was not altered, but social behaviors of the middle-ranked fish were significantly affected by EE2, suggesting that EE2 may cause different impact in different ranks.

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.

Psychotropic drugs are designed to modulate behaviours in humans, and preclinical studies have demonstrated that these compounds can also alter behavioural responses in aquatic vertebrates. The effects of antidepressant drugs have been tested from a pharmacological discipline using anxiety-like behaviours including thigmotaxis (wall hugging) and scototaxis (light avoidance) on mice and zebrafish, using well-defined exposure paradigms. Behavioural testing has 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 behavioural responses in aquatic vertebrates. The effects of antidepressant drugs have been tested from a pharmacological discipline using anxiety-like behaviours including thigmotaxis (wall hugging) and scototaxis (light avoidance) on mice and zebrafish, using well-defined exposure paradigms. Behavioural testing has 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 behavioural responses in aquatic vertebrates. The effects of antidepressant drugs have been tested from a pharmacological discipline using anxiety-like behaviours including thigmotaxis (wall hugging) and scototaxis (light avoidance) on mice and zebrafish, using well-defined exposure paradigms.
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

Interspecies differences 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 phototaxis 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 between behaviours 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.

Physiological basis of individual tolerance to the benzodiazepine oxazepam in zebrafish (Danio rerio)

L. Vossen, Upsalla University / Department of Neuroscience; J. Fick, Umea University / Department of Chemistry; T. Brodin, Umea University / Department of Ecology and Environmental Science; S. Winberg, Upsalla University / Department of Neuroscience

Pharmacological assays 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*). Previous behavioural studies 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.

TU327

Physiological basis of individual tolerance to the benzodiazepine oxazepam in zebrafish (Danio rerio)

L. Vossen, Upsalla University / Department of Neuroscience; J. Fick, Umea University / Department of Chemistry; T. Brodin, Umea University / Department of Ecology and Environmental Science; S. Winberg, Upsalla University / Department of Neuroscience

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TU328

Reversible behavioural alterations in burbot, Lota lota, from exposure to environmentally relevant levels of oxazepam

J. Sundin, Norwegian University of Science and Technology / Department of Neuroscience; F. Shi, Norwegian University of Science and Technology / Department of Biology; J. Fick, Umea University / Department of Chemistry; M. Thorlacius, Marine and Freshwater Institute; T. Brodin, Umea University / Department of Ecology and Environmental Science

Benzodiazepines are frequently detected in the environment. They persist in wastewater effluent and can be found at high concentrations in treated effluent. Furthermore, several benzodiazepines are resistant to photodegradation, enabling them to persist in the environment. Benzodiazepines are designed to alter human behaviour by binding to GABA-receptors, which are found in a wide range of animals including all vertebrates. We investigated the effect of the benzodiazepine oxazepam on behaviour using the burbot, *Lota lota*. We found that high levels of oxazepam affected swimming activity, diurnal as well as nocturnal, while the environmentally relevant level had no detectable effect. There was also an effect on boldness, with fish exposed to high levels of oxazepam spending more time hiding than the control- and low level fish. Interestingly, the effects of high oxazepam were no longer detectible when the fish were tested again after being kept in water without drugs for five days. Our results suggest that effects of pharmaceuticals may be reversible, if the exposure duration is relatively short and the animal have the possibility to move to uncontaminated water.

TU329

Behavioural endpoints and biochemical biomarkers as tools to investigate effects of Citalopram in brown trout (Salmof lario) in f. fario

M. Ziegler, University of Tubingen / Animal Physiological Ecology; S. Tisler, University of Tuebingen / Environmental Analytical Chemistry; L. Reinelt, University of Tubingen / Animal Physiological Ecology; R. Triebskorn, University of Tuebingen / Animal Physiological Ecology

Citalopram (CIT) is a selective serotonin reuptake inhibitor (SSRI) which is commonly used as an antidepressant drug. It binds to serotonin receptors for the serotonin reuptake from the synaptic cleft and thereby inhibits the reuptake of serotonin into the pre-synapse. Due to high concentration rates and moderate elimination during wastewater treatment, CIT is one of the most abundant SSRIs in surface water. Several studies showed that environmentally relevant concentrations of 1 µg/L may affect aquatic organisms. The aim of this study is to investigate effects of CIT in different life stages of brown trout (*Salmo trutta f. fario*) with focus on development, behaviour and individual health. Both, eggs of 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 month 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, hsp70-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 species showed an impaired swimming activity and an increased swim up in the aquaria. In 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. This stress situation resulted in a high activity of fish for those exposed 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 flurry 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; T. Brodin, Umea 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 animal behaviour 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

Scents and sensibility: EEZ disrupts male 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

A growing 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 309
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-day 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 Daphnia. To examine the impact of EE2 on 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 paired 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 ‘sigmoid’ display with both control and EE2-exposed males spending more time performing sigmoid displays for control females compared to EE2-exposed females. When males were presented with both visual and chemical cues, males spent more time with females, and EE2-exposed males spent more of that time with the females. Our results underscore the importance of studying multiple mate choice cues simultaneously, and highlights the possible ecological implications of altered chemical communication for exposed wildlife.

TU332
effects on Daphnia magna, a model organism, because they are amenable for behavioral analysis and mechanistic dissection of complex processes. Larvae are exposed to a point source of test chemical at different concentrations and the behavior is tracked with an automated video recording system. Various parameters such as the larva’s space use, locomotor activity and velocity are evaluated. Active natural responses are detected by staining the larvae for an endogenous activity indicator (pERK) after their exposure to a toxicant. Results: We observed an aversive response at 1 µM, expressed by an increased dwell time in the nicotine containing zone. Higher concentrations (10 µM), on the other hand, appear to be clearly aversive, and larvae tried to escape the dish. Attractive and aversive responses have been reported to be attributed to differential activity levels in the Habenula with activating addition or inhibition of the reward center in the telost brain. We are investigating whether neuroactive molecules (Imidacloprid, Thiadloprid) and psychoactive pharmaceuticals (Citalopram, Lamotrigine, Orazepam) 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 different chemicals. 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 test alpine cold adapted species? V. Di Nica, University of Milan - Bicocca (VAT IT12621570154) / Department of Earth and Environmental Sciences; V. Lencioni, F. Bellamoli, MUSE-Museo delle Scienze / Dept. of Physics and Dept. of Biology; E. Nicoletti, University of Turin; T. Giardina, University of Turin; H. N. Alves, UFPE / Zoology; P. S. Carvalho, UFPE - Universidade Federal de Pernambuco / Zoology; R. N. Alves, UFPE / Universidade Federal de Pernambuco / Zoology. 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 caused by TBT. Newly Poecilia vivipara fish at six days after birth (dab) obtained from a laboratory breeding stock were exposed for 96h to waterborne tributyltin at 0.1; 1.0; 4.5; 7 and 9 µg TBT L⁻¹, plus controls and solvent controls. After exposure, we evaluated swimming speeds and trajectories of the fish, counter-current swimming resistance, ability to capture Artemia nauplii, growth in weight and length, and morphology of the eyes. After exposure to 4.5; 7 and 9 µg TBT L⁻¹, histopathological analysis of the retinal pigment epithelium (RPE) indicated a hypopigmentation of the pigment epithelium villi and basal region in TBT exposed fish. In addition to these alterations, RPE invaginations, photoreceptor degeneration, iris epithelial cell atrophy and iris melanin condensation were observed. After exposure to 9 µg TBT L⁻¹, swimming speed, swimming resistance, daily capture of Artemia nauplii and growth in weight were reduced by 85%, 60%, 33.6% and 56% relative to controls, respectively. The morphology changes detected in the retina and iris may have had a significant effect on prey detection and prey detection capacity, which together with the detected effects in swimming endpoints might have led to a deficiency in prey capture and growth. These changes can reduce the chances of exposed fish to recruit to the adult population.

TU333
Chemosensory behavioral reactions of zebrafish larvae to environmental contaminants D. A. Beasley, C. M. vom Berg, Eawag Swiss Federal Institute of Aquatic Science and Technology / Environmental Toxicology. Background: Selecting an appropriate behavioral response to a potential rewarding or threatening stimulus is critical for the survival of an animal. Therefore, organisms possess an innate ability to react to threatening and rewarding situations. For example, Daphnia magna, take up these nanoparticles and induce growth and the formation of structures such as a spine or helmet. The 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 are a key component in the freshwater ecosystem. Due to their broad feeding preferences, they are frequently observed in the wild and therefore necessary, to prevent an ecological imbalance in the freshwater environment. Ag and TiO₂ manufactured nanomaterials (MNMs) are widely used in the commercial industry because of their unique properties. Silver is known for its antimicrobial properties and is therefore used in soaps and bandages as well as clothing and washing machines. Titanium on the other hand is used in products such as sunscreen, paint and toothpaste because of the bright white pigment it contains. Due to their small size, nanoparticles are not being effectively removed from wastewater treatment plants and end up in freshwater systems such as rivers and streams. Filter feeders, like the cladoceran Daphnia, take up these nanoparticles and larvae as a model organism, because they are amenable for behavioral analysis and mechanistic dissection of complex processes. Larvae are exposed to a point source of test chemical at different concentrations and the behavior is tracked with an automated video recording system. Various parameters such as the larva’s space use, locomotor activity and velocity are evaluated. Active natural responses are detected by staining the larvae for an endogenous activity indicator (pERK) after their exposure to a toxicant. Results: We observed an aversive response at 1 µM, expressed by an increased dwell time in the nicotine containing zone. Higher concentrations (10 µM), on the other hand, appear to be clearly aversive, and larvae tried to escape the dish. Attractive and aversive responses have been reported to be attributed to differential activity levels in the Habenula with activating addition or inhibition of the reward center in the telost brain. We are investigating whether neuroactive molecules (Imidacloprid, Thiadloprid) and psychoactive pharmaceuticals (Citalopram, Lamotrigine, Orazepam) 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 different chemicals. 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$_2$; (NM105) MNMs on the predator defence response; by chronically exposing *Daphnia magna* to fish kainorones 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 moult and concluded. The non-monotonic response in swimming distance is maintained for 21 days in view of the temporal pattern. An in vivo effect is taken of each daphnids 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 Exposure

M.E. Nielsen, P. Rosley, 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 behavioral and 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: Behavior as an indicator of effect in *Danio rerio* (zebrafish) exposed to nanogold

T. Bohu, North-West University / School of Biological Science; S. Brand, North-West University; V. Wepener, North-West University / School of Biological Science Pharmaceutical 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 Tecniplast™ tanks for a period of six hours and videos were analysed using Noldus EthoVision software. The critical swimming speed was performed in a Lologe® swimming tunnel, briefly fish were acclimatized within the chamber for one hour and swam at a starting speed of 2 b/s with a 0.5 b/s speed interval, fish were swam until they were unable to keep up with the increasing water flow. The DNA microarray revealed that 20 mg/L was the least related to the control group. At 20 mg/L there was a significant increase in gene expression for all genes analysed but protein biomarkers showed no significant response. The behaviour results showed significant changes in distance moved, swimming speed, acceleration bouts, zone altitudes and time spent within the top zone - responses which are seen in fish responding to toxicological stress. The exposed fish has a significantly lower critical swimming speed when compared to the control. Since swimming performance and social interaction during swimming is essential to life whole organism behaviour shows a toxicological response to nAu which is in agreement with genetic responses seen.

TU338 The effects of silver and silver nanoparticles via different routes of exposure on behaviour in marine amphipods

M. Vannuci-Silva, UNICAMP / Institute of Biology; S.A. Kohler, University of Portsmouth / Animal Physiological Ecology; G. Umbuzeiro, School of Technology, UNICAMP / LAEG; A. Ford, University of Plymouth / Biological Sciences Behavioural responses are an important endpoint because they provide a link between biochemical and ecological effects of environmental contaminants. Silver is increasingly being used in nanomaterials and, consequently, being released into the environment in different forms. The behavioural consequences of metal exposure in crustaceans and other invertebrates are 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$_2$; (NM105) MNMs on the predator defence response; by chronically exposing *Daphnia magna* to fish kainorones 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 moult and concluded. The non-monotonic response in swimming distance is maintained for 21 days in view of the temporal pattern. An in vivo effect is taken of each daphnids at the end of the experiment, to observe and compare the microscopic details of the anti-predator defences in the treated and untreated daphnia.

TU339 Developing methods to determine aquatic invertebrate behavioural endpoints for regulatory ecotoxicology studies

A.C. Brooks, Cambridge Environmental Assessments / Department of Environmental Science; A. Lawrence, Cambridge Environmental Assessments / Regulatory Ecotoxicology; M. Hackett, Cambridge Environmental Assessments / Cambridge Environmental Assessments; M. Allen, F. Joyce, F. Pickering, Cambridge Environmental Assessments / Cambridge Environmental Assessments (CEA) / Aquatic Ecotoxicology 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 signified using 0.25 µg/L *Chironomus*; 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 already the gold standard. The aim of this work is to develop methods for determining 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.
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 genetics to toxicology, we have developed an olfactory system map of the sexual or feeding behavior of our crop pest model following application of sublethal doses of deltamethrin, methylinol and chlorpyrifos. Whereas sublethal doses of methylinol appeared to disrupt the feeding behavior of larvae, we demonstrated a hormetic response of males to sublethal dose of deltamethrin. We completed our study by molecular (qPCR), biochemical (proteomic, AChE activity and metabolic) 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 nanoparticles on olfaction in rainbow trout (Oncorhynchus mykiss) P. Peruzzo, 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 olfactory function. Although the copper ion (Cu²⁺) has a low toxicity, whereas at least in a laboratory toxicology, the impact of copper 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 Cu²⁺ on olfactory acuity and olfactory-mediated behaviours of rainbow trout. To establish CuNPs or Cu²⁺ induced olfactory-impairment thresholds, inhibitory concentration (IC) curves were determined. Fish were exposed to a geometric dilution series of CuNPs or Cu²⁺ for 24 hours, and fish olfactory acuity was measured using electro-olfactography (EOG). Afterwards, fish were exposed to CuNPs or Cu²⁺ at concentrations known to impair olfaction by 50% (322 and 6.8 µg/L for CuNPs and Cu²⁺, respectively) for a 24 h or 96 h exposure period. The response of fish to a social cue (taurocholic 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 Cu²⁺. 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. The results continued to support the results of neurophysiological experiments. Although fish exposed to water or Cu²⁺ 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 Cu²⁺ in the exposed fish. In summary, over the same exposure periods, CuNPs showed a higher degree of toxicity compared to Cu²⁺. Partial olfactory recovery was documented for continuous Cu²⁺ exposure. However, the mechanism of olfactory toxicity caused by CuNPs is not clear and needs further investigation.

Informed substitution of hazardous substances 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 S. Valsalam, 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 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 particularly detailed picture of the PFAA in the economic sectors and to better understand 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 interesting 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 PFAs 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 liquors. The overall survey underlines 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, Buzzi 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 allow for appropriate control of 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 wools and combed wools), pre-consumes materials (combed and carded wools, knitted fabrics, spinning and twisting trimmings), and regenerated cotton-type materials (derived from denim recycling).

Operational plan involved quantitative and qualitative assessment concerning the regeneration of the woolen-type raw material used by carded spinning companies in Prato textile district, sampling (more than 100 woolen-type regenerated raw material selected by origin and type and more than 40 cotton-type regenerated materials) and chemical analysis (made by Buzzi Lab) of some priority groups of concerned substances: APEOS (Ethoxylated Alkylphenols), Aromatic amines from azo-colorants, Chlorophenols, PPC (per-fluorinated compounds), Allergenic and Carcinogenic Dyes, Heavy metals (such as Cu²⁺, Ni²⁺, Pb²⁺, Zn²⁺, Cd²⁺) for fish toxicity, Long Chain Fluorocarbons (PTFE, HFP, PFOA, etc.) for environmental persistence in the environment. Using an integrated approach for comparative risk assessment among conventional hazardous substances and alternatives for textile finishing, Two case studies: flame retardants and durable water and oil repellents. The first one focused on the evaluation of sublethal effects of flame retardants (FRs) and durable water repellent (DWRs) on fish olfactory function. 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 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 mandatory laws and also ensure a proper control of levels of contamination. CID will support industry to select functional and safer alternatives.

TU345 Substitution of firefighting foams containing per- and polyfluorinated alkyl

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substances (PFASs)

A. Biegel-Engler, German Environment Agency - UBA / Chemicals; L. Vietke, 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 degradable in the environment. They can reach into the environment causes a contamination. Short chain 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. Those 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, authorities 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 use 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 different reasons – risk reduction being one of them. In the particular the SMEs have constantly been 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. Waeterschoot, 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 economical 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 to what extent a change in 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

Ecotoxicity of the hydrolate byproduct of three biopesticides on the unicellular green alga Chlamydomonas reinhardtii

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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 (hydrolate) of them 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 absinthium (Tarrerol, 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 these 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 absinthium 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 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 S. Montana are likely to cause toxic effects on D. Magna and V. Fischeri 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. Burillo, 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

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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 (Lamiaceae), which has demonstrated a wide range of applications due to its importance for cosmetic activity. Furthermore, compounds from these species 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 speciesare evaluated for their biological and pharmacological activities, as well as its chemical characterization, limited data are available on ecotoxicological characterization. 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 S. Montana are likely to cause toxic effects on D. Magna and V. Fischeri 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. Burillo, 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

J. Sánchez, C. Vázquez, A. Bíguez, J. Val, J. Sánchez, C. Vázquez, A. Bíguez, J. Val, Universidad de Zaragoza; 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 biocides are, nowadays, being developed. Although biological activity of biocides 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) focuses on the production and optimization of plant/ferulic/aguaiwaste-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 has been assessed using the community-level physiological profile – CLPP-. This method relies on the ability of microbial functional community for degrading different carbon sources present in Biol Ecologates®. The active toxicity hydrocarbons were 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 bioprecedes 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. Burillo 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 nontarget effects (NTO) non-target effects (NTE) in the environment. Alpinia galangal essential oil (AGEO) has been considered to control the outbreak insect pest, Rictina 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 I. Eakers. As AGEOs were formulated for emulsifiable concentrate (EC), they were mixed with ethanol and tergitol in a ratio of 5:1. 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, 48-h LC50 values for the VFE0 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 oil against Cyprinus carpio
H. Jeon, K. Kim, H. Jeon, Y. Kim, Y. Choi, S. Lee, Kyungpook National University Recently, many researchers have developed natural insecticides to control insect pests that contain 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 EOE against Cyprinus carpio was determined in a static condition for 40 days. When cinnamon EO EC was applied as a treatment, they were mixed with ethanol and tergitol as surfactants. To select an appropriate surfactants, 8 different types of surfactants (Tween 80, Sodium dodecyl sulfate (SDBS), Nonident, Triton X-100, Sodium dodecyl Benzene Sulfonate (SDBS), Kolinphor, 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 EOE, chronic toxicities of cinnamon EOEC was determined in the 5 different concentrations for 40 days. Each concentration was triplicate exposed to 10 of C. carpio adults. The treat five concentrations were 0.08, 0.16, 0.46, 2.56, and 5.12 ppm and the mean survival rate was 8.48 ± 0.47. The survival rate of the control group was 9.33 ± 0.58 and the positive control containing ethanol and tergitol was 8.09 ± 1.00. The mean temperature and pH of the test water was 24.06 ± 0.58 °C and 7.51 ± 0.03, respectively. The mean of dissolved oxygen of the test water was 7.29 ± 0.07 mg/L and the mean of hardness was 82.14 ± 2.04 mg/L. After the complete exposure, the mean of length of alive fishes was 3.00 ± 0.17 cm and the weight was determined as 0.37 ± 0.17 g. With these results, cinnamon EOEC can be considered as safe, natural insecticides for the environment.

TU353
Thiosemicarbazone scaffold for the design of antifungal and antiflatoxigenic agents: evaluation of ligands and related metal complexes
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Food safety is the safeguarding and protection of food from anything harmful affecting consumer health and is an extremely important issue facing the world. Food hazards can be divided into physical, chemical and biological. Examples of biological hazard are mycotoxins, that are toxic, secondary metabolites produced by many species of filamentous fungi. Generally, mycotoxins represent a significant threat to human health as they can be carcinogenic, neurotoxic and toxic to endocrine or immune system. In particular, aflatoxins are a class of mycotoxin produced principally by two species of Aspergillus, A. flavus and A. parasiticus. Aflatoxins are found in various cereals, oilseeds, spices and nuts as a result of a fungal contamination that can occur in the field, during harvest, transport and storage. IARC has classified aflatoxins in Group 1 as carcinogenic agents to humans. The most dominant and potent aflatoxin is aflatoxin B1 and several studies indicate that high exposure to AFB1 can cause chronic toxicity and increases the incidence of hepatocellular carcinoma. A lot of methods can be applied to eliminate these toxins from food and guarantee the food safety and health concerns of consumers. Our research aims to develop new typologies of inhibitors of Aspergillus proliferation and of aflatoxin production, harmless to the environment and to human health. We have evaluated the biological activity of several thiosemicarbazone ligands starting from molecules of natural origin, like vanillin, perillaldehyde and their derivatives. In order to improve the biological activity, metal complexes were then synthesised. These molecules once synthesized and characterized, were initially tested to determine their antifungal and antiflatoxigenic activity towards A. flavus. These compounds showed different efficacy in reducing fungal growth and mycotoxin accumulation. The most active compounds were used to perform cytotoxicity assays on healthy human cells, particularly on human cell lines derived from the districts that can be exposed to xenobiotics. Furthermore, we performed toxic and genotoxic assays on bacteria and plant cells. In conclusion, this approach allows us to study the antifungal and antiflatoxigenic activity of several thiosemicarbazones and to determine the potential risk for environment and human health with a view to use these compounds in field. Financial support: Fondazione Cariplo-Projekt N. 2014-0555, http://aflatoxonline.it/

Understanding human and environmental exposure to chemicals in urban systems (P)
TU354
Electronic products are related with household exposures in Canadian residents
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Key Words: electronic products, hand wipes, household exposure, FRs and plasticizers

Food hazards can be divided into physical, chemical and biological. Examples of biological hazards are mycotoxins, that are toxic, secondary metabolites produced by many species of filamentous fungi. Generally, mycotoxins represent a significant threat to human health as they can be carcinogenic, neurotoxic and toxic to endocrine or immune system. In particular, aflatoxins are a class of mycotoxin produced principally by two species of Aspergillus, A. flavus and A. parasiticus. Aflatoxins are found in various cereals, oilseeds, spices and nuts as a result of a fungal contamination that can occur in the field, during harvest, transport and storage. IARC has classified aflatoxins in Group 1 as carcinogenic agents to humans. The most dominant and potent aflatoxin is aflatoxin B1 and several studies indicate that high exposure to AFB1 can cause chronic toxicity and increases the incidence of hepatocellular carcinoma. A lot of methods can be applied to eliminate these toxins from food and guarantee the food safety and health concerns of consumers. Our research aims to develop new typologies of inhibitors of Aspergillus proliferation and of aflatoxin production, harmless to the environment and to human health. We have evaluated the biological activity of several thiosemicarbazone ligands starting from molecules of natural origin, like vanillin, perillaldehyde and their derivatives. In order to improve the biological activity, metal complexes were then synthesised. These molecules once synthesized and characterized, were initially tested to determine their antifungal and antiflatoxigenic activity towards A. flavus. These compounds showed different efficacy in reducing fungal growth and mycotoxin accumulation. The most active compounds were used to perform cytotoxicity assays on healthy human cells, particularly on human cell lines derived from the districts that can be exposed to xenobiotics. Furthermore, we performed toxic and genotoxic assays on bacteria and plant cells. In conclusion, this approach allows us to study the antifungal and antiflatoxigenic activity of several thiosemicarbazones and to determine the potential risk for environment and human health with a view to use these compounds in field. Financial support: Fondazione Cariplo-Projekt N. 2014-0555, http://aflatoxonline.it/
plastizers. Our results indicate that participants are exposed to various FRs and plastizers through their daily household environment. The Canadian adults’ external exposure of hands to FRs and plastizers 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.

TU354
Modelling diffuse emissions and fate of engineered nanoparticles used in outdoor paints to urban surface waters at high spatial and temporal resolution
M.D. Núñez, University of York / Environment; A. Praetorius, University of York / 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 modeling approach 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 (TiO\textsubscript{2}) 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 TiO\textsubscript{2} ENPs in 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, triclocarban and triclocloro in personal care products from Korea
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Parabens (p-hydroxybenzoic acid esters), triclocarbon (TCS) and triclocarban (TCC) have been extensively used in various cosmetics and personal care products (CPSPs) 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 CPSPs in our daily life. In this study, ten parabens and their metabolites, TCS and TCC were measured in 243 CPCPs, 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 1020 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 and their metabolites were calculated from the consumption of leave-on products and 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 CPCPs, 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 consumer 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 cosmetic products (3 basic cosmetics, 1 UV protective products, 3 body products, 2 cleansing 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 previous studies, but 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 ranged 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 mothers’ 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
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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 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 their conjugates, such as choline phosphotriesterase (TCPy, metabolite of chlorpyrifos), 4-nitrophenol (PNP, metabolite of parathion), malathion dicarboxylic acid (MDA, metabolite of malathion), 3-chloro-4-methyl-7-hydroxycoumarin (CMHC, metabolite of coumaphos), 2-isopropyl-6-methyl-4-pyrimidol (IMPy, metabolite of diazinon) and 2-dethylamino-6-methyl pyrimidin-4-ol (DEAMPy, 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 a biomarkers of the most common PYR pesticides. The determination of the above mentioned compounds was performed using isotope dilution 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 DEAMPy (98%), PNP (97%), 3-PBA (91%) and TCPy (87%). The metabolite showing the highest concentration was DEAMPy 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.
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 (napthalene and phenanthrene) measured in placenta presented higher concentrations than high molecular weight PAHs (pyrene and benzo[a]pyrene). More 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. Non-significant correlations were found between PAHs levels and anthropometrical 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
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The aggregate exposure pathway (AEP) model is a conceptual framework to help align chemical exposure information including (i) production, use and release, (ii) chemical fate and concentrations in various media (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, prioritizing 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 emphasizing the relatively high potential for human exposures to chemicals in indoor environments compared to outdoor sources. Following the same exposure scenario, unit emission rate based whole body concentrations (exposure potential) range from 3 × 10^-1 to 5 × 10^1 mmol/kg. The differences in ranking chemicals for exposure based on either external (intake fraction) or internal (exposure potential) 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 rates 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
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Lead is a soft, ductile, toxic 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 Bukkuyum and Anka LGA of Zamfara State, Nigeria, due to chronic lead toxicity were reported by Medecins Sans Frontieres (MSF, Holland) to the health authorities (UNEP/POCHA 2010). The cause of the high mortality was acute and chronic lead poisoning as a result of massive environmental contamination from artisanal mining and processing of gold in Pb-rich ore by poor headsmen and farmers. This outbreak was reported as the worst in modern history (UNEP/POCHA 2010). Open-pit mining of lead in the Isiaghau Region of Ebonyi State since 1965 has exposed large volumes of marcasites, pyrites and tailings contaminating the environment and food chain pathways. The research was designed to investigate the environmental impact of lead mining on the bio-ecosystem of Isiaghau town and environs. Soils, 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 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 Isiaghau 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
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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 availability in environmental media such as soil, air, dust and water. Dissolution and alkaline fusion are commonly employed. Various instrumental techniques that have been used recently includes electrothermal vapouriser 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 evaluates the potential of the proposed instrumental 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; food optimisation; spectroscopy; wastewater

TU363
A stonework snail as a new biomonitor of metal contamination in the urban environment
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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 inhales fine particles, is a promising indicator of environmental pollution and contamination urban areas. The species is an ideal organism widely used as biomonitor of urban pollution, i.e. mosses, lichens and vascular plants, accumulate particles of soil and rock dust, making it difficult to recognize the element contribution from atmospheric deposition and the metal bioavailability to consumers. By analysing the chemical composition of the shells, soft tissues and faeces of snails collected from vegetated walls, at roadside and in streets, this three studies shows that many of the elements currently monitored in soft tissues of P. papillaris (purged of the gut contents) showed the highest Cd, Cu and Zn concentrations at the most trafficked sites. Data from faeces suggested that this species ingests large amounts of inorganic particles scraped from the stone surfaces, as indicated by the very high Al, Cr, Fe, Mn, and Pb concentrations. Most lithophilic elements and Pb are scarcely absorbed in the snail digestive tract and soft tissues mainly accumulate Cd and essential elements such as Cu, Zn and Mn. Although the chemical composition of the shells was characterized by low concentrations of all analyzed elements, the samples collected at the most trafficked sites had significantly higher Cu, Fe, and Zn concentrations. This bioaccumulation in P. papillaris shells likely remains after death, potentially providing a historical record of the snail exposure to metals over lifetime.

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, BC, Canada. Over 190 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 leaded 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 ED95 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 homeowners.

TU365 Soil quality analysis, a lever for identifying sources of trace elements and managing urban allotments for urban agriculture production M. Lettger, G. Castel, UniLaSalle; A. Rouan, Rouen AgHyle 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 homogeneous; 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 (Northern France), for three purposes: pasture, a forest recreation, and market 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 are needed before planning 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 rhizomediazisation potential A. Di Guardi, University of Insubria / Department of Science and High Technology; G. Raspa, Sapienza University of Rome / Department of Chemical Engineering Materials and Environment; E. Terzaghi, University of Insubria (Chemical Engineering); M. Legraz, University of Toronto / Chemical Engineering and Applied Chemistry; L. Castel, UniLaSalle; A. Rouan, Rouen AgHyle Unit

The former Caffaro s.p.a., a chemical factory among the largest former polychlorinated biphenyls (PCBs) producer in Europe, which produced such contaminants during the historical contamination to produce 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 rhizomediazisation.

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 metals and metalloids such as Cu, Pb 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 50th percent 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 inhalable 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 bioaccessibility 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-wide Pb inputs from road dust determined 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, unfractonated 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 and Metallurgy, University of Belgrade; N. Zaric, Innovation Center of the Faculty of Technology and Metallurgy, University of Belgrade; T. Sovelic 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 the most significant pollutants according the European Environment Agency. The street dust samples were collected in summer 2016 at three different locations. The samples were fractionized 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 et al., 1979): adsorptive and ion-exchangeable phase (using ammonium acetate at the moderately reduced pH of 5.13 kg/ liter), exchangeable ammonium oxalate and oxalic acid, and organic sulphide phase (using hydrogen peroxide acidified 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. In comparison with the Serbian national Regulations demonstrated that the concentrations of Cd and Zn in these three fractions were higher than the maximum allowed values at some locations only, indicating serious contamination with these metals at some locations. The phase partitioning study revealed that Zn and Cu were bounded mainly in the second phase. Pb and Cd were predominantly associated with the third phase. The metals were redistributed in the three fractions in one example 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. Regulations: About allowed quantities of dangerous and harmful matters in soil and irrigating waters and methods about their analysis. "New" OPEs: isopropylated, tert-butylated and di-tert-butylated Triazine phosphate Isomers in E-waste, House, Car and NIST SRM Dust L. Jantunen, Environment and Climate Change Canada; T.E. Rodgers, University of Toronto / Chemical Engineering and Applied Chemistry; V.H. Arrandale, Cancer Care Ontario; S. Bernstein, Environment and Climate Change Canada; J.
Ascor Fang, T. et al.: Oxidative Potential of Ambient Water

between several factors, some increasing the response and some suppressing it. was more sensitive to organic substances, while the AA m assay showed a different sensitivity towards the oxidant species: the DTT method species whose concentration is very differ

composition and dimension. Despite the very different composition of PM in the samples collected by a 10

determination. In this work we applied three of the most used organisms, and different acellular assays are currently used in literature for its index of PM ability to generate reactive oxygen species (ROS) in biological

The scientific world is still quest

Sapienza University of Rome / Chemistry. Laboratory; F. Estrany, Universitat Politecnica de Catalunya UPC; A. Garbayo, Agbar, Barcelona Water Company; X. Alzadaz, Polytechnical University of Catalonia Drinking water supply companies have traditionally focused their efforts on providing a product with health guarantees, a safe and clean water. Disinfection has been a main purpose of the water treatment. A broad range

and technologies are available. Chlorine dioxide has been increasingly used because of its ability to avoid the formation of trihalomethans (THMs), the most common and well-known disinfection by-products. NN-Diethlyl-p-phenylenediamine (DPD) method has been without any doubt the most common procedure for the analysis of free and combined chlorine (chloramines) and also, chlorine dioxide. While this method easily permits the differentiation between free and combined chlorine, the selectivity of the analysis of chlorine dioxide when chlorine is present has recently been questioned. As a result, this procedure has been removed from Standard Methods (American Water Works Association) and qualified as “reserved” method. Given this circumstance and the need of having a selective method for chlorine dioxide, several UV-Vis spectrophotometric methods have been evaluated by our group (1). Here, the results using leucoemethylene blue are presented. This chromophore agent is obtained by reduction of methylene blue and its use for the analysis of chlorine dioxide is scarcely described in the literature. Our experiments show that it presents a good analytical performance, and what is more important, measurements are not interfered by elemental chlorine. The method showed a good accuracy with real water samples (relative error below 14 % for chlorine dioxide concentrations between 0 and 1.5 mg/L). This reagent has revealed to be the best option among the different compounds that we have used – amaranth, lissamine green, and choro phenol methyl red. The only drawback of the procedure is the interference by high concentrations of sulphate. Ongoing work is taking place to avoid it by previous precipitation of the interferent or liquid extraction of the dye. The method has been successfully developed (1) P. López et al. Chemical and sensory analysis of chlorine dioxide in drinking water. Part II. SETAC Europe 26th Annual Meeting. May 2016. Nantes (France).

TU370

OXIDATIVE POTENTIAL OF PARTICULATE MATTER COLLECTED AT INDUSTRIAL AND URBAN SITES
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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 the oxidant potential (OP) 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 (dithiothreitol - DTT, acid ascorbic – AA, and 2,7-dichlorofluorescin –DCFH, Fang et al., 2016. Huang et al., 2016) to PM2.5/PM10 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 ions, seem thus 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. A second period in microwaves and the DTT assay had 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 Dithiothreitol (DTT) 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.
Challenge in setting, meeting and measuring specific protection goals for plant protection products (P)

TU374 Joint Annual Meeting of the International Society of Exposure Science and the International Society for Environmental Epidemiology (ISES-ISEE 2018) 
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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 how 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/workgroupings/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 SCT-GCP ecosystem services 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 interspecies 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 monitoring. We discuss challenges and ways forward.

 TU375 French Phytopharmacovigilance: a national scheme for monitoring the adverse effects of plant protection products
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Phytopharmacovigilance is the latest complement to ANSES’s existing missions concerning the assessment of the risks associated with plant protection products before marketing, and the issuing and withdrawal of marketing authorizations. It is also fully in line with the third component of the Ecophyto plan. This national plan, established for the first time in 2008, was recently renewed. It aims to reduce pesticide uses in accordance with the requirements of Directive 2009/128, establishing a framework for Community action to achieve the sustainable use of pesticides. A specific scheme for funding these studies is planned through a tax on sales of plant protection products payable by the marketing authorisation holders. To meet this objective, phytopharmacovigilance relies on three fundamental and complementary methods of data collection and knowledge production: a network of surveillance or vigilance bodies, collection of spontaneous reports and ad hoc studies on the adverse effects of plant protection products. These studies are financed by NPV to meet three different needs: 1) when the information provided by the surveillance and vigilance bodies is seen to warrant clarification, 2) to investigate spontaneous reports or 3) to collect new data / information. To identify the adverse effects of plant protection products on biodiversity and ecosystems, Phytopharmacovigilance is based on the systematic and regular collection of information produced by the existing surveillance and vigilance bodies, covering risks and impacts on wildlife, crops, fauna, flora, air, water, and soil. In the full article (2 pages word/pdf), a detailed list of studies and network working on “Pesticides impacts on biodiversity” and “Monitoring of pesticides (water, air, etc...)” is described.

 TU376 Measuring and Modeling Aluminium Bioavailability and Toxicity to Aquatic Organisms
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The ability to accurately predict the aquatic toxicity of aluminium (Al) in natural surface waters has eluded scientists for the past several decades. In 1988, the US Environmental Protection Agency (USEPA) released nationally-recommended ambient water quality criteria for Al of 750 and 87 µg/L as acute and chronic criteria, respectively. However, these applied only to waters with a pH between 6.5 and 9, and the chronic toxicity database was limited. Therefore, in 2009 we assembled a team of scientists to help expand this database and identify a means for measuring and predicting the toxicity of Al to aquatic organisms as a function of water chemistry. A series of chronic toxicity tests were performed, as part of this effort, with several freshwater species. The species were selected to meet requirements for the EU REACH dossier, USEPA water quality criteria or European Water Framework guidelines for environmental quality standards. To develop bioavailability models, multiple tests with a green alga (Pseudokirchneriella subcapitata), a cladoceran (Ceriodaphnia dubia), and a fish (Pimephales promelas) were performed across a range of DOC, hardness and pH conditions. These latter data were included in the development of a biotic ligand model (BLM) for the prediction of toxicity as a function of water chemistry. The toxicity data sets were also used to develop a multi-linear regression (MLR) model to provide a simplified means to predict toxicity as a function of DOC, hardness, and pH. Due to its complex environmental chemistry, measurement of the “toxic” form of Al in natural waters cannot be performed using the conventional “total” or “dissolved” analytical approaches. Studies have recently been completed which allowed for the measurement of “bioavailable” Al in natural waters where suspended solids are present and contribute to measurements of total Al, but are non-toxic. The presentation will focus on modeling Al toxicity and measuring Al in natural waters.
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 ERA's 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 establishment of measures of ecosystem health, 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, traditional techniques in specific and frequently caused by natural disasters, 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 Technical Committee, 2016. Recovery in environmental risk assessments at EFSA. EFSA Journal 2016; 14(2):4313. 85 pp.

TU380
Habitat Equivalency Analysis for a Restoration Resilience Model of the Rio Dóce Basin
P.N. Boech, Ramboll Environ / Ecological Sciences; E. Singer, F. Gomès, 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 Dóce 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 scale up and address the issues caused by the disaster. HEA is being refined through a process of stakeholder engagement to determine the valued environmental components (VECs); and thus the valued ecosystem services (VES) that should drive the resilience restoration goals for each reach of the Rio Dóce River. HEA is a well accepted spatially and temporarily 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 guide the output, scale, 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 Dóce basin.

TU381
Using risk and recovery information in environmental 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 effect of major events on site scale, with environmental impacts, and whether the site will sustain the provision of ecosystem services; a resilient ecosystem 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 following major events. 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 cost-effective strategies that will 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, size, design, and make, and is equipped with non-standardised spill containment systems. The sites are distributed throughout the Spanish mainland and in the Baleares and Canaries 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. The Monte Carlo simulation was used to manage the potential range of scenarios that could be associated with particular assumptions in the model. Oracle’s Crystal Ball add-on to Excel was used to assign probability distributions to such uncertain model inputs. Probabilistic inputs were considered as random variables within the input ranges and a Monte Carlo simulation was used in the model. The simulation 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 preventive maintenance to those sites which could give rise to the highest financial and reputational liabilities.
There is a global call for sustainable 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. We found that in both cases the quality of the stakeholder focus was too much on the acceptance of the outcomes rather than the process itself and, as such, are not sufficient for assessing the quality of a stakeholder engagement. We will present proposals for extended criteria that address the limitations and highlight the principles for a more democratic stakeholder involvement. Rowe, G., & Frewer, L. J. (2000). Public participation methods: A framework for evaluation. Science Technology & Human Values, 25(1), 3-29.

TU385 Assessment and Management of Radiation Risks following a Nuclear Accident: The Shamisen Project Recommendations

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The Fukushima Daiichi accident in 2011 represents a poignant reminder of the complex interplay between environment, society and economics. Contamination of both terrestrial and marine ecosystems had wide reaching impacts for the affected populations. While the strict control of foodstuffs ensured that the radiological impacts on human health were minimal, the economic and societal consequences have been enormous. The loss of livelihood from bans on fishing and farming have hit farming and fishing communities, exacerbating the already existing concern for recruitment of younger generations to family businesses. The return of evacuees to depopulated areas has been attempted 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 festivities. The economic consequences from food bans go beyond the loss 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 decisions made by experts rather than for support of affected populations. This paper presents the main conclusions and recommendations of the SHAMISEN project. The 28 recommendations promote a management strategy that targets the overall well-being of populations, that addresses not only radiation effects, but also aims to alleviate psychosocial impacts and strengthen stakeholder engagement. In 'n

TU386 SETAC Ecosystem Services Interest Group

S.E. Aptiz, 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

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This study measures the indoor particulate matter (PM<sub>10</sub>) concentration and the equilibrium equivalent radon (EECR<sub>n</sub>) concentration in two university buildings with different ventilation systems. A low volume sampler using Teflon filter paper was used to collect the PM<sub>10</sub> samples and indoubtedly 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 indoor stations. The results showed PM<sub>10</sub> concentrations recorded in Building 1 and Building 2 ranged between 19.1 to 237 µg m<sup>-3</sup> and 23.4 to 159 µg m<sup>-3</sup>, respectively. In Building 1 and 2, the annual average inhalation doses were 2.7% and 3.17 ± 1.74 Bq m<sup>-3</sup>, respectively. The average annual inhalation doses recorded at Building 1 and 2 were 0.014 ± 0.005 mSv y<sup>-1</sup> and 0.020 ± 0.013 mSv y<sup>-1</sup>, 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 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

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The global public health impact from household fine particulate matter (PM<sub>2.5</sub>) is extremely large however, there is a limited understanding of health effects associations with specific PM<sub>2.5</sub> 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 Epidemiology (PURE)-AIR pilot study were selected to identify differences in chemical and biological measurements of household PM<sub>2.5</sub>. In 6 households, personal air monitors collecting PM<sub>2.5</sub> were worn by female participants and paired with stationary monitors, resulting in personal (n=6) and home (n=6) PM<sub>2.5</sub> filters for each household. PM<sub>2.5</sub> was removed from filters via sonication in methanol. Aliquots of individual filter samples were removed for oxidative potential assessment. Remaining PM<sub>2.5</sub> samples of the same collection method were then pooled (n=6/group) and the soluble fraction of PM<sub>2.5</sub> was extracted for determination of heavy metals. The chemical analysis was then performed with the annual inhalation dose of the occupants at the indoor stations. The results showed PM<sub>10</sub> concentrations recorded in Building 1 and Building 2 was 2.7% and 3.17 ± 1.74 Bq m<sup>-3</sup>, respectively. The average annual inhalation doses recorded at Building 1 and 2 were 0.014 ± 0.005 mSv y<sup>-1</sup> and 0.020 ± 0.013 mSv y<sup>-1</sup>, 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 radon concentration were still below the standard recommended by ICRP.

TU389 Toxicity of Airborne particulate matter as a factor to choose the most convenient school

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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 educational infrastructures are the driving factors determining school’s choice. However it is used to assume that environmental air inside schools is safe enough. The global public health impact from household fine particulate matter (PM<sub>2.5</sub>) is extremely large however, there is a limited understanding of health effects associations with specific PM<sub>2.5</sub> 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 Epidemiology (PURE)-AIR pilot study were selected to identify differences in chemical and biological measurements of household PM<sub>2.5</sub>. In 6 households, personal air monitors collecting PM<sub>2.5</sub> were worn by female participants and paired with stationary monitors, resulting in personal (n=6) and home (n=6) PM<sub>2.5</sub> filters for each household. PM<sub>2.5</sub> was removed from filters via sonication in methanol. Aliquots of individual filter samples were removed for oxidative potential assessment. Remaining PM<sub>2.5</sub> samples of the same collection method were then pooled (n=6/group) and the soluble fraction of PM<sub>2.5</sub> was extracted for determination of heavy metals. The chemical analysis was then performed with the annual inhalation dose of the occupants at the indoor stations. The results showed PM<sub>10</sub> concentrations recorded in Building 1 and Building 2 was 2.7% and 3.17 ± 1.74 Bq m<sup>-3</sup>, respectively. The average annual inhalation doses recorded at Building 1 and 2 were 0.014 ± 0.005 mSv y<sup>-1</sup> and 0.020 ± 0.013 mSv y<sup>-1</sup>, 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 radon concentration were still below the standard recommended by ICRP.
Among the different air pollutants found in schools, PM$_{2.5}$ (airborne particulate matter smaller than 2.5 µm; also referred to 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 conducted the present study. On it, we collected two fractions of fine PM (PM$_{2.5-10}$ and PM$_{10}$) in indoor classrooms of selected schools located under the influence of three different environments: urban, petrochemical, and chemical. Subsequently, we exposed human alveolar epithelial cells (A549) to IC$_{50}$ 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 among the two PM sizes or three sampling sites. However, differences appeared 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 Admissions
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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 calculated for alcohol addiction and other mental illnesses after exposure to extremely high temperatures (99th percentile) and the 50th percentile of the daily mean temperature as a 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°C 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
J. Li, Jinan University; J. Zhou, C. Wu, L. Bao, L. Shi, E.Y. Zeng, Jinan University / School of Environment

Abstract 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 same e-waste were calculated with the upper bound of 8.14 – 10$^{10}$ g $^{1}$ thermal treatment and open burning, respectively. Airborne particles (87%) were the main carriers of PBDEs, followed by residual ash (13%) and gaseous contaminants (0.3%), in thermal treatment, while they were 30%, 43% and 27.2% in open burning. The input-output mass ratios of $\sum$PBDE were 0.21-10 in thermal treatment and 0.01–0.36 in open burning. All PBDEs were largely affiliated with fine particles, with geometric mean diameters at 0.61–0.83 µm in thermal degradation and 0.57–1.16 µm in open burning from plastic casings, compared to 0.44-0.56 and RL-0.55 µm from printed circuit boards. The main emission mechanisms for lightly and heavily brominated BDEs were suggested to be evaporation and mechanical formation, respectively. The difference between the size distributions of particulate PBDEs in emission sources and adjacent air implicate a noteworthy redisposition process during atmospheric dispersal.

TU392
How risky is the schoolyard? An approach from chemical composition of particulate matter
F. Kacik, S. Sawicka, Universitat Rovira i Virgili / Chemical Engineering; J. Roviira, Universitat Rovira i Virgili; J. Sierra, Faculty of Pharmacy University of Barcelona / Faculty of Pharmacy, Soil Science Unit; M. Schuhmacher, Rovira i Virgili University / Department d Enginyeria Quimica

ABSTRACT
According to last estimations, there are globally around 6.5 million deaths due to exposure to air pollutants. Among them, Particulate Matter (PM) is considered as the most harmful one. This material consists of 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). These three fractions of PM were collected in the schoolyard (high volume samplers Thermo-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 others. 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 school 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: increasing sleeping time decreases exposure to airborne particulate matter
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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 (RR) for increases in emergency room (ER) visits were calculated for alcohol addiction and other mental illnesses after exposure to extremely high temperatures (99th percentile) and the 50th percentile of the daily mean temperature as a 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°C 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.

TU394
Occupational Cement Dust Exposure: effect on blood level of some antioxidant enzymes and vitamins in Owerri, Nigeria.
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Abstract Despite that Cement dust with particulate matters are hazardous to humans, yet Occupational cement dust exposure continues among Cement workers. In this study, we assessed the effect of exposure of cement dust on blood levels of some antioxidants enzymes and vitamins in Owerri, Nigeria. By random sampling method, 35 Cement workers, 35 Cement Dealers and 35 controls were selected for this study. Blood antioxidant enzyme such as glutathione peroxidase, superoxide dismutase (SOD) and catalase (CAT) were determined using ELISA kits. The results showed no differences in cytokines release among the two PM sizes or three sampling sites. However, differences appeared 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.
There were significant decreases in blood levels of vitamin C, vitamin E, glutathione peroxidase and catalase (P<0.002, P<0.004, 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=0.0108), vitamin E (P=0.0303) and catalase (P=0.013) respectively, but there was a positive significant correlation of catalase with SOD (r=0.47). 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. Balleri, Università degli Studi di Milano / Department of Environmental Science and Technology; L. Ballerini, 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. But for a main source of ammonia emissions, the agro-zootechnical compartment plays a key role in the secondary PM formation. Indeed, secondary inorganic aerosol from NH3 accounts for 40% of PM10 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 compost, manure drying, biogas exploitation. The Intensive Rearing of Poultry and Pigs. 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 environmental footprint. Further integrated analysis of all interactions and 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 NH3-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. Bar, 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 hydrophobic organic contaminants 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 have shown 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 tests, the PAHs bioaccessibility into 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. Kukucka, P. Pribylova, P. Prokes, Masaryk University / RECETOX; G. Lammel, Max Planck Institute for Chemistry / Multiphase Chemistry Department Air pollution remains to be one of the most important environmental issues in society 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 city (industries, transportation, coal-based domestic heating) and a regional background. Samples were collected in summer and winter. To assess the most specific contribution of the particles pollutants and the outdoor air pollution exposure to particle-bound PAHs was reduced by more than 90% if the size-dependent PAHs bioaccessibility and deposition efficiency were involved into the assessment.

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 / Department of Environmental Science and Technology. 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 epidemiological 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, NO2 and NOx) 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. Baderma, 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. Depig, Cidere / Nanomedicine; M. Lodì, 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 protection, with a particular emphasis on air pollution reduction. 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 EU28. In 2013 outdoor air pollution was classified as carcinogenic to humans (Group 1) by the European 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 transport and traffic contribute 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/IT000492) project aims to create a safer alternative to the present systems (steel brake pads), replacing the frictional bond with a new cementitious hydraulically binding binder. The study here presented evaluated the toxic 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-tumorigenic bronchial epithelium 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 aerosols particles A. Kramer, Oregon State University / Environmental and Molecular Toxicology; S.L. Massey Simonich, 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) haven in some cases, been demonstrated to be more toxic than their parent PAHs, and are recognized as increasingly important, in particular with respect to health effects of exposed populations. 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-select 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, as well 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 coefficient of the air pollutants. The concentration of PM2.5 in 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 particle F. Nagashima, Kyushu University; K. Nansai, National Institute for Environmental Studies; S. Chatani, National Institute of Environmental Studies; S. Kagawa, Kyushu University

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Source contributions to PM10 levels in a coastal area in northern France: a one year study

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The Hauts-de-France Region is one of the most concerned areas in France by exceedances of the PM10 daily mean limit value (50 µg.m⁻³). For a better understanding of these phenomena, the identification as exhaustive as possible of the main contributors to secondary PM10 emissions in this area was estimated. 185 daily levels were 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 resulting from the marine compartment. It includes natural emissions such as sea salts [1] and anthropogenic emissions linked to the marine traffic especially in the English Channel, that forms a narrow corridor with one of the greatest concentrations of shipping in the world (up to 800 vessels sailing per day). PM10 sampling and measurement campaign were performed continuously during one year in 2013 at Cape Gris-Nez, a coastal French site located in front of the Straits of Dover. PM10 levels were measured using MPI101 analyzer (Environment SA®) and collected using the DAB8 sampler (Digitel®, 30 m³/hr) on a daily basis. The characterization of PM10 was performed considering major and trace elements, water-soluble ions, EC/OC as well as tracers of biomass burning (levogluhane) as primary biogenic emissions (arabitol, mannitol) and marine biogenic emissions (methanesulfonate ions). These chemical parameters were used to explain PM10 levels on the coastal site, identify PM10 sources and estimate their contributions. Sources profiles were identified from the use of a Constrained Weighted non NMF) model: fresh sea salts, aged sea salts versus fresh sea salts are mainly evidenced during the summer season. For the year 2013, the mean contribution of the different sources were 37% for sea salts and aged sea-salts, 43% for the secondary inorganic aerosols, 7% for biomass combustion, 5% for marine traffic. This distribution varies highly depending on the period and more particularly during exceedances of daily PM10 limits values.

Source-to-exposure assessment of industrial pollutants in Australia, using the Pangea multi-scale framework

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Effective planning of airshed pollution mitigation is often constrained by a lack of integrative analysis ability to relate the relevant emitters to the receptor populations at risk. Both emitter and receptor perspectives are therefore needed to consistently inform emission and exposure reduction measures. This presentation aims to extend the Pangea spatial multi-scale multimedia framework to evaluate source-to-receptor relationships of industrial sources of organic pollutants in Australia. Pangea solves a large compartmental system in parallel by block to determine arrays of masses at steady-state for 100,000+ compartments and 4,000+ materials over a time period covering exposure routes and receptor scenarios, and further computes population exposure by inhalation and ingestion. From an emitter perspective, the spatial distribution of population source impacts show high spatial variations in intake fractions from 0.68 to 33 ppm for benzene, and from 0.006 to 9.5 ppm for formaldehyde, contrasting urban, rural, desert, and sea emission source locations. Extending analyses to the receptor perspective, population exposures from the combined emissions of 4,101 point source contributions were estimated for benzene and formaldehyde over 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-suited to inform product oriented approaches such as LCA, and from a receptor perspective for health risk mitigation. <br clear="all"/>
Microplastic Indoor Air Pollution Using a Simulated Breathing Mannequin - µFT-IR Imaging Quantification of indoor air pollution has been performed. A mannequin designed to imitate the human respiratory system is used to collect samples. This method allows for the determination of particle size and concentration. The mannequin takes in air through the mouth, which is led through a copper pipe, cut 20 mm SterliTech silver membrane filter appropriate for µFT-IR imaging system equipped with a 128x128 Mercury Cadmium Telluride (MCT) Focal Plane Array (FPA) is used. Samples are directly scanned on the double-bowl metal shielding, there is no standardized design applied in all studies in terms of bowl size, shape, deployment configuration. Many different µFT-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 spatial/temporal trend analysis. Yet, no information is available on the comparability of data from all the different designs. We brought together 12 types of µFT-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 µFT-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 deployed 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 - µFT-IR Imaging Quantification

TU411

Determination of Cross Component Concentration Gradients of Polyyclic Aromatic Hydrocarbons using PE Passive Samplers

Several polyaromatic hydrocarbons (PAHs) are considered as human carcinogens or toxic to reproduction, and are thus a relevant class of ‘substances of very high concern’ according to the European Chemicals Legislation REACH. Emission of PAHs is mainly caused anthropogenically by the incomplete combustion of fossil fuels. Due to the hydrophobic behaviour of these compounds a significant accumulation within soils has been observed. Recently decreasing atmospheric concentrations could trigger a change of equilibrium conditions between soil and atmosphere. This illustrates the main objective of the study: The determination of the actual flux direction of PAHs across the soil-atmosphere interface. Polyethylene (PE) passive samplers have been used to detect sensors concentration gradients of the 16 EPA PAHs at this interface as well as the respective flux direction. Atmospheric monitoring has been conducted seasonally for two subsequent years using 80 µm thick PE sheets at three rural sites. During the second year an additional height has been implemented as well as active sampling. Soil samples were taken at each location at several intervals up to 50 cm depth and equivalent samples were collected in situ with 30 µm thick PE sheets. A numerical approach, based on the double film diffusion model, was applied to the experimental data in order to deduce the atmospheric concentration over time. Seasonal deployments illustrate significant variations with 10 fold higher PAH concentrations in the atmosphere during winter compared to summer monitoring. Concentrations within the soil depicted homogenous profiles, considering these representative PAH concentrations in the soil during winter compared to summer monitoring. Concentrations within the soil depicted homogenous profiles, considering these representative PAH concentrations in the soil during winter compared to summer monitoring.
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 Clár’s resonance structures were able to best predict the last volatile rings of the PAHs, but did not offer insights in terms of which carbon is most reactive. All other computational approaches provide 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 unstudied PAH-TPs that are likely to form in the atmosphere. Furthermore, the results suggest the environmental chemists to prioritize which PAH-TPs might be formed in the environment; the organic 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
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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, qualitative information is limited about PAHs in air, and normally rely on the availability of active sampling techniques, usually expensive and laborious, needing powerful source, inexistate in remote areas. Conversely, passive sampling allows cheap and easy 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 XAD-2 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 (GC/MS) prepared as described by Wania et al. (2003). The samples were cut into segments to measure the concentration of TBARS in horse hair as an indicator of oil industry pollution. The horse hair samples from mane and tail were collected in two areas. One near Slavonski Brod, where an issue of air pollution is present due to the outdated refinery plant in Bosanski Brod, and the 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 in the horse 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 source of information for monitoring air pollution by oil industry.

TU417 Mortality for environment-related diseases in La Spezia, northwest Italy: an epidemiological analysis on hospital discharge rates.
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Background. La Spezia Province, northwest Italy, is a potentially high risk area because of the passive 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
Risks of conazole fungicides should be performed. The objective of the present work was to assess the ecological hepatoxicity, carcinogenicity, reproductive toxicity and endocrine disruption. Their reported ecotoxicity in water, chronic toxicity to mammals with safety. Application of pesticides, including conazole fungicides (CFs), is an indispensable part of modern agricultural management, contributing to food security and ecosystem services and health. Hence, risk assessment considering targets taxonomic 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 data indicated that only 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 (25% and 40%, respectively). The most frequently CFs were epoxiconazole (48% of soils) and tebuconazole (36%), followed by flusilazole (23%), prochloraz (21%), propiconazole (13%), cyproconazole (8%) and difenoconazole (7%). Overall, the CF 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/epu-pesticide database. [2] M. Hvezdova, et al., Sci. Total. Environ., vol. 613–614, pp. 361–370, 2018.

TU418 Risk Assessment of Polyethylene Residues and Organoleptic Attributes of Bambara nut puddling (Okpa) Samples prepared using Alternative Cooking Materials
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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 (Okpa) a well-prepared 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 (Okpa) 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-Peak 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, Propene-1-ol, difluoromine, Hexanoic acid, Amoy nitrite, Tolune, Butenenitrite, 2-Butenal, Thiarrane, Nonaconic acid, Ethylenediamine, Furfural, Hydrogen azide, 2-pentene, Formic acid, and ocetic acid; with Acetic acid occurring the most and Argon, Allene, and Difluoromine occurring the least. Pudding made with cellophane had the highest VOCs with 45% D-mannohexitolose, 45% hexanoic acid, 25% propane-1- ethenylthio and had other VOCs ranging from 4-9%. All the cooking materials had hexanolic acid at concentrations of 25-42%. The result also showed that butenic acid and 2-butylene range from 4-7% in all samples except Banana leaves puddling. Organoleptic evaluation of the Bambara pudding 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. Mulhearn, Ensai 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
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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 of azole-based fungicides, commonly used to prevent fungal growth on turf grass and agricultural crops. CFs are still widely used despite their non-target ecotoxicity in water, chronic toxicities to man-made materials with hepatotoxicity, carcinogenicity, reproductive toxicity and endocrine disruption. For example, in the EU classification, epoxiconazole and fluazifop are suspected carcinogens [1]. Presence 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 vertebrate and invertebrate species, and plant species, should be performed. The objective of the present work was to investigate the ecological risks of conazole fungicides based on the data from the comprehensive survey of

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were detected in passive samplers but were not detected in water samples suggesting the importance of combined 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 were assessed by analyzing for CMIT/MIT exposure was carried out to investigate any potential associations between CMIT/MIT and death. 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 deaths of Korean victims who were exposed to the disinfestant, chloromethylisothiazolinone/methylisothiazolinone (CMIT/MIT), extensively used in agricultural production to prevent pests, diseases, weeds or other plant pathogens to reduce yield losses and to protect crops. The cells were cultured in a minimal medium supplemented with 10% fetal bovine serum (v/v), penicillin (100 U/ml), streptomycin (100 mg/ml), amphotericin B (2.5 mg/ml) in a humid environment with 5% CO2 (v/v), at 37°C. For the cytotoxicity assays, the cells were seeded in 96-well plates, for enzymatic determinations and protein deposition in Petri dishes (7.5×104 cells) and for genotoxicity parameters in 96-well plates. The results were shown in 29.88 (25.9×104-34.37 μg/ml 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 tripolar and micronuclear divisions at 17.5 and 25 μg/ml and bridges 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.

TU424
Intra-tracheal administration of the disinfestant, 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

Conclusion: This 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 (NRGC-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.

TU425

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 cells were cultured in a minimal medium supplemented with 10% fetal bovine serum (v/v), penicillin (100 U/ml), streptomycin (100 mg/ml), amphotericin B (2.5 mg/ml) in a humid environment with 5% CO2 (v/v), at 37°C. For the cytotoxicity assays, the cells were seeded in 96-well plates, for enzymatic determinations and protein deposition in Petri dishes (7.5×104 cells) and for genotoxicity parameters in 96-well plates. The results were shown in 29.88 (25.9×104-34.37 μg/ml 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 tripolar and micronuclear divisions at 17.5 and 25 μg/ml and bridges 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 E. The cells were cultured in a minimal medium supplemented with 10% fetal bovine serum (v/v), penicillin (100 U/ml), streptomycin (100 mg/ml), amphotericin B (2.5 mg/ml) in a humid environment with 5% CO2 (v/v), at 37°C. For the cytotoxicity assays, the cells were seeded in 96-well plates, for enzymatic determinations and protein deposition in Petri dishes (7.5×104 cells) and for genotoxicity parameters in 96-well plates. The results were shown in 29.88 (25.9×104-34.37 μg/ml 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 tripolar and micronuclear divisions at 17.5 and 25 μg/ml and bridges 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.

TU427
Potential Salinity Enhanced Impacts of the Phototoxicity of the Fungicides to Inland Silverswords, Menidia beryllina

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**E.N. Velebiysky, Louisiana State University / Department of Environmental Sciences; W. Xu, Louisiana State University AgCenter / Renewable Natural Resources; K. Armbrust, Louisiana State University / Environmental Sciences School of the Coast and Environment**

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 been reported to half-live in seawater and freshwater. While the rate of degradation and half-life of dichloran is strongly impacted by the seawater (5.7 hours), the distribution of intermediate products is altered significantly; 2-chloro-1,4-benzoquinone forms nearly double the concentration in seawater as opposed to freshwater. Chlorothalonil quickly degrades to 4-hydroxychlorothalonil via soil degradation and hydroxychlorothalonil can desorb back into the water column where it can be photodegraded further. 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 0.10 mg/L, with >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.

**TU428**

**From mother to offspring: multifunctional effects of carbendazim at individual and subcellular levels in *Daphnia magna***

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Anthropogenic activities such as the use of pesticides may have indirect disasterous consequences on aquatic ecosystems, with little work done on carbendazim, which has a high potential to end up in aquatic ecosystems mainly through runoff. The deleterious effects observed at the population level can often be depicted or explained by changes in homeostasis at cellular and individual levels. In the present study, an isoclonal population of *Daphnia magna* (clone k6) was exposed to an environmentally relevant concentration (5 µg/L) of carbendazim during the first generation. The effects of carbendazim on survival/mortality, reproduction, parental length, DNA damage (determined by comet assay), biochemical biomarkers (cholinesterase, catalase and glutathione S-transferase), lipid peroxidation and energy-related parameters (carbohydrates, lipids and proteins jointly with energy available and energy consumption) were assessed in some generations. The long-term exposure to carbendazim presented no effect on the intrinsic rate of natural increase (r) and length of adult *D. magna*. However, daphnids longevity decreased at F12 generation and an increase in DNA damage from generation F3 to F13 was found when compared to daphnids in clean medium. Cholinesterases and glutathione S-transferase activities and lipid peroxidation showed differences between non-exposed and exposed populations to carbendazim. However, for catalase and energy-related parameters (except lipids) no differences were observed between these two *Daphnia* populations. Overall, at the tested concentration, carbendazim induced low effects under a long-term exposure to a daphnid population.

**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 such 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 while sorption was consistently overestimated for anionic cationic 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 isoniazid 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/EFPPI Innovative Medicines Initiative Joint Undertaking (iPIE grant no. 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. Minero, University of Torino / Chemistry**

Sunlight illumination of surface waters induces several photochemical reactions that play a role in the transformation of organic compounds and of xenobiotics, in the inactivation of pathogens and in biogeochemical cycles. These processes involve both the direct photolysis of the target molecules (directly triggered by absorption of sunlight, if any), and their indirect or sensitised transformation. In the latter case, sunlight is absorbed by naturally-occurring photosensitisers (e.g. chromophoric dissolved organic matter or CDOM, nitrate and nitrite that produce several transient species during specific photolysis and photochemistry of freshwaters, but its effects could be very different in boreal vs. temperate environments. In the former case the main effects would involve water clarity (browning), while in the latter case a role of photoinorganic compounds and of xenobiotics. In the present study, an isoclonal population of *Daphnia magna* (clone k6) was exposed to an environmentally relevant concentration (5 µg/L) of carbendazim during the first generation. The effects of carbendazim on survival/mortality, reproduction, parental length, DNA damage (determined by comet assay), biochemical biomarkers (cholinesterase, catalase and glutathione S-transferase), lipid peroxidation and energy-related parameters (carbohydrates, lipids and proteins jointly with energy available and energy consumption) were assessed in some generations. The long-term exposure to carbendazim presented no effect on the intrinsic rate of natural increase (r) and length of adult *D. magna*. However, daphnids longevity decreased at F12 generation and an increase in DNA damage from generation F3 to F13 was found when compared to daphnids in clean medium. Cholinesterases and glutathione S-transferase activities and lipid peroxidation showed differences between non-exposed and exposed populations to carbendazim. However, for catalase and energy-related parameters (except lipids) no differences were observed between these two *Daphnia* populations. Overall, at the tested concentration, carbendazim induced low effects under a long-term exposure to a daphnid population.

**WE003**

**How Pharmaceutical Industrial waste can make your medicines ineffective**

**N. Verma, Baddi University of Emerging Sciences & Technology / Pharmacy**

Spread over 380 square kilometers in Himachal Pradesh’s Solan district, the Baddi-Barotiwala-Naglaraj (BBN) 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 has concerned 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 or flows through nallahs, canals and rivulets into the Sirsa 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 remains prone to antibiotic 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 manufacturers to install and implement state-of-the-art sewage treatment and disposal technologies. Manufacturers with high-end WWTPs should also be strictly monitored. The SPCBs should conduct surveillance of APIs or antibiotic residues in the treated effluents and make data publicly available.

**WE004**

The environmental concentration and evaluation of active ingredients in pharmaceuticals in rivers flowing through urban area in Japan

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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 index risk 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 (48 ng/L), ibandronate (44 ng/L), bendrofluazide (12 ng/L), losartan (17 ng/L) for antihypertensive agent, and sulpiride (546 ng/L) for antipsychotic agent, clarithromycin (445 ng/L) for antibiotic agent, 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 concentration of sucrose measured at the same time. The pharmaceuticals whose maximum detect concentrations of active ingredients in each river water exceeded the predictive environmental concentrations (PEC) were five ingredients of canadesantr, olmesartan, lorazepam, rosuvastatin and epinastine, even when the dilution ratio was doubled. This result suggests that in some circumstances it is necessary to consider the concentration dilution factor 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 cloriblithic acid.

**WE005**

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 offer a cheaper treatment of water as it deploys the concentration of sucrose measured at the same time. The pharmaceuticals whose maximum detect concentrations of active ingredients in each river water exceeded the predictive environmental concentrations (PEC) were five ingredients of canadesantr, olmesartan, lorazepam, rosuvastatin and epinastine, even when the dilution ratio was doubled. This result suggests that in some circumstances it is necessary to consider the concentration dilution factor 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 cloriblithic acid.

**WE006**

The role of the water-sediment simulation test and its outcome in the environmental risk assessment (ERA) of pharmaceuticals

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In view of the revision of the ‘Guideline on the environmental risk assessment of medicinal products for human use’ (EMEA/CHMP/SWP/447/00, June 2006, rev. 2) current fate assessment is highly discussed concerning the water-sediment simulation test in tier A of the guideline. At the moment, only the partitioning into sediment triggers further assessment in the next tier of the guideline. Derived half lives were not used in refined predicted exposure concentration (PEC) calculations and transformation products (TP) were not specifically considered in the ERA. Now, UBA evaluates the data received in the last 10 years in order to determine the gaps and the benefit of the current fate assessment for the overall risk assessment e. g. classification of persistence. Especially the role of TP in the environment due to their frequent higher mobility compared to the parent compound is considered in the presented research. As a first step an overview is prepared on the overall performance of pharmaceuticals in the aquatic environment. It is clearly demonstrated that total system half-lives already show a high persistence of pharmaceuticals in the aquatic environment. Furthermore it should be considered that especially for the sediment compartment often no kinetic model fits well enough to predict DT50 values. The risk of ground water contamination by bank filtration will be estimated by the new phase-chemical model. It is estimated that the identification of relevant TP is still often missing in provided studies. The water sediment simulation study is the only experimental study in the ERA which gives information about the possible behaviour and occurrence of parent compounds and TP in surface waters. Such results are relevant for monitoring and for the understanding which compartments are affected by pharmaceuticals. Instead of waiving OECD 308, the results should be better included in the ERA and communicated.
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 empirical 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


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 toxicity 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-inspired approach to predict the toxic effects of NSAIDs in the aquatic environment. In addition, we will assess the pharmacodynamic aspects of NSAIDs toxicity. 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 of the NSAIDs as dose-response curves. The data was used to predict plasma concentrations of NSAIDs in wild fish. The overlay of the two approaches led to a visual model that enables 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 to assess the toxic 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 ecopharmacovigilance 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. Oehlmann, Johann Wolfgang Goethe-Universität Frankfurt / Aquatic Ecotoxicology

Lethal and sublethal effects of a long-term exposure of Chironomus riparius (L.) used as a model species to perform 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 exposed group compared to the control. However, CI of the LC50 still overlapped (0.506 to 0.882 mg/L for the control and 0.729 to 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 to 1.02 mg/L for the control and 1.08 to 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 control was measured 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 carazapemazine after long-term low-level exposure. Chronic toxicity tests to study the sensitivity 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 code: 02WRM1367A).

Effects of duloxetine and econazole on freshwater species towards individual and combined conditions

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Thousand of biologically active pharmaceuticals ingredients (APIs) are used in human and veterinary medicine over the world. Nowadays, removal 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 1.1 mg L⁻¹. Level an type of drugs interactions were determined using the Combination Index-isobologram method. The enantiomer concentration of the target compounds in the culture media were measured and the correlation 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 profiles of APIs are commonly observed for the receptors of SERT and NET (NSAIDs) in the aquatic environment. We propose that this antiinfective approach could be extended to the evaluation of emerging pollutants. Although the presence of low concentrations of non-steroidal anti-inflammatory drugs (NSAIDs) in the aquatic environment has raised the concern of 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.

WE010 Application of newly developed in vitro assay to detect physiological activities of antidepressants in wastewater

M. Ibarra, M.O. Ibarra, D. Kato, H. ZHANG, Kyoto University

Over recent years, growing numbers of human pharmaceuticals have been detected in wastewater effluents of wastewater treatment plants (WWTPs). One of the major concerns is to determine the target risks to aquatic species has been raised because they are designed to be biologically active. One of most concerned pharmaceuticals are antidepressants. For example, selective serotonin reuptake inhibitors (SSRIs) such as fluoxetine and sertraline could alter the behaviour of fish in vivo testing. Antidepressants such as SSRIs, serotonin-norepinephrine reuptake inhibitors (SNRIs), and dopamine reuptake inhibitors (DRIs), and tricyclic antidepressants (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 are present in aquatic systems after the discharge and before they reach the marine organisms, we must know the extent to which such compounds 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 measured 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, SNRIs, 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

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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 quantification of these effects is key to improve current understanding of the ecological risks of pharmaceuticals to non-target organisms 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 objective 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 scores 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. Ungaretti, 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 implausible 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 target, read-across method 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 propranolol, 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 benzoylecgonine exposure at different levels of the biological hierarchy on Daphnia magna**

M. Parolini, University of Ontario Institute of Technology / Science and Environment Policy; B. De Felice, Università degli Studi di Milano; C. Ferrario, University of Milan Bicocca; N. Salgueiro, University of Toronto / Science and Environment Policy; C. Ferrario, University of Milan Bicocca.

A number of monitoring studies have shown that benzoylecgonine (BE), a metabolite of cocaine, is the main illicit drug residue measured in both wastewater and surface waters worldwide. Although the aquatic concentration of BE can be considered still low, the exposure to this molecule may cause diverse adverse effects. Few 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 its metabolite guanylurea on F1 progeny 28 days post hatch. The last decades, the number of patients suffering from diabetes type 2 is increasing. Consequently, a rising consumption of antidepressants 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, 1, 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, 100, 1000 µL) 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 Wassernetzwerk Baden-Württemberg. By a multi-approach, we identified the toxicity of MF and GU in aquatic organisms worldwide. 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 scores 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 antidepressant drug metformin and its transformation product guanylurea on brown trout (Salmo trutta f. fario)**

S. Jacob, Universität Tübingen / Animal Physiological Ecology; L. Kundy, M. Biecker, University of Tuebingen; R. Trischkorn, University of Tuebingen / Animal Physiological Ecology

The last decades, the number of patients suffering from diabetes type 2 is increasing. Consequently, a rising consumption of antidepressants 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, 1, 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, 100, 1000 µL) 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 Wassernetzwerk Baden-Württemberg. By a multi-approach, we identified the toxicity of MF and GU in aquatic organisms worldwide. 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 scores 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.

**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. Pandelides, 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 and Environment Policy; D.A. Holdway, University of Ontario Inst. of Tech / Science and Environment Policy; D.A. Holdway, University of Ontario Inst. of Tech / Science and Environment Policy

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 conducted 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. Pandelides, 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 and Environment Policy; D.A. Holdway, University of Ontario Inst. of Tech / Science and Environment Policy

One of the most common 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
guanylurea 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 guanylurea (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 females when compared to control fish, with guanylurea appearing to be roughly 1,000 times more potent than its metformin-like analog. Furthermore, these studies show significant changes in the metabolism of 28 day old male medaka exposed to both metformin and guanylurea, 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 Guanylurea

J. Straub, F.Hoffmann-La Roche Ltd / Roche Group Safety, Health & Environmental Protection; D.J. Caldwell, Johnson & Johnson / Environment Health Safety; V. D'Aco, Quantum Management Group, Inc.; T. Davidson, Bristol-Myers Squibb; H. Kram, Novartis; K. Nicolaou, AstraZeneca / Safety Health Environment; B. Simon-Hettich, Merck KGaA; J.G. Tell, 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 water. Guanylurea (GUU), a transformation product of MET in WWTP, and both MET and GUU are further degraded in the environment. A comprehensive aquatic life risk assessment of MET and GUU in surface water is presented that is based on literature data, previously unpublished data from industry studies conducted to support new drug registration applications as well as new studies commissioned to fill data gaps. Predicted environmental concentrations (PECs) for MET were modelled based on documented usage for the USA with the PhATE model and for the European Union with the GREAT-ER model. These PECs were compared with measured environmental concentrations (MECs) for both the USA and EU. A predicted no effect concentration (PNEC) for MET was derived by deterministic procedures based on multiple chronic studies with algae (4), daphnids (5) and fish (5, two species). Both the PEC/PNEC and MEC/PNEC risk characterization ratios were well below 1, indicating no significant risk for MET with high Margins of Safety. However, since MET is known to be primarily degraded during wastewater treatment to GUU, relevant chronic studies for GUU were conducted to derive a PNEC. In addition, PECs were derived for GUU for the USA and EU as above for MET. Fate and removal/in-stream-loss parameters for both MET and GUU show high transformation in wastewater treatment plants. After human consumption FLX enters the c environment mainly by the kidney. After human consumption FLX enters the c environment mainly by the kidney. After human consumption FLX enters the c environment mainly by the kidney. After human consumption FLX enters the c environment mainly by the kidney. 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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 to many contaminants, including pharmaceuticals, some are not fully 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 sulfamethazine, and the antiepileptic drug carbamazepine, 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 Cytotherat, 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 environment of action. For an in vitro study, a naturally occurring cytostatic aquatic test organism was used. 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 safe 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 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 cor 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 in vitro study, a naturally occurring aquatic test organism was used. The toxicity data includes testing of three trophic levels, represented by algae, crustaceans and fish – usually following OECD-guidelines 201, 211 and 210. Both the applicant and the assessor evaluate the studies to assure adequate data quality. Over the last decade, this regulatory work resulted in a data base containing effect data on approximately 300 active pharmaceutical ingredients (APIs) – which was evaluated in our current project. The highest evaluated APIs show NOECs below 1 µg/L, which is a fate and effect concentration of about 1 µg/L, for crops in the low ng/L-range, particularly for substances with endocrine mode of action. The predominant part of substances with NOECs between 0.01 and 1 µg/L is non-endocrine, belonging to a diverse range of pharmaceutical classes. For approximately 2/3 of investigated APIs, valid effect studies on all three trophic levels were available – allowing a comparison of sensitivity. In over 60 % of cases, the effect value of most and least sensitive test organism was greater than 10, in over 20 % of cases greater than 100. Fish were the most sensitive test organism in more than half of the cases, while algae and crustaceans were the most sensitive in one quarter, each. Detailed information concerning specific pharmaceutical groups/mode of action will be given in the final poster. Our results will help to identify possibilities and limitations of the current regulatory approach, and provide information for future modifications of the regulatory framework.

WE024 Prioritisation of human pharmaceutical substances - a regulatory perspective I. Rönnfahrt, German Environment Agency - UBA / Section IV 2.2 Pharmaceuticals; C. Konradi, Federal Environment Agency (Umweltbundesamt) / Section IV 2.2 Pharmaceuticals; A. Hein, S. Schwarz, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals; K. Westphal-Settele, German Environment Agency (UBA) / Section IV 2.2 Pharmaceuticals; I. Ebert, German Environment Agency UBA / Section IV 2.2 Pharmaceuticals

Pharmaceuticals in the environment have been recognized by the European Commission as emerging issue. Possible actions to reduce their emission into the environment and the need for amendments of the legislation are currently discussed in the ‘strategic approach to pharmaceuticals in the environment’. At the German market, there are currently about 2300 active pharmaceutical substances used in human medicinal products; at least 1200 of them are compounds of potential environmental concern. For the majority of these 1200 compounds data for an environmental risk assessment (ERA) are incomplete or lacking, with the result that their potential environmental impact cannot be assessed in an appropriate manner. The reason for this is simple: So called ‘legacy products’ have been authorised before the ‘Guideline on the environmental risk assessment of medicinal products for human use’ came into effect in 2006. According to the current legislation, all pharmaceuticals have to be prioritised and assessed on the basis of an ERA. However, there are no statutory provisions in place to how to deal with legacy products. Hence, there is a vital need to prioritise active substances used in legacy products for further investigations and evaluation of their environmental impact as well as risk management activities. This is of particular importance because many of them are frequently detected in surface water and other environmental compartments. Moreover, active substances which are persistent, mobile, bioaccumulative and/or toxic can have a specific mode of action as e.g. endocrine active substances, are in general of high environmental concern. We propose a step wise prioritisation concept that allows the identification of active substances with a high potential environmental impact and/or a high potential presence in the environment. The poster outlines parameters which should be considered in a prioritisation approach, as e.g. consumption data and their trends over the years, mode of action, monitoring data, available data on fate and effects in the environment and metabolism in patients. The proposed tiered prioritization approach considers also elements of the EMA Guideline for environmental risk assessment of human pharmaceuticals. It is important to recognise that any approach needs to be fully transparent in order to be understood and should be regularly adapted to the current state of knowledge.

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. Floeter, 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 animals, need to be considered in a more detailed 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 it may 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 (perfluorinated octyl sulfonate) 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 analyses 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).
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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 vivo experiments were conducted and linoleic acid (LA) induced a lipid content increase in fish, while MeHg decreased it. To understand better these results, two in vitro experiments were carried out on trout primary cultured adipocytes to study the effects of FA and those of MeHg. Effects of FAs - 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 ω-linoleic (ALA), eicosapentaenoic, docosahexaenoic (DHA), LA, arachidonic and docosapentaenoic (DPA) acids and 2 µL/mL lipid mixtures. At day 13, for each FA, the higher the concentration, the more the lipid accumulation. At 600 mM, 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, the effect of a combination 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
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The prevalence of obesity is a major health concern of our times, affecting an 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 species of aquatic organisms. Such phenomena is an 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 ecological effects of metformin and its analogue guanylurea in developing fish, we found a significant decrease in length (~6%; 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. When male medaka were exposed to an extremely low concentration of guanylurea (1.0 ng/L), there was a similar percent decrease in length and wet-weight. 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 metabolism 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 the current concentrations of metformin and guanylurea in receiving waters are of ecotoxicological concern for resident fish populations.

WE030 Levels of proteins, carbohydrates, lipids and cholesterol in the digestive gland of juvenile catarina clam Argopecten ventricosus (Sowerby, 1842), exposed to toxic metals
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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) of 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 (Bilgh 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 in 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 soil 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 compactness 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 un-treated 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 DT_{50} 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 ascribable to the detrimental effect of the additive on the microbial abundance and activity.

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 ecotoxicological impact of soil materials the bacterium Vibrio fischeri showed 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 residues at effect concentrations in spoil material.

WO035 Biodegradability of the anionic surfactant sodium lauryl ether sulphate used as the main component in two foaming agents for tunnelling process - EPB-TBM tunnelling


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 soil 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 the foaming agent P1 (85 mg/kg SLES concentration) 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 un-treated 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 d) soil samples were collected for assessing SLES concentration by MBAS spectrophotometric method. Moreover, microbiological analyses were performed in order to assess microbial abundance (DAPI counts), cell viability (Live/Dead method), dehydrogenase activity and the phylogenetic structure of the microbial community 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 detectable in all soils. Microbial community diversity and cellular vitality were 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.

WO036 Development of new foaming agents with better environmental impact for EPB soil conditioning - The Polyfoamer ECO line


The rapid development of TBMs in the tunnelling industry has been mainly due to its advantages over conventional excavation methods, such as continuous operation, safer working conditions, reduced damage at surface level and higher 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 C6-C12; Italian Decree 120/2017) are not exceeded. However, there are currently neither SLES soil threshold limits by an European and Italian legislation (Annex 4 of the Italian Decree 120/2017), nor comprehensive studies on its ecotoxicological effects on soil and water organisms. The use of ecotoxicological tests makes it possible to overcome the limitations 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 ecotoxicological impact of soil materials the bacterium Vibrio fischeri showed 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 residues at effect concentrations in spoil material.
geological formation with alternance of limestone and marlstone) and the material called “S” (a cohesive clay). The amount of the surfactants inside the conditioned samples “S” and “M” have been measured with the instrument HPLC-MS (“High-Performance Liquid Chromatography Mass”) at different stages from the addition of the foam to the soil: at time 0, at 3 and at 7 days. Toxicity tests with the bio-luminescent bacteria Vibrio Fischeri (ISO 13148:2-2007) and the fish embryonic Daphnia magna (96 hours) have been carried out. Several environmental tests with the new foaming agents Polyfoamer ECO confirm that those formulations allow to reduce the impact on the soil and therefore to facilitate its re-use in short periods as a by-products. 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, fast 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.

WE037 Determination of anionic surfactants by Pressurized Liquid Extraction (PLE) followed by the modified Methylene Blue Active Substances (MBAS) method in spoil material from excavation processes


Recent years have been characterized by a rapid worldwide growth in underground constructions in the form of new infrastructures such as pipelines and communication cables as well as road and railway tunnels. The utilization of underground space offers a new strategy to urban planning, including a huge development of the mechanized tunnelling industry by the use of Tunnel Boring Machines (TBMs). Polyether-based surfactants have been a fundamental component of appropriate soil conditioning products, principally foaming agents. Anionic surfactants are the main constituents of commercial foaming agents widely used as lubricating products in the mechanized excavation, improving the stability of the excavation face and reducing the friction between soil cuttings. Among the 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 execution of engineering 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 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.

WE038 Distribution and persistence of anionic surfactants in leachate and conditioned soil: mesocosm study for EPB mechanized tunnelling


The development of the mechanized tunnelling industry by EPB-TBMs (Earth Pressure Balance -Tunnel Boring Machines), results in a wide use of foaming agents and polymers as lubricating products for soil conditioning. Anionic surfactants, and particularly sodium lauryl ether sulphate (SLES) are the main components of foaming commercial products. Soil debris from excavation processes can contain residual concentration of SLES. The potential re-use of the spoil material for public green areas or industrial purpose (e.g. land covering) depends on the site-specific SLES persistence in the excavated soil and on the related environmental exposure scenario. In this context, we evaluated the SLES leaching in two different soils in order to simulate check whether underground water contamination may occur in a scenario where the spoil material is located close to a water body. For this purpose, we evaluated the persistence (DT₅₀) of SLES in two soils (S1: silty-clay soil; S2: gravel in a clay-silty-sand matrix soil) conditioned separately with two common commercial foaming agents, respectively F1 and F2, used at conditioning ratio giving final concentration in both the soils of about 150 mg/kg. The presence of strengthening foaming polymers (P1 or P2, 527 and 50 mg/kg respectively), needed in some cases to increase foam persistence, was also considered. After a preliminary phase at laboratory scale, a mesocosm experiment was conducted in order to entail the scale-effect, which is very significant when the soil is involved. Sodium lauryl ether sulphates were set-up mixing 100 kg of each soil with water, foam and polymer and then stored for 28 days in high-density polyethylene bins (HDPE diameter of 30 cm and height of 100 cm). The effect of soil type, grain size or aeration on SLES persistence was evaluated. 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.

WE039 Preliminary environmental risk assessment of sodium lauryl ether sulphate contained in foaming agents used in mechanized tunnelling


The sodium lauryl ether sulphates (SLES) are a heterogeneous group of amphiphilic compounds characterized by linear aliphatic chains (ranging from C8 to C18) with a polar group (sulphate or sulfonate) neutralized with a counter ion. Given the variability of their molecular composition ANS are considered mixtures. They are utilized in several applications (i.e. detergents, cleaning products, fracking or soil conditioning in the excavation industry). Among ANS, the sodium lauryl ether sulphate (SLES) is commonly utilized as a foaming agent to facilitate the excavation procedures in mechanized tunnelling. However, its use raises concern for the environment considering the presence of SLES residues in soil debris produced during the excavation. In addition, the absence of soil threshold limit for SLES in the EU legislation does not facilitate the re-use of soil debris as by products (e.g. land covering) and, consequently, a huge amount of such detritus can be discharged as a waste with high economic costs. In absence of a threshold limit, performing an environmental risk assessment (ERa) of foaming agents containing SLES can be a possible alternative. However, the ERA is hampered by both the rather scarce data on the effects of SLES and the site specific condition of use which lead to different levels of exposure. Indeed, the selection of the type and quantity of foaming agents depends on soil, geological conditions, and characteristics of the tunnel boring machines. Furthermore, several commercial formulations are available on the market with different percentages of SLES and several other components. This study is part of a wider project aiming to develop a methodology to be applied to identify environmentally acceptable levels of SLES residues in soil debris produced during the tunnelling operations in Italy. Particularly, we report the results referring the preliminary ERA that has been used to select, among all the available commercial formulations, the one leading to the lowest level of risk for the environment in a specific condition of use. The risk has been characterized based on PEC/PNEC ratios. PECs were calculated by predictive models and considering the percentage of SLES in the commercial formulations as well as the required treatment ratios for tunnelling operations. PNECs (soil and surface water) for SLES were derived from ecotoxicological data (terrestrial and aquatic organisms) which were obtained from laboratory tests on several test organisms.
agent products are anionic surfactants such as the alkyl ether sulphates (AES). The possible re-use of huge amounts of spoil material produced during the excavation process as by-products (e.g. land covering) or its discharge as a waste depends on the residual concentration of AES in the soil. The first option has the undoubted advantage to lower the costs of disposal. However, there are concerns about the potential environmental risk related to the re-use of conditioned soil. In fact, even if anionic surfactants are generally considered biodegradable and not toxic, there is little information in literature on their environmental fate and the possible ecotoxicological effects of the commercial formulations of foaming products and of the conditioned soils. The aim of this study was to evaluate the environmental compatibility and the ecotoxicological effects of two different soils treated with two different foaming agents containing the anionic surfactant AES, applying a suitable battery of bioassays. For this purpose, a soil was used as a positive control, containing two soils with different geopedological characteristics, conditioned with two foaming agents at the same treatment ratios (TR, L/m³) used for mechanized drills. Soil samples were collected at different maturation times (0, 7, 14, 28 days) in order to perform the ecotoxicological tests on the spoil material or in its aqueous extracts. The bioassays selected are representative of different trophic levels for the aquatic and terrestrial compartments: Microtox test with the bacterium Vibrio fischeri, Fish Embryo Acute Toxicity Test (FET) with the species Danio rerio, germination and growth test with the plant Lepidium sativum and test with the worm Eisenia fetida. In parallel, sub-samples of soil and eluatate from each mesocosm were analyzed in order to determine the residual concentrations of the anionic surfactant AES. The overall results obtained showed different ecotoxicological response depending both on the kind of soil and condition and on the specific surfactant used. The test system used is able to (i) simplify the test system and (ii) to check the suitability of the test system for simplifying the test system and (iii) to check the suitability of the test system for simplifying the test system and (iv) to see the ecoaccumulation of the substances used. The results from this study suggest 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** Expeditious test for on-site monitoring activity in mechanized tunneling applications


In the vast majority of tunnel projects performed with TBM-equipped 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 industrial by-products. A necessity to use new approaches to plan systems ensuring an unavoidable minimization of the spoil disposal management in a virtuous cycle of reuse of the resources leads to relevant economical and logistical advantages. The raising awareness about the chemical composition of the products injected during the excavation resulted in the development of experimental procedures aimed at studying the environmental impact of chemicals and their permanence in the soil during the excavation and after its completion. Commonly accepted standards have been developed 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 controlled and monitored environments are predisposed, so that at present it’s not possible to measure the level of pollution through expeditious tests directly on site. A joint research activity between Sapienza University and National Research Council of Rome has developed a test procedure able to provide expeditious 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. Moreover, the test seems to be particularly suited to priority of monitoring large volumes, such 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 some additive used in mechanized tunneling: effects on daphnids, algae and cress.

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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 toxicology of these active mixtures is not yet fully known, as well as the potential effects deriving 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 analyses 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.

**WE043** Bioaccumulation, tissue distribution, and trophic magnification of organic ultraviolet absorbents in freshwater ecosystem in the Pearl River catchment, China

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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-ethylhexyl-4-trimethoxycinnamate were detected in eggs than in muscle, probably indicating maternal transfer of the compound. The calculated bioaccumulation factors (LogBA FW) were generally > 3.3, suggesting potential 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 benzoazinazole stabilizers, suggesting potential of biomagnification of the UVAs in the freshwater fish.

**WE044** Hyalella azteca as non-vertebrate alternative species for bioaccumulation studies

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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 considerably large number of vertebrate test organisms. Thus, there is a need for a relatively quick, cheap, and preferably alternative test method that enables the ranking of structurally closely related 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 fish through bioaccumulation studies with *Hyalella* are similar to those obtained from fish (Schlechtrem, 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 20000), (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

**WE045**

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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 BMF 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 permanently ionized chemicals at environmental pH (range 3 to 9). A parallel dataset was compiled with bioconcentration factors (BCFs) of the same chemicals derived in water exposure studies with fish (OECD 305-1 guideline). Bivariate correlation analysis (Pearson and Spearman) revealed that a logKOW was not a sufficient predictor of BMF, although with significant positive correlation (R=0.40), and b) that significant correlation was shown only with logD at pH=3 (R=0.35). Furthermore, significant negative correlation was shown between BMF and solubility (R < -0.60). These preliminary results indicate that commonly used predictors for bioaccumulation (e.g., logKOW) are of limited relevance for ionizable chemicals, and other predictors should be identified. Ongoing research is focusing on the prediction of BCMF from quantum-chemistry-based estimations of partitioning coefficients (e.g., permeability coefficients and lipophilicity).

**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

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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 stereoisomers were tested. The logKOW predicted by QSAR ranges from 4.75-5.41 and n=2 when determined by HPLC (OECD 117). The slow stir method (OECD 123) provides a logKOW of 5.09 which is retained as the reference value. Various structure-activity relationship models were used to predict the fish bioconcentration factor, which ranged from ~1000 to ~4500, not exceeding the EU criteria for (very) Bioaccumulative substances (vB), however, the structure was mostly outside the applicability domain of the models. Therefore in vitro assays were conducted on rainbow trout S9 fractions and hepatocytes confirming the potential of biotransformation; the refined BCF values calculated with IVIVE extrapolation models were < 1000. In addition the bioaccumulation potential of one isomer was investigated in a flow-through test on the invertebrate Hyalella azteca resulting in a BCFSs or kinetic < 500 L/kg. Finally an experimental fish BCF of ~500 (OECD 305) confirms that the fragrance composed of various isomers is not 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


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 processes in a food web. TMF can be used to differentiate between labelling and true biomass enrichment and to answer different questions in regulatory and monitoring affairs. The TMF can be used in the evaluation of the biomagnification potential of chemicals under REACH. However, TMF may be also applied in the context of the Water Framework Directive to normalize chemical monitoring data of fish to a common trophic level as well as to derive environmental quality standards for the protection goal 'secondary poisoning of predators'. To date, only a few detailed TMF studies have been performed and the investigated endpoints have shown considerable variation. The aim of this study is to define a sound concept for TMF investigations to enhance both, the reproducibility and accuracy of TMF estimates to allow the regulatory usage of this endpoint. The developed concept focuses on freshwater habitats, covers different invertebrate and fish species and will be tested in a long field study. A water body will be selected under consideration of several aspects such as the chemical burden of the water body, the type of contamination source, and species diversity in the water body. Invertebrate and fish species will be collected in the water body during spring/summer 2018. The trophic levels of the species will be determined applying different methods such as comparison of stable isotope patterns in the consumer (e.g., δ15N against δ13C in fish tissue and δ34S in fish bile) and δ13C vs. δ15N (δ15N vs. δ34S), the atomic δ13C vs. atomic δ15N. Stable isotope analysis of different amino acids.). Sample handling will follow the protocols applied by the German Environmental Specimen Bank (ESB) including cryo-milling, homogenization, sub-sampling, and long-term storage. During all processing steps samples will be kept constantly at a temperature < -150°C. The sample material obtained will be analyzes to derive TMF estimates for different compartments in a food web. To determine the TMF, data from standard tests, providing a sound justification to waive data requirements. This can be achieved either by using appropriate benchmarking-, and statistical methods will be applied. The validated concept may provide the framework for a new TMF testing scheme integrated in the German Environmental Specimen Bank (ESB).

**WE048**

Obstacles in identifying PBT/PvB-substances under REACH for high tonnage chemicals


Appropriate ecotoxicological and toxicological information provided by registrants is crucial for identifying substances with PBT/PvB properties under REACH (Regulation (EC) No 1907/2006, Registration, Evaluation, Authorisation and Restriction of Chemicals). The availability of that information in REACH registration dossier of substances manufactured or imported in quantities of 100 to 1000 tons per year (tpa) is evaluated in the current project on REACH compliance. This is a follow-up project on substances registered in quantities of 1 000 tpa or more, important for human health, the environment or the ecosystem (P), exposure and environmental fate (B), and reproduction toxicity and endocrine disruption (E). The aim of this study is to identify obstacles in identifying substances with PBT/PvB properties that are shortcomings in data quality, data gaps or inappropriate data- waiving/adaptation approaches. A minimum of 12% (for abiotic degradation) and a maximum of 61% (for ecotoxicity) of the dosiers were found to be “non-compliant”. It was recommended that registrants should thoroughly review and update their dossiers in order to fulfil the information requirements. This can be achieved either by using appropriate standard tests, providing a sound justification to waive data or using appropriate surrogate data. The poster will show preliminary results on the dossiers of substances registered in the tonnage levels of 100 to 1000 tpons per year and its...
WE049

PBT/vPvB: 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 help 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 examined what parameters are considered most relevant to characterise the concern of PBTs/vPvB. 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.T. Rogers, 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 environment, industry and consumers. 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 polynomial parameter linear free energy relationships (ppLEFRs) 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, Kau USA / R&D; T. Suzuki, Kao Corporation, S.A. / Product Safety & Regulations; I. Davies, Personal Care Products Council / Science; J. Coleman II, Kao Corporation, S.A.

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. However, industry, regulators, and we modified the wet deposition processes to account for intermittent rainfall. The approach starts with a grouping and ranking of PBT/vPvB substances (stage 1). Following to this, exposure dynamics are analysed with a multimedia stock pollution approach (stage 2). The evaluation of impacts arising from the stock can be evaluated via different routes (stage 3). To assess the cost-effectiveness and proportionality of possible (policy-) measures for PBT/vPvB control, the routes to impact evaluation are linked to assessments of costs for restricting or stopping a specific or multiple uses of a PBT/vPvB substance (stage 4), and to benchmarks, being standard values of a specific parameter to which the actual/estimated value of that parameter can be compared (stage 5). The approach offers a ready-for use framework for a concern-based evaluation of PBT/vPvB substances to be used as decision-support in REACH authorisation and restriction processes.

WE053

A consistent Approach for PBT/vPvB Assessment for Pharmaceutical Products

E. Nlen, Smithers Viscient / Department of Regulatory Affairs; K. Malekan, Smithers Viscient / Environmental Fate and Metabolism

Keywords: Persistence, bioaccumulation, Toxicity, Pharmaceuticals Track 6: Environmental policy, risk management, and science communication.

Session 6.7: PBT/vPvB Assessment: Update on regulatory guidance,

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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 assessment 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, it is not regulated for pharmaceuticals but may be different for pharmaceuticals. There are specific 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 forward. 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 non-PBT. Furthermore, the identification of PBT substances under REACH (Registration, Evaluation and Authorisation 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 not address this problem. A sufficient amount of 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 challenges 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 not address this problem. A sufficient amount of 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 challenges 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.

WE056 Interaction of sulfonamide with soil humic acid: ESR investigations with nitroxide spin label A. Rieke, E. Bondarenko, H. Steinhoff, University of Osnabrueck / Physics; G. Ür, K. Hideg, T. Kälai, University of Pecs / Organic and Medicinal Chemistry; M. Matthies, University of Osnabrueck / Institute of Environmental Research

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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 data was the aim of a research project funded by UBA. Transformation tests in soil with 13C-labeled substrate were carried out in accordance with the OECD 307 guideline. Different extraction methods and chemical breakdown procedures were performed and compared in order to characterize 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 different soils and the assessment of reversible and irreversibly 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 / Analytically, log k’ has a clearly larger applicability domain than log Kow, because sorption phases and compared their sorption properties against those of various environmental and biological materials. Retention times on commercial ion exchange chromatography columns were measured in full 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. Generally good correlations (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’. Naturally, log k’ has a clearly larger applicability domain than log Kow, because log Kow is unavailable for ionic chemicals derived from strong acids/bases (e.g., sulfonates, quaternary ammoniums), whereas log k’ can be measured for such ions too. This study offers a step forward to the development of accurate prediction models for sorption coefficients of ionic chemicals in the environment.

WE059 Simulation of the fate of co-labeled 13C3-15N-glyphosate 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. Poiselsi, Technical University of Denmark (DTU) / DTU Environment; K. Nowak, TU Berlin / Institute for Environmental Research (Biology V); M. Küster, Helmholtz centre for environmental research - UFZ / Department of Environmental Biotechnology; S. Trapp, Technical University of Denmark DTU / DTU Environment
The combination of dynamic simulation and stable isotope techniques allows tracking the assimilation of pesticides into biomass [1]. Here, we simulated the fate and distribution of 13C- and 15N-glyphosate in an Oregon wastewater degradation test [2]. The mathematical model used consisted of two compartments for sediment (slow and rapid ad-desorption), one compartment for dissolved mass, and microbial growth and metabolism. The flow of both N and C were balanced. The model considers two biodegradation pathways for glyphosate, namely the sarcosine-pathway with complete mineralization, and the incomplete pathway with Acetate as end product. Stable isotope techniques were used to estimate the soil microbial degradation rate, which was determined by labelling with 13C- and 15N-glyphosate in a water degradation test. The amount of soil biomass was determined by labelling the soil with 13C and 15N-glyphosate and determining the amount of soil biomass that was 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. Generally good correlations (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’. Naturally, log k’ has a clearly larger applicability domain than log Kow, because log Kow is unavailable for ionic chemicals derived from strong acids/bases (e.g., sulfonates, quaternary ammoniums), whereas log k’ can be measured for such ions too. This study offers a step forward to the development of accurate prediction models for sorption coefficients of ionic chemicals in the environment.

WE060 Determination of persistent organic pollutants (POPs) in soil from sites adjacent to landfills: different provinces of the Republic of Armenia
A. Aleksanyan, Hazardous Substances & Waste Policy Division / Head of Division; Y. Bunyatyan, 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/BE Project Armenia
Sources of environmental pollution by persistent organic pollutants (POPs), either used for many years correctly applied pesticides or 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), Gavar (Gegharkunik Marz), Amaghu (Ararat Marz) and Buz (Ararat Marz). The obtained soil samples were analyzed for determination of the following POPs: - Hexachlorocyclohexane (HCH) isomers: α-, β-, γ-, δ-HCH; -DDT isomers: 2,4'- DDT, 4,4'-DDT, 2,4,5'-DDT, 2,2',4'-DDT; -DDT metabolites: 2,4',5'-DDE, 2,4',5'-DDE, 2,4'-D-DDD, 2,4'-DDD: - Hexachlorobenzene, - Heptachlor, - Aldrin - Dieldrin - Heptachlor epoxide A and Heptachlor epoxide B, - Endosulfan I and Endosulfan II, - Endrín, - Mixr, - 14 Dioxin-like polychlorinated biphenyls: congeners No. 77, 81, 105, 114, 123, 126, 156, 157, 167, 169, 180, 189, 189. Quantification of POPs was done 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 0.25 mm x 0.25 μm. Special attention was paid to the total concentrations of HCH isomers, DDT isomers and DDT 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. Schaeffer, 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 bioaccumulation are available. Reversed-phase high-performance liquid chromatography (HPLC) has been used for quantification of POPs 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 stable and bound with very high sorption parameters compared to the theoretical microbiological degradation. However, providing the proof for type II NER is a critical issue in NER assessment. Harsh extraction conditions may release both types of NER but type II NER are considered to be ‘irreversibly bound’ as proposed in the updated ECHA guideline for PBtox/VPb assessment [4]. This is the first study simulating the formation of biogenic NER using experiments with 14N-labeled molecules. [1] Kästner, M., Nowak, K. M., Miltner, A., Trapp, S., & Schaffer, A. (2014). Classification and Modelling of Nonextractable Residue (NER) Formation of Xenobiotics in Soil – A Synthesis. Crit Rev Env Sci Technol, 44(19), 2107–2171. [2] Wang, S., Seiwert, B., Kästner, M., Miltner, A., Schaffer, A., Rentzsch, T., Q. Yang, Nowak, K. M. (2016). (Biodegradation) glyphosate water degradation test: a novel isotope co-labeling approach. Water Res., 99, 91–100. [3] Brock, A. L., Kästner, M., Trapp, S. (2017). Microbial growth yield estimates from thermodynamics and its importance for degradation of pesticides and formation of biogenic non-extractable residues. SAR QSAR Environ Res, 28(8), 629–650. [4] European Chemical Agency (2017). Guidance on Information Requirements and Chemical Safety Assessment. Chapter R.11: PBtox/VPb assessment, Helsinki, Finland.
The Photolytic Fate of Fungicides

WE062
Photodegradation of Atrazine in the Presence of Indole-3-acetic Acid and Natural Montmorillonite Clay Minerals

C. Gu, Nanjing University / School of the Environment; L. Zhang, Nanjing University

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, the knowledge of environmental degradation pathways in (micro)organisms and in sediments is a key factor in understanding the potential environmental impact of these chemicals.

WE063
Photodegradation Half-lives of a Fragrance Ingredient in Natural Waters at Depth Calculated from Laboratory Study Results

J. Litt, Firmenich Research & Development; K. McNeill, ETH Zurich / Institute of Biogeochemistry and Pollutant Dynamics; M. Emberger, A. Casilli, V. Hewins, Firmenich, Inc / Research & Development; S. Gimeno, Firmenich / Product Safety and Regulatory Affairs

Photodegradation, an important abiotic degradation process, is rarely considered in the persistence assessment of chemical substances. The use of pesticides has allowed for increased crop productivity in agriculture. 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 is the short time of exposure of the environmental matrices to the degradation 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 photocatalytically produced reactive intermediates (e.g., triplet state dissolved organic matter, single oxygen, 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 photodegradation are important to quantify in order to accurately characterize the environmental fate of fungicides.

WE064
The Photolytic Fate of Fungicides

J. Apell, MIT / Civil & Environmental Engineering; K. McNeill, ETH Zurich

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 is the short time of exposure of the environmental matrices to the degradation 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 photocatalytically produced reactive intermediates (e.g., triplet state dissolved organic matter, single oxygen, 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 photodegradation are important to quantify in order to accurately characterize the environmental fate of fungicides.

WE065
Study Design Considerations for E-Fate Testing of UVCB Substances

C. Louwig, Charles River / Environmental Fate and Metabolism

Substances of unknown or variable composition, complex reaction products or biologically active substances are of potential concern for their environmental impact. In silico-radiolabelling studies have been used to generate qualitative information on the potential release of these substances to the environment, but for practical reasons, toxicological testing is required to verify in vitro compatibility with the environmental target of concern. Toxicological testing is time-consuming, expensive, and often involves strong ethical considerations. An alternative approach is based on the generation of a radiolabelled surrogates to which the target substance is similar in chemical structure. The experimental design of such studies must be based on the chemical properties and structures of the target substance of concern and the radiolabelled surrogates used. In this study, we also investigated the influence of smectite hydration status on the stability of the radiolabelled surrogates and the potential promotor of the degradation rate compared to that saturated with calcium ion (Ca²⁺-montmorillonite), and this reaction was significantly suppressed as pH increased. In this process, montmorillonite not only increases the yield and prolongs the lifetime of hydrated electrons by stabilizing radical cations through electrostatic attraction with the negative charges on the inner surface of the clay layer, but also provides a confined space where the probability of contact between atrazine and active radicals is markedly increased. In this study, we also investigated the influence of smectite hydration status on the degradation efficiency of atrazine, which revealed that freeze-dried K⁺-montmorillonite promoted the degradation process to a greater extent than freshly-prepared K⁺-montmorillonite, while the freeze drying process had no significant influence on the hydration status of Ca²⁺-montmorillonite.

WE066
In silico investigation of the triplet-sensitised phototransformation of phenols induced by chromophoric dissolved organic matter

E. Papa, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA); L. Monti, University of Insubria / Department of Theoretical and Applied Sciences DiSTA; A. Sangion, P. Gramatica, University of Insubria / Department of Theoretical and Applied Sciences (DiSTA); M. Minella, D. Vione, University of Torino / Chemistry

In silico investigation of the triplet-sensitised phototransformation of phenols induced by chromophoric dissolved organic matter. The next step of our undertaking to develop methodologies to extrapolate laboratory data to the aquatic environment, we chose a fragrance ingredient, Myrhone, 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 Myrhone and 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 Myrhone 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, depth 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 clorophyll-a absorption was included in the step of photon transformation which governs this half-lives that 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 indicates 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.
In this paper, solubilization of persistent organic pollutants, PAHs, PCBs, pesticides and emerging pollutants, as PBDEs or PCN, was investigated in water samples, using some anionic, cationic and non-ionic surfactants. These pollutants are well known for their considerable toxicity, persistence and bioaccumulation toward both human health and environment in addition to their low aqueous solubility. However, the use of surfactants to water solution enhances solubilization of hydrophobic organic compounds. Above the critical micelle concentration (CMC), surfactants exist as aggregates in solution and hydrophobic compounds move to hydrophobic micellar core region. This technique was employed as a predictive method to traditional liquid-liquid extraction with hexane. The physical and chemical properties as size, shape, ionic strength and hydrophobicity are important to identify the appropriate surfactant depending on the type of compound to be removed. The method consists in two steps: a) removal of analytes from aqueous solution and into the micelles, and b) movement of micelles from aqueous solution to the organic solvent followed by micellar deformation with addition of NaCl. Both steps are effective, easy and with high recovery of pollutants. Furthermore, the samples 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 non-ionic surfactants, tail length (%) of the alkyl chain and 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.

In silico Tools to Assess the Confidence of QSAR Model Predictions

R. Kühne, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry; S.S. Kutsarova, O. Mekenyuan, University of Zlataros / Laboratory of Mathematical Chemistry; G. Schuurmann, 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 to particular data sets 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 for the QSAR approach are provided. This study demonstrates that in silico methods are able to provide reliable predictions in the QSAR domain and may be employed in this regard.

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 / Regulatory Assessment & Risk Assessment Center

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 does not consider data sets 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 for the QSAR approach are provided. This study demonstrates that in silico methods are able to provide reliable predictions in the QSAR domain and may be employed in this regard.

Innovative analytical method to enhance POPs and emerging pollutants extraction in water samples by micelles using GC-MS/MS

S. diGiacomo, University of Pisa / Chemistry and Industrial Chemistry; I. De Angelis, A. Lazzarelli, University of Pisa / Department of Chemistry and Industrial Chemistry

The aim of this paper is to solubilize persistent organic pollutants, PAHs, PCBs, pesticides and emerging pollutants, as PBDEs or PCN, was investigated in water samples, using some anionic, cationic and non-ionic surfactants. These pollutants are well known for their considerable toxicity, persistence and bioaccumulation toward both human health and environment in addition to their low aqueous solubility. However, the use of surfactants to water solution enhances solubilization of hydrophobic organic compounds. Above the critical micelle concentration (CMC), surfactants exist as aggregates in solution and hydrophobic compounds move to hydrophobic micellar core region. This technique was employed as a predictive method to traditional liquid-liquid extraction with hexane. The physical and chemical properties as size, shape, ionic strength and hydrophobicity are important to identify the appropriate surfactant depending on the type of compound to be removed. The method consists in two steps: a) removal of analytes from aqueous solution and into the micelles, and b) movement of micelles from aqueous solution to the organic solvent followed by micellar deformation with addition of NaCl. Both steps are effective, easy and with high recovery of pollutants. Furthermore, the samples 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 non-ionic surfactants, tail length (%) of the alkyl chain and 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 assumed that it may cause these effects. The substances on the candidate list is the most effective screening algorithm. With the protection of drinking water and 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 vPvM/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 (PMT). Two existing screening algorithms for vPvM 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 mobility (vM) and very mobile (vM) substances new screening algorithms were developed using the substance properties of water solubility (Sw) and the soil/sediment organic-carbon-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 pHs. 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 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 tonnes > 10 t per manufacturer or importer. The screenings identify substances according to criteria proposed by UBA and the developed QSAR algorithms were applied on the existing database. The screening algorithms 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, NGI / Environmental Technology; S. Hale, Norwegian Geotechnical Institute; A. Striffler, denkares; D. Sättler, 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 growth in knowledge and regulatory requirements related to 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 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. Pscreen) was performed according to REACH guidelines. For mobility, a criteria of a measured (or estimated) log Koc > 4 is 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.

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. Korneziowska, ReachEdge 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 six or less fluorinated carbons (“short chain”). Fluorotelomer-based products can be 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 superior performance and critical properties on high-end performance garments, workwear, first responder gear and in other high performance areas. 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 Foaming Foams (AFFF). The non-polymeric fluorotelomer-based products provide superior surface wetting and leveling properties and can incorporate complex ingredients, e.g. alcohols and amines, that are used to improve performance. They can be used as a surfactant in a closed loop system. vPvB can accumulate in food chains over time while vPvM can accumulate in pristine environments over time.

WE075 LIFE project PHOENIX: a new project for the management of water pollution from short chain perfluoralkyl acids in Veneto region (Italy)

F. Russo, M. Vazzoler, V. Groppi, Region Veneto, Direzione Prevenzione, sicurezza alimentare, veterinaria; F. Zanon, F. Da Prà, R. Lava, M. Mazzola, G. Onofriò, L. Da Rugga, ARPA Veneto; M. Bonato, University of Padua, Department of Biology, and Department of Veterinary Medicine; G. Paratore, A. Grasso, G. Santovito, L. Tallantini, University of Padua, Department of Biology; M. Carrer, L. Palmeri, University of Padua / Department of Industrial Engineering; N. Tornem, University of Padua, Department of Biology; S. Valsecchi, F. Cappelli, Water Research Institute - Italian National Research Council IRSA-CNR; S. Polesello, Water Research Institute- CNR/ Water Research Institute

The most important source of pollution was identified in a fluorochemical plant, sited in an area of groundwater recharge. The Veneto Region immediately put in place mitigation actions that were more effective for long chain PFAS than for short chain ones. For that reason, within the framework of the Community Life Program, a project aimed at guaranteeing an effective management of the water pollution and the improvement of the environmental conditions. While this unique stability makes these products ideal in many end-use applications, as well as in providing people, equipment and property, it also makes them resistant to degradation and persistent in the environment. Each of these new fluorotelomer-based chemicals released on the market have the potential to be released during use and could create an environmental footprint. Thus it is essential to follow published best practice guidance (BPG) in handling these products. This poster will highlight recent advances in toxicology, including multiple endocrine evaluations, safer-alternatives assessment methodology, analytical advances, challenges and successes in the development of short-chain fluorotelomer-based products and an overview of their value, uses and some critical uses. A perspective on when and how best to use these products, while at the same time minimizing the environmental footprint will be featured in this Poster Presentation.

WE076 Ecotoxicological characterization of aquifers at Junin Formation and Pampeano from Hydrogeological Sub-region II, Buenos Aires Argentina

W.D. Di Muzio, CONICET-PIRET / PIRET; M. Suenot, PIRET CONICET, National University of La Juan; J. Alberdi, piret conicet unlu; s. curieses, S. Martinez, CONICET PIRET UNLU; A. Silva, UBA Fac Cs Exactas; D. Galassi, Universita L’Aquila; T. Di Lorenzo, ISE CNR

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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 the Junín Formation, which consists of sandy and silty sediments of silty to sandy brown to light brown color, very friable, and with 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 Platetane), 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 glycosphate and chloropyrifos, TOC, arsenic and fluoride. Also, cytotoxicity 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 equipped Copepods, Acari, Collembola, Insecta, Oligochaeta, Nemata, which preliminary results were used 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 are not 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 target HILIC-MS screening method for very polar compounds and quaternary ammonium compounds and a non-target HILIC 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, urtropin, metformin and guanishurea and newly detected compounds cyanurate, cyanuric acid and the azo dye Direct Blue 15. Despite the large 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 a 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. Nagotka, Federal Environment Agency (UBA) / 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 plastics 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 occurrence of other phthalates and non-phthalate plasticizers. In contrast, these plasticizers are more frequent in the environment, and are recent plasticizers like bis(2-hydroxyethyl) methacrylate (DINCH) or bis(2-carboxyethyl) bis(2-hydroxyethyl) methacrylate (DINCH). The phthalate plasticizer Di(2-ethylhexyl) phthalate (DEHP) is the most abundant plasticizer detected in the US- and Europe-Passport databases. Our results indicate a fast appearance of new plasticizers like bis(2-hydroxyethyl) methacrylate (DINCH), bis(2-carboxyethyl) bis(2-hydroxyethyl) methacrylate (DINCH), which are 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
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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 significant 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 threaten 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 (Ceridaphnia dubia). The microalgae 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, 16:8 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, 1x10⁵ cell mL⁻¹ of P. subcapitata as food). P. subcapitata was more sensitive to DB15 (150 μg L⁻¹) than C. dubia (150 μg L⁻¹). Chlorophyll-α and -b were significantly increased in the alga 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 reproduction were significantly decreased in C. regia; 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 effluents on the health status of fish
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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 of the investigated facilities are conventional treatment plants, combining mechanical, biological and chemical treatment. The third one 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 cage exposures conducted prior and subsequent to the upgrade. Several biomarkers, including histopathological alterations, the formation of micronuclei and binuclei, changes in vitelligenin 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 was observed. However, the biomarker values of the WWTP 3 effluents 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 reuse
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Pharmaceutical residues in sewage effluents pollute 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 (OBP) that may have deleterious effects on fish. In this study we screened the concentrations of 103 pharmaceuticals and biological effects at a Swedish STP using a full scale parallel ozonation line. 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 O₃/L). 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 light/dark photoperiod). On day 2, we measured the fecundity of eggs. After hatching, we measured the hatching rate. In 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 OBP. Furthermore, the ozonated effluent fortified with organic and a toxic compound in fish. A novel endocrine related behavioral phenotype was recorded in the adult fish exposed to the ozonated effluent. No adverse effects on the fish progeny was noted. Whether these biological effects would have an adverse impact on the population level remains speculative. Ozonation is a capable method for removing pharmaceutical residues from sewage effluents. Yet its implementation should be carefully monitored in order to minimize undesirable toxic side-effects.

**WE085** Toxicity evaluation during secondary effluents treatment by UV/H₂O₂ using Eruca sativa and Artemia salina

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When advanced oxidation processes are applied they are 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 final degradation of organic matter and the identification of the characteristics of the region, time of year, etc. In the specific case of the city of Limeira SP, there is a high concentration of compounds from industrial origin and metals (Al, Fe, Zn, Cr, Ni, Cu and Pb) above that allowed by the Brazilian Legislation (CONAMA) in sewage due to the presence of many jewelry semi-jewelry industries. This work evaluated the toxicity of a secondary effluent, fortified with organic and toxic compound in the laboratory and stored at 4°C. Based on the preliminary tests it can be concluded that the secondary effluent treatment by UV/H₂O₂ in presence of high concentration of metals, nitrate, carbonate and industrial contaminants has no significant increase on toxicity.

**WE088** Hospital effluent induced oxidative stress on Xenopus laevis larvae

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Hospitals are one of the main sources of emerging pollutants to wastewater treatment plants (WWTP) that usually are fairly equipped to treat this kind of compounds. Activities performed in hospitals require the use of several compounds, which are potentially toxic, they can reach municipal wastewater, affecting how they get into municipal waste water treatment plants, in some cases the procedure carried out in this WWTP is not able to remove all the contaminants, when they are not properly disposed, exposure to them can generate harmful effects on aquatic organisms. Physiochemical and pharmaceutical (11 pharmaceuticals) characterization of the hospital effluent were made, results shown a high concentration of mercury, and pharmaceuticals on concentrations of µg/L. Also oxidative stress was evaluated on Xenopus laevis larvae exposed to this hospital effluent; twenty oocytes were selected for each exposed group (control, 0.1, 0.3, 0.5, 0.7, 0.9 and 1%) in the middle blast stage, they were maintained at constant temperature 23 ± 2 °C, for 96 hours until they reached the larval stage. They were...
weighted, homogenized and centrifugated for the determination of hydroperoxides, lipoperoxi- 
ses, carbonolated protein content, and the antioxidant activity of 
superoxide dismutat and catalase, results shown statistically significative 
increments regarding control group in all the biomarkers evaluated, thus indicates 
that the hospital effluent tested in this work can generate oxidative stress on 
* Xenopus laevis* larvae, based on the results obtained, hospital effluents can generate 
oxidative stress in other species and due the lack of appropriate WWTP hospital 
effluents can represent a risk for aquatic organisms.

**WE086**

An assessment of (anti-)androgenic activity in sludge from a rain spillway 
basin of the WWTP Aachen Soers as well as in sediments from the catchment 
area of the recipient water, the river Wurm

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Hormonally active micropollutants (MPs) are well-known problems in aquatic 
environments. They can severely alter entire ecosystems by disrupting 
the endocrine system of its organisms. Adverse effects can extend to invertebrates 
and vertebrates including humans. As many MPs cannot be completely eliminated 
during conventional treatment in municipal wastewater treatment plants (WWTP), 
they enter the recipient waters. So far, mostly the effects of estrogenic active 
compounds have been investigated. However, a crucial part of the occurring 
hormone-antagonists is caused by antiandrogen receptor inhibiting or activating 
compounds. Thus, the scientific attention has increased to account for their 
importance. Due to their strong lipophilicity, the main part of these compounds 
accumulate in sludges of wastewater treatment plants and can be used as a tool 
to elucidate the endocrine-disrupting MPs in the implementation of an additional treatment step like ozonation. Within the 
DemO2AC 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 
and after 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 impact of heavy rain events. Additionally, a sewage sludge sample 
was tested, to gain more information. Assessment of (anti-)androgenic activity was 
performed by testing sample extracts using the (anti-)AR-CALUX® assay. These 
stimulations were conducted as part of an exploratory study. First results revealed an antiandrogenic potential as well as 
cytotoxicity in the highest concentrations of the samples. The full depiction of the 
(anti-)androgenic activity in the catchment area of the Wurm will be available at 
the time of the conference.

**WE087**

Processes underlying the environmental fate of pharmaceuticals in the 
Nairobi River Basin “impact zone”: implication for environmental risk 
assessment

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University / Environmental Science

Recent investigations have highlighted the widespread occurrence of active 
pharmaceutical ingredients (APIs) in African wastewater. 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 facilities. The Nairobi River basin ("impact zone") in Kenya is an example of such heavily 
contaminated areas. The wastewater generated from the city’s informal settlements and the 
sufficient WWTP is directly discharged in the Nairobi River basin leading to a 
large-scale "impact zone" characterized by occurrence of high levels of ammonia, 
biocidal 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 
sorbed concentration and quality related to distribution processes of APIs in the 
impact zone and the individuation 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 persistence (similarly to studies 
on the antipetepelic carbazapine 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.

**WE088**

Occurrence of pharmaceuticals, metabolites and transformation products 
from combined sewer outflows in London measured by high resolution targeted, 
suspect screening and untargeted chemical analysis

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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 ~2 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 
methodology involving solid phase extraction (SPE) and liquid chromatography and high 
resolution accurate mass spectrometry (LC-HRMS). The work was divided into four 
part: (a) the identification of CSO markers based on HR-MS; (b) determination 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 
comparing influent and effluent wastewater CSOs were identified including 
caffeine, bezafibrate, benzoylegonine and furosemide which were present 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 
discharges (e.g. herbicides and carbamates). 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 
mixing 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 were combined to provide an understanding of complex occurrence data potentially influenced by timed CSO events. [1] K Munro, TH Miller, CPB Martins, AM Edge, DA Cowan, LP Barron, 

**WE089**

Occurrence, fate and bioactivity of pesticides in wastewater

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Unlike for contaminants of emerging concern (CECs), data available for the 
occurrence, fate and bioactivity of pesticides (herbicides, fungicides, and 
seepesticides) 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 screening (YES) and yeast androgenic 
screening) we were able to visualise the bioactivity of pesticides in wastewater 
treated using secondary treatment or ozonation was investigated. It was found that 
of the 12 pesticides showed either antiestrogenic or anti-androgenic 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 bioactivity 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 physicochemical 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 increase 
was reported. These findings further demonstrate the importance of combining 
bioanalytical tools to analytical chemistry in the evaluation of wastewater quality
WE090 Fate of perfluorooalkyl substances within a small stream food web affected by sewage effluent
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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 studies focused on bioaccumulation of PFASs in indicator organisms and their ability of adaptation to the polluted environment. Two hundred brown trout (Salmotrout) 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 studied localities. So far, only those 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. Those 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 accumulation of OCS in males. In order to study the first moments of bioaccumulation,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).

WE091 Patterns of natural and human-made interacting processes on source, transport and fate of trace metals in the Adriatic Sea basin
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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, when being irradiated by UV light, forms a product 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.

WE093 Study of the efficiency of removing organic load and generation of energy through a bioelectrochemical system coupled to a constructed wetland
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Bioelectrochemical systems coupled to wetlands (BES/CW) acquire the capacity to treat effluents of various kinds. Although several studies have been developed to evaluate the efficiency of these systems for chemical oxygen demand (COD) removal and energy generation. To this aim, it was implemented two plastic containers with a volume of 20 L and an operating volume of 9.6 L, packed with river gravel and planted with phragmites sp., carbon felt was used for the treatment process to reduce organic pesticide concentrations and associated toxicity in water when being irradiated by UV light. This is a product related difference in the degradation potential of TiO2 for the selected PPPs. 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.
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 mAm-2 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 conversion of energy from domestic waters 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
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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 and the influence 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 obtained for mixture adsorption analysis (AC ANALYS) showed that: adsorption isotherms were best described by Langmuir and Freundlich isotherms, the maximum monolayer adsorption capacity was 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 KJmol⁻¹), thermodynamically feasible (ΔG < -2.30 to -6.13 KJmol⁻¹) and had increased entropy.

WE095 Diurnal patterns and removal of selected elements in two Norwegian wastewater treatment plants with primary treatment
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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), Trondheim, Norway and HØra, Kristiansand, Norway (HØRA) in Trondheim, Norway. Both WWTPs have significant industrial contributions (up to 40% in LARA), employ primary and preliminary treatment steps, including chemically aided flocculation (ClFeO₃/polyamine in LARA, polyacrylamide in HØRA), and discharge directly into Trondheimsfjord. In a 7 day sampling campaign, 24 h composite samples of influent and effluent wastewater, as well as sludge samples, were taken to determine influent concentrations and removal of Al, P, S, Cr, Fe, Ni, Cu, Zn, As, Cd and Pd. To study release patterns and gain information about potential sources, diurnal variations of elemental concentrations were determined and modelled in 8 h composite samples of raw influent wastewater from morning, evening and night discharges. Element concentrations in LARA discharges were highest for S-P and Al and lowest for Cd<As>Cr and Pd. Concentrations of Al, P, Cr, Cu and Cd were higher in HØRA than LARA, with Fe loadings being approximately double. Removal efficiencies varied between the analysed elements, and were highest for Al (86%), P (74%) and Cu (57%) in LARA, which utilises both inorganic and organic flocculants. In contrast, removal rates were below 50% for P, Cu and S in HØRA. However, in LARA concentrations of Fe, Ni and S were significantly higher in the treated effluent compared to the raw influent, deriving from the use of inorganic flocculant. This was also reflected in Fe and S concentrations in treated sludge. Elemental concentrations in 8 h composite samples mostly followed general diurnal discharge patterns, with higher concentrations in mornings and evenings and lower concentrations at night. In HØRA, concentrations of most elements further correlated well with total suspended solid concentrations (TSS), with 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
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Effluent samples from wastewater treatment plants are expected, due to the treatment processes, to have lower concentrations of toxicants and pathogens than the effluent. 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 Phuthaditjhaba’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 effect on invertebrates in the area. Further identification and presence or absence of invertebrates in the sampled riparian zone will determine if effluent has any impacts on invertebrate diversity.

WE097 The DemO3AC-project: Chemical and ecotoxicological investigations of the wastewater treatment plant Aachen
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Micropollutants (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 influence 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. The data show that the WWTP is effective in reducing the amount of micropollutants by about 70% and indicate that the WWTP does not have any impacts on the biota. However, the toxicity was already markedly reduced at the outlet of the WWTP inlet for the two selected micropollutants. Further identification and presence or absence of invertebrates in the sampled riparian zone will determine if effluent has any impacts on invertebrate diversity.

WE098 To use or not to use: sewage overflow dredging
M.H. Wagelmans, Bioclear earth

In a densely populated country like the Netherlands, with a dense sewage system,
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 Noorderzijlvest has started a pilot for reusing sewage overflow dredgings as new construction materials or 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 makes the use of this material viable. Work in this depot was finished 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 ESBI (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 reuse possibilities will be given as well as the meaning of the project for other water boards.

WE099 Assessing wastewater processes at olive oil refinery industry in Kazakhstan
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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 treatment. The assessment was performed considering wastewater discharge from refinery processes at three factories in the country. While Kazakhstan’s 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 ponds with a low predation level of pollutants, consequently allowing discharge of high concentration of pollutants (total petroleum hydrocarbons (TPH) exceeds concentration by 30-80 times, ammonia (NH₃) 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, lack of the factories provides analyses of, e.g., heavy metals contamination in discharged wastewater. TPH concentration in wastewater is often exceeded at each factory and there is no analysis done for different hydrocarbon fractions. The national regulation promotes 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 ponds with a low predation level of pollutants, consequently allowing discharge of high concentration of pollutants (total petroleum hydrocarbons (TPH) exceeds concentration by 30-80 times, ammonia (NH₃) 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, lack of the factories provides analyses of, e.g., heavy metals contamination in discharged wastewater. TPH concentration in wastewater is often exceeded at each factory and there is no analysis done for different hydrocarbon fractions. Consequently, it is strongly recommended to provide a unified and transparent methodology for the country’s oil refinery industry to assess all important pollutants in discharged wastewater and to include all types of hydrocarbon fractions.

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
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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⁻¹ to low µg L⁻¹), they have been specifically designed to be biologically active at low concentrations in human tissues and therefore it is reasonable to assume that aquatic wildlife may also be susceptible to their effects particularly under conditions 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, neurotoxicity, endocrine disruption, immunological alterations) in aquatic organisms at environmentally relevant concentrations has been widely proven. Ciprofloxacin (CIP) and flumequine (FL) are broad-spectrum antibiotics of the fluoroquinolones class. Fluoroquinolones toxicity was observed in rodents several species with different trophic levels growing together, where each species has its own economical value. Macroalgae 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 these compounds, 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 ecosystems can prevent or reduce contamination with antibiotics. As biofilters, these organisms are located at the exit point of fishponds or near cages, potentially accumulating pharmaceuticals.
producing among others oxidative stress, cytotoxicity, and hepatotoxicity were induced after treatment with CIP in mice and rats. However, ecotoxological effects on aquatic organisms of CIP and FL are practically unknown. In our study, experiments 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 along time. The activated sludge respiration rate after post-exposure depuration, bioaccumulation of pharmaceuticals in clams was examined and changes in a suite of molecular biomarkers was used to evaluate the biochemical status of clams during both exposure and depuration: biochemical responses related to oxidative stress (CAT, SOD, GR, T-GPx activities and LPO levels), detoxification (GST activity) and neurotoxicity (AcHe activity), and mRNA expression of genes associated with regulatory system of xenobiotic exposure. Results obtained indicate a general activation of oxidative stress and neurotoxicity related features in enzymatic responses as well as changes in genetic profiles suggesting that selected pharmaceutical mixture in aquatic environment represent a risk for the clam S. plana.

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. Especially, 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. Therefore, the antibiotics usage in livestock production 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 not 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 20s 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, Norflloxacin, 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 about pharmaceuticals concerning their environmental risk. Reference: (1) Eun Jeong Han; Dong Soo Lee, Application of emission estimation model to the environmental risk assessment of the pharmaceuticals in agricultural manure.

WE104 Development of microplate based assay and its application to establish differences in cyanobacteria sensitivity to antibiotics
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Antibiotics are continuously entering the environment and pose a risk to environmental health through their direct effects upon microorganism communities and to human health through antimicrobial resistance. They are designed selected to target bacteria but in current environmental risk assessment (ERA) only one species of cyanobacteria and the activated sludge respiration inhibition test (API) are proven to be sensitive to 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. Total antibiotics treated differences in 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 inhibition 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.

Direct and indirect effects of antibiotics in the leaf-shredding macronvertebrate Gammarus fossarum
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Recent studies indicated that both leaf-decomposing microorganisms (i.e., bacteria and fungi) and macronvertebrate detritivores (i.e., shredders) can be affected by antibiotics via direct and indirect pathways (i.e., via altered microorganism-mediated food quality). 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 gammarid 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 diet without antibiotics, to a diet containing antibiotics, or to a diet where the experimental leaves that were microbially colonized in the presence of CIP, or a combination of the latter two effect pathways. During the feeding activity assay, G. fossarum was rather tolerant towards waterborne antibiotic exposure with LC50 and EC50 values of 13.6 and 6.4 mg CIP/L, respectively. Furthermore, the shredder did not show statistically significant preferences for control over CIP-exposed leaves during the food choice assays. However, the shredders’ leaf consumption and growth were significantly affected when subjected to the diet-related pathway. Our data indicate that indirect effects of antibiotics on shredders via the diet-related effect pathway could be more relevant than waterborne exposure. Since shredders play a key role in the leaf litter breakdown of heterotrophic stream ecosystems, diet-related effects might result in implications for the energy dynamics of these systems.

Efficacy of removal antimicrobial resistance genes during avian manure composting process.
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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 alternatives. 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
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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 South Atlantic coast, was established as representative of 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 are 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 agents, hormone analogues and antibiotics. The presence of antibiotics in this study focuses on the environmental risk assessment of enrofloxacin (ENR) and its main metabolite (ciprofloxacin, CIPR), associated with its use in poultry farming in this study. The environmental risk ratios (RQ) have been calculated following the European Guidelines on Environmental Risk Assessment of Veterinary Drugs (EU 2005). In the case of the CIPR, information has been used on the metabolism and excretion of the ENR in chickens, to estimate the environmental hazard associated with its agricultural reuse. Many of them have toxic potential for terrestrial and/or aquatic organisms. The environment can act as a reservoir not only for residues, but also for antimicrobial resistance genes, and may spread them into the food chain. This is a particularly serious case of antibiotics that can accumulate in soil, such as florquinolones, which have a high adsorption capacity for humic matter and, as a consequence, may become persistent. It is of great importance in this work focuses on the environmental risk assessment of enrofloxacin (ENR) and its main metabolite (ciprofloxacin, CIPR), associated with its use in poultry farming in this study. The environmental risk ratios (RQ) have been calculated following the European Guidelines on Environmental Risk Assessment of Veterinary Drugs (EU 2005). In the case of the CIPR, information has been used on the metabolism and excretion of the ENR in chickens, to establish the levels of CIPR in soil and later, to assess their environmental risk. The results indicates that the estimated PECsoil for ENR (443 µg/kg), implies risk for terrestrial organisms, specifically in plants (RQ> 1). No risk is identified for CIPR. Finally, an ENR environmental risk map has been generated in Spain. Allowing us to identify the "hot spots" where the greatest environmental management and surveillance efforts should be applied. This spatial analysis (ArcGIS 10.2) was carried out using a simple addition method (MultiCriteria Decision) and two risk factors were included: the avian density and the capacity of the soil to accumulate this antibiotic (De la Torre et al., 2012). The environmental relevance of these results is discussed and the effectiveness of the process of depositing in battery cages is indicated to minimize the risk of these drugs. This work is funded by RTA2014-00012- C03-02 and S2013/ABI-2747.

WE110

Environmental risk of enrofloxacin used in aviculture

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The main target of antimicrobial residues in animal excreta supposes a health and environmental hazard associated with its agricultural reuse. Many of them have toxic potential for terrestrial and/or aquatic organisms. The environment can act as a reservoir not only for residues, but also for antimicrobial resistance genes, and may spread them into the food chain. This is a particularly serious case of antibiotics that can accumulate in soil, such as florquinolones, which have a high adsorption capacity for humic matter and, as a consequence, may become persistent. It is of great importance in this study focuses on the environmental risk assessment of enrofloxacin (ENR) and its main metabolite (ciprofloxacin, CIPR), associated with its use in poultry farming in this study. The environmental risk ratios (RQ) have been calculated following the European Guidelines on Environmental Risk Assessment of Veterinary Drugs (EU 2005). In the case of the CIPR, information has been used on the metabolism and excretion of the ENR in chickens, to establish the levels of CIPR in soil and later, to assess their environmental risk. The results indicates that the estimated PECsoil for ENR (443 µg/kg), implies risk for terrestrial organisms, specifically in plants (RQ> 1). No risk is identified for CIPR. Finally, an ENR environmental risk map has been generated in Spain. Allowing us to identify the "hot spots" where the greatest environmental management and surveillance efforts should be applied. This spatial analysis (ArcGIS 10.2) was carried out using a simple addition method (MultiCriteria Decision) and two risk factors were included: the avian density and the capacity of the soil to accumulate this antibiotic (De la Torre et al., 2012). The environmental relevance of these results is discussed and the effectiveness of the process of depositing in battery cages is indicated to minimize the risk of these drugs. This work is funded by RTA2014-00012- C03-02 and S2013/ABI-2747.

WE111

Impact of antibiotics on the feeding rate of the freshwater shrimp Gammarus pulex

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Antibiotics are one of the main categories of pharmaceuticals and their release into the 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 Ailus glutinosus leaves. The study aim was to establish if the feeding rate of Gammarus pulex was altered when their food source (Ailus 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 Sulamethoxazole and Trimethoprim bacteriostatic agents that are commonly prescribed together and (3) exposure to the bactericidal agent and broad-spectrum antibiotic Ciprofloxacin. 24 h experiments were performed using Ailus 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 Image J 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=0.667) 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 *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 wastewaters, 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 (intI1 PCR - class 1 integron) 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 pathogenic 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 susceptibility of these strains, the yeast isolates were tested individually with 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 Mooi river: 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.J., Virta, M. (2016) FEMS Microbial Ecology 92 (3): fww014 (2) Spencer, SJ., Tamminen, M. (2016) FEMS Microbial Ecology 92 (3): fww014 (3) Parnainen, K., Karkman, A., Tamminen, M., Lyra, C., Paulin, L., Hultman J. and Virta, M. (2016) Scientific Reports 6: 35790

**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

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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 Feucherolles (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(ll). The mobility of SMX evaluated in water-saturated columns showed higher mobility of SMX than expected from the sorption study. Unexpectedly, this increased mobility was observed only in the OM amended soil, suggesting that OM contributes 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 silty 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, su1 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 taxons, resistant to the antibiotic. These results permitted to characterize the global fate and impact of SMX in an agricultural soil, SMX gets strongly mobile within 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

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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 disease and promoting growth, aquaculture relies on antibiotics to manage 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 gene-protein association. 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. (2016) FEMS Microbial Ecology 92 (3): fww014 (2) Spencer, SJ., Tamminen, M. (2016) FEMS Microbial Ecology 92 (3): fww014 (3) Parnainen, 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. Ragas, 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
fected by antibiotic treatment. However, the increasing occurrence of antibiotics and resistance genes in the environment is of increasing concern. The measured concentrations of antibiotics are relatively low, but 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 antibiotics 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 revealed that environmental matrices are preferentially enriched in genes of weak 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 is the consequence of bacterial exposure (e.g. via urban effluents) is still under debate. These results are expected to support the development of integrative models capable of providing meaningful risk assessment to support decision-making.

WE117
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 (WWTs). Most WWTs 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 selection for resistant bacteria. Foraminifera, as common aquatic microorganisms (e.g. via urban effluents) is still under debate. These results are expected to support the development of integrative models capable of providing meaningful risk assessment to support decision-making.

WE118
The effect of antibiotics on representatives of aquatic algal and plant species

The study on Lemma minor was conducted according to the OECD Guidelines for the testing of chemicals 221. Lemma 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 Lemma minor species was most sensitive to the sulfamethoxazole, with its EC50 being below 10 mg/L. The test on algae was conducted according to the OECD Guidelines for the testing of chemicals 201. Chlorella sp. were cultured in Tryptone and algae numbers were counted in Goryaev chamber under a microscope. The macrocide 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 antibiotics that are abundant in Kazakh waters 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.

WE119
The Presence of Human and Veterinary Antibiotics in Urban and Rural Streams in North Carolina (adsorption and degradation of nanoparticles in Zebrafish)
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 pollution. In this study, we compiled this sparse information by conducting an extensive literature meta-analysis to evaluate global trends. Our investigation revealed that environmental matrices are preferentially enriched in genes of weak 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 is the consequence of bacterial exposure (e.g. via urban effluents) is still under debate. These results are expected to support the development of integrative models capable of providing meaningful risk assessment to support decision-making.
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 primary interest to improve antibiotic use rates and, as a consequence, reduce the bacterial resistance threat in 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 4µg/L OTC (through water); group B: 10µg/L of Fe₂O₃ (equivalent to 4µg/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 SAMNs@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)

WE125 ANALYTICAL METHOD FOR DETERMINATION OF FULLERENE (C60) NANOPARTICLES IN SEAWATER SAMPLES. L.R. Diniz, Universidade Estadual do Maranhão / Agroecologia; L. Capellini, Universidade Federal de São Paulo / UFESP / Departamento de Química Fullerences are allotropic forms of carbon produced in highly energetic processes of hydrocarbon 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 fullerences 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 nanomaterial fullerene (C60) in seawater samples. It will be tested two methods of extraction: 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/MS). Keywords: Marine pollution. Fullerences. Nanomaterials.

WE126 Screening of per- and polyfluoroalkyl substances (PFASs) and total organic fluorine in wastewater effluent from Nordic countries. F. Chen, MTM Research Centre, Orebro University / SCHOOL OF SCIENCE AND TECHNOLOGY; U. Eriksson, R. Aro, MTM Research centre Orebro University; L. W. Yeung, University of Orebro / Department of Chemistry; T. Wang, MTM Research Center; R. Kallenborn, Norwegian University of Life Sciences / Chemistry, Biology and Food Sciences; A. Karram, Orebro 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 FPOA, 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 fluorine 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 using liquid chromatography tandem mass spectrometry (LC-ESI-MS/MS), 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. Fünfrocken, H. Heck, Saarland University, K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaeffer, B. Grothé, H. Beck, 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 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 quantification 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
tetrac

Eighteen selected pharmaceuticals and personal care products (PPCPs), consisting of five non-antibiotic pharmaceuticals (N-APs), four sulfonamides (SAs), four tetracyclines (TCs), four macrolides (MCs), 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 5.07–17.43 pg/kg in sediment samples. Four M
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**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 65600 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 purification and extraction (SPE 13.14 µl in sediments) target substances were flowed into Luxi river annually based on the 89 primary stream. 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 WWTWs, lagoons, irrigation channels and coastal areas. Water samples were analysed using solid phase extraction. The predominant species among the EDCs were perfluorooctanoic acid (PFOA) in water, perfluorooctanesulfonic acid (PFOS) in sediment, soil, and fish, respectively. PFOS and PFOA were detected in all water, sediment, and fish samples. In air, 85% 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.

**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 Institutes of Water Resources and Hydropower Research IWRHR

In the present study, eighteen selected pharmaceuticals and personal care products (PPCPs), consisting of three non-antibiotic pharmaceuticals (N-APs), four sulfonamides (SAs), four tetracyclines (TCs), four macrolides (MCs), 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 5.07–17.43 pg/kg in sediment samples. Four M

**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=2), 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 determined. The predominant species among the PFCs were perfluorooctanoic acid (PFOA) in air, perfluorooctanesulfonic acid (PFOS) in sediment, soil, and fish, respectively. PFOA and PFOS were detected in all water, sediment, and fish samples. In air, 85% 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.
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 / EM-DLD; 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 used in cooling towers. Several treatment technologies such as reverse osmosis, electrodialysis 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 application 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 considered are benzotriazole (corrosion inhibitor), DNBP (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 as tracers for the fate of the CW system? Do the resulting 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. Faltermeier, Eberhard Karls Universität Tübingen / Center of Applied Geoscience; C. Zwienen, Environmental Analytical Chemistry, Center for Applied Geoscience, University of Tübingen / Geosciences; M. Schwientek, Eberhard Karls Universität Tübingen; C. Zaril, 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 Schönbrunner 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. The tracer is applied on the results of the salt tracer tests and provide information about hydrological loss and gain for the Schönbrunner 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 Schönbrunner River and adjoining compartments.

**WE135**

**Occurrence of pharmaceuticals at extremely high concentrations in surface waters in Nigeria**

O.M. Onunkanwo, 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. de Santa Catarina / Biochemistry 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, 38.69 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 10 compounds detected. While the published data from around the world, these values show 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 processes. This study provides an up-to-date database on published data.
The wastewater generated by the human activity contains several anthropogenic contaminants, including emerging pollutants. Sewage sludge is generated during the deproportion 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 collected from different wastewater 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, supematant was cleaned up by the solid phase extraction (SPE) with Strata-X cartridges and eluates were eluted with methanol at gravity flow. Once extracted, the analytes were identified by liquid chromatography-mass spectrometry (LC-QqTOF-MS). As a result 50 compounds were identified, being the pharmaceuticals the most relevant, present in all samples, including noudiones (adenosine triphosphate), amino acids (phenylalanine) or peptides (leucine-glycine-phenylalanine). 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 detect 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 issue and different subsequent environmental processes. However, reports on CBs and TCS in aquatic organisms-especially the aquatic organisms in typical epidemic areas of schistosomiasis prevalence in China-are lacking. The lack of CBs from the production and use of Sodium pentachlorophenate (Na-PCP) has been identified as one of the most important sources. Dongting Lake is the second largest fresh water lake of China, which is also an area with most widely distributed onchocerciasis and has the most severe schistosomiasis epidemic situation in China. Na-PCP has been sprayed as molluscicide in Dongting Lake from 1960s to 1990s, it was estimated that over 9.8x10^6 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/incurrent contamination status, distribution of CBs in fish from Dongting Lake.

**WE140 Occurrence of bisphenol A in Mediterranean mussels (Mytilus galloprovincialis) sampled from the north Adriatic coastal waters (Slovenia)**

C. Fernández, J. Zaltauskaite, L. Bing Heng, Y. Wu, I. Meng Ian, W. Chen, Department of Biomedical Sciences; D. Miškelytė, Vytautas Magnus University / Department of Animal and Environmental Biology, Kaohsiung Medical University, Kaohsiung Taiwain; A. Muhib, University of Benin Benin City / Department of Environment and Management and Toxicology.

The increasing levels of pharmaceutical compounds in surface and underground water in third world countries is on the increase. We examined the occurrence of one pharmaceutical compound, bisphenol A, in blue mussel samples (Mytilus galloprovincialis) sampled from the north Adriatic coastal waters (Slovenia) during a 3-month long field study carried out over the 56-day juvenile 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 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, gulping of air, rapid 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 96h median lethal concentration LC50 values of Aciatispinum was 800, 700, 594.5 and 358.80mg/L respectively.

**WE141 Reproductive and maternal effects of Tamiifu metabolites in medaka (Oryzias latipes)**

J. Zaltauskaite, L. Bing Heng, Y. Wu, I. Meng Ian, W. Chen, Department of Biomedical Sciences; D. Miškelytė, Vytautas Magnus University / Department of Animal and Environmental Biology, Kaohsiung Medical University, Kaohsiung Taiwan; A. Muhib, University of Benin Benin City / Department of Environment and Management and Toxicology.

The aim of this study was to assess the reproductive effect of medaka (Oryzias latipes) under long-term Tamiifu metabolite exposures. This study carried out the 56-day long-term toxicity, 14-day reproduction, and 21-day hatchability trial bioassays to observe the survival, growth, and egg production of the adult medaka, and hatchability of embryo, and larvae body length of F1 medaka under the Tamiifu metabolite exposure concentration (0, 0.3 and 90 µg/L). Results showed that the survival and growth rates of adult medaka were no significant difference between the control and exposure groups. However, the egg production and F1 hatching rate of 90 µg/L exposure group had a downward trend compared with control group, but there were no significant decrease. This study found that larvae body length of exposure groups were significantly shorter than that of control group. This study concluded that Tamiifu metabolite could have a significant impact on larva growth development.

**WE143 Earthworms (Eisenia fetida) response to chronic exposure to triclosan**

J. Zallauskaite, V. Vytautas Magnus University / Department of Environmental Sciences; D. Mitkevityte, Vytautas Magnus University.

Triclosan (TCS) is a broad-spectrum antibiotic and antifungal 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 on survival, growth, 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**

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The study was performed at SETAC Europe 28th Annual Meeting Abstract Book.
Microplastics in Agriculture Soil.

K.B. Olesen, Aalborg University / Department of Civil Engineering; N. van Aalst, Aalborg University / Civil Engineering Department - Section of Water and Environment; M. Simon, Aalborg University; F. Liu, J. Volkertsen, 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. Different analytical techniques such as microflour transform infrared (μFT-IR) spectroscopy and attenuated total reflectance (ATR) enables a reliable identification and quantification of microplastics. Studies show the tendency of microplastic accumulation in wastewater sludge. This sludge is used as fertilizer in agriculture farming. This study focuses on the occurrence of microplastics in the size range 5000-10 µm in soils that received wastewater sludge as fertilizer. It presents the methods of sample preparation and presents field data. In Sweden 3 fields were sampled. Monitored amounts of sludge fertilizer have been spread over a period of 35 years. The fields have either received 3 tons/year, 1 tons/year or no sludge fertilizer. 40 kg of soil were sampled from each field. The microplastic concentration is in general low; therefore the plastic needs to be extracted from other material present. Due to limited size range of interest, two different IR techniques are applied for microplastic identification. This requires two different plastic extraction methods. Therefore, two sample protocols were developed: < 500μm and >500μm. < 500μm More than 500g of soil was dried and sieved through a 500μm metal sieve. To remove the inorganic fraction a gravimetric separation was used. For a sample of this size a custom made aerator-device was built. The sample was agitated with air for 1 h, then centrifuged (1.6-4.8%). 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 filtered over a 10 µm metal mesh. The device was refill with ZnCl2 and the agitation sequence was repeated. To remove the organic fraction the filtrated material was treated with enzymes for several days and oxidised with H2O2. The remaining particles were suspended in ethanol and a sub sample was deposited on a window and scanned by a state-of-the-art μFT-IR Imaging system (128x128 pixel Focal Plane Array (FPA) microscope detector). >500μm 10 kg of soil was wet-sieved through an 8nm, 6mm, 4mm, 2mm, 1mm and 500μm sieve. After the soil was dried it was floated in a..
ZnCl$_2$ 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: Novel Analytical Strategies for Anthropogenic Compounds in Plants: Variations in biological markers for substrate application on DnBP and DEHP dissipation

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Plants play an important role in the maintenance of life. Besides providing us with food, they also function as natural bioremediation systems. Pharmaceutical products in soil can be found in the discharged solutions and also in spinach. On the other hand, relatively environmentally friendly DnBP and DEHP dissipation in bok choy was observed. DnBP is a 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 continuous 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 is 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

E. 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. Mesocosm 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, mesocosm studies allow for a more realistic application and dissipation of test item. Therefore, mesocosm 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 test are suitably robust and can be used to assess recovery. Here we will use results from our past studies to share experiences of assessing plant health. 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. Meregalli, Cambridge Environmental Assessments

This study 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 Luvisol, Arenosol Epieutric, Haplic Cambisol, Dystric Cambisol). Sewage sludge samples were taken from two wastewater treatment plants. Two experiments were performed. a) Soils mixed with sewage were packed in plastic columns, humidified to a value close to a field water capacity and 14 days incubated under laboratory conditions. Next, a ponded infiltration was applied and cumulative water outflow and solutes discharge from the bottom were measured. b) Spinach (Spinacea 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 uptakes were soil and sludge dependent. In general, mostly larger discharges were observed from the Arenosol Epieutric and Cambisols. Mobility of compounds depended on their sorption affinity to particular soil, i.e. also on the contents of organic matter in the soil. Measured concentrations in spinach showed selective uptake of mobile pharmaceuticals in soil water. For instance strerrine and carbamazepine were found in the discharged solutions and also in spinach. On the other hand, relatively large amount of fexofenadine and venlafaxine was found in the discharged solutions but very low or negligible concentrations were measured in the spinach parts.

WE151 Will spent mushroom substrate application affect the dissolution and plant uptake of phthalate esters?

J. Gao, Institute of Soil Science, CAS / Key Laboratory of Soil Environment and Pollution Remediation, CAS; F. Zhu, Institute of Soil Science CAS

To investigate whether spent mushroom substrate (SMS) amendment was an appropriate way to reduce di-(2-ethylhexyl) phthalate (DEHP) and di-n-butyl phthalate (DnBP) contents in soil and whether SMS could reduce DnBP accumulation in bok choy, a study was conducted. Standardised SMS amendment exhibited no effect on DnBP dissipation in soils and plant uptake of DnBP. Variations in soil pH and enzyme activities were determined. The concentrations of phthalate esters (PAEs) in soils, bok choy and atmosphere were examined with gas chromatography or gas chromatography–mass spectrometry. This study was focused on a mobility of pharmaceuticals from sewage sludge 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.

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WE154
Interspecific competition impact on organism responses to chemical stress: an SSD-based approach.
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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 dynamic. 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 competitive ability). For each treatment, we replicated 5 times, e.g. by day exposure or transport. In such cases, the plants might recover if the effects are reversible. Neglecting the recovery potential in the risk assessment is definitely protective but might be over-restrictive in more cases for example unnecessary losses of crop yields. The recovery subgroup of the SETAC Plants Interest Group aims to review the different approaches to analyse recovery of plants and to make suggestions how relevance of these effects could be included in a risk assessment framework. In the present work, we will focus on aquatic algae and macrophytes and the regulation of plant protection products in the EU. Experimentally, recovery of algae and macrophytes can be assessed in single species laboratory tests or micro- and mesocosm studies. In refined exposure laboratory toxicity tests, usually the recovery of the growth rate is assessed since the populations are kept in the experimental growth phase. In micro- and mesocosm studies, it is possible to analyse also recovery of abundance or biomass and potential indirect effects. The differences of these two options and their potential consequences for risk assessment will be discussed. Effect modelling can be used to extrapolate from empirical data to other exposure scenarios or species. However, while the prediction of refined exposure laboratory toxicity tests seems to be straightforward, the prediction of effects under field conditions is still challenging. In addition, the use of such models in the risk assessment requires clear criteria on which magnitude and duration of effects can be considered acceptable.

WE156
Rimsulfuron toxicity and recovery in duckweed (Lemna minor) M. Ompinec, 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 Lemma minor at low concentrations. This study also evaluated recovery by Lemna 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 ≥0.0006 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 0.0006 mg/L were reduced 25.4% relative to the controls. Interestingly, a horometric response was observed at the 0.00125 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/toxidynamic (TK/TD) modelling - Increasing the realism in risk assessments for aquatic plants S. Halme, 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 effect side, either an ecotoxicological threshold or an environmental concentration can be 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 assessments for lotic bodies (streams) in which chronic concentrations usually last for a few hours or days. Only since models for the prediction of environmental concentrations do not only deliver maximum concentrations but also temporally explicit exposure (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 exposure patterns. For characterizing the 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 the validation of a Lemna minor model that was parameterized to describe the effects of different sulfonyleurea herbicides. The results demonstrate that the TK/TD Lemna model with its specific parameterization is able to reliably predict effects. Using the TK/TD Lemna model allows to perform a more realistic environmental risk assessment and to link time variable-exposure to effects.

WE158
Assessing soil toxicity of methylyparaben using plants and collemboila 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 ecosystem. 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 well regulated. Hence, 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 collemboila. Plants were exposed methylparaben from 0 to 400 mg/kg for 14 and 21days. In plant toxicity tests, shoot and root growth, root development, stomatal opening size, chlorophyll contents and photosynthetic factors were measured. In the collemboila test, methylparaben was exposed at 0 to 500 mg/kg for 5 days and mortality was observed. The most sensitive point 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 collemboila 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
WE159
Evaluation of phytoxicity for Bisphenol A with new endpoint, phytoestrogen
D. Kim, J. Kwak, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science
Bisphenol A (BPA) and other endocrine disrupting chemicals (EDCs) are known as chemicals that show hormonelike action or inhibit hormones, the phytoxicity 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 provides an endpoint that is associated with their toxic action mechanism, takes a long time to assess toxicity. Therefore, we tried to evaluate phytoestrogen, a new toxic endpoint for EDC materials, using bisphenol A. 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 soil ecotoxicity of bisphenol A is limited. Therefore, we evaluated the toxicity of bisphenol A to plant (mung bean) by using traditional endpoints and evaluated the applicability of phytoestrogen, a new endpoint for EDCs materials. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458), and funded by 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 as substance with various isomers which are used as insecticide and detergent. Although DEHP and nonylphenol are likely to release into the soil environment, 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 contents, and photosynthetic activity were evaluated in the 21 day-chronic experiment. This study is meaningful because the soil toxicity 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 glycoside based formulation on phytoplanktonic green microalga
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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 water bodies is a risk for biota, particularly for the phytoplankton microalgae communities due to their frequent use as herbicides. In this work we described the effects of a glyphosate formulation (44% monopotassium salt of N-phosphonomethyl glycine) on the growth, chlorophyll content and oxidative stress parameters of 4 phytoplanktonic green microalgae evaluated. Cultures of Scedesmus acutus, Ankistrodesmus fusiiformis, Monoraphidium cortortum 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. cortortum 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. cortortum was the most sensitive strain (3.37 mg/L), followed by A. fusiiformis (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. cortortum 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. cortortum, 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. Mereghetti, 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 colonise. 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 alga 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 combat invasive species to restore habitats 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. In

WE163
Auxinic herbicides: the impact of water plants’ root measurements on the risk assessment
G. Gonsior, 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, which was developed for herbicides, is used to determine effects on algae and other aquatic species, and has been shown to be comparable to natural conditions. In this testing methodology, shoot length, as well as, fresh and dry weights need to be recorded. The OECD 239 guideline requires that only a qualitative assessment of the roots is undertaken. Auxinic substances are known to exert their herbicidal activity by affecting growing tissues. As such, roots of Myriophyllum plants may be affected after exposure to auxins. The methodology described in the OECD 239 guideline can be adapted to include measurements of fresh and dry weights for whole plants, rather than just the shoots, thereby assessing, indirectly, also possible effects on the roots. However, it needs to be evaluated if an indirect quantitative assessment of the roots in the Myriophyllum studies with auxinic substances would result in significantly different endpoints that may lead to different conclusions compared to risk assessments based on other endpoints. Results will be presented to clarify if effects on the roots in a water sediment system are providing additional information relevant for the risk assessment.

WE164
Testing the emergent macrophage, 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. Kubiriza, 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 suitable test parameters, to determine the required test concentration, 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 imazapic, 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 UNL; M. Saenz, PRIET CONICET, National University of Luján; W. 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 facilty in wastewater are easily absorbed on by the vegetation. 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 effect. Macrophyes are key elements in aquatics ecosystems linked with metal removal. The following species were considered: Ceratophyllum demersum. Following the OECD 2014 guideline for sediment-free toxicity test, plants were exposed to a range of concentrations (1-16 Ni, 4-64 Zn or 0.5-8 Cd mg/L) and fresh weight, main shoot length and total shoot length were chosen as endpoints. For the bioaccumulation assays, plants were exposed to a constant metal concentration, during the time until internal metal concentration reached a steady state. To make sure of a constant external metal concentration, a daily renewal of the media was carried out. Besides, the influence of these metals on antioxidative enzymes activity was evaluated for the three lower concentrations of each one. These enzymes are involved in the plant defense mechanisms activated by heavy metal exposure. Determination of catalase (CAT), guaiacol peroxidase (GPOX) and ascorbate peroxidase (APOX) were performed on homogenates from the total plant mass. In the main, fresh weight resulted in the most sensible endpoint reaching an inhibition of almost 50% for 40 mg Zn/L and presenting significant inhibition for concentrations higher than 2 mg Ni/L and 1 mg Cd/L. Cd exposed plants over 1 mg/L presented signs of chlorosis and disaggregated easily at the higher concentrations. Metal uptake reaches the steady-state between days 11-14 for all metals. CAT activity at test concentrations remained near control values, while data on Ni hyperaccumulation is scarce. Our aim was to bring more understanding of the physiology of T. praecox exposed to Ni and its toxicity limits might be relevant for the potential application of this species in phytostabilization or phytoextraction technologies at contaminated soils.

**WE167** Phytoextraction of heavy metals in Cienea of Tamasopo wetland, México, by Typha latifolia C. Wong, C. Carranza, Universidad Autonoma de San Luis Potosi / Laboratorios de ciencias ambientales; A.J. Alonso, Universidad de Guanajuato / Departamento de Farmacia

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 solution. 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 phytoextraction; 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 plants 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 from 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 metal is not removed from entering the plants; (2) shoot excludision, 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 phytoextraction 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 Ciénega of Tamasopo with plants that were considered to be free of contamination; 2) in a second ring, 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 °C for 18 hours; 3) grinding and spraying of root and leaves in analytical mill (KIIA Werke M20); 4) acid digestion with HNO3 in plate at room temperature of root and leaves [5] and sediments; 5) quantification of metals by IC-MS in digestion and water column samples. The results show that Typha latifolia accumulate Mn/Zn>Cr>Pb>Cu>A>Hp>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 UNL; s. curieses, priet conicet unlu; W. Di Marzio, CONICET-PRIET / PRIET

Removal of heavy metals from the environment due to industrialization and urbanization is a great problem worldwide, due to their toxicity to many life forms. Aquatic waste from metal plating, mining operations, tanneries, smelting, alloy industries, and storage batteries are sources of metal contamination. Biological methods have been recommended as effective alternative for removal and recovery of heavy metals from aqueous solutions. Aquatic plant biomass represents an abundant biological resource that possesses immense capacity to accumulate heavy metals and therefore have been exploited worldwide in the field of wastewater treatment technologies. Aquatic plant species including floating and submerged, as Lemna, Spirodella, Ceratophyllum and Myriophyllum, have shown potential for metal removal from wastewater. The aim of this study is to evaluate the efficiency and capacity of different species of aquatic macrophyte in removing heavy metals from an artificial wastewater in a multi-metal solution. The initial whole eco-toxicity of a multi-metal system composed by Cd, Ni and Zn was assessed by growth inhibition test with the green algae P. subcapitata, acute toxicity test with D. magna and ex vivo cytotoxicity test with E. foetida coelomocytes. An experiment was set up for 10 days, by the addition of 10 grs of fresh weight of plants from different species mentioned above, in the metals solution. Previous works have shown that metal uptake rates were faster within the first 48 hours, and decrease with time and with metal concentration solution, so at this time and at 3 and 5 days, respectively, plants were removed and new plants were placed in the same multi-metal system. At these time intervals, samples of solution and plant were taken for metal determination. The harvested plants were dried at 95°C in an oven and a microwave acid digestion were carried out. Metal determinations in aqueous and plants sample were made by flame atomic absorption spectrometry. There was a gradual decrease in metal contents in the artificial wastewater at time intervals. The metal removal capacity was different for each species and for each metal. At the end of the experiment, the multi-metal system treated with aquatic plants was assessed with the same battery of tests used in the beginning. The whole eco-toxicity of the artificial wastewater decrease after treatment with aquatic plants, demonstrating an efficiency method for metal removal and recovery.
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-PIRET / PRIET; M. Saenz, PRIET CONICET, National University of Luján  
The presence of metals in the environment represents one of the mayor concerns as they are persistent in nature, non-biodegradable and can bioaccumulate in living aquatic and terrestrial plants. Metals can cause oxidative stress in these organisms by altering the antioxidant trophic level composed partly by aquatic vascular plants, also called macrophyte. 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 are the determined morphological endpoints. Physiological changes were evaluated as enzymatic activity of catalase, ascorbate peroxidase and guaiacol peroxidase, determined at the lowest concentrations. Both metal concentrations, bringing about a 50 % inhibition of frond number (EC50) was determined. In order to compare the sensitivities 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 activities were higher than control, however neither of both presented significant differences with it. For the mixture analysis, multiple regression was used to fit the observed %frond number inhibition (%FNI) to dissolved metal concentration (M_{Cd}). 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 individual toxicities (ΣTU) for each single EC_{50} value in the mixture. The ΣTU of all test cases resulted 1.13 suggesting that this mixture presents an additive toxicity to Lemna gibba. Enzyme activity was also calculated at the lower concentrations of the mixtures. In general an increase in the enzymatic activity was observed. Ascorbate peroxidase and guaiacol peroxidase presented the maximum increase, while catalase had a moderated activity rise.

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. curises, J. Alberdi, CONICET PRIET UNLU; W.D. Di Marzio, CONICET-PIRET / 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, wood preservation. The aim of this study was to test the effects of the mining waste that outpoured of the Fundão dam caused 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, Crotaalaria junccea, Canavalla ensiformis, Cajanus cajan, Cajanus cajan, Dolichos lablab, Mucuna pruriens gray, Mucuna pruriens black and Lupinus albus). The ecotoxicological assays followed the OECD guidelines for the mixture of a natural soil (NS) from Mariana (uncontaminated) and the waste (W). The combinations of mixture 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 the species, except Lupinus albus and Avena strigosa, had EC_{50} and/or EC_{20} in at least one of the seven parameters evaluated. The species that presented 50% inhibition of root growth were C. junccea (73.07%), P. glaucum (82.68%) and C. cajan (97.54%). The height of the first two species was affected by 20% in the proportions 78.61 and 85.91%, respectively. The proportions 87.32 and 40.61% of waste affected 50% of the length of the longest root of C. junccea and P. glaucum. The results showed that: the species tested presented different indices to soil fertility; the acidity of the medium 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  
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New types of pesticides based on nanoparticles (NPs) are now being used to optimize phytosanitary practices. 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 (1) and reported the importance of soil microbial communities (OMC) on metal ecotoxicity due to its role as dispersing and stabilizing agent (2). A high OM content is likely to increase NPs toxicity by favoring their dispersion. Based on this assumption, our goal was to assess 1) whether the plant modifies the microbial ecotoxicity of NPs because of organic matter enrichment in the rhizosphere through the root exudation and 2) whether the plant variety mitigates the ecotoxicity according to plant traits. Endpoints that relate to soil fertility by mining waste; the activity of metalloenzymes were compared. The combinations of mixture 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: Activity of catalase, 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 guaiacol peroxidase activities were higher than control, however neither 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_{Cd}). 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 individual toxicities (ΣTU) for each single EC_{50} value in the mixture. The ΣTU of all test cases resulted 1.13 suggesting that this mixture presents an additive toxicity to Lemna gibba. Enzyme activity was also calculated at the lower concentrations of the mixtures. In general an increase in the enzymatic activity was observed. Ascorbate peroxidase and guaiacol peroxidase presented the maximum increase, while catalase had a moderated activity rise.

WE173  
Use of Posidonia oceanica as a potential bioindicator species of metal pollutants: cellular and molecular responses to mercury exposure  
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The marine phanerogam Posidonia oceanica, thanks to its worldwide distribution
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 μgL-1 Hg Cl2) under constant laboratory conditions. Biochemical markers of oxidative stress, stress of glycolytic 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 monouncellic 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 bronzing, 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 methods involving plants to macroscopic, such as a visual appearance. 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 confirmed using Triticum aestivum, and Pterium aquilinum. 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-TOF-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 metabolomic 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
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Rosemary (Rosmarinus officinalis L., Lamiaceae) is an aromatic shrub native from Mediterranean regions and grown 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 the leaves. The effects of the concentration and availability of the essential 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) at 200 and 400 ttha 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 detritivore systems
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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; azoxystron, 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. Gammarids 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 the treatment 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 confirmed using Triticum aestivum, and Pterium aquilinum. 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-TOF-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 metabolomic approach and provided an insight into quantitative chemical accident damage assessment.

WE177
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-Institut / 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 in 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. Wieringa, 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, 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)**

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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 largest freshwater lake in the Balkans, is considered as an unique area for research. In this study, we focused on three sites 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, “Menn” and “Poj” located in the ultramafic area of the lake, at the vicinity of a Fe-Ni dump site for “Menn”, and nearby the outlet of a creek for “Poj”. 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, 91.9 mg/kg for Ni, 172.2 mg/kg for Mn, and 872.9 mg/kg for Fe. 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.
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 onto a Chelx-embedded hydrogel layer, providing a measurement of labile and weakly-bound metals. To evaluate DGT passive sampling measurements as a potential indicator of bioaccumulation in organisms, a field experiment will be carried out in April 2018 on 6 locations in Flanders (Belgium), in 4 freshwater and 3 brackish aquatic systems. Bioavailability of metals will be assessed by active biomonitoring through a 4 weeks exposure of caged macroinvertebrates, 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 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 macroinvertebrate 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
Biotturbation in contaminated sediments: effects on exposure, toxicity and biogeochemistry.

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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. O3) 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 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 macroinvertebrate 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.

WE185
The diffusive gradients in thin films (DGT) technique predicts toxicity of nickel contaminated sediments to a marine amphipod

M. Gillmore, University of Wollongong / School of Chemistry; 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.I. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; D.F. Jolley, University of Wollongong / School of Chemistry.

Mineralogy 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 concentrations and response of bioavailable nickel to determine use of traditional extraction methods 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, silty-sandy and sandy sediments, respectively. Conventional extraction methods 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), Site 2 (1300 mg/kg TR-Ni) and Site 3 (200 mg/kg TR-Ni) had reproductive 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 (1.0-3.0) mg/m² for silty, silty-silt and sandy sediments, respectively. Conventional extraction methods 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 reproductive responses were 88% (±10) and 71% (±1) 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 a integrated method of TIE and EDA

J. You, H. Li, F. Cheng, Jinan University / School of Environmental Sciences; H. Wang, Guangzhou University / Environmental Protection College; E. Alencastro, École Polytechnique Fédérale de Lausanne / Central Environmental Hygiene Laboratory; N. Dubois, Eawag; L. Rossi, Lombi, University of South Australia / Future Industries Institute; D. T. Welsh, Griffith University / Environment Futures Research Institute; M. S. Adams, CSIRO Land and Water / School of Chemistry; G.A. Price, QIMR Berghofer Medical Research Institute; W. Bennett, Griffith University / Environmental Futures Research Institute; S. Höss, Ecossa / Hydrique Ingénieurs; J. Ferrari, Centre Ecotox EAWAGEPFL; A. Yuan, Guangzhou, China using a integrated method of TIE and EDA.

The SH gradients in thin films (DGT) passive sampling is an innovative technique, allowing for the rapid measurement of the lability and toxicity of metals in sediments. For Site 1 (0.4 mg/m² DGT-labile Ni) and Site 2 (1.0 mg/m² DGT-labile Ni) sediments, respectively reproductive responses were 88% (±10) and 71% (±1) 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.

WE187
Water discharges from the city of Lausanne during rainfall in Lake Geneva: Use of a triad approach to assess their influence on sediment quality

M. Calleja-Martinez, T. Benejum, R. Vivien, Centre Ecotoc; S. Pesce, Istea Lyon-Villeurbaine / 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, Ecossa / Animal Ecology; B. Ferrari, Centre Ecotox EAWAGEPFL.

A triad approach represents an integrated method of TIE and EDA. The SH gradients in thin films (DGT) passive sampling is an innovative technique, allowing for the rapid measurement of the lability and toxicity of metals in sediments. For Site 1 (0.4 mg/m² DGT-labile Ni) and Site 2 (1.0 mg/m² DGT-labile Ni) sediments, respectively reproductive responses were 88% (±10) and 71% (±1) 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.

The SH gradients in thin films (DGT) technique predicts toxicity of nickel contaminated sediments to a marine amphipod

M. Gillmore, University of Wollongong / School of Chemistry; 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.I. Simpson, CSIRO Land and Water / Centre for Environmental Contaminants Research; D.F. Jolley, University of Wollongong / School of Chemistry.

Mineralogy 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 concentrations and response of bioavailable nickel to determine use of traditional extraction methods 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, silty-sandy and sandy sediments, respectively. Conventional extraction methods 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), Site 2 (1300 mg/kg TR-Ni) and Site 3 (200 mg/kg TR-Ni) had reproductive 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 (1.0-3.0) mg/m² for silty, silty-silt and sandy sediments, respectively. Conventional extraction methods 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 reproductive responses were 88% (±10) and 71% (±1) 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.
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, and the chemical and ecotoxicity 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 (PICT) 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 elevated in the samples collected at each monitoring point, and ecotoxicity 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 benthic microorganisms. 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 hydrodynamic model. Overall, this study paves 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. Shulakaveich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; Y. Müller, RWTH Aachen University / Institute for Environmental Research; S. Hotz, RWTH Aachen University / Department of Ecosystem Analysis ESA; S. Schiwy, RWTH Aachen University / Department of Ecosystem Analysis; S. Karmatz, RWTH Aachen University / Institute for Environmental Research Department of Environmental Analysis; S. Oster, H. Hollert, 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 DemO3 AC-project aimed at assessing 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 Wurms receives effluents from various WWTPs within the catchment area. Two of them, the WWTP Aachen Soers and the WWTP Eillendorf, 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 as well as for the chemical analyses of the OCs and PAHs as well as for the determination of the estrogenic and mutagenic potential. The results showed estrogenic and mutagenic potential in sediment extracts upstream the tested WWTPs. The embryotoxic potential (enlarged heart, enlarged swim bladder) was identified mainly as copper, zinc, PCBs and PAHs contamination, was elevated in the samples collected at each monitoring point, and ecotoxicity 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 benthic microorganisms. 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 hydrodynamic model. Overall, this study paves the way for the development of practical tools for assessing the impacts of urban stormwater discharges in lakes in Switzerland.

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 Toxicológicas; M. Artal, University of Sao Paulo - USP / Toxicology and Environmental Health; Y. S. A. dos Santos, Faculdade de Ciências Farmacêuticas - USP / Toxicology and Environmental Health; D. Scholte, University of Applied Sciences / Ecossa / School of Technology; G. Umbuzeiro, School of Technology, UNICAMP / LAF - a new solution for sewage disposal in several countries is primary treatment followed by chlorination and its discharge in the sea. In Santos city, SP, Brazil, 1 cubic meter of urban effluent are discharged into the Santos bay every day, 4.5 km from the beach. To assess the toxicity of environmental samples it is important to use species that are representative of the ecosystem we want to protect. So, the aim of this work was to evaluate the acute toxicity of water and sediment samples collected in the area under the influence of this discharge using the native marine amphibious Parhyale hawaiensis. Three campaigns were conducted. Acute toxicity tests were performed in water and in fresh and dried sediment as well water and sediment extracts. The sediment and water extracts were tested using 96-well microplates, and the sediment using 12 wells-microplates containing sediment and water in 1:4 (w/v). Exposure conditions were 96, 24±2°C, 12/12h light and dark. All water and water extracts samples did not present toxicity. Fresh and dried sediment was toxic ranging from 17 to 100% mortality as well the respective organic extracts. The observed toxicity is probably mainly related to organic contaminants adsorbed to the sediment particles. The sediment of the area seems to be adversely affected by the influence the outfall discharge. Acknowledgements: FAPESP 2015/24758-5 and CNpq 400362/2014-7.

WE191 Swimming in turbid water: impacts of suspended fine sediments on fish physiology
M. Lefranc, S. Amaudrut, L. Merle, J. ORourke, Hepia, University of Applied Sciences Western Switzerland / Ecology and Engineering of Aquatic systems research group; L. Espinet, INRA; S. Bony, INRA-CNRS / IPE; A. Devaux, INRA-CNRS / UMR LEHNA / USC INRA IGH ENTE; J. 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; L. Espinet, INRA; S. Bony, INRA-CNRS / IPE; A. Devaux, INRA-CNRS / UMR LEHNA / USC INRA IGH ENTE; J. 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 this context, sediment-dwelling Amphipods and damselfly 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 to 0, 0.4, 4, 40 and 1000 mg/L of non-contaminated fine sediments (minica) for 28 days, mimicking ditching 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

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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 erythrocytes 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. 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. Hetens, SPHERE / SPHERE, K. Dachenhophareaux, University antwerp / Department of Biology SPHERE and ECOERE Research Groups; J. Touchies, E. Anato, 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 biota. Sediment-related metals can be present in various forms in sediments - 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 the diffusion controlled technique of the Diffusive Gradient in Thin film 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) invertebrates 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 mortality in field experiments. The toxic potential 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 mortality in field experiments. The toxic potential of the results from laboratory studies under field conditions.

WE193
Ecotoxicological effects of sediments influenced by a municipal wastewater treatment plant - state of a receiving river before implementing an ozonation treatment
N. Wilbrand, RWTH Aachen University; A. Shul'iakevich, Institute for Environmental Research (RWTH Aachen University) / Institute for Environmental Research; Y. Muller, RWTH Aachen University / Institute for Environmental Research; S. Schiwy, RWTH Aachen University / Department of Ecosystem Analysis; H. Hellert, 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. Many hazardous substances are 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, enter into surface waters. To minimize 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 DemoAC-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-Eilendorf 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 a pressurised liquid extraction, cell-based bioassays 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 Danio rerio. This test utilizes the fish’s phototaxis (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, ISPRA 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 Environ readability maintained by ecotoxicology. M. Boer, Institute for Environmental Research; Y. Müller, RWTH Aachen University / Institute for Environmental Ecology; I. Roessink, Alterra / Environmental Risk Assessment Team; M. Boerwinkel, Wageningen Institute of Environmental Research; M. Kraak, University of Amsterdam / IBED-FAME; J. Vonk, University of Amsterdam IBED Institute / Aquatic Environmental Ecology; I. Roessink, Alterra / Environmental Risk Assessment
Toxicity of sediment-bound lufenuron to aquatic arthropods in laboratory bioassays
T. Brock, Alterra, Wageningen University and Research Centre / Environmental Risk Assessment Team; D. Belgers, Wageningen Environmental Research Alterra / Environmental Risk Assessment Team; I. Roessink, Alterra / Environmental Risk Assessment
Lipophilic pesticides are frequently detected in sediments, potentially leading to toxic threats on benthic organisms. Currently, prospective sediment risk assessments for pesticides are mainly based on results of laboratory bioassays 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 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
10-day and 28-day toxicity estimates from sediment-spiked laboratory bioassays with benthic arthropods belonging to different taxonomic groups are presented. In the 10-d sediment-spiked toxicity tests the LC50 values showed the following order from low to high LC50: Caenis horaius > Chironomus riparius > Gammarus pulex > Ephemeroidea taxonomy > Selicestio personatum > Chironomus dilutus > Hyallela azteca > Asellus aquaticus and Sialis lutaria. The Hazardous Concentration to 5% of the tested species (HC5 and 95% confidence limit) derived from these 10-d LC50 values was 2.2 (1.2-5.7) µg/g organic carbon (OC). This HC5 value is approximately a factor of 2 lower than the 10-d LC50 estimate (4.3/7.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 horaius > Ephemeroidea taxonomy > Hyallela azteca > Gammarus pulex > Sialis lutaria. The HC5 and 95 confidence interval derived from these 28-d LC10 values was 0.13 (0.02-1.50) µg/g OC. This HC5 value is approximately a factor of 3 lower than 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 HC5 obtained from 28-LC10 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 10-d- 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 USF and surface water in T. angustior AG 219 sediment test systems

**A. Dorn**, Hochschule Niederrein / Department of Chemistry; **P. Dallmann**, Bayer AG Crop Science Division; **D. Faber**, Bayer AG, Crop Science Division / BCS D

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 Niederrein / 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, pore-waters 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 2 (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 concentration 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-FUCU; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FUCU; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University/Biology Department & CESAM, Aveiro University. Aquaculture activity in Portugal experienced true global development firstly at the beginning of the 1970’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 encouraged the emergence of marine aquaculture as an alternative means of producing animal protein, releasing, at the same time, pressure over wild populations.

Production from capture fisheries has relatively stabilized for the past decades, whereas aquaculture production of aquatic animals has followed a rising trend, amounting, by 2014, 73.8 million tonnes produced. Asia contributed for about 89 percent of that production, followed by America, with a production of around 5 percent and Europe, contributing for about 4 percent of the world’s aquatic animals’ production in 2014. Portugal is a traditional fishing country, with yet little stake in aquaculture activity in Portugal has presented a rising trend over the years, however, extensive and semi-intensive rearing systems are poorly controlled, raising questions not only about the influence of environmental factors on production, but also on the threats that the activity may pose to the surrounding environment. Among these are, for example, the destruction of natural habitats due to facilities extension and aquaculture effluent discharges with high nutrient input to the surrounding marine waters. Careful site selection and efficient waste management plans are imperative to minimize these potential threats of aquaculture practices. Although fish supply for human consumption from aquaculture has already surpassed that of fisheries, concerns about farmed fish quality have been raised. Fortunately, it has also resulted on the honing of aquaculture methods and practices, especially concerning the control of water quality and animal feeding, in order to achieve the highest quality product.

**WE199**
Characterization of the ontogenetic variation and nutritional composition of Gilthead seabream and European seabass reared in two Portuguese estuaries

G. Roche, MARE-FUCU; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FUCU; C. Nunes, ICECO & QOPNA, Aveiro University; M.A. Coimbra, QOPNA, Universidade de Aveiro; F. Gonçalves, University of Aveiro / Department of Biology and CESAM; J.C. Marques, University of Coimbra / MARE, Dep. of Life Sciences, Coimbra University; A.M. Gonçalves, MARE, Dep. of Life Sciences, Coimbra University/Biology Department & CESAM, Aveiro University. Aquaculture activity in Portugal has already surpassed that of fisheries, concerns about farmed fish quality have been raised. Fortunately, it has also resulted on the honing of aquaculture methods and practices, especially concerning the control of water quality and animal feeding, in order to achieve the highest quality product. From the 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.

**WE200**
Effects of aquaculture antibiotics on marine biofilms and on the amphipod Gammarus aequicaudus

B. Gonzalez-Gaya, IMDEA Water (GB41912732) / Environmental Chemistry; N. Garcia Bueno, I. Gomez, J. Martinez, C. Marin, B. Martinez-Lopez, A. Marin, 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 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 fluencequin) on the community composition of marine biofilms exposed to these substances and on the amphipod Gammarus aequicaudus. Marine biofilms were exposed to oxytetracycline and fluencequin for one week under laboratory conditions. Subsequently, the exposed biofilms were used to feed G. aequicaudus organisms for two weeks. The G. aequicaudus aquaria set up was run with two treatments in parallel; (1) with input of antibiotics only from the biofilm (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 crustaceans 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 architecture (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 higher biofilm protection up to 1.19 ± 0.07 g/L, while the highest tested concentratio contributed to the decrease of the biofilm coverage. Ongoing work includes the evaluation of antibiotic’s bioaccumulation in the biofilms, bacterial genetic characterization (microbiome and resistance), diatoms identification, and photophysical activity assessment. Regarding the G. aequicuada 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**

Shifts in the diatom assemblage structure and biological traits of marine biofilms exposed to antibiotics used in aquaculture

N. García Bueno, C. Marin, A. Marin, University of Murcia / Ecology and Hydrology; B. Gonzalez-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, biofilms are often found to be a resistant biological structure and can harbor various sources of contaminants in the treatment of which requires the intensive use of antibiotics. The objective of this study was to evaluate the potential side effect of two antibiotics used in aquaculture (oxytetracycline and flumequine) on the diatom assemblage structure and biological traits of marine biofilms exposed to these substances. Biofilms were grown during two weeks under natural conditions on glass slides. Then two experiments were conducted in the laboratory: control field-grown marine biofilms were exposed to 1, 10, 100 and 1000 g/L of each 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 replicate. The fine structure of diatoms was analyzed under a scanning electron microscope (JEOL-6100). The diatom composition, the relative abundance of species (%), the Shannon-Wiener diversity index (H’) and 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 apornia and Coccomis planئت. High exposure concentrations of oxytetracycline and flumequine (100 and 1000 g/L) reduced the abundance of the general dies, Hyalosphenia and Licnopora. 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 outcome of a variety of parameters. The use of environmental toxicological probes 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 analysed. The method provided a rapid assessment of several endpoints in the same exposed samples. Effects on growth, photopigments and the detection of intracellular ROS production, using 3 molecular probes, were measured after 72 hours. H₂O₂FFDA was used for determining the oxidative burst, DHR 123 for mitochondrial oxidation, and BODIPY-581/591 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 and regulatory frameworks. 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. antifoulants, molluscicides, parasitic chemicals as oxytetracycline and flumequine) on 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 and regulatory frameworks. The revised version of BathAuto also offers improved graphical outputs, and the ability to calculate several options for compliant cage treatment regimes.

**WE205**

Effects of an aquaculture parasiticide (diflubenzuron) on non-target shrimp
Benzobicyclon is a proherbicide 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 flooded rice fields are prime habitat for crayfish to reside; therefore, crayfish are at risk for exposure to pesticides used in the rice production. Benzobicyclon readily hydrolyzes to benzoicyclon hydroxylate, and therefore it likely undergoes photolysis as well. The potential for toxic or phototoxic impacts of benzoicyclon 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. Albelnenn, Universidad 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 flavonoidincluding 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 ± 0.41 g) of Solea senegalensis. The 96-h toxicity tests were conducted with continuous aeration and water renewal every 24 hours, at a temperature of 19-20°C and a photoperiod of 12h light/12h dark. Juveniles were exposed to 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 acetylthiocholine 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).

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, CEHTRA; P. Thomas, CEHTRA SAS; P. Baldoni-Andrey, C. GELBER, F. Monnêde, TOTAL SA

In the regulatory context of ever increasing environmental responsibility (OSPAR convention, BREF CW), 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® but it is an additional 100 times more sensitive. The aim of this study was to compare the toxicity of a number of agricultural and industrial pollutants on numerous bacterial species (all in 11 species, 9 of which are marine and include Vibrio fischeri, plus 2 freshwater bacteria) against only one for Microtox® (Vibrio fischeri). Using a set of narcotic substances with different hydrophobicities and two mixtures (one home-made formulation comprising equimolar concentrations of four of the narcotics tested and one petroleum based complex substance) a comparison of both tools was realised with the aim to determine which one is the better tool to evaluate effects on bacterial species. While it was recognised that the substances tested would not be directly comparable to whole effluents, this method was felt to be appropriate to compare the two assays. The in-built EC50 calculation software were also verified. Some errors were detected with the LumiMARA® effects calculation software, and these were recalculated by hand using Rextox software, when possible. We observed that Microtox® is more sensitive than LumiMARA® and that in the latter test, freshwater bacteria toxicity is generally lower than that of marine bacteria. This suggests that there may be a small but real difference between freshwater and marine bacteria toxicity however this cannot be concluded on the basis of this research. Moreover, Vibrio fischeri is the bacteria that usually has the lowest EC50 compared to other bacteria. Thus, the marine bacterium Vibrio fischeri classically used to determine the biotic effect
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. Sachkov, Tomsk Polytechnic University / School of Nuclear Science & Engineering; E. Kovel, Siberian Federal University; N. Kudryasheva, Institute of Biophysics SB RAS

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 C60, C70, C76, C84, SWCNT, with values of the inhibition parameter IC50 equal to 0.012 and 0.16 mg/L, respectively. The immobilised enzyme system was developed. If the value of optical density of the nanomaterial solution was greater than 0.1 in the range of 400–600 nm, the light emission intensity was multiplied by the correction factor. It was shown that the inhibitory activity of CNM on Red + Luc decreased in the following order: MWCNT > SWCNT > C60HyF.n. The soluble enzyme system Red + Luc had high sensitivity to MWCNT and SWCNT, with values of the inhibition parameter IC50 equal to 0.012 and 0.16 mg/L, respectively. The immobilised enzyme system was developed. If the value of optical density of the nanomaterial solution was greater than 0.1 in the range of 400–600 nm, the light emission intensity was multiplied by the correction factor. It was shown that the inhibitory activity of CNM on Red + Luc decreased in the following order: MWCNT > SWCNT > C60HyF.n.

**WE211** 
Effect of low-dose gamma-radiation on luminous marine bacterium Photobacterium phosphoreum  
A.S. Petrova, Krasnoyarsk State Agrarian University / Institute of Agroecological Technologies; D.V. Dementyev, Institute of Biophysics SB RAS / Radiobiology Lab; N. Kudryasheva, Institute of Biophysics SB RAS

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 phosphoreum was used as a biosensor to test the bioluminescence inhibition with the bioluminescent intensity as the physiological parameter tested. To investigate the sensitivity of the bacteria to the low-dose gamma-radiation exposure, the irradiation conditions were varied as follows: bioluminescence intensity was measured at 5, 10, and 20 mGy/h for 175, 100, and 47 h, respectively, at different dose rates (up to 4100 mGy/h). There was no noticeable effect of gamma-radiation in this dose range and 10 mGy/h, while the 20 mGy/h exposure revealed an authentic bioluminescence inhibition. The 20 mGy/h 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 did not demonstrate monotonic 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 ribosomal 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 treatment.

**WE212** 
Bioluminescent Assay for Toxicological Assessment of Nanomaterials  
E. Esimbekova, Institute of Biophysics SB RAS; E. Nemtsova, Siberian Federal University / Institute of Biophysics; V. Kratavsuk, Siberian Federal University / Biophysical Laboratory

Due to the increasing scale of production and usage of a vast number of new materials in industrial and economic activities, society is faced with problems associated with a lack of materials safety assessment regarding humans, ecosystems and the biosphere as a whole. Nowadays, numerous toxicological investigations using living organisms, cell lines, etc. are carried out in laboratories in order to assess the potential risks of using these materials and their biological effects on human health and the environment. A rapid bioluminescent enzyme inhibition-based assay was applied to predict the potential toxicity of carbon nanomaterials (CNM) presented by single- and multi-walled nanotubes (SWCNT and MWCNT) and aqueous solutions of hydrazine fullerene C60(C2H4F)n. This assay specifically detects the influence of substances on parameters of the soluble or immobilised coupled enzyme system of luminous bacteria: NADP+ / FDNB-oxidoreductase + luciferase (Red + Luc). A protocol based on the optical properties of CNM for correcting the results of the bioluminescent assay was developed. If the value of optical density of the nanomaterial solution was greater than 0.1 in the range of 400–600 nm, the light emission intensity was multiplied by the correction factor. It was shown that the inhibitory activity of CNM on Red + Luc decreased in the following order: MWCNT > SWCNT > C60HyF.n. The soluble enzyme system Red + Luc had high sensitivity to MWCNT and SWCNT, with values of the inhibition parameter IC50 equal to 0.012 and 0.16 mg/L, respectively. The immobilised enzyme system was developed. If the value of optical density of the nanomaterial solution was greater than 0.1 in the range of 400–600 nm, the light emission intensity was multiplied by the correction factor. It was shown that the inhibitory activity of CNM on Red + Luc decreased in the following order: MWCNT > SWCNT > C60HyF.n.

**WE213** 
Delayed chlorophyll fluorescence in biomonitoring of environmental pollution  
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 fluorometers 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 (RIDEF) in 24 plant samples. Simultaneously with RIDEF, 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 RIDEF up to 5 times. Our method also showed a high sensitivity in bioassay of toxicity of natural and waste waters where Chlorrella vulgaris alga was used as a photosynthetic indicator. RIDEF of photosynthetic induction decreased by the factor of 2 (EC50 equal to 0.012 and 0.16 mg/L) 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; N. Gaevsky, Siberian Federal University

The main regulating factor for the transition of plants from active vegetation to winter dormancy is the decrease of temperature of air and soil. If the temperature factor and air pollution also have a significant influence both during the autumn photoperiodic reaction and at different phases of winter dormancy. 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 vegetation into the dormant phase, the temperature of the microenvironment of the cells of photosynthesizing parenchyma of needles undergo a number of changes. Changes in the assembly of the photosynthetic apparatus are mirrored in changes of fluorescent 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° C and 70° C) 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 ambient pollution levels, and the trees growing in industrially polluted 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. Saksenkov, A.E. Balayans; 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 fluorescent microscopy. 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 bioindication, not only on generally accepted test facilities, but also on representative hydrobionts for this reservoir. Crustaceans of the order Copepoda, which have well-expressed fatty inclusions in the form of drops, there are several hundred species. Epischura baicalensis Sars (Copepoda, Copepodidae) - endemic of Lake Baikal - dwells practically in the entire water column of the pelagic lake. E. baicalensis 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 luminescent microscopy make it possible to detect the microquantities of 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 fluorescent microscope. It has been experimentally revealed that E. baicalensis 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 drops was proposed.

WE216
The correlation between fluorescent properties of water extract from soil and its effect on bioluminescent enzymatic bioassay
E. Nemtseva, O. Chmurina, Siberian Federal University / Laboratory of Bioluminescent Biotechnologies; M. Gerasimova, Siberian Federal University / School of Engineering Physics and Radio Electronics; V. Kratasyuk, 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. The aim of the work consists in assessing and comparing the 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 3.05-11.3% were studied by the method of excitation-emission matrix (EEM) fluorescence spectroscopy. The luminescence in the range of 290-600 nm under excitation at 250-800 nm was measured 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. Kolosova, Siberian Federal University / Biophysical; D. Gulnov, Siberian Federal University; N. Rimatskaia, Siberian Federal University / Biophysical; A. Listisa, O. Sutormin, V. Kratasyuk, Siberian Federal University

Design of simple, quick and highly sensitive bioassays is extremely necessary for ecological soil monitoring. Enzyme systems may be a perspective basis for the development of modern methods of bioassay. With sets of enzymes, it is possible to simulate the effect of toxic substances present in natural environments on living organisms. Moreover, coupling enzyme-target with bacterial luciferase provides advantages in the signal detection. The purpose of this study is to evaluate the possibility of using various enzymatic systems for the analysis of soil contamination. In this work NADH: FMN-oxidoreductase, alcohol dehydrogenase (ADH), NADH: FMN-oxidoreductase + bacterial luciferase (two-enzyme system), NADH: FMN-oxidoreductase + bacterial luciferase + alcohol dehydrogenase (three-enzyme system) were examined. The enzyme activities were measured by addition of the model soil pollutants such as a blue copperas, the insect powder (“Oxas Profi” (Bayer CropScience)) and diesel fuel. The values of the toxicological parameters \( k_{\text{ADH}} \) and \( k_{\text{ADH}} \) (concentrations of the pollutants causing the system inhibition by 20% and 50% respectively) were determined. The sensitivity of each enzymatic test system to the aqueous extract of soil was also analysed. The blue copperas (II) – water solution shows an inhibitory effect on all enzymatic systems. The value of \( EC_{50} \) is from 0.088 to 8.75 µM. The insect powder-water solution also shows an inhibitory effect on all enzymatic systems except ADH enzyme system. In contrast, the diesel fuel impacts only on enzyme systems coupled with bacterial luciferase. As a result the blue copperas (II) – water solution decreases catalytic activities all enzyme systems; the insect powder-water solution decreases only NADH: FMN-oxidoreductase catalytic activity; the diesel fuel decreases luciferase activity. The addition of aqueous extract of soil leads to activation of catalytic activity of NADH: FMN-oxidoreductase: for the two- and three-enzyme systems the addition of the aqueous extract of soil leads to inhibition of catalytic activities of the enzyme systems (more than 50%). The NADH: FMN-oxidoreductase + bacterial luciferase system showed the greater sensitivity to the soil pollutants than other systems. This fact is confirmed the prospects of using this system for environmental monitoring. *The study was supported by a grant from the Russian Science Foundation (project No. 16-14-10115).

WE218
Are changes in bioluminescence kinetics of Photobacterium phosphoreum related to low-dose radiation connected with genetic mutations?
O. Guseynov, V. Guseynova, Siberian Federal University; T. Rozhko, Krasnoyarsk State Medical University. prof. VF Voino-Yasnetsky; A. Bondar, Institute of Chemical Biology and Fundamental Medicine SB RAS; N. Kudryasheva, Institute of Biophysics SB RAS

Luminous bacteria of marine origin are widely employed as biological sensors for monitoring environmental pollution, including radiation stress. Due to the use of radioactive element and related concerns about the increase of background radiation, 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 (\(^{214}\)Am) and beta-emitting (\(^{14}\)C) radioisotopes as ions of ionizing radiation. Bioluminescence kinetics of Photobacterium phosphoreum in solutions of \(^{214}\)Am(NO\(_3\))\(_2\), 7 KBr solution, and tritiated water, 100 MBq/L, were recorded and their stages were determined as follows – absence of effect, activation, and inhibition. For genetic alterations the bioluminescence at different stages of the bioluminescent 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 \(^{214}\)Am, or 0.11 and 0.18 Gy for \(^{14}\)C. 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 remains stable in genetic material. The high sensitivity of the bioluminescence reaction allows for measuring mutations in the DNA of the bacteria. Nucleotide sequences of target DNA fragments were determined and compared in bacteria exposed to \(^{214}\)Am or HTO and control bacterial suspension not exposed to radiation. All compared gene sequences were discovered to be identical which does not indicate any occurrences of mutation events in the analyzed gene under the applied conditions of low-dose alpha and beta radiation. The results of this study indicate no significant changes in the bioluminescence kinetics. Previous results on bacterial DNA exposed to low-dose gamma radiation (0.25 Gy) were analyzed and compared to those for alpha and beta irradiation. It is concluded that bioluminescence activation and/or inhibition under the applied conditions of low-dose alpha, beta and gamma radiative exposure is
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: halaluxifen-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 driven by 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, halaluxifen-methyl (Arylex™ active), for the broadleaf weed control, in spring and winter soft and durum wheat. This highly efficacious herbicide requires low use rates and its inherent properties (rapid degradation in the soil and plant) mean a low environmental and human health impact. Utilising halaluxifen-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 (e.g., pasta), and in the environment. Results will be presented and discussed. Therefore, the properties of halaluxifen-methyl are fully aligned with increasingly strict environmental requirements from regulatory authorities and the Food Chain Secondary standards.™ Trademark of Dow AgroSciences

WE220
Cradle to grave Life Cycle Assessment of Traditional and Vegetative roofs
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The aim of this research is to evaluate 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. The LCA modelled a traditional gravel ballasted roof (TGBR) 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 media, 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 TGBR 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
V. Hall, 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 understanding of the costs and environmental impacts of the high performance 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-García, L. Lijó, Universidade de Santiago de Compostela / Chemical Engineering; A. Núñez, L. González Louro, 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 consumption of resources and, therefore, on causing a large impact on the environment. The definition of sustainability includes three main pillars: society, economy and environment. However, considering the social and economic aspects of urban metabolism, two main gaps emerge. The first one is the lack of standardisation. Indicators are used to evaluate these aspects, but different specialized organisms propose different sets of indicators. The second gap is the difficulty of comparing indicators to each other in order to evaluate which city is the most sustainable in a sample. This study aims to fill both gaps by systematically assess the sustainability of several cities in Galicia (NW Spain). To select an appropriate set of indicators, including environmental, social and economic criteria, a Leopold matrix has been constructed considering: i) the data available for the studied cities, ii) the frequency of occurrence in the data sets of specialized agencies (United Nations, European Commission, OECD and The World Bank) and iii) the relevance for the case study. The selected indicators do not have a significant common unit of measurement; therefore, to obtain a common scale for comparisons, all indicators should be normalized. In this study, this has been done by considering unsustainable and sustainable values as reference (Phillis et al., 2017). Finally, a composite indicator, i.e. a sustainability index, is obtained for each city based on the three composite sub-indicators of the sustainability dimensions (environmental, social and economic criteria). Acknowledgements This work was financially supported by the Spanish Ministry of Economy and Competitiveness (project ref. CTQ2016-75136-P) and by Xunta de Galicia (project ref. ED431F16/160010). Dr. S. González-García would like to express her gratitude to the Spanish Ministry of Economy and Competitiveness for financial support (Grant reference RYC-2014-14984).

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, RECOVERY 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, application and end of life scenarios, 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 included in the analysis are: Climate Change, Acidification, 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 years to push the implementation of sustainable technologies 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 15904:2012 and GHG Protocol 2013, there is no specific methodology for selecting the appropriate materials and technologies that should be included in road pavements. 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. The study presented in this article 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: demoEAUmed solution
A. Claret, C. Hidalgo, Leitat Technological Center / Sustainability Division; S. Vélez, A. Llopis, ACOTOT Technical Office LEITAT TECHNOLOGICAL CENTER / Sustainability Division

The main objective of demoEAUmed 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, demoEAUmed has demonstrated the integration of innovative wastewater/greywater technologies to have an optimal and safe closed water cycle in Mediterranean tourist facilities. Water resources are limited and unequally 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. demoEAUmed affords the reuse of greywater and wastewater generated in tourist 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 demoEAUmed. Life cycle stages of construction and operation of technologies and their environmental impacts have been measured. Finally, the results determined that the technologies and combined configurations have achieved important environmental impact savings thanks to the greywater/wastewater recovery and water reuse. As an example, for demoEAUmed combined strategies, the carbon footprint is reduced up to 156% (greywater scenario) or up to 62% (wastewater scenario) thanks to water reuse. Focusing on the technologies, main environmental impacts are localized on the operation stage, due to electricity consumption. Concerning the LCC, the overall cost of treating one cubic meter (1m³) of greywater or wastewater by the demoEAUmed technologies along their life cycle are being determined. Finally, S-LCA has presented some indicators and the quantification of the socioeconomic impacts and benefits provided by demoEAUmed solution.

WE226
Integrating Life Cycle Assessment and Risk Assessment to support decision making in the framework of Enhanced Landfill Mining
G. Sanve, KU Leuven Research & Development / Department of Materials Engineering; K. Van Acker, KU Leuven / Materials Engineering

Life Cycle Assessment (LCA) is also conducted in order to assess the environmental benefits obtained with the implementation of sustainable technologies and combined configurations have achieved important environmental impact savings thanks to the greywater/wastewater recovery and water reuse. As an example, for demoEAUmed combined strategies, the carbon footprint is reduced up to 156% (greywater scenario) or up to 62% (wastewater scenario) thanks to water reuse. Focusing on the technologies, main environmental impacts are localized on the operation stage, due to electricity consumption. Concerning the LCC, the overall cost of treating one cubic meter (1m³) of greywater or wastewater by the demoEAUmed technologies along their life cycle are being determined. Finally, S-LCA has presented some indicators and the quantification of the socioeconomic impacts and benefits provided by demoEAUmed solution.

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 disposal routes for these substances in the UK. The results show that rubbish disposal (34%) is the common disposal method among the UK residents with highest estimated emission of APIs to the environment being estimated for paracetamol within the range 7.63 mg/person/day (sewerage 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 pharma waste deployed 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 ILCD 1.0.8 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.

WE230 Streamlined life cycle assessment of emerging batteries in early design phases using CCaLC tool
Cristina Tomasi-Montenegro, KIT, Karlsruhe Institute for Technology; M. Wei, Karlsruhe Institute of Technology KIT / Institute for Technology Assessment and Systems Analysis ITAS

Tomasi-Montenegro, C a, M. Wei, M. a, n, HHI, Helmholtz-Institute Ulm, Helmholtzstr 11, 89081 Ulm, Germany. b ITAS, Institute for Technology Assessment and Systems Analysis, Karlsruhe, Germany. 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 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 is characterized by solar and wind power, energy storage technologies are required to level fluctuating energy production and demand. However, even though when it is recognized that the energy storage technologies exhibit different maturity statuses, information about their associated environmental impacts is required to evaluate the sustainability trade-offs inherent to a technology decision-making process. In order to avoid environmental burdens shifting, a life cycle 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. Isubo, 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 at the national, regional, or sector level. Thus, this method can help to understand the most immediate 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 IDEA2 and WIO (Waste Input Output table) and the environmental impact assessment method (LIME). The Japan Energy Policy Research Institute is developing a 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.

WE233 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. The current TPP framework is considered less effective compared with the specific regional Free Trade Agreement. 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 at the national, regional, or sector level. Thus, this method can help to understand the most immediate 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 IDEA2 and WIO (Waste Input Output table) and the environmental impact assessment method (LIME). The Japan Energy Policy Research Institute is developing a 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.
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, this approach cannot be directly associated 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 comprehensive 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. Espin Gallart, Fundacio CMT, Centre Tecnologic; I. Bezova, L. Vendrell, Fundacíó CMT Centre; F. Clares, Fundacíó CMT 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 socio-ecological performance of a new process, service or project. 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. One of the main strong points is its 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: technical indicators, environmental 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 reference to the studied indicators must be defined based on expert knowledge 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 scores. As a case study, this methodology has allowed to determine the impacts of the project during different dimensions of the project. This methodology allows to determine which socio-economic impacts have the higher contribution.

WE236 SETAC Sustainability Interest Group

D.L. Carr, Texas Tech University / Biological Sciences

WE237 SETAC LCA Interest Group (Europe)

H. Stichnoth, Thiinen Institute / Agricultural Technology

WE238 Life cycle assessment of a thermoplastic starch obtained from mango kernel

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Agrifood industry generates large amounts of residues with potential to be used as feedstock for bio-based products. Mango agro-industry in Brazil is expected to increase to 1.4 million tons by 2024, and processing residues can account for more than 40 % of the total. 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 (MK-TPS), and compares it with food-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 the allocation for MK-TPS show lower climate change, fossil depletion and ozone depletion, but higher impacts on terrestrial and freshwater 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 urban residue as feedstock and the selection of the 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 biomonitors (P)

WE239 Geostatistically estimating spatial structures of heavy metals and nitrogen accumulation in mosses sampled between 1990 and 2015 throughout Germany

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

Mosses are used to spatially complement the collection of atmospheric deposition by technical samplers and to validate deposition modelling results. Since 1990, the European Moss Surveys have been providing 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 that 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.


WE240 Semi-volatile organic contaminants (SVOCs) in pine needles from Iceland

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Iceland is famous for a great number of things, but vegetation (particularly forestry) is not one of them. However, trees do exist in this country and pine stands and recently widsely widespread are the case descrit in this study. The aim of this study is to identify the biomonitoring of compounds such as the semi-volatile organic contaminants (SVOCs). The most common species are somewhat different from those used more frequently in these kind of studies, but offer nevertheless the same performance and possibilities. Pinus contorta, Pinus mugo, Pinus silvestris and Pinus cembra needles were collected upon availability in 24 sampling sites that included remote and rural areas but also some urban settlements like Reykjavík or Selfoss. In seven of these sites it was possible to collect needles from more than one species, allowing a comparison between their respective uptake abilities for SVOCs. In this work the levels of polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), organochlorine pesticides (OCPs) and musks were analysed and allowed an original description of the status of the art of these compounds in this remote location. Acknowledgements: This work was the result of the project: (i) POCI-01-0145-FEDER-006939 (LEPAPE – UID/EQUI/000511/2013) funded by the European Regional
WE241 Study of global diffuse pollution levels in remote high mountain areas and their impact on the organisms from these ecosystems

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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 accumulate in various organisms, including lichens, 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 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 a.s.l. 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 gillbladder 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

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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 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 accumulate in various organisms, including lichens, 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 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 a.s.l. 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 gillbladder 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.

WE243 Biological monitoring of environmental quality near a solid waste incinerator in central Lithuania

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WE244 What is it nothing: Levels of PCDD/Fs in the surroundings of a hazardous waste incinerator

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WE245 The use of land snail Cornu aspersum as sentinel organism to monitor air pollution

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The use of biodetector organisms for monitoring air pollution allow to assess real hazards 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 biodetector of airborne pollutants effects by transplanting snails in plastic cages positioned in urban area strongly impacted by several industrial activities nearby. Ten sites were selected based on emissions from both industrial and urban 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 antioxidant enzymes Catalase (CAT) and Glutathione-S-transferase (GST), lipid peroxidation (MDA) and total Metallothionein proteins content (MTs) in midgut. Results obtained by generalized linear mixed models (GLMMs) revealed significant correlations among trace metals levels and biological responses investigated and with the distance from...
WE246
The relationship between lead exposure on dogs and their behavior around Pb mining area, Kabwe, Zambia
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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 24.2 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 means of 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 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.

WE247
Monitoring and impact assessment of terrestrial ecosystem using Eisenia fetida affected by chemical incidents
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Many chemicals can be accidently spilled in the environment and it is important to know their presumable toxicities on the living organisms to determine risk assessments. There are no information on the terrestrial organisms of six chemicals possibly spilled into the environment, containing sulfuric acid, methanol, methylthylketone, nitric acid, formic acid, and toluene. In this study, we conducted acute toxicities of these six chemicals on Eisenia fetida in an artificial soil according to the OECD guideline 207. We used E. fetida adults grown in our laboratory for 10 generations in soil consisting of pig manure composts fortified with steamed sweet potatoes at 25°C. The earthworms used in this study were sexually developed with an average body weight of 100 to 200 mg. The artificial soils were composed of industrial sand (70%, 50 to 100 micron particle), kaolin (20%, pH 4.5 to 7.0), and peat (10%). After mixing the components, artificial soils were composed of industrial sand (70%, 50 to 100 micron particle), kaolin (20%, pH 4.5 to 7.0), and peat (10%). Using the filter papers, methanol and exhibited 26 fold lower acute toxicity than sulfuric acid, the strongest toxic compound. Among the tested chemicals, LC50 values, whereas pure acetonitrile was used in the control group. LC50 values of sulfuric acid, methanol, methylthylketone, nitric acid, formic acid, and toluene were 1.41, 5.71, 2.16, 1.76, 1.24, and 2.86 g/kg soil, respectively. These results are very different from the acute toxicities using filter papers, which toluene exhibited 26-fold lower acute toxicity than sulfuric acid, the strongest toxic compound among the tested chemicals. Using the filter papers, methanol and methylthylketone did not possess a negative effects on the earthworm. With these results, earthworms may act differently to the chemical incidents in relation to their residential condition when they expose to the chemicals.

WE248
Biochemical and behavioural responses in two endogeic earthworm species exposed to parathion
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The earthworm species Eisenia fetida is a common organism in the soil toxicity testing framework, however, recent studies have point out endogeic species are more sensitive to pesticide than E. fetida. Moreover, interspecific differences in the response of this ecological group of earthworms to agrochemicals should be investigated for a better understanding of pesticide impact at population level. Here, a two endogeic and abundant species in the agroecosystem (Aporrectodea chlorotica and Aporrectodea caliginosa) were inoculated in Oleabland® (ethyl parathion)-contaminated soils. Behavioural (burrowing, casting and feeding, this latter assessed through earthworm mass changes) and biochemical (acetylcholinesterase [AChE] and carboxylesterase [CbE] activities) were measured after 7 days of pesticide exposure. Our results clearly showed species-specific differences both for the behavioral and biochemical activities. Indicating A. caliginosa the most sensitive species to this pesticide under the exposure conditions of our study. Although CbE activity was determined in an attempt to account for these interspecific differences because the implication of this esterase activity in organophosphate detoxification, we found that CbE activity of both species had the OP sensitivity. However, an in vitro inhibition trial with ethyl parathion evidenced a higher sensitivity of A. caliginosa AChE activity compared with that of A. chlorotica, which suggested that this toxicological endpoint may contribute to the interspecific differences of behavioural responses such as cast production rate. Our findings suggest the use of more than one endogeic earthworm species to assess toxicity from organophosphate insecticides, overall when these earthworms have a beneficial impact on soil fertility.

WE249
Cr transport in sweet peppers plants cultivated with vermiconcompost tannery wastes
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Untreated waste 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 tannery wastes in order to investigate the role of Cr (III) and Cr (VI) in the vermiconcompost and its possible transportation through the plant, the content of 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 dynamcis of the Cr (III), root accumulation conforms a higher degree of Cr (III) and Cr (VI) uptake than the leaves. Differences in the chromium contents were not observed between samples and treatments which received vermiconcompost tannery wastes with others, without addition of chromium residues. Keywords: vermiconcompost; tannery wastes; chromium; sweet pepper

WE250
Insecticide resistance in the natural enemy E. auricularia: detoxification pathways and sensitivity of acetylcholinesterase to organophosphate insecticide
A. Le Noyenn, UAPV/IMBE/INRA; M. Siegwart, INRA Avignon / Unité PSH, Faculté de Biologie de la Production Intégrée, Site Agroparc; Y. Capowiez, INRA Avignon; M. Rault, UAPV/IMBE / IMBE UAPV UMR 7263, Pôle Agrosciences; Apple orchards are highly treated crops, in which organophosphorus (OP), neonicotinoid and synthetic pyrethroid compounds were heavily sprayed insecticides. These compounds are toxic to non-target arthropods and increase the risk of resistance making apple orchards an interesting case to study the deleterious effects of insecticides on the target species. In the context of reduced pesticide use, the development of biocontrol agents has to be promoted. This work focuses on the assessment of the resistance/tolerance to OP insecticide of the earwig Forficula auricularia, an effective generalist predator. The threshold activities of enzymes that belong to detoxification pathways involved in insecticide resistance were estimated depending on the origin of earwigs. Then, variations in those activities were assessed under environmental conditions prior and after exposure to normal application rate of chlorpyrifos. Adult earwigs were sampled in apple orchards conducted under different management strategies: conventional, Integrated Pest Management (IPM), reduced pesticide use thanks to mating...
disruption practice), and organic ones. Two frequently involved in pesticides resistance enzyme families: Glutathione-S-transferases (GST) and Carboxylesterases (CbEs) were studied, by measuring their activities on earwig 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 depends on their age. Most of the earwigs of the control group and conventional orchards. Moreover AChE inhibition increased when earwigs were exposed to both chlorpyrifos combined to a specific inhibitor of ChEs. Moreover, we observed that basal-activities of ChEs and GST of unexposed individuals are higher in conventional orchards compared to OP and organic ones. All these observations support the hypothesis of a molecular target modification in AChE to a decrease of affinity with the insecticide, and highlight the role of ChEs ensuring effective protection of AChE.

Our findings suggest the acquisition of resistance to chlorpyriﬁs 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

S. Wu, Guangzhou Institute of Geochemistry / State Key Laboratory of Organic Geochemistry; L. Zhang, 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 Quantum use of halogenated organic pollutants (HOPs), such as polychlorinated biphenyls (PCBs), polychlorinated dibenzo-p-dioxins (PCDDs), and chlorinated dibenzo-p-dioxins (PCDDs), 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 6δC 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 δ13C 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 PBDIEs 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, a 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 = 1.5-6.5), 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. Verderano, R. Scudiero, University Federico II / Department of Biology Insect repellent properties: the bioactivity of Glyphosate-based herbicide (GRH), 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 “non 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=20); group 1 and 2 were exposed to pure Gly 0.1 and 1 µL/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 luteate the nematode-shaped arrangement, at high dose the anomaly of rosettes increases. Spermatids and active sperm are damaged and 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 perfluoralkyl substances decreases according to the laying order in the yolks of yellow-legged gull eggs

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Acetylcholinesterase (AChE) activity, the molecular target of OP insecticide, and highlight the role of CbEs ensuring effective protection of AChE. In conventional orchards and point out the necessity to understand these mechanisms in order to evaluate their relevance as biocontrol agents.

In the present study, we determined the levels of PFA in three-egg clutches of the yellow-legged gull (Larus michahellis) breeding in a colony located at the Comacchio lagoon (Northeastern 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 δPFAA 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, perfluorooctanoic acid (PFOA), perfluorooctanoic acid (PFAA), perfluorooctanoic acid (PFOS) 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 (Lamarck, 1803) (Decapoda, Grapsidae) from two brazilian mangroves areas with different levels of contamination

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The crab Goniopsis cruentata is a common semi-terrestrial species in brazilian mangroves. Its geographical range includes the western 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 some regions of Brazilian coast. These ecosystems are located in regions of intense anthropic activity and have been proved to accumulate heavy metals. The use of occasional and non-availability of analytical methods allowed to outline comparisons over space and time and provides significant ecototoxicological 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, hepatopancreases and gills) of G. cruentata and compare populations from contaminated and noncontaminated areas. Samples were collected in two mangrove areas (Itapocu State of Sào Paulo and Praia dos Carretos) 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>hepatopancreases>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 (grain size, pH, salinity) that reduce the mobilization of these chemicals to the tissues 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 when consumed.

**WE255**

Maternal Transfer of persistent halogenated organic pollutants in Watersnakes (Enhydris chinesis)

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Halogenated organic pollutants (HOPs) such as polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs) and dichlorodiphenylchloroethanes (DDTs) are ubiquitous contaminants in the environment. Maternal transfer of HOPs to the offspring is a significant channel of distribution for HOPs. This channel is important for the concentration of HOPs in the offspring and its potential biological effects. Several studies are focus on viviparous species, but ovoviviparous species have not yet been studied. It is known that watersnake (Enhydris chinesis) was ovoviviparous species. Their fertilized eggs develop into new individuals in the maternal body before producing offspring. The source of contaminants in watersnake eggs mainly derived from maternal tissues. In order to fully elucidate the deposition of contaminants in eggs, Firstly, the lipid-normalized concentration ratios of egg to muscle (EMR) were usually used to assess maternal transfer efficiency of contaminants in oviparous organisms. Secondly, due to relatively high lipid and weight of egg in watersnake, the ratios of contaminant burden in egg over the sum in muscle and egg (EMER) was useful to evaluate the tissue distribution of contaminants in watersnake eggs. The values of EMR, and EMER were respectively 2.93 and 95% for PCBs and 0.35 and 68% for PBDEs. Meanwhile, DDTs, PCBs, PBDE, HBB, PBB 153 and lower-brominated BDE congeners showed the ratios of EMR and EMER higher than 1 and 88% (the lipid percentage of egg to egg plus muscle), respectively. The results indicated that these chemicals were readily transferred from muscle to egg or preferential accumulation in egg compared with muscle. Other chemicals, such as higher-brominated BDE congeners, DP, PBB209, and DBDPE, showed ratios of EMR and EMER lower than 1 and 88%, respectively, indicating less readily maternal transferred or a preference for muscle. A multi-linear relationship exists between EMER and log $K_{OW}$ of the chemicals for the watersnake. For compounds with high hydrophobicity (log $K_{OW}$ > 8), a negative relationship between EMER and log $K_{OW}$ is observed ($\rho < 0$). This result was used as an indicator of the difference between the value of land before and after transformations is representing the damages to the ecosystem quality. We performed a case study for the deployment of a 10 MW photovoltaic solar farm in the UK. The results demonstrated that the upstream life cycle processes transform 6354 m² of natural land into artificial land covers. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in about 33% compared to upstream use. The processes from $2364/ year to $1587/year, resulting in a decrease of $765/year. The majority of ecosystem service value decreases are in China, where the manufacturing processes take place. The rest of Asia, Australia, Russia and Africa also suffer from noticeable ecosystem service value decreases because of upstream production industries. Europe, where the solar farm is deployed, only suffers modest ecosystem service value decreases due to upstream processes. In comparison to other processes, this implies that despite the apparent advantages of clean renewable electricity production at the deployment location, the majority of ecosystem service damages might be relocated to other parts of the world.

**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

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The ultra trace-analysis of halogenated flame retardants (HFR) leads more and more to the question of analyzing substances of actual or future relevance such as e.g. DecaBDE Plus and other dechloranes or novel brominated flame retardants together with legacy compounds as PBDEs. In order to address this issue, comprehensive analytical methods covering at the same time compound groups of different chemo-physical properties are more and more required, especially for monitoring purposes like analyses within environmental specimen banks. The presented method is validated for a broad range of different environmental matrices (spruce shoots as representatives for plant materials, bream fillet as representative for animal tissue, herring gill eggs as representatives for bird eggs and riverine suspension) and other dechloranes or brominated benzenes and alkyl benzenes, ethers and esters (TBA, ATE, BATE, PBT, PBB, HBBz, DPTE, BEHTPB, DIDBTB, TBTBP, Dec602, Dec603, Dec604, DPMA, Cl10-antiDP, Cl11-antiDP, syn-EP, anti-EP, DBDPE). In this way, it gives an analytical basis for further extension towards other compounds, we will show details of different analytical aspects of the method, especially regarding different column chromatographic clean-up steps and use of modern analytical equipment as e.g. a GC-API-MS/MS-system, pointing out possibilities and limitations of such a broad scope of analytes.

**WE257**

A method to calculate carbon handprint

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Environmental impacts are typically assessed by measuring and modelling the negative effects that products, services and companies cause to the environment. In practice, this means evaluating the used resources and energy and the emissions caused. However, many companies do good causing climate positive environmental impacts. The strong need for communicating the positive environmental impacts has been identified e.g. by Pikkaola et al. (2010). Only, we lack systematic methods to quantify and communicate these impacts that are also called handprints. This presentation proposes a concept to assess and communicate the carbon handprint of a product. The method is in line with life cycle assessment (LCA) as its methodology and is built on the principle that reducing one’s own footprint is not a handprint. Instead, the handprint comes through improvements caused in the performance of another actor. The most fundamental parts of defining the carbon handprint are to recognize the mechanisms of forming the handprint and to define the baseline. The carbon handprint can be created via more efficient material or energy use, by reducing or avoiding unwanted materials, waste reduction or extended service life and reuse. Also carbon capture and storage is a way to contribute to carbon handprint. The paper demonstrates through case studies situations where different approach for the determination of the handprint is required. The quantification of the carbon handprint requires several carbon footprints calculated in order to find out if the new solution or product actually reduces the carbon footprint of another actor or life cycle approach. The footprints are used as target actor using the baseline solution, the new solution and the target actor using the new solution.

**WE258**

Assessing regionalised Life Cycle Assessment (LCA) and economic values of ecosystem goods and services: Impacts of upstream natural land transformations on ecosystem quality

A. Ayajeby, University of Exeter / Renewable Energy

Setting up operational and spatially-explicit sustainability assessment models with practical levels of data requirement is becoming more essential as the trend of globalising economy is surging and accounting for impacts of human activities is becoming more complicated. Here we developed a model based on regionalisation of Life Cycle Assessment (LCA) that is capable of employing a holistic perspective while taking into account natural land transformations that are related to the life cycle processes. Furthermore, our model can interpret the impacts of land transformations on the ecosystem quality. Economic values of Ecosystem Services (ES) are used as an indicator of the difference between the value of land before and after transformations is representing the damages to the ecosystem quality. We performed a case study for the deployment of a 10 MW photovoltaic solar farm in the UK. The results demonstrated that the upstream life cycle processes transform 6354 m² of natural land into artificial land covers. We also estimated that these transformations reduce the ecosystem service value of the transformed natural land in about 33% compared to upstream use. The processes from $2364/ year to $1587/year, resulting in a decrease of $765/year. The majority of ecosystem service value decreases are in China, where the manufacturing processes take place. The rest of Asia, Australia, Russia and Africa also suffer from noticeable ecosystem service value decreases because of upstream production industries. Europe, where the solar farm is deployed, only suffers modest ecosystem service value decreases due to upstream processes. In comparison to other processes, this implies that despite the apparent advantages of clean renewable electricity production at the deployment location, the majority of ecosystem service damages might be relocated to other parts of the world.

**WE259**

Recent advances in natural capital accounting


At the recent World Forum on Natural Capital (27-28 November 2017) a wide range of companies and governments whose business models are related to life cycle impacts took part in the forum. In the past, companies have good reasons to account for their environmental impacts. However, many companies do good causing climate positive environmental impacts. The strong need for communicating the positive environmental impacts has been identified e.g. by Pikkaola et al. (2010). Only, we lack systematic methods to quantify and communicate these impacts that are also called handprints. This presentation proposes a concept to assess and communicate the carbon handprint of a product. The method is in line with life cycle assessment (LCA) as its methodology and is built on the principle that reducing one’s own footprint is not a handprint. Instead, the handprint comes through improvements caused in the performance of another actor. The most fundamental parts of defining the carbon handprint are to recognize the mechanisms of forming the handprint and to define the baseline. The carbon handprint can be created via more efficient material or energy use, by reducing or avoiding unwanted materials, waste reduction or extended service life and reuse. Also carbon capture and storage is a way to contribute to carbon handprint. The paper demonstrates through case studies situations where different approach for the determination of the handprint is required. The quantification of the carbon handprint requires several carbon footprints calculated in order to find out if the new solution or product actually reduces the carbon footprint of another actor or life cycle approach. The footprints are used as target actor using the baseline solution, the new solution and the target actor using the new solution.
including all natural capital could support greater prosperity if it were more appropriately valued and hence more efficiently used. The second is governance regimes based on scientifically informed political decisions should protect natural capital. Governance of natural capital stocks should be informed by biophysical limits, potential irreversibility, thresholds and risks to essential function. At the global level, the UN Sustainable Development Goals apply to all countries and provide a foundation for such a governance framework. We are all consumers and beneficiaries of natural capital but it seems clear that SETAC members can also inform the debate. As environmental scientists we can contribute to developing an understanding of criticality – the tipping points for ecosystems, in particular where these relate to chemical pressures. There are opportunities to work with economists to ensure natural capital accounting and valuation is accurate and measurable, preferably quantitatively. One of the strongest themes was that we all need to improve our story telling across multiple disciplines and institutions.


The sustainability of hybrid-electric vehicles (HEVs) has been called into question (Bailey et al., 2017, Hickman, 2012, Publishers, 2008, Biello, 2016). With the recent onslaught of HEVs to the motor vehicle market, there is a need for the internalization of the costs—both environmental and economic—associated with one of its most valuable parts, the HEV motor. For this purpose, a screening Life Cycle Assessment (LCA) and Life Cycle Costing (LCC) study has been carried out on the entire value chain of a dismantled HEV motor. The results of this study are analyzed quantitatively. The aim is to identify bottlenecks for such a quantitative analysis as well as to identify the hotspots from both an environmental and economic point of view. Furthermore, the results will serve as one of the important inputs in laying the foundation for the development of the sustainable HEV motor. This study computes total life cycle costs of a HEV motor. The analysis considered current and operating costs in order to define the total vehicle cost of ownership over 10, 15, and 20 year life expectancies. The development of an integrated life cycle costing and life cycle analysis will allow any individual to evaluate properly tradeoffs of a hybrid-electric vehicle. Reference: G. Bailey, G. MANCHERNI, N. & VAN ACKER, 2017, Sustainability of Permanent Rare Earth Magnet Motors in (H)EV Industry. Journal of Sustainable Metallurgy, 3, 611-626

WE261 Developing a National Food Inventory to estimate the Carbon Footprint of the diet. Average Spanish, Future requirements and policy recommendations L. Batlle-Bayer, Universitat Pompeu Fabra UB / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; 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. Fullana, Universitat Pompeu Fabra UB / UNESCO Chair in Life Cycle and Climate Change Escola Superior de Comerç Internacional ESCI; R. Aldaco, Universidad de Cantabria / Department of Chemical and Biomolecular Engineering

Dietary patterns have a significant impact on greenhouse gas emissions (GHGs), and diet choices can increase or reduce the Carbon Footprint (CFP) of consumers. Recently, more research has focused on estimating and comparing the CFP of different diets; however, high uncertainty is caused by the lack of reliable, available or representative data. The current study discusses this issue on data availability, and it results from our previous study on the CFP of the annual food consumption of an average Spanish citizen. To calculate the CFP of the average Spanish dietary pattern, a list of food categories with its representative food products was formed, and an extensive literature review was done in order to build up an inventory (inputs, outputs and emissions) per each food product. The system boundaries of this study are from cradle-to-consumer, and data for all life cycle stages (crop cultivation, farming systems, fisheries, industrial processing, manufacturing, distribution and consumer use) were gathered. Furthermore, food losses and food waste along the whole supply chain were also considered. While total annual emissions, about 1.4 Tn per Spanish citizen, were considered within the use phase, this result is uncertain due to lack of representation data at National level. The proxies used to fill the data gaps were considered of good quality. However, there is a need to develop inventories for production of certain food products for which there is no inventory data available, as well as other life cycle stages, such as the wholesale & retail and the consumer phase. Furthermore, we suggest the inclusion of environmental data in food policy, for example, adding the CFP of products and dietary patterns within the national dietary guidelines.

WE262 Life Cycle Air Emissions External Costs Assessment for comparing Electric and traditional passenger cars P. Girardi, P.C. Brambilla, RSE Spa / SFE

The scope of this study is to compare the externalities of electric, gasoline and diesel motorisations of an average passenger car (aYW Gold) 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 HEV motor, the geographical area, the height of the release population; the release 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 on transport air emissions (http://www.sinanet.isprambiente.it/itia/isp/efetransp/). The usage 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 PM_{10}, PM_{2.5}, SO_x, NO_x, NH_3, NMVOC, CO_2 have been taken into account for externalities evaluations considering that more than ten thousand processes were involved, for each LCA phase accounting for more than 2% of the weighed emission of PM_{10}, PM_{2.5}, SO_x, NO_x, NH_3, NMVOC, a specific height of realisate and geographica area have been assigned distinguished by: Italy (wher car are used and most of electricity produced), Germany (where car are produced), Austria (where battery are assembled) Lybia, Algeria, Holland, Russia (where electricity is produced). With the performed calculations it is possible to compare the environmental impact of electric vehicle: Electric Golf performs better in term of external costs, mainly thanks to the minor 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 application B. De Caevel, J. Dulbecco, RDC Environment; A. Ciroth, GreenDelta; T. Huppertz, I. Descos, RDC Environment; J. Garcia, SCORE LCA

The complexity of production processes and products combined with an increased demand for commoditize environmental impact assessment has created the need 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 phase). 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 external impacts. Life Cycle Assessment has created the need 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 provide the keys to understand 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 perimeters considered for each of them. The third part presents how to implement LCC, with detailed recommendations. The fourth part presents 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. Styliaou, University of Michigan - School of Public Health / Environmental Health Sciences; V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; V.L. Fulgoni III, Nutrition Impact, I. Descos, RDC Environment; J. Garcia, SCORE LCA

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. A study, performed in 2015, estimated that 1.9 million deaths are attributable to the consumption of processed meats. The complexity of production processes and products combined with an increased demand for commoditize environmental impact assessment has created the need 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 phase). 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.
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 demonstrates 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 impacts in LCA. CFs are estimated by coupling age- and gender-adjusted nutrient-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 v5.1, 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 combined model that most precise FU is to compute protein sources based on the consumption of all food items and diets in LCA. Expanding this approach to various food items 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 food items and diets in LCA. Expanding this approach to various food items could help decision-makers and consumers not only make better comparisons but also identify sustainable food items and adopt sustainable diets.

**WE267**

The safe and sustainable loops framework for assessing residual material flows


The circular economic system was developed to foster an industrial system that is restorative or regenerative by intention and design. An obstacle in the transition to such a system is that restoration of materials by reuse or recycling is subjected to safety legislation with an origin in the linear economy. In order to combat this obstacle, a shift is required from a purely safety based assessment to a more holistic assessment focused on sustainable development. Such a holistic assessment would impact both the absolute safety assessment, a requirement by law, with an assessment of the relative benefit that reuse of material flows have on all aspects of sustainability. However, assessing all aspects of sustainability is not practical for final decision making or feasible, considering the state of development of the tools, methods and data availability. Assessments of current recycling options are mainly focused on safety risks towards the environment and human health. Here we propose a first step in including environmental impacts or benefits related to closing material loops and increasing material value. This step is part of a bottom up approach to a more holistic methodology. It holds a novel framework (Safe and Sustainable Loops, SSL) aimed at assessing the safety as well as the sustainability changes of residual material flows within a clearly defined scope. In the Netherlands specific end of waste criteria can be applied to make the use of residual material flows as a resource. Furthermore, SSL forms a step in the construction of themes that are important in the choices regarding derogation of residual material flows for new applications. These themes are the building blocks of the framework, the modules. In theory, the framework itself is the backbone that connects these modules together. The current themes which are developed into modules are: Substances of very high concern (SVHCs), Pharmaceutical residues, Pesticides, Pathogens, Antimicrobial resistance, Circularity and Environmental Sustainability. These were selected for the first iteration of the framework because of their relevance for assessing risks and benefits of residual material flows during the past few years. The aim of this approach is to allow a level playing field using a generic framework with modules based on lessons learned from earlier cases.
framework which links measurable metrics of impact to value terms that resonate with the public, and reflect value statements made by the community. When the trade-offs are considered, it is important to consider the needs, demographics and vulnerabilities of a diverse population. Sustainability and ES concepts can and should be support environmental decision making; the application of threshold criterion ensures ‘strong’ sustainability in which environmental considerations are not ignored. The consideration of the environmental framework which guides stakeholders to consider the extent to which they prioritize impacts to all (rather than just a narrow sub-set) of their values provides for a balanced public comment process, less subject to single- or narrow-issue lobbying. Identification of the risks and benefits of most interest to stakeholders also can support negotiation and optimization of alternatives under consideration, support collaborative design of more sustainable options and help inform the design of a long-term monitoring plan that addresses community values. The goal should be to envision a sustainable approach from the beginning of a project with a collaborative input from a large group of stakeholders, supporting informed, transparent, and balanced decision making that protects services of importance to the community. Tools and approaches, and the path forward, will be discussed.

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 *E. 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. Henrique, 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 at assess if an amphibian skin bacterium could increase its tolerance to NaCl after long-term exposure to low levels of salinity. *E. 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; 18g/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 PGM nucleotide sequencing method (BOX-PCR). Results of growth showed that long-term exposure to NaCl slightly increased the tolerance of *E. toletana* to this salt, EtC₀ for growth were: 22.5g/L (8.64-36.4) for Et-LB; 30.3g/L (23.2-37.4) for Et-NaCl, and 26.1g/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** Impact of agriculture brackish effluents in saline ecosystems: when the low salinity cannot be an advantage but an impact


Salinity is a major indicator of the relative factors of soil and water degradation worldwide. Anthropogenic salinization due to the use of low quality water and/or over-irrigation 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 salinize normal soils, they can degrade saline wetlands by decreasing the native soil salinity. This work reports 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. The latter led to an increase of flooding periods, a decrease of soils salinity in the low salinity sites and an increased 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 vegetation 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.

**WE271** Context dependent toxicity - do ecological interactions alter the effects of salinity on stream macroinvertebrate communities?

B.J. Jefford, J. Reich, J. Bray, University of Canberra / Institute for Applied Ecology.

The effect 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 the way species are formed via interaction between species 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.
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, phosphorous 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 hierarchical partitioning with ecological quality indices based on invertebrates (% EPT, MMI, ASPT, BMWP, GSI, 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 a threat to the worst and most different water quality standards (USA, UAE, EU). Although observed associations may not be direct causes of ecological impairment, it 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 oxygen value for chloride (200 mg/L) that should not be exceeded to achieve good ecological status according to the water framework directive. Thus, lowering of the chlorine/ oxygen ratio of associated species should be considered and protect and restore stream biodiversity. Moreover, the results suggest that preventing release of poorly treated wastewater should be prioritized over up-grading of well-functioning treatment plants.

WE274
Estimating protective potassium concentrations for freshwater mussels, a taxon of global conservation concern T. Augspurger, U.S. Fish and Wildlife Service / Ecological Services Globally, 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 water 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 endangered mussels necessitated derivation of protective potassium limits (because there is no current or standard). Although observed associations may not be direct causes of ecological impairment, it 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 oxygen value for chloride (200 mg/L) that should not be exceeded to achieve good ecological status according to the water framework directive. Thus, lowering of the chlorine/oxygen ratio of associated species should be considered and protect and restore stream biodiversity. Moreover, the results suggest that preventing release of poorly treated wastewater should be prioritized over up-grading of well-functioning treatment plants.

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) F. Cacchiarelli, ISPRRA-Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; A. Bonometto, A. Feola, E. Ponis, ISPRRA Institute for Environmental Protection and Research; A. Sfriso, University Ca Foscari di Venezia; B. Matticchio, IPROS; M. Lizier, 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 landward areas due to lack of ecological coherence, favours self-regulation processes, between lagoon and mainland. In the past, the protected 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 recreation of favourable habitats for faunal species of community interest. The project actions involve: diversion of a freshwater flow from the Sile river into the lagoon (necessary for the recreation of the typical salt gradient of buffer areas between lagoon and mainland); restoration of intertidal morpholgy 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 spatially-distributed effluents and synthetic solutions (e.g., NaCl/CaCl2) of systesm to: counteract the depletion of lagoon bottom and fish communities; reduce eutrophication through reedbed phytoremediation function, favouring the presence of sensitive species and high ecological value aquatic plants; improve conservation status of bird species, including those listed in Annex I of the Birds Directive; increase the presence of fish species, listed in Annex II of the Habitats Directive. The restoration of salinity gradients will also contribute to increase biodiversity on the Natura 2000 network site, and to help achieving targets defined by the 2020 Biodiversity Strategy.

WE276
Comparing the growth of fescue and clover plants in petroleum industrial effluents and solutions of similar salinity P. Srikhumsumuk, University of Strathclyde / Department of Civil & Environmental Engineering; C. Knapp, J. Renschaw, University of Strathclyde / Civil and Environmental Engineering

Effluents (produced and flow-back waters) from the petroleum industry have been investigated for their potential toxicity to the environment, particularly regarding to chemical composition and salinity. The purpose of this study was to investigate whether their toxicity is any greater than exposure to solutions of similar salinity. The tolerance of Festuca rubra L. (fescue) and Trifolium pratense L. (clover) were investigated for 8 weeks under hydroponic conditions to compare their growth in brine effluents from tertiary recovery operations. Experiments further compared serially-diluted effluents and synthetic solutions (e.g., NaCl/CaCl2) of similar salinities. There were different growth responses to the wastewater and saline solution among both plant species. F. rubra was exhibited a significant higher survival percentage than T. pratense. After four weeks of exposure, T. pratense exhibited greater sensitivity and lethality. Interestingly, biomasses of both plants were greater from industrial wastewater than the comparable brine solution. Although the tertiary wastewaters contained abundant inorganic and organic substances that may have triggered plant survival and salt-tolerance, F. rubra grew under salts stress, and presented a mechanism to crystalize 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) A. Tomaz, S. Fialho, A. Lima, Instituto Politécnico de Beja; A. Penha, H. Novais, M. Potes, M. Iakunin, G. Rodrigues, Instituto de Ciências da Terra; P. Alvarenga, L. Ferreira, Centro de Investigação e Desenvolvimento Agrícola; Ph.D. Tiago Salgado, Instituto de Ciências da Terra; P. Palma, Instituto Politécnico de Beja / Department of Technologies and Applied Sciences

In Mediterranean regions, climate changes have enlarged water limitation for agriculture. Therefore, it is very important to assess the quality of irrigation water 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 (ECₐ), 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 crustling problems, as well as, potential yield reductions in the most significant crops of the Alqueva perimeter. Higher ion concentrations in water salinity may select water salinity or atmosphere evaporative 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
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Hirschberg 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 default diet compositions in the first tier risk assessment. The so-called PD factor (composition) is a portion or portion of the standard refinement parameters which intend 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 field studies are based on collated 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 default residue levels for different taxonomic units (dicotyledonous plants or monocotyledonous 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.

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 generated under multiple conditions in stress and toxicity tests. While vertebrate species are usually well-known; there is a lack of information on invertebrates. The study of the later 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. A total of 42 of these genes were selected as reference to design an array for Real-Time PCR analysis. Stress response, detoxification mechanisms, endocrine system, or epigenetics were some of the pathways analyzed in the array. In order to validate the toxicological and ecological interest of this approach, individuals were treated with an antibiotic, tetracycline, for seven days or were left starving for 7 and 10 days. The results obtained for these experiments are presented, showing the interest of designing specific arrays to perform more detailed analysis of molecular endpoints that can be related with toxicant mode of action and stress situation. We hope that the methodology presented here can serve as an example for the study of other species in order to improve our knowledge of their biology. This work has been funded by the Ministerio de Economía y Competitividad, CICYT (Spain), CTM2015–64913-R.

WE281 Effects of temperature on the transcriptome of the marine copepod Temora longicornis
J. Semmourow, Ghent University (UGent) / Animal Sciences and Aquatic Ecology; J. Andaeslem, Ghent University / Laboratory for Environmental Toxicology and Aquatic Ecology; G. Janssens, Ghent University / Applied Ecology and Environmental Biology; K. De Schampaert, Ghent University (UGent) / Applied Ecology and Environmental Biology
Over the past decades, the world's oceans and seas have been influenced by several human induced impacts, including climate change. In the North Sea region, the average sea surface temperature of the water has already risen between 1.2°C over a time period of twenty-five years. This rise is likely to continue. Understanding the impacts of this changing environmental condition in zooplankton communities is crucial, as alterations in the zooplankton communities can affect entire marine ecosystems. Here, we focus on the potential effects of an increase in temperature on the calanoid copepod species, Temora longicornis, the dominant zooplankton species of the southern part of the North Sea. Since responses to environmental stress are genome-driven, a genetic study on the physiological responses to thermal stress can provide an increased mechanistic understanding and help predict potential responses to climate change in this copepod species. Therefore, we sequenced the whole transcriptome (using RNA-sequencing technology) in T. longicornis, after being exposed to thermal stress, to investigate gene expression differences as a response to temperature fluctuations. As such, this dataset will provide a valuable tool for understanding how temperature driven, a genetic study on the physiological responses to thermal stress can provide an increased mechanistic understanding and help predict potential responses to climate change in this copepod species. Therefore, we sequenced the whole transcriptome (using RNA-sequencing technology) in T. longicornis, after being exposed to thermal stress, to investigate gene expression differences as a response to temperature fluctuations. As such, this dataset will provide a valuable tool for understanding how temperature

WE282 A conditional approach to modern endpoints - quantitative assessment of stress gene expression response to a range of copper concentrations in the freshwater mussel Anodonta anatina
G.M. Ekelund Ugge, Lund University / Biology; A. Jonsson, University of Skövde / Department of Bioscience; O. Berglund, Lund University / Dept of Biology
In the field of ecotoxicology, modern transcriptomics technologies have the potential to improve and complement current toxicity assessment methods and biomonitoring protocols. Early warnings of general stress and specific toxic modes of action could in theory be used as biomarkers of pollutant exposure or adverse effects. However, necessary base level understanding is currently lacking considering how gene expression may vary under realistic exposure scenarios. Therefore, we adopted an approach of quantitative assessment as an alternative to more descriptive methods. We chose the freshwater mussel Anodonta anatina as our model organism. Being a stationary filter feeder, it shows promises for use in exposure studies under both laboratory and field conditions. Furthermore, it is the most abundant freshwater mussel species in Sweden, and occurs in freshwater ecosystems over most of Europe. For the present study, mussels were collected locally in Vinné (southern Sweden), on a location free from point source pollution. After two weeks of acclimation to laboratory conditions, mussels were exposed for 96 h to one of three copper treatments (nominal concentrations of 1, 10 and 100 μg Cu²⁺), or a control treatment (n= 5 per treatment). Using RT-qPCR, relative expression of a selection of general stress genes will be quantified in extracted digestive gland and gill tissue. Preliminary data will be presented, testing the hypotheses that the amplitude (fold-change) of relative expression differs (i) between treatments of the same gene, and (ii) between two genes in the same treatment. Results from this initial experiment will be used to design a follow-up experiment, in order to test the dose-dependence of gene expression responses. Gradually, successively increased exposure scenario complexity (e.g. duration, chemical composition) will help us to better understand how expression patterns potentially vary under environmental exposure. By subsequent incorporation of biochemical and physiological biomarkers, we also aim to link stress gene expression patterns to effects at higher biological levels. Ultimately, a more thorough understanding of natural and pollution-induced variation in gene expression may allow transcriptomics to be usefully and successfully incorporated into various ecotoxicological assessment protocols.

WE283 Validating a contamination assessment tool from lab to the field: Folsomia candida exposed to a fungicide-based formulation
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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 action, spinosad and indoxacarb. Therefore, in the present work, we investigated metabolic perturbations in juvenile gill-head bream (Sparus aurata) exposed over 14 days via the water to BP-3 (50 mg/L). Liver and brain were collected prior to dosing and on exposure days 2, 4, 7 and 14 from control and exposed (n=10) animals. Samples were flash frozen and then stored at -80°C until analysis. Methanol:chlorform (80:20, v/v) mixture was used for non-selective extraction of fish tissues and subsequent non-target analysis was performed by means of UHPLC-Orbitrap MS in positive and negative modes with both C18 and HILIC separation. Metabolites were identified using Compound Discoverer (Thermo) interfaced to MZmine and the statistical data treatment was carried out with R software. Mortality was not observed during the experiment, and no statistical changes in fish weight, fish length, condition factor and hepatic somatic index were observed regardless of tank or dosing period. First of all, using sequence quality control samples, data had to be corrected to remove the effect of injection order. On the other hand, since some metabolites were significantly affected by the experimental conditions, we applied a targeted approach to identify metabolic perturbations in gilt-head bream. Specifically, the time-series statistical analysis was carried out to identify the major trends (adjusted p-value < 0.05) associated with the interaction between exposure day and animal group (exposed or control). Metabolites driving group separation were further investigated using the Kyoto Encyclopedia for Genes and Genomes (KEGG) in order to determine affected pathways. Overall, these data demonstrate the potential of metabolomics to detect biological responses to environmental contaminants. Keywords: Benzophenone-3, gill-head bream, non-target metabolomics.

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WE288

EFFLUENTS FROM PULP AND PAPER MILLS PROMOTE METABOLIC ALTERATIONS IN LIVER AND GONADS OF FISH

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Effluents from pulp and paper mills are internationally recognized as containing toxic substances with properties to alter the reproductive capacity of fish. The objective of this study was to evaluate the metabolic modifications (using metabolomics tools) of fish gonads and liver (Danio rerio) exposed to effluents from two different paper industries. The impact of the embryonic (embryo) and larval (postembryonic) stage of fish on the effluent was studied by incubating Danio rerio larval fry for 12 days in a semi-recirculating system with two effluents from industrial sites, one with an acute toxicity (1 mg/L) and the other with no toxicity (5 mg/L). The results showed that the exposure to the toxic effluent induced significant changes in the metabolic pathways associated with glucose and lipid metabolism, as well as changes in the expression of genes involved in the stress response. These findings suggest that effluents from pulp and paper mills can have significant impacts on the health and reproduction of aquatic organisms, and that further research is needed to understand the mechanisms underlying these effects.
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 point to the alteration of their reproductive capacity.

**WE289**

**Developing biomarkers of sewage effluent exposure in the freshwater amphipod Gammarus fossarum**

D.R. Caputo, University of Portsmouth / Biological Sciences; T. Werner, Ecotoxic Centre and Environment and Resource Engineering Department of Anatomy Physiology and Cell Biology; S. Robson, University of Portsmouth / School of Pharmacy & Biomedical Science; A. Ford, University of Portsmouth / Biological Sciences; S. Schade, Birmingham University / Biosciences; N. Taylor, Cambridge Environmental Assessment Centre SEAC; J. Colbourn, M.R. Viant, University of Birmingham / School of Biosciences

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 (WWTPs). Amphipods were sampled from a freshwater stream located in Elgg, Switzerland in September 2017, using standard kick-net method. This stream flows through an 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 sexes and females, sampled upstream and downstream were used to get 20 samples containing total RNA. A subsample of amphipods was collected for transcriptomic analysis and additional samples were fixed to record population markers, such as sex ratio, fecundity rate and potential interspecies phenotype transferabilities. 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 expression and metabolomic data will be performed, to further 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**

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The adverse outcome pathway (AOP) concept represents a framework to organize mechanistic understanding of toxicological interactions by causally linking critical molecular key events (KE) 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*, applying a multi-omics approach, to further understanding of the biological functions impaired after algal wastewater exposure. The approach towards achieving this end was a suite of targeted (direct-injection mass-spec, DIMS; RNA sequencing) and targeted (LC-MS/MS, -UV, qRT-PCR) metabolomics, lipidomics and transcriptomics technologies. The methodology enabled us to profile the concentration- and time-response profiles of molecular signatures from algae exposed to non-specific mechanism (baseline toxicity) and target-specific mechanism (carotenoid biosynthesis inhibition) toxicants. To enable this work, a rigorously controlled algal culturing and testing system was optimised regarding growth rate, final cell density, pH stability, cell cycle synchronisation, reproducible exposure to volatile chemicals, and rapid quenching and harvesting of biomass for omics data collection. Furthermore, a unique multi-phase experimental design was developed for rapid identification (untargeted), characterisation and verification (targeted) of putative KEs over a time-course design. Multi-omics data from toxicant-exposed *C. reinhardtii* were collected and initial progress made towards computational analysis, putative KE designation, and targeted verification of identified biomarkers. With this study, a powerful experimental approach for hypothesis-free KE discovery and AOP hypothesis is being developed, employing omics-driven algal phenotyping to advance the integration of omics data into AOP development and ultimately, to provide mechanism-based support for regulatory decision-making in environmental risk assessment.

**WE291**

**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 µgL) and Pb (5, 25 µgL) both individually and in a binary mixture. After a 14 day exposure, a number of physiological and molecular parameters were assessed. This included: environmental stress hormone, metabolic and cellular activities, inductions or depletions 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 µgL 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 different genotoxic relationship of treatments and the highest binary mixture exposure (32, 25 µgL Cu and Pb, respectively). Mussels exposed to 25 µgL 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 mussels’ 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**

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Current regulatory toxicity testing methods have become unsuitable for the thorough assessment of chemicals for commercial use, as lack of insight into toxicological mechanism prevents accurate predictive risk assessment. Adverse outcome pathway (AOP) concept is a framework for collating mechanistic data from a diverse range of methodologies, including *in silico* and *in vitro* approaches, for use in regulatory decision making. The aim of this work was to develop and test a more comprehensive experimental design, for the targeted characterisation of key events in the toxicological response of *Chlamydomonas reinhardtii* upon herbicide exposure, thereby contributing to the development of a quantitative AOP. Here we present how an initial hypothesis for an AOP was created from available literature evidence, with focus on ‘omics and multiple-endpoint assay data, for the selected herbicide, norflurazon. This hypothesised AOP allowed development of targeted assays for investigation of predicted key events in a time- and concentration-response methodology. LC-UV was used to monitor suspected toxicological markers, the carotenoid biosynthesis pathway (phytoene, phytofluene, b-carotene). qPCR was used to identify differential mRNA expression of chloroplast-specific thiorodoxin PRX1, and a lipid peroxidation assay was applied for determining downstream effects of non-specific oxidative stress. A concentration- and time-dependent response in phytoene accumulation was observed, whilst concentration dependent b-carotene depletion was shown at later times and 24 hours post exposure. CAR was identified within an hour of exposure, whilst lipid peroxidation occurred between 4 and 24 hours post-exposure. Significant (p < 0.01) effects on cell number, an adverse outcome, were observed at 2000µg/L after 24 hours. This study highlighted the necessity for use of synchronous algal cultures for AOP development and ultimately, to provide mechanism-based support for regulatory decision-making in environmental risk assessment.
WE293
Effects of water-borne benzo[a]pyrene on early-life stages of the fathead minnow (Pimephales promelas)
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Polycyclic aromatic hydrocarbons (PAHs) are a class of ubiquitously distributed environmental pollutants that mainly originate from petrogenic and pyrogenic sources such as combustion of fossil fuels and other organic material. Various PAHs, including benzo[a]pyrene (BaP), have been demonstrated to cause a wide range of effects in exposed wildlife, including alterations of immune responses, impaired development and reproduction, as well as mutagenesis and carcinogenesis. Most studies to date, however, have used comparably high exposure concentrations, dietary routes of exposure or intraperitoneal injection to administer BaP, and knowledge of low-dose effects at concentrations around water solubility (approx. 4 µg/L) is generally limited. This route of exposure, however, must be considered highly relevant in light of the distribution of PAHs even into remote aquatic systems. To bridge this knowledge gap, early-life stages of the fathead minnow (Pimephales promelas) were exposed to waterborne BaP as a model compound to characterize toxicity pathways that drive the sensitivity of early-life-stage fish to PAHs. Molecular responses at the whole transcriptome, proteome and metabolome level will be investigated at the swim-up stage, and quantitatively correlated with effects on aipical (growth, survival, development), histopathological, and biochemical endpoints 28 d post-hatch. The data generated within this experiment will help to better understand the relevance of aqueous exposure to BaP specifically, and PAHs in general, and provide important insights into the relevance of molecular responses in early-life stages as early-warning biomarkers for apical outcomes in juvenile and/or adult fish. This study is part of the EcoToxChip project (@ecotoxchip).

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
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GhEnToxLab unit; P. Alleström, Norwegian University of Life Sciences; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

Daphnia magna is used in toxicoLOGY and environmental science as a monitor for ecosystem health. Epigenetic analyses 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 incorporated Hi-C and ChIP-seq data 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 of choice for analyzing the genomic localization of histone modifications. Exposure to the well-known epigenetic modulator, the DNA methylation inhibiting agent 5-Aza-cytidine, resulted in a global reduction of DNA methylation in Daphnia magna. One target, H3K4me3, 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-Aza-cytidine exposure when characterizing epigenetic stress response in D. magna. Acknowledgements: funding from the Norwegian Research Council (NRC) project 222628 (CERAD).

WE297
Role of microRNAs in the response of the European eel Anguilla anguilla to water pollution
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MicroRNAs (miRNAs) are a class of small non-coding RNA. These 20-24 nucleotides-long sequences associate with the 3’-untranslated region (3’-UTR) of target messenger RNAs (mRNAs), and post-transcriptionally regulate the expression of numerous genes by mediating translational repression or mRNA degradation. In mammals, more than 50% of mRNAs are predicted to be the subject of miRNA-mediated control. One miRNA may regulate hundreds of target mRNAs, and one mRNA may contain multiple binding sites for multiple miRNAs, thus resulting in a complex regulatory network. Although miRNAs are involved in regulation of almost all cellular processes, such as development, growth, apoptosis, immunity and maintenance of tissue-specific function, mechanistic aspects of this regulation are not fully understood. In human, the aberrant expression of miRNAs has been linked to various diseases and toxic environmental factors such as heavy metals. The aim of the study was to identify miRNAs with miRNA expression profiles that correlate with PAH exposure in a well-characterized model organism. The first aim of the present study was to identify miRNAs in the European eel Anguilla anguilla by using next generation sequencing. We identified 210 evolutionarily conserved and 145 novel miRNAs. Amongst these 375 miRNAs, 242 were predicted to be able to interact with 3,637 transcripts in the previously described A. anguilla’s transcriptome. No gene ontology, nor metabolic pathway, was significantly enriched in the list of target genes, suggesting that miRNAs might affect any biological process. Our second aim was to compare the differential expression of miRNAs between a pristine site located in Arcachon bay and a polluted site in the Gironde estuary (France). Nineteen miRNAs were up-regulated and 22 were down-regulated depending on the pollution profile. This approach may provide evolutionary novel molecular markers and the comparison of miRNAs regulation with classical transcriptomic studies are likely to reveal new aspects of the toxicology mechanisms involved between environmental factors and diseases etiology.

WE298
Exposure to copper during embryogenesis caused temporary increased tolerance in two subsequent generations in the three-spined stickleback (Gasterosteus aculeatus)
L.V. Laing, University of Exeter / Biological Sciences; H. Littler, J. Fitzgerald, University of Exeter / Biosciences College of Life and Environmental Sciences; N. Bury, Kings College London; R. van Aarle, Centre for Environment Fisheries and Aquaculture Science / Biosciences College of Life and Environmental Sciences; R. Wilson, University of Exeter / Biosciences; J. Mill, University of Exeter / Exeter Medical School; E.M. Santos, University of Exeter / Biosciences College of Life and Environmental Sciences

The sustainability of fish populations in our increasingly polluted environment is critically dependent on their ability to adapt via (epi)genetic mechanisms. Copper is an essential element but when present at high concentrations in the water it can become toxic to aquatic organisms. Recent studies in the UK suggest that copper is the most significant metal pollutant threatening fish in UK freshwaters. We conducted a series of copper exposures in stickleback to investigate whether prior exposure can result in altered susceptibility in subsequent generations. Stickleback embryos were exposed to 0.015mg/L copper during early life (9-dpf), causing ~1.2% mortality, ensuring that selection for a tolerant genotype did not occur. They were then kept under control conditions until sexual maturity. Copper pre-exposed fish were shown to have a significantly higher basal copper tissue burden as adults; and upon re-exposure, they showed a differential response compared to control fish. Mortality curves on F1 embryos revealed that embryos originating from parents who were exposed to copper during embryogenesis were significantly more tolerant to copper when compared to controls. This copper tolerance was shown to be still apparent in subsequent generations. Stickleback impose a major threat to native fish populations and decrease the sustainability of native fish populations. Our findings demonstrate that early life copper exposures can cause long-term increased tolerance in subsequent generations of the three-spined stickleback. Stickleback impose a major threat to native fish populations and decrease the sustainability of native fish populations. Our findings demonstrate that early life copper exposures can cause long-term increased tolerance in subsequent generations of the three-spined stickleback.

Emergence and multidimensional interactions of engineered nanoparticles in toxicity (P)

WE299
Do global warming increase bioaccumulation of copper nanoparticle in

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SETAC Europe 28th Annual Meeting Abstract Book
particular, the Trojan horse effect has been investigated in this study, in order to present a long potential toxic effects, transfer in the detected in aquatic organisms, there is a lack of data on their bioaccumulation, nanotechnology. Although both fullerenes and carbon nanotubes have been described in the relationship between changes in contaminant and NM uptake, bioconcentration, and toxicity. The specific aim of the review was to describe more specifically the interactions that have been observed and to classify the most common mechanisms. As the literature evaluation demonstrated, the existing evidence for interference of NM with the uptake of chemicals and NM: (1) increase in accumulation and toxicity (2) increase in accumulation and no change in toxicity (3) increase in accumulation and decrease in toxicity (4) no change in accumulation and toxicity (5) no change in accumulation and decrease in toxicity (6) decrease in accumulation and increase in toxicity. However, we assume that these observations were caused by different underlying mechanisms and processes, hence we developed a process-oriented, tiered approach considering (1) Adsorption / Interaction between NM and chemicals, (2) Uptake of NM by organisms, (3) Desorption of chemical inside / outside the organism, and (4) Toxicity. A review of the existing literature on mixture effects of nanomaterials (NM) and chemicals in environmental organisms was conducted in order to evaluate the current state of knowledge. More than 120 studies were assessed to explore the relationship between changes in contaminant and NM uptake, bioconcentration, and toxicity. We propose: (1) Trojan horse (+) (2) Trojan horse (-) (3) Surface enrichment (4) Retention (5) Inertism (6) Coalism The poster will present in detail the characteristics of the 6 groups and the criteria that were used for the assignment of datasets. All in all, this in-depth analysis of mixture datasets underline the importance of a process-oriented approach in the elucidation of specific mixture effects. The tiered approach results in a consistent terminology to unambiguously describe the different mechanisms of mixture effects that may occur in environmental organisms. Acknowledgement - DK was partially funded by the German Federal Ministry for Education and Research (BMBF) in the frame of the DaNa2.0 project (Data and knowledge on nanomaterials), grant no. 03X0131.

WE301 Investigating the Trojan horse effect of nanoparticles on an aquatic community - An outdoor mesocosm study T. Strauss, Research Institute gaiac; gaiac - Research Institute for Ecosystem Analysis and Assessment and S. Claessen, Research Institute gaiac; T. Knautz, M. Hammers-Wirtz, Research Institute gaiac; gaiac - Research Institute for Ecosystem Analysis
Carbon based manufactured nanomaterials (C-MNMs) are promising materials in nanotechnology. Although both fullerenes and carbon nanotubes have been detected in aquatic organisms, there is a lack of data on their bioaccumulation, partitioning, and toxic effects. The study of the fate of these materials in the food chain, and the potential of them to act as anthropogenic pollutants. Most effect studies performed until now dealt with waterborne exposure of single species for short time periods in the laboratory. Here, we present a long-term experiment under environmentally relevant conditions. In particular, the Trojan horse effect has been investigated in this study, in order to obtain more data on the interaction between nanoparticles, other pollutants and biota. In principle, pollutants can become more bioavailable by adsorption to carbon-based nanomaterials. In addition, a spatial transfer of contaminated nanoparticles from the water phase to the sediment could increase the exposure to benthic macroinvertebrates but might also reduce the effect on the planktonic organisms. An outdoor freshwater mesocosm study was conducted with C60 fullerenes and the biocide triclocarban (TCC) using twelve outdoor ponds with a water volume of 3 m3. In addition to uncontaminated controls, both substances were tested alone and in combination. The aim of this mesocosm study is to investigate long-term effects of C60 fullerenes on the community level and to assess their potential to affect the toxicity of TCC. In this outdoor mesocosm study direct and indirect effects on single species as well as on community level endpoints like diversity were evaluated. The taxonomic groups of interest were cladocerans, zooplankton (e.g. Daphnia species), and macroinvertebrate species (e.g. chironomids, mayflies, oligochaetes, leeches). Different sampling techniques were used in order to include macroinvertebrates living on and within the sediment as well as hatching insects. In this presentation the results of the mesocosm study will be presented. This work has been supported by the German Federal Ministry of Education and Research (BMBF) as part of the Nano-transfer project.

WE302 Nano silver based products and environmental challenges: toxicity and accumulation in a marine sentinel species G. Liberti, University of Siena / Department of Physical, Earth and Environmental Sciences; A. Ale, Inali-Conicet; C. Jimena, Instituto National de Linnomología (CONICET-UNL); 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 sentinel species as the Mytilus galloprovincialis in terms of biological responses and Ag accumulation. Animals were 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 (NRR) and micronuclei frequency (MN) were measured in mussel’s hemocytes. Catalase (CAT) and glutathione-s-transferase (GST) activities were assessed 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 exposure to AgNP, though no statistical significance in terms of 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. Rebello Costa, Department of Biology & CESAM - University of Aveiro / Biology; C. Quintaneiro, Department of Biology & CESAM - University of Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; I. Lopes, University of Aveiro / Department of Biology & CESAM, 3810-193 Aveiro
The gold nanoparticles are widely used in medical therapy and cosmetics. A review of the existing literature on mixture effects of nanomaterials and chemicals indicates 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 before their use by society at a large scale, since they will ultimately be released in the environment. Thus, the aim of this study was to determine the effect of gold nanorods (Au-NR, 45nm) in the feeding rate, growth and oxidative activity of the frog 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/mL 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) was 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 LDH activity. Furthermore, an example of reactive oxygen species (ROS) may have led to the inactivation of catalase and the induction of an oxidative stress 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 (e.g. impairment of 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

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The disposal of various plastic nanocomposites containing multiwalled carbon nanotubes has been reported only in the last decades. Thus, wMWCNT 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. wMWCNT undergo thereby structural changes compared to their pristine state, like formation of hydroxyl and carboxyl groups on the surface of the wMWCNT. As a consequence, weathered wMWCNT (wMWCNT) have altered agglomeration–dispersion characteristics compared to pristine 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/TCC and 0.1–16.0 mg/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 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 to toxic effects only in the absence of TCC. The mixture test could be shown to 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 respect to long-term incubation times and low wMWCNT amounts. Acknowledgements The work is supported by the European Project “EN2O-Transfer” that receives funding from the Bundesministerium für Bildung und Forschung (BMBF) under agreement with the FP7 ERA-NET SIENN.

WE305 Comparative assessment of the interactive effects of Carbon-based nanoparticles and Benzo(a)pyrene on zebrafish embryos

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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). As model organism, this aim to determine the effects of both CNMs 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 of 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 distinct 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 response pathways were activated and that the CNMs were not covalently linked to the hydrocarbon. The CNPW 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 nanoparticle on Hemocytes of mussel Mytilus galloprovincialis

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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 µg/mL). Subsequently, a statistical analysis was performed in order to detect significant differences. The use of iron oxide nanoparticles (IONPs) as an environment remediation tool is increasing number of studies are aiming to investigate the effects and mode of action of engineered nanomaterials (ENM) in this way. However, a systematic assessment of the outcome of these studies in order to identify common responses between pollutants and CNMs which could be not s...
assays taking also into account the predicted adsorption of Zn. The ha-IONPs concentrations used were 0.45 μg/L and 0.52 μg/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 24 h in terms of IC_{50} (0.006 μg/L vs. 0.010 μg/L with and without ha-IONPs, respectively). However, the shape of the dose-response curve became shallower (e.g., the IC_{50} for Zn was 0.070 μg/L with and without 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, IONPs 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 EC_{50} value for Zn increased from 0.23 mg Zn/L to 1.11 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 accumulation 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 products, safer use, and safer production process. Graphene-related nanomaterials (GRMs) are among the newest and most important NMs. However, if adsorbed on NMs, IONPs interact with the environment by increasing their uptake inside the cell, allowing a deeper and complete analysis of their interactions and toxicological properties. In this study, we evaluated the internalization of different forms of GRMs, including single-walled carbon nanotubes (SWCNTs), multi-walled carbon nanotubes (MWCNT) and graphene oxide (GO) in fish hepatocytes (derived from topminnow (Cyprinodon variegatus)). GO was chosen because in the presence of serum proteins, GO has attracted great interest in the development of new biomedical applications. In this study, GO was selected as a model material to assess the internalization process of graphene-related nanomaterials (GRMs) in fish cells. For this purpose, we compared the internalization of GO with that of CNTs and SWCNTs.

WE310
Molecular mechanism and physicochemical properties of Cadmium-TiO2 nanoparticle mixtures when co-exposed to the nematode Caenorhabditis elegans
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The number of engineered nanomaterials (ENMs) is rising continuously in consumer products and industrial fields. Therefore, knowledge about their ecotoxicity in aquatic and soil systems is very important but rare. Nanoscale titanium dioxide (nanoTiO2) is probably among the most relevant ENMs with a projected accumulation rate in European river sediments of 1.4 mg kg^{-1} yr^{-1} (Gottschalk et al., 2009). In addition, the use of TiO2 in two freshwater animals in combination with cadmium (Cd) has been associated with the nematode Caenorhabditis elegans than bulk TiO2, especially under simulated solar radiation (SSR), probably a consequence of its photocatalytic property. Further experiments by Samet (2017) focused on the interaction of TiO2 with cadmium (Cd), another environmental contaminant. C. elegans was exposed to nanoTiO2, Pb2+ primary particle size of 21 nm) and Cd in single and co-exposure for 72 h under dark conditions and SSR. Choosing growth and reproduction as toxic endpoints, co-exposure with 40 mg·L^{-1} nanoTiO2 and 50 μg·L^{-1} Cd under SSR led to a synergistic inhibitory effect of 80% of reproduction, twice as high compared to nanoTiO2 alone. As Cd is known to induce intracellular calcium signaling as part of protective cell processes (Thévenod, 2009), in the study presented here, the effect of the mixture on intracellular calcium release will be investigated applying the following methods: 1) The molecular mechanism of nTiO2 and Cd will be investigated with NS8593, a known human TRPM7 ion channel blocker. Because of high reproduction inhibition, the TRPM-like channel gene gon-2 could interact with the mixture. Gon-2 is responsible for gonadal cell division in C. elegans. If Cd or a Ca channel blocker (such as TTX) increase or decrease the same effects under SSR. 2) The mode of action of nTiO2-Cd-agglomerates is still not identified. They could interact if Cd is bound to nTiO2 or if Cd and nTiO2 are in close proximity. The impact of TiO2-Cd-agglomerates will be examined using calcium as a potential competitive ligand. 3) The photocatalytic activity of nTiO2 could damage cell membranes under SSR and Cd could enter the cell. Measurements of membrane integrity with propidium iodide and hexokinase will be tested. First results will be presented. Angelstorf et. al., 2014. Environ. Toxicol. Chem., 33, 2288-2296. Gottschalk et al., 2009. Environ. Sci. Technol., 43, 9216-9222. Samet, Abstract SETAC Brussels 2017. Thévenod 2009. Toxicol. Appl. Pharmacol., 238, 221-39.

WE311
Influence of temperature and salinity on toxicity of zinc oxide nanoparticle on the marine copepod Tigriopus japonicus
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ZnO nanoparticles (ZnO-NPs) are among the 20 most popular and highly studied nanomaterials in commercial products. About 93% of ZnO-NP-containing products are paints, cleaning and personal-use products, from which ZnO-NP can be easily released. Annually, about 250 tonnes of ZnO-NP were estimated to be released from sunscreens alone into the marine environment. However, there are no comprehensive regulations of NMs, including ZnO-NP, in any countries due to the diverse physicochemical properties of NMs and their complicated interactions with the environment. In the marine environment, ZnO-NPs are exposed to various environmental factors, such as temperature and salinity, but influences of these factors on the physicochemical properties and toxicity of ZnO-NP are often tested individually. As both factors co-exist in the environment and may influence one another, it is vital to study their effects concurrently to tease out 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 temperature (15, 25 & 35 °C) and salinity (12, 22 & 32 PSU), i.e., a 3 × 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 is more toxic than ZnO-Bulk, with temperature and salinity, ZnO-NP was the most 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 between ZnO-NPs and marine organisms from which we can 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, 3810-193 Aveiro; A.M. Soares, University of Aveiro / department of Biology & CESAM; T. Tourinho, University of Aveiro / Department of Chemistry / CICECO / LNEC; I. Lopes, 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. In this work, we study the multigenerational effects of gold nanorods (AuNRs) ranging from 8 to 90 μg·L^{-1} for 72 h. At the end of the assays, growth rate was computed for all generations of each alga. The following physico-chemical parameters of AuNR concentrations were monitored: size, morphology and total concentration of Au. In addition, the toxicity of the capping agent
cetyltrimethylammonium bromide (CTAB) was quantified by exposing both algae to the concentration of CTAB present in the highest tested concentration of AlN: 90 µg/L for C. vulgaris corresponding to 0.257 mC of CTABand 53 µg/L for R. subcapitata corresponding to 0.152 mC of CTAB. Chlorella vulgaris exhibited a higher tolerance to AlN than R. subcapitata: EC50,27 for F0 was 79 µg/L and 39 µg/L respectively. For C. vulgaris, a gradual increase of its tolerance to AlN was observed over generations; after being exposed for four generations to this chemical parameter significant effects on growth rate were observed among all concentrations and the control. A different pattern of response was observed for R. subcapitata. This species significantly increased its sensitivity to AlN from F0 to F2 generation, but recovered a similar sensitivity to that quantified for F0 from F2 to F4. CTAB significantly reduced the growth of microalgae by 42%. Over generations, the sensitivity of the two algae species to CTAB was not changed. The results obtained in the present work reveal that traditional standard assays with short-term exposure may over- or underestimate the real risk posed by AlN to freshwater microalgae. Therefore, it is suggested that long-term exposures should be included in the ecological risk assessment.

**WE313 Effects of climate change combined with copper nanoparticle on early development of Japanese medaka (Oryzias latipes)**

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Nowadays, global warming and aquatic acidification were occuring by rising carbon dioxide (CO2). The factory have been continuously emit copper nanoparticle into ocean and river. They probably induced harmful biological effect on 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). For this, the embryos were exposed to 25 nm copper nanoparticle (30 µg/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 downward 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 conclusions, medaka larvae have more sensitive than embryos by survival ability. Moreover, 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.

**WE314 The use of the marine mussels Mytilus hemocytes as a model for studying the impact of NPs on innate immunity**

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Nanoparticles (NPs) are widespread used in consumer products and industry; they are known to induce interactions with various biological systems and can show their potential impact on environmental species. Recent studies have demonstrated that NPs could affect a number of marine species, and interact with their immune system. Within the PANDORA project (Probing safety of nano particles, Toyo University / Graduate School of Life Sciences; T. Ariyoshi, C. Kataoka, S. Kashiwada, 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 nanoparticles of heavy metals and metal oxides used in multiple purpose for 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 nanoparticles (SNCS, 40 nm) using medaka model. SNCS have embryonic (at 0.5 mg/L of SNCS) and (at 0.05 mg/L) disrupted hatching, 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 (TiO2-NP, Φ=90 nm) are well-known causing oxidative stress by UV radiation; however, there are some reports that TiO2-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. TiO₂-NP which does not dissociate ions, was employed as a reference to ion dissociation NP (i.e. SNCs). In exposure of TiO₂-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 SNCs and TiO₂-NP regarding general toxicity, oxidative stress, cytotoxicity (apoptosis and necrosis), immunity-toxicity, and tolerance to bacteria-related diseases. Through this study, we will figure out that dissociated ions are 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

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Increasing production and use of nanoparticles contributes to their widespread dissemination in the environment and their unique physicochemical 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 ecotoxicology. 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-Chromotest 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 (nano-Al₂O₃). Larvae of Daphnia magna on the fat, transport, and effects of nanomaterials, including metal based particles such as nano-Al₂O₃, in the environment. The interest in nano-Al₂O₃ 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 Al₂O₃ macro form. The nanocompound caused changes in the genetic material of bacteria A. hydrophila. Decrease in genetic stability of obtained genotoxic profiles of bands for primary 0.125 mg/L differed from the results obtained 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 nano-Al₂O₃, 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 nano-Al₂O₃ 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. Mansouri, 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. Toxicants 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 contact with As in the whole life cycle 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 toxicants 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. AMARIEJ, Universidad de Alcalá; K. Boltes, University of Alcalá / Chemical Engineering; P. Letón, University of Alcalá

Nanoparticles, in particular metal oxide nanoparticles, have found extensive usage in a wide range of services and industries. Subsequently, they can be released into environment and finally end up in water bodies. That may suppose a potential risk to aquatic environment, exerting toxic effects at the level of cells/tissues or the whole organisms.² The present study, evaluate the toxicity behavior of cerium oxide nanoparticles (CeO₂-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 bacterial-luminescence reduction and 24h sludge enzymatic activity and oxidized stress were used as endpoints. Nanoparticles concentration ranged from 0.6 to 160 mgL⁻¹. The particle size and the ζ-potential of NPs in the culture media were measured to analyze the relation between stability profile and the observed toxicity behavior. The obtained results reveal toxic effects of CeO₂ 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 pharmaceuticals compounds did not produce significant changes on nanoceria (nCeO₂) for treatment: i) negative control, ii) treated with 0.625 mgL⁻¹ n-CeO₂, and iii) water and food spiked with n-CeO₂. The 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, Jamting 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: Nano 4: 390-193 Athens. [2] Saleh Demeshe, E, Chang, H. Am 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 REMFATAVARES.

WE321
Toxicity of nanoparticles of titanium dioxide to Daphnia longispina: waterborne versus dietary exposure

J. Padilla, Institute for Environmental Sciences / University Koblenz-Landau; C. Venancio, Department of Biology / I. Lopes, University of Aveiro / Department of Biology / M. Ornelas, University of Alcalá; B. Gylyte, S. JURKONIENE, R. Vitkus, Nature Research Centre / Institute for Environmental Sciences / University Koblenz / Centre / Institute of Botany

Nanoparticles of TiO₂ (n-TiO₂) are extensively used in many commercial products. Maybe for this reason, this nanoparticle is amongst the most studied in ecotoxicology. This study intended to discriminate the toxicity caused by n-TiO₂ to the daphnids species Daphnia longispina, either through waterborne or dietary exposure routes. For this, neonates of D. longispina were exposed to a control and to the following n-TiO₂ for treatments: i) macro, 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, Jamting 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: Nano 4: 390-193 Athens. [2] Saleh Demeshe, E, Chang, H. Am 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 REMFATAVARES.

WE322
Dynamics of Cu accumulation in charophyte cell compartments after its exposure to nCuO

Manuondragan, NatureResearchCentre / Institute of Botany, Laboratory of Aquatic Ecotoxicology; B. Gylyte, S. JURKONIENE, R. Vitkus, Nature Research Centre / Institute of Botany

In plant and bacterial cells, prior to be internalized, NPs have to pass the endocytic membranes. In this study, the fractionation procedure was verified by cyttoplasm and vacuole specific biomarkers,
malate dehydrogenase and  α Mannosidase, respectively. A high-purity vacuum chamber (99.5%) and cytoplasm (86.7%) fractions of the cells of *Nitzschia obstusa* 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. Niculiusi, University of the Basque Country / CBET 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. Katsumiti, M.P. Cajaravalie, 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  
In the aquatic environment, complex mixtures of pollutants are usually found. Polycyclic aromatic hydrocarbons (PAHs) are prioritory 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 in the presence of macromolecules. A "Trojan horse" effect was observed when graphene nanoplatelets were exposed to adorsed oil compounds from naphthenic North Sea crude oil WAF using in vitro toxicity assays in hemocytes of marine mussels. Two approaches were tested to obtain graphene nanoplatelets with adsorbed oil compounds: filtration and centrifugation. Hemocytes were exposed to a wide range of concentrations of GO, GO/PVP and GO/PVP with and without adsorbed oil compounds and to a series of WAF dilutions. After 24 h exposure, cell viability (MTT assay) and ROS production were assessed. Centrifugation (270g for 30 min) successfully separated WAF solution from graphene nanoplatelets with adsorbed oil compounds. This procedure was thus used for in vitro toxicity testing. WAF decreased cell viability and increased ROS production in hemocytes starting at 25% WAF. GO, GO/PVP and rGO-PVP nanoplatelets were moderately toxic to mussel hemocytes and produced a significant increase in ROS production. In exposures to graphene with adsorbed oil compounds, hemocytes viability decreased at similar concentrations as in exposures to nanoplatelets alone. However, ROS production increased in hemocytes exposed to lower concentrations of graphene with adsorbed oil compounds (10 mg/L) compared to nanoplatelets alone (25 mg/L), indicating that adsorbed oil compounds increase nanoplatelets toxicity. In conclusion, a protocol to obtain graphene nanoplatelets with adsorbed oil compounds was established. Nanoplatelets with and without adsorbed oil compounds showed similar cytotoxicity to hemocytes but the ones with adsorbed oil compounds increased ROS production earlier, indicating that graphene nanoplatelets may act as "Trojan horse" carriers of oil compounds. This work was funded by the EU H2020 (GREAT project (grant 679266), Spanish MINECO (project NACE, CTM2016-8130-R), Basque Government (consolidated research group IT8113-10) and University of the Basque Country (UIF 11/37).

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. Eliq, The University of Birmingham / GEES; 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) physicochemical 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 (1) changes to their environments. Herein, we investigated key biological endpoints, such as (1) changes to their environment, growth, reproduction, and gene expression of related molecular 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 work was funded by the EU H2020 (GREAT project (grant 679266), Spanish MINECO (project NACE, CTM2016-8130-R), Basque Government (consolidated research group IT8113-10) and University of the Basque Country (UIF 11/37).

WE325  
Evaluating the contribution of environmental stressors to sediment concentrations of PAHs in the northern Gulf of Mexico  
L. M. Baritelle, 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 temperature, salinity, 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 physiochemical properties of the overlying water column had little to no significant effect on the concentrations of the majority of the measured pollutants. The current research supports the idea that sediment organic compounds influence toxicity levels. Significant measurements 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; I. sabater, CSIC-IDAEA / Department of Environmental Chemistry; C. Font, V. Acuña, 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-driven pressures is causing drought events leading to desiccation to increase in number and intensity. To date, little is known about how desiccation events shape the response of river microbial communities to WWTP effluents. The present study used 24 experimental channels in a replicated regessional design to evaluate how an acute desiccation event shapes the response of a complex microbial community (i.e. a river biofilm) exposed to a dilution of a WWTP effluent. We found that desiccation and wastewater effluent significantly affected bacterial community and key biofilm processes such as photosynthesis, dentification and methaneogenesis. After the desiccation event, the biofilm associated to coarse sediment showed a stimulatory effect even at low dilution factors, which was not observed under control (i.e. no desiccation) conditions. Our results seem to indicate a simplification of the biofilm community after the desiccation event and a subsequent co-tolerance phenomenon. We argue that the acute desiccation event...
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 / Biolo; A.M. Soares, University of Aveiro / department of Biology & CESAM; C.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 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 lifetime fitness costs when associated with increased variability in temperature. Although fitness loss via increased temperature and pollution are known to interact and thereby affect fitness, in our study, a combination of increased temperature and pollution did not affect alone, when both stressors acted together the costs were disproportionally greater. The combined effect of fluoxetine and variable temperature was found to be greater than the sum of the single effects.

WE328 Influence of extreme heat events in the recovery capability of Mytilus galloprovincialis exposed to mercury contamination
E. Coppola, Department of Biology & CESAM - University of Aveiro / Biology; B.M. Henriques, CESAM - University of Aveiro and CIIMAR 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, often related to multiple human induced stressors. Our results indicated that stressors affected 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)
F. Gomes, Instituto Português do Mar e da Atmósfera / Division of Aquaculture and Seafood Upgrading; C. Figueiredo, M. Baptista, MARE - Marine and Environmental Sciences Centre / University of Aveiro / Biology; F. Costa, M. Almeida, N. Afonso, Instituto Português do Mar e da Atmósfera / Division of Aquaculture and Seafood Upgrading; F. Camacho, IPMA, LP.; M. Santos, Instituto Português do Mar e da Atmósfera / Division of Aquaculture and 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 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 weight), used as a model. Specifically, growth (G), routine metabolism (R), excretion (faecal, 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 viscerosomatic 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 health and ecosystem functioning.

WE330 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; E. Figueira, University of Aveiro / Biology CESAM; M.E. Pereira, CESAM University of Aveiro / Department of Chemistry

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1.40 W/m².) of UV radiation reduced a 2-fold decrease in the invertebrate populations. The results indicate that single γ-radiation reduced L. minor reproductive rate at a high dose (47.1 mGy/h, 7.9 Gy) after 7 days' exposure. At the cellular level, γ-radiation inhibited photosystem II (PS II) maximal efficiency (Fv/Fm) and oxidative phosphorylation (OxPHOS) and enhanced the non-photochemical quenching (NPQ), light-saturated PS II operating efficiency (Fv'/Fm'), electron transport rate (ETR) and reactive oxygen species (ROS) formation. Single UV radiation caused similar effects as IR and additionally induced morphological change (size and colony disconnection) in the plant. When exposed in combination, enhanced reproductive inhibition, OxPHOS reduction, PSI inhibition, NPQ and ROS formation were observed for the high γ-radiation dose (47.1 mGy/h). Antagonistic effects on Fv'/Fm', pigments content, photochemical quenching (qP) and ROS formation were observed at low to intermediate γ-radiation doses (13.2 and 20.3 mGy/h).

Homogeneous reactions were not the only way to model the interaction between γ-irradiation and NO/M. We use the CA model to study the combinatorial effect of low-dose γ-irradiation and NO/M on plant growth and development. The results indicate that single γ-radiation reduced L. minor reproductive rate at a high dose (47.1 mGy/h, 7.9 Gy) after 7 days' exposure. At the cellular level, γ-radiation inhibited photosystem II (PS II) maximal efficiency (Fv/Fm) and oxidative phosphorylation (OxPHOS) and enhanced the non-photochemical quenching (NPQ), light-saturated PS II operating efficiency (Fv'/Fm'), electron transport rate (ETR) and reactive oxygen species (ROS) formation. Single UV radiation caused similar effects as IR and additionally induced morphological change (size and colony disconnection) in the plant. When exposed in combination, enhanced reproductive inhibition, OxPHOS reduction, PSI inhibition, NPQ and ROS formation were observed for the high γ-radiation dose (47.1 mGy/h). Antagonistic effects on Fv'/Fm', pigments content, photochemical quenching (qP) and ROS formation were observed at low to intermediate γ-radiation doses (13.2 and 20.3 mGy/h).

Material and Methods

The study was done to investigate the effects of IR and NO/M on plant growth and development. The results indicate that single γ-radiation reduced L. minor reproductive rate at a high dose (47.1 mGy/h, 7.9 Gy) after 7 days' exposure. At the cellular level, γ-radiation inhibited photosystem II (PS II) maximal efficiency (Fv/Fm) and oxidative phosphorylation (OxPHOS) and enhanced the non-photochemical quenching (NPQ), light-saturated PS II operating efficiency (Fv'/Fm'), electron transport rate (ETR) and reactive oxygen species (ROS) formation. Single UV radiation caused similar effects as IR and additionally induced morphological change (size and colony disconnection) in the plant. When exposed in combination, enhanced reproductive inhibition, OxPHOS reduction, PSI inhibition, NPQ and ROS formation were observed for the high γ-radiation dose (47.1 mGy/h). Antagonistic effects on Fv'/Fm', pigments content, photochemical quenching (qP) and ROS formation were observed at low to intermediate γ-radiation doses (13.2 and 20.3 mGy/h).

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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, physicochemical properties like pesticide structure, solubility, adsorption and degradation seems 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 into the sea by swimmer movement and drifters released into the water, 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 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 their lipophilic characteristics and resistance against water flow, 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’s growth depression, and direct released of sunscreen Toxins, 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

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The Marico River, part of the Marico River system in 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 unimpacted 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, to determine metal contaminated 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 selected 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 conducted among sites. Positive correlations were found between metals 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 frauducum Mull.)

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Snails are widely used as sentinel species in marine and terrestrial biomonitoring. Their wide 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 bioindication 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 at 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 mussels (clones Brandybaena frauducum (Mull.)) were used collected from Moscow city (Kartmazovo, Kuz/mink/Ismaiov Park) with respective and annual average and maximum allowable concentrations. Pair comparison was done based on cardiac activity monitoring in monitored groups of mussels (thermic treatment (20-50min, 50±0,5°C)). It was revealed that snails of the same genotype (striped and without strips) from chemically polluted sites (Kartmazovo, Kuz/minky) differed in low thermostereoscope from those of the reference side and Ismalovsky Park demonstrated in dynamics of HRs. The isolated phenomenon 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

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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 aliotic 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 custracean Daphnia magna immobilization at the temperatures 10°C, 16°C and 20°C in laboratory experiments. Cypermethrin was almost twice as toxic at 10°C (2.17 ± 0.20 µg/L) compared with 20°C (4.10 ± 0.30 µg/L). The EC50 value of 16°C was 2.64 ± 0.21 µg/L which was closer to EC50 value of 10°C than 20°C. 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°C was 30.60 ± 0.74 hours compared with 33.12 ± 0.79 and 32.86 ± 0.83 hours respectively at 16°C and 20°C. The only statistically significant difference between the temperatures was between 10°C and 16°C. 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

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The risk assessment of metals has a long history and over time a large collection of 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, physicochemical properties like pesticide structure, solubility, adsorption and degradation seems to be crucial for the interaction with nTiO₂, NOM, and UV-A, and the ultimate pesticide toxicity.
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. We are currently working on the development of a computer program to automatically search 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 Rudipatubarum from the Vallona lagoon (northern Adriatic Sea, NE Italy): Application of Biomonitoring

E. Castiglione, ISPRA Institute for Environmental Protection and Research / Mitigation and Prevention of Impacts; V. Bernardello, R. Boscolo Brusà, G. Franchescini, G. Sesta, C. Maggi, D. Berto, M. Gabellini, C. Viro Lambertii, ISPRA Institute for Environmental Protection and Research Rudipatubarum (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 mollusces 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 mollusces. In this context, some issues could arise especially when comparing different sites in a long-term biomonitoring with data obtained from different periods of the year. In this study, bioaccumulation of metals, Polycyclic Aromatic Hydrocarbons (PAHs) and Butyltins (BTs) in Manila clams were monitored twice a year, from November 2010 to June 2015, in order to assess impact of human activities on R. philippinarum population from the Vallona Lagoon, a transitional area located in the delta of the Po River (NE, ITALY) which is the largest and most important Italian watercourse and one of the main sources of contaminants to Adriatic environments. Although levels were quite consistent with those reported from other geographical areas with low to medium pollution, seasonal trends were showed for each contaminant with higher concentrations on autumn rather than on spring surveys. The physiological condition of clams was also examined through two indices (condition index and survival in air) and they both exhibited seasonal variations connected to natural endogenous and exogenous factors. Physiochemical indices (condition index and survival in air) and they both exhibited seasonal variations connected to natural endogenous and exogenous factors. Physiochemical indices (condition index and survival in air) and they both exhibited seasonal variations connected to natural endogenous and exogenous factors. Physiochemical indices (condition index and survival in air) and they both exhibited seasonal variations connected to natural endogenous and exogenous factors.

WE344 Chemical stress on aquatic communities under semi-arid conditions: towards an improved multimetric approach

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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**

Diplodon chilenis to the assessment of water quality in a Patagonian river

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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.

**WE347 Growth, Photosynthetic and Antioxidative Defense System Response of Hordeum vulgare to Combined Stress of Heat Wave and Drought**

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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 photosynthesis 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 malondialdehyde content and considerably stronger stimulation of antioxidative enzymes. Full recovery of photosynthetic parameters after heat wave 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 heat wave treatment compared with watered plants and revealed an important of soil water availability even during the short-term heat wave period. Keywords: Hordeum vulgare, heat wave, drought stress, antioxidant system, photosynthesis, growth

**WE348 Does elevated CO2 protects plants against heat waves damage?**

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The frequency and severity of heat waves is increasing as a result of climate change. Extreme climatic events are considered to have the most severe impact on crops and weeds to heat waves and CO2 may also cause shifts in their competitive interactions. The aim of the study was to examine the influence of extreme events (heat wave plus drought) and CO2 on the growth of spring barley (Hordeum vulgare L.) and wild mustard (Sinapis arvensis L.). Barley and wild mustard, growing together in the microcosms at the combination 2:1, were subjected to short-term (6 h) and a chronic treatment (8°C vs. 21°C) under ambient CO2 (400 ppm) and elevated CO2 (800 ppm). The growth and response of photosynthesis system of both plant species were evaluated.

**WE349 Combined effects of increasing 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. Vighi, 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 climatic 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 independently. 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 (Low, Control, Low + Concentration) in each environmental scenario. The insecticide was applied twice, with a 10 day interval between applications. Test units without desiccation were reffilled twice per week with distilled water. Test units exposed to drought stress were not reffilled and allowed to desiccate. After that, these units were reffilled 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 Copepoda, 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
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Climate change is a major concern for agriculture and 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. Differential responses of crops and weeds to elevated temperature and CO2 may also cause shifts in the coexistence of different species. 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 at the 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
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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, the risk of predation and infection is high and, therefore, there might be a trade-off of natural stressors, such as predation. Perception of predation 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, body web dynamics and ecosystem functioning. Chlorantraniliprole (C. riparius) is a neonicotinoid insecticide known for its high efficacy and selective use in the control of insect pests. In the present study, the combined effects of insecticide exposure under predation risk on freshwater detritivores we studied the behavioural and developmental responses of Chironomus riparius. First, 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 anas species as food resource, the shredder Sericostoma vittatum, the collector C. riparius and their natural predator the dragonfly Cordulegaster boltoni. A full factorial design tested the effects of the CAP (0 or 2 µg/L), presence/absence of the predator C. boltoni and of the chlorantraniliprole on the anas loss coefficient (a) and the direct effects on the freshwater detritivore. The results showed that exposure to an environmentally relevant concentration of CAP decreased leaf decomposition in all treatments. Predation risk marginally reduced decay rates of leaf decomposition. Considering detritivores interaction, an interspecific competition is suggested since the presence of shredders impaired chironomids performance despite the increased in leaf fragmentation. C. riparius growth rate was thus decreased independently by all factors (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
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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 anuran 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 sulfrontancerz) 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 metabolism genes expression (dio2, dio3, thi1, tra, trb and kif9) were mostly upregulated in these groups, showing disrupting effects of diuron for amphibians. 3,4-DCA presented similar responses to diuron on L. catesbeianus and its effects were also pronounced at higher temperatures. Native tadpoles of Rhinella schneideri and Euphlyctis nattereri had their antioxidant defense system affected by exposure to the herbicides clomazone and sulfortamazine. Sulphate and clomazone increased carboxylesterase activities in tadpoles exposed at higher temperatures. Integrated Biomarker responses (IBR) index showed a synergic effect of temperature and sulfortamazine or clomazone in R. schneideri and E. nattereri. Our results showed that temperature in the field may influence the effects caused by the exposure to herbicides used on sugarcane crops, showing how the sensitivity of amphibians to herbicides may be increased at higher temperatures 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
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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. In the present study, we tested whether the adaptation or acclimation of natural phytoplankton communities towards contemporary stressors, such as predation. Perception of predation 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) is a neonicotinoid insecticide known for its high efficacy and selective use in the control of insect pests. In the present study, the combined effects of insecticide exposure under predation risk on freshwater detritivores we studied the behavioural and developmental responses of Chironomus riparius. First, 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 anas species as food resource, the shredder Sericostoma vittatum, the collector C. riparius and their natural predator the dragonfly Cordulegaster boltoni. A full factorial design tested the effects of the CAP (0 or 2 µg/L), presence/absence of the predator C. boltoni and of the chlorantraniliprole on the anas loss coefficient (a) and the direct effects on the freshwater detritivore. The results showed that exposure to an environmentally relevant concentration of CAP decreased leaf decomposition in all treatments. Predation risk marginally reduced decay rates of leaf decomposition. Considering detritivores interaction, an interspecific competition is suggested since the presence of shredders impaired chironomids performance despite the increased in leaf fragmentation. C. riparius growth rate was thus decreased independently by all factors (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.

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. Mbalby, The University of Sheffield / Dept. of Animal & Plant Sciences; S. Beulke, Envisreach / 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
### WE355

**Ranking micropollutants in effluent by exposure indices evaluated via suspect/ontarget 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-related indices. Thus, the risk-based 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 chromatograph peak area was applied for the ranking. WWTP effluent samples were taken in September, 2016 and analyzed via suspect/ontarget 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 (clindamycin, fluconazole, sulfamethoxazole, sulfamethazine), anticonvulsant (carbamazepine, carbamazepine-epoxide, oxcarbazepine), antisthiamines (diphenhydramine, fexofenadine), antidepressive agent (ibersartan, valsartan), antipsychotic (amisulpride), and central nervous system (CNS) stimulants (caffeine), and antiulcer (cimetidine). 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.

### 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. Hu**, 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), gut phenotypic 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 temperature 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 35.3ºC and 32ºC, respectively, in a term test to exposure of 2ºC per day. In T. kingsejongensis, LT50 and NOEL were determined to be 24.8ºC and 12ºC, respectively. Levels of ROS and in response to temperature increase of 2ºC per day. In future weather conditions, copepods, 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.

### WE357

**Effects of water browning on zooplankton physiology and fitness driven by food characteristics in a long-term enclosure experiment**  

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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 becoming increasingly important 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 seston characteristics and the elemental and biochemical composition of the daphnids. Surprisingly, daphnids kept in brown water showed higher (both physiological and biological (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 common across systems we have the ability to identify prevalent patterns and trends. This allows us to go beyond comparisons that rely on community structural endpoints and are potentially only relevant at local scales.

### 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**, 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 (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 common across systems we have the ability to identify prevalent 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. Bensted**, Fera Science Ltd / Centre for Chemical Safety and Stewardship; **R. Ashauer**, University of York / Environment  

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TriCosm (P. subcapitata, Ceriodaphnia, Hydra) was developed as an intermediate link between simple single-species tests and complex multi-species systems, to detect small stressor-induced alterations in ecological interactions. The achievement of standardization, replication and reproducibility was given close attention during the development of the system, yet the TriCosm was found to be compliant in terms of repeatability and reproducibility only in the short term. Here we present experiments designed to discern effects of variation due to ecologically important factors that impact on the community dynamics in this aquatic multi-species system.

WE360 Improving toxicity to natural and chemical stressors by inducing early life stages in the rotifer Brachionus sp. Cymans
L.G. Almeida, MARE – Marine and Environmental Sciences Centre / Instituto Politécnico de Leiria; C. Ferreira, Polytechnic Institute of Leiria / Polytechnic Institute of Leiria; M.F. Lemos, Instituto Politécnico de Leiria / MARE IPLeiria; H.N. Cabral, Faculdade de Ciências da Universidade de Lisboa / MARE-FCUL; P. Bossier, Universiteit Gent / Laboratory of Aquaculture & Artemia Reference Center; G.C. Novais, Polytechnic Institute of Leiria / MARE IPLeiria

Rotifers are widely used as bio-indicators and models for ecotoxicology due to characteristics such as high ingestion rate, rapid growth, ease of culture in small volumes, ease of establishing clone cultures, short generation time, small size, and sensitivity to various toxicants. The monogonont rotifer Brachionus plicatilis (Müller, 1786) is a euryhaline species, typically found in salt lakes and coastal brackish waters, presenting high commercial importance and value, since it is commonly used as live feed for several marine species larvae in aquaculture productions. In the last decade it has become commonly accepted that environmental stimuli can induce phenotypic alterations in the organisms. Thereby, the primary objective of this project was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different naturally occurring concentrations of natural substances, such as acute toxicity bioassays and 48h chronic toxicity bioassays were conducted with two strains of Brachionus sp. Cymans (MR10 and IB3), a biotype within the B. plicatilis complex, obtained from the Laboratory of Aquaculture and Artemia Reference Center (Ghent University, Belgium). The bioassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 25°C and 25°C as control environmental conditions. The organisms were exposed to different concentrations of antibiotics, pesticides, and oxidative stress inducers, as well as to different salinity and temperature conditions. Consequently, to test for possible increased tolerance to these stressors, neonates (0-4h) were exposed to short non-lethal temperature shocks (cold and heat), and after a recovery period, survival tests were performed at each temperature sensitivity values compared. Results show that temperature shocks during early life stages result in changes in the sensitivity of rotifers to different stressors. These are very promising results, and their application in an aquaculture context could be advantageous to decrease the mass mortality in rotifer production. Future research within this project will address possible epigenetic mechanisms (DNA methylation or histone modifications) behind those greater efficiencies and assess if their maintenance can be achieved through several generations.

WE361 Effects of a mixture of pharmaceuticals in a freshwater model ecosystem
S. JOACHIM, INERIS-UMR SEBIO / CIVS; Y. David, INERIS; K. Notti, Société WESS / Laboratoire d’Ecotoxicologie; H. QUEAU, N. Delorme, Istrea Lyon / UR MALY Laboratoire Ecotoxicologie; K. Socsey, Université de Liège ULg; P. Baudoin, C. TURIES, INERIS / INERIS UMR SEBIO ECOT; A. Catteau, A. Bado-Nilles, INERIS; M. Fourgeau, Unamur; O. Geffard, Istrea / UR MALY Laboratoire Ecotoxicologie; J. Porcher, INERIS / INERIS UMR SEBIO ECOT; A. Geffard, Université de Reims Champagne Ardenne; F. De Laender, Université de Namur ASBL / Research Unit in Environmental and Evolutionary Ecology; R. Beaudouin, INERIS / Models for Ecotoxicology and Toxicity METO

Owing to their ecological importance, freshwaters provide important services such as high ingestion rate, rapid growth, ease of culture in small volumes, ease of establishing clone cultures, short generation time, small size, and sensitivity to various toxicants. The monogonont rotifer Brachionus plicatilis (Müller, 1786) is a euryhaline species, typically found in salt lakes and coastal brackish waters, presenting high commercial importance and value, since it is commonly used as live feed for several marine species larvae in aquaculture productions. In the last decade it has become commonly accepted that environmental stimuli can induce phenotypic alterations in the organisms. Thereby, the primary objective of this project was to assess if temperature shocks during early life stages of rotifer development could improve their tolerance to different naturally occurring concentrations of natural substances, such as acute toxicity bioassays and 48h chronic toxicity bioassays were conducted with two strains of Brachionus sp. Cymans (MR10 and IB3), a biotype within the B. plicatilis complex, obtained from the Laboratory of Aquaculture and Artemia Reference Center (Ghent University, Belgium). The bioassays were performed in accordance with the International Standards ISO 19820 and ISO 20666, respectively, using 25°C and 25°C as control environmental conditions. The organisms were exposed to different concentrations of antibiotics, pesticides, and oxidative stress inducers, as well as to different salinity and temperature conditions. Consequently, to test for possible increased tolerance to these stressors, neonates (0-4h) were exposed to short non-lethal temperature shocks (cold and heat), and after a recovery period, survival tests were performed at each temperature sensitivity values compared. Results show that temperature shocks during early life stages result in changes in the sensitivity of rotifers to different stressors. These are very promising results, and their application in an aquaculture context could be advantageous to decrease the mass mortality in rotifer production. Future research within this project will address possible epigenetic mechanisms (DNA methylation or histone modifications) behind those greater efficiencies and assess if their maintenance can be achieved through several generations.

WE362 Relationships between aquatic toxicity, chemical hydrophobicity and mode of action: log kow QSRAs revisited

Quantitative structure toxicity relationships (QSRAs) 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 classifications. Log kow QSRs were developed as linear regression 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, ionos/moreregulatory/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.

WE363 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

Apart 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 end point (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 and a minimum 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. Azvedo, BASF SE, Agrarzentrum Limburgshof / 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 organisms (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 (Erc50). Various probability distributions are available for the derivation of a SSD (e.g., lognormal, logistic) as well as publicly-available tools (RIVM’s ETX, MOSAIC, SSD from the University of Lyon, US EPA’s SSD
WE366  
Effects on NTA communities: HCs vs NOEC design
E.M. Bakker, Eurofins-Mitox; S. Aldershof, Bioresearch and Evaluation

We discuss two examples of field fauna study designs with non-target arthropods (NTA). In both cases a hay meadow was chosen as a paradigm representative for off-field habitats at risk. One example concerns an HC, approach where EC, for various x were estimated from a field experiment and used to derive a Species Sensitivity Distribution. The other example concerns a more “classical” approach where a limited number of rates was tested in a replicated block design and the NOEC endpoint was found via statistical hypothesis testing. The merits and caveats of both approaches will be discussed and a protocol for evaluating and documenting statistical and biological significance of a NOEC study design will be presented.

We analyse whether “No Effects” may have statistical or biological causes. In the HC-study consistent dose-response curves were obtained within 4 major arthropod taxa (63 out of 776; 8%) and SSD’s could be constructed for each of them. Due to full overlap of curves the classes could be combined, resulting in narrow confidence intervals. In the NOEC-study 66 from 596 (11%) taxa were valid for univariante analysis, representing all major taxa. The protocol developed for the classification of results yielded an informative evaluation and allowed results to be classified as inconclusive or conclusive on a confidence scale of 1-4. Both study designs were fit for purpose and the HCs biologically and statistically valid results. Where the HCs-design was statistically straightforward, the regulatory implication of the findings was not. On the other hand, where the regulatory implication of the NOEC is clear, the methodological issues related to hypothesis testing hamper a clear-cut presentation. An evaluation summary table, involving MSD-analysis, as presented here may be helpful in this regard.

WE367  
α-Dominance versus β-Prominence
E.M. Bakker, Eurofins-Mitox; S. Aldershof, Bioresearch and Evaluation

The NOEC or an equivalent regulatory set ECα value are key endpoints to assess safety of pesticides or other chemicals to consumer's risk, better known as Type I error (false positive result in a regulatory context implies a potential economic loss), and environmental risk, better known as Type II error (false negative result in a regulatory context implies a risk to environmental health. Statistical insignificance (P>α, α is the type 1 error) is defined as the concentration that shows x% effect compared to the control and the limit is 5% error acceptance which seem hazardous

The NOEC or an equivalent regulatory set ECα value are key endpoints to assess safety of pesticides or other chemicals to consumer's risk, better known as Type I error (false positive result in a regulatory context implies a potential economic loss), and environmental risk, better known as Type II error (false negative result in a regulatory context implies a risk to environmental health. Statistical insignificance (P>α, α is the type 1 error) is defined as the concentration that shows x% effect compared to the control and the limit is 5% error acceptance which seem hazardous
Moreover, FOCUS exposure patterns are frequently challenged in regard to their representativeness for aquatic higher tier exposure testing is proposed in the current EFSA guidance document for aquatic risk entries into water bodies resulting in complex exposure patterns which often 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 conditions and enabling 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 the efficient testing 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 complicacy 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-tier modelling simulations where the variability of treatment and climate constellations are taken into account. Detailed analysis of the multitude of 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 ecotoxicity testing and finally acceptability in a regulatory context. The aim of this poster is 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. Gonsior, Eurofins Agroscience Services Ecotox GmbH; U. Memmert, G. Eck, E. Eschenbach, Eurofins Regulatory AG; C. Halner, Eurofins Agroscience Services Ecotox GmbH / Aquatic Ecotoxicology

Aquatic higher-tier exposure testing. The aim is to higher-tier risk evaluations proposed in the current EFSA guidance document for aquatic risk assessments for plant protection products. It offers scope for risk refinement by defining ecotoxicologically relevant concentrations that might be less conservative than constant exposure scenarios realised in standard effect studies or to justify time-weighted average concentrations in context with chronic risk assessments. Higher-tier exposure testing results from complexity to tier laboratory 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 assessing 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, F0) were exposed to 4 pulsed applications at weekly intervals. The performance of the reproduction in terms of egg numbers and fertilization 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 application at the test substance was chemically 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, calculated with the FOCUS tools). The analysis of the AUC as well as of the DT50 values showed that the dissipation 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.
Exposure tests have become part of the regulation framework for plant protection products in the EU (EFSA Aquatic Guidance Document 2013). A pulse dose test can be used to address areas of risk that cannot be satisfied with the standard suite of aquatic toxicity tests. A pulse dose considers situations where the expected exposure events in the field are significantly shorter than in the standard laboratory tests. However, the challenge is to consider exposure from multiple scenarios within one test. Therefore, the maximum exposure (peak) concentration, the number of peaks, the duration of the peaks, and the interval between peaks are considered to simulate a realistic profile covering a large number of scenarios. In this study, three different life stages of rainbow trout (Oncorhynchus mykiss) were exposed to the test chemical. To set these pulses as sharp as possible, the fishes were transferred from treatment vessels to untreated vessels at each time of pulse application. All vessels, including controls, were kept under flow through conditions. The concentrations of the test chemical were measured at start and end of each pulse event. Fertilised eggs, newly hatched fry and juveniles, already swimming up, were exposed. Glass aquaria with a total volume of 30 L were used. The evaluation of biological effects was based on mean measured concentrations measured for the test substance pulses and could be compared with the predicted environmental concentrations based on FOCUS modeling simulations. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible impairment of the sensitive stages. However, it was demonstrated that the performance of the life stages exposed was acceptable and conforms to quality criteria set by the test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address a very complex exposure regime to cover the ‘worst case’ when a single laboratory exposure is unrealistic.

**WE377**

TIER2+: Developing the Tools for Future Risk Assessment - New Chronic Invertebrate Test Systems and the Application of Realistic Exposure Scenarios

A. Dabrunz, F. Kümmling, C. Lang, Eurofin Agroscience Services EcoTox GmbH / Aquatic Ecotoxicology

According to recent and proposed guidance of the European Food Safety Authority (EFSA) current aquatic toxicity test systems should be critically reviewed, adjusted in regards of realistic (e.g. pulsed) exposure and complemented by establishing new test systems. To account for these challenges we will present data on a twofold strategy including A) test systems and B) exposure conditions:\n
- An experimental data of newly established (sub)chronic test systems, which are suitable meeting Tier 2 regulatory requirements (e.g. SSD approach). The test design was shown to provide a suitable approach to address a very complex exposure regime to cover the `worst case` when a single laboratory exposure is unrealistic.

**WE378**

Optimisation of a chronic toxicity flow-through set up to investigate the adverse effects of chemicals to Daphnia magna

C. Beyer, IES Ltd; A. Peither, Innovative Environmental Services IES Ltd; S. Höger, Innovative Environmental Services (IES) Ltd / Environmental Toxicology; A.S. Steiner, University of Appl. Sc. Northwestern Switzerland / Institute of Ecopreneurship; P. Corvini, University of Applied Sciences Northwestern Switzerland

Daphnids are playing an important role as representative or indicator species for aquatic invertebrates in the environmental risk assessment for plant protection products, chemicals and pharmaceuticals. To investigate chronic toxicity, semi-static Daphnia magna reproduction tests following Test Guideline OECD 211 have to be performed. So far this test design is also used for highly degrading substances, despite the fact that by using semi-static test design the exposure concentration of the parent test compound is decreasing and metabolic products are accumulating during the renewal intervals of 2-3 days. To ensure a steady exposure level, 2 peak applications (up to 10 peaks) per 120 h were used. The evaluation of biological effects was based on mean measured concentrations measured for the test substance pulses and could be compared with the predicted environmental concentrations based on FOCUS modeling simulations. In contrast to a continuous exposure, the procedure of several pulse applications may have an impact and possible impairment of the sensitive stages. However, it was demonstrated that the performance of the life stages exposed was acceptable and conforms to quality criteria set by the test guidelines (OECD, USEPA). The test design was shown to provide a suitable approach to address a very complex exposure regime to cover the `worst case` when a single laboratory exposure is unrealistic.

**WE379**

Eggs and larval fish test, an alternative method to marine fish exposure: Sensitivity and interest of early life stage.

F. Lancher, C. Dupuy, A. Jourdan, Groupe SGS France; J. Bertin, SGS Multibl / Ecotoxicology

Multi-trophic level bioassays are usually carried out to determine toxicity of effluents, chemicals, cosmetic ingredients, etc… Toxicity to species is different according to the compound type considered, therefore tests on plants, invertebrates and vertebrates should be conducted. On the other hand, vertebrate organism tests should be avoided when possible, including test on juvenile fish. Alternative methods need to be developed for juvenile fish testing, with equivalent predictability and sensitivity. Several alternative methods exist for freshwater studies but there is no standardized method available for seawater fish. This study is a first step in the evaluation of a marine fish embryo and larve test as alternative to adult marine fish test OSPAR HOCNF guideline, for example. The embryo and larvae age 51 Xenopus laevis to differentiate between the test substance (peak) and reference substances were evaluated. To this purpose, within 72 hours post-fertilisation, the blastula stage eggs were exposed to reference substances separately. The effects of the toxicants on embryos and larvae were observed daily during a 10-days exposure period. For each reference substance and species, EC50 and mortality rate were calculated. To avoid vertebrate testing, results of this study were compared to published data. Several reference substances had a significant impact on survival of eggs and/or embryonic development. The sensitivity of the organisms is significantly different according to reference substances. Moreover, this test was used to evaluate toxicity of waste seawater samples in multi-trophic level bioassays (i.e. combination with single-species on algae, copepod and oyster larvae tests). Based on these results, marine fish embryo test appears as a credible alternative to juvenile fish testing. Therefore additional experiments will be conducted to validate this model.

**WE380**

Lack of Relevance of Normalized Hindlimb Length Measurement in Assessment of Thyroid Disruption in the Amphibian Metamorphosis Assay

S. Pawlowski, M. Dammann, S. Champ, BASF SE; M. Mathis, Port, Fort Environmental Labs, Inc.

The OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100 (amphibian metamorphosis assay - AMA) represents a Tier 1 ecotoxicity test designed to evaluate thyroid disruption. The test exposes Nieuwkoop and Faber (Nieuwkoop and Faber 1956) Xenopus laevis to different concentrations of the test substance for 21-days and the following endpoints are measured: mortality, hindlimb length (HLL), body length (snout to vent -SVL), body weight, developmental stage, asynchronous development, and thyroid histopathology. Of these endpoints, SVL and body weight are measures of growth, whereas developmental stage, asynchronous development, HLL, and thyroid histopathology are in the assessment of thyroid disruption. Recently, the relevance of hindlimb length normalized to SVL as a marker of thyroid disruption has been questioned based on its relationship to the growth endpoints (SVL, weight) and the relationship between limb length and differentiation. To evaluate normalized HLL, the correlation between HLL and either SVL or body weight was evaluated in the controls from 10 independently performed AMA studies at study day (SD) 21. Eight of the 10 AMA studies did not have significant late stage development per OECD Test No. 231 and USEPA Test Guidelines OPPTS 890.1100. For the 2 studies, data were censored to separate ≥ NF stage 60 from the >NF stage 60. Negative or no correlation between hindlimb length and SVL was found in 7 of the 8 studies examined without late stage development (r²=0.315-0.725, 0.553). Negative or no correlation between hindlimb length and either SVL or body weight was found in 1 of the 2 studies (r²=0.452, 0.511). In each of the 10 studies, no asynchronous development was consistent with the absence histopathological findings in the control. The degree of limb length differentiation relative to other morphological markers of developmental stage determine if asynchronous development occurred. Since hindlimb differentiation is controlled by the thyroid axis during metamorphosis, it represents a more suitable endpoint in assessing potential thyroid disruption. To conclude, hindlimb differentiation, developmental stage and thyroid histopathology should be used in a weight-of-evidence based assessment of thyroid axis disruption. Normalized HLL should not be included in the assessment.

**WE381**

Acute toxicity test using Mediterranean fish species (Dicentrarchus labrax L., 1758): Intercalibration exercises towards standardized procedure
but also standard test organisms for the RA for pharmaceuticals and chemicals. Diatoms are not only part of the risk assessment (RA) for plant protection products, but due to the numberless combinations of 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), followed by the development of a specific test design to determine the toxicity, the testing itself and finally the choice of the most suitable evaluation method within the various possibilities of calculation and interpretation of the results. In this presentation we focus on the testing of algae, but many aspects can be transferred directly to acute and chronic toxicity testing with daphnids or fish. This is important as in daily business in most cases a package of aquatic studies has to be conducted and results shall be comparable. The presented working procedures demonstrate that every test item - independent from its characteristics - can be tested according to established OECD Test Guidelines, but in some cases extensive biological and chemical background and innovative capacity is required to find the best test design. To make it even more complicated, there are different ways to interpret the analytical data and the most appropriate is clearly not always the required endpoints. The different possibilities are introduced and discussed as well.

**WE384 Activity based Collombola sampling may improve the data of field studies for regulatory purposes**

F. Mack, A. Appeltauer, J. Illig, Eurofins Agroscience Services Ecotom GmbH; S. Knaebe, EAS Ecotom GmbH / Ecotom Field Service

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 Römcke 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 migrate 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 can 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 Deheelen et al. 2016. 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. Römcke, J., Schmelz, R., Knaebe, 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

**WE385 New Technology evaluating Acartia tonsa as a biological model**

S. Abreu, University of Aveiro / Dep. Biology & CESAM; S.M. Leandro, Polytechnic Institute of Leiria / MARTE Marine and Environmental Sciences Center, A.M. Soares, University of Aveiro / department of Biology & CESAM; R.E. Martins, M. Oliveira e Silva, University of Aveiro / DETI IEETA

Copepods play an important ecological role on marine ecosystems and may act as a sentinel of environmental degradation resulting from direct or indirect human impacts. The copepod *Acartia tonsa* is a calanoid species with a worldwide distribution and relatively easy to maintain for several generations under captive conditions. These characteristics allow this species to be a potential biological model to be used on ecotoxicological studies or live food for larviculture. On the bottleneck for its massive utilization relies on the time consumption procedures related with counting and cultures monitoring. To overcome such constraint, the aim of the present study was to evaluate the application feasibility of a new technology based on automatic counting and evaluation of copepod of *A. tonsa* and other copepod species as well as microplastics or other particles and/or organisms. The technology D Counter constitutes an innovative approach, by the fact of turning the data harvesting process much more efficient and accurate, breaking the traditional, error-prone, human-based counting methodology. The obtained results for *A. tonsa* cultures indicates a high significant correlation between manual and automatic counting, constituting the first step for the use of this biological model on experimental studies.

**WE386 Solubility limits of lanthanides in standardized ecotoxicological media**

Setac Europe 28th Annual Meeting Abstract Book
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The biogeochemical cycles of several lanthanides (LNs) are being progressively disrupted by their increasing use in industrial sectors such high-tech applications and clean energy generation. Except for a few hotspots located close to industrial plants, 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 ecotoxicity following standardized 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, precipitation may form and lower LNs solubility and reduce to a fraction of the expected value the concentrations to which organisms are exposed. The presence of possible LN-containing precipitates can further complicate the interpretation of the corresponding biological responses. In this contribution, we use thermodynamic speciation modeling to examine the equilibrium theoretical speciation of LN in standardized ecotoxicological media for algae, lichens, diatoms (e.g., ochtis and oxytetracyclines for Cr, and thallidomides in the case of some lanthanides). In such situations, the calculation of meaningful effect concentrations for hazard and risk assessment must be kept constant and stable over the test duration. Increasing evidence suggests that this is often not the case when dealing with elements that tend to form chemical species with low water solubility. While thermodynamic modeling does not account for the kinetics aspects of speciation, it still provides useful indications as to the actual exposure conditions likely to be experienced by organisms in standard ecotoxicity tests.

WE387

Improving ecotoxicity tests for trace elements forming poorly soluble chemical species in test media

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In order to get an appropriate interpretation of ecotoxicological results the exposure concentrations of test organisms to the contaminant of concern must be kept constant and stable over the test duration. Increasing evidence suggests that this is often not the case when dealing with elements that tend to form chemical species with low water solubility. While thermodynamic modeling does not account for the kinetics aspects of speciation, it still provides useful indications as to the actual exposure conditions likely to be experienced by organisms in standard ecotoxicity tests.

WE388

Long term ecotoxicity testing of limonene for hazard classification: not such a lemon after all

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Limonene is a stereosomeric substance taking its name from lemon, which dominates the composition of the essential oils of citrus fruits. When synthesised as dipentene it is a racemate. However, in botanical sources it is present as the D- or L-enantiomer in Natural Complex Substances (NCSs) obtained at anything from traces in some plant extracts to over ninety percent in orange oil. These oils are commonly used as fragrances and flavours. The poster presents the reader range of applications (cosmetic products, food manufacture, fragrance perfumery, botanical insecticide, household cleaning products, etc.). Therefore, it is predominantly released back to the environment after use. The racemate and both D- and L-limonene received a harmonised classification under Annex VI of the EU C&L regulation as: ‘(Very toxic to aquatic life) and Aquatic chronic category 1: (Very toxic to aquatic life with long-lasting effects).’ Both classifications have a severe impact on storage, handling and transport requirements of limonene and the many (natural) complex substances and fragrance and flavour mixtures that contain even small amounts of it. The existing classification is a result of a limited data set notably for chronic endpoints. The chronic category 1 classification is extrapolated from the acute category 1 toxicity, log Kow >4 and erroneously assumed not-rapid biodegradability of the substance. As limonene is a narcotic substance its Chronic 1 assignment was expected to be conservative. Due to doubts on the chronic classification and the consequences for labelling, storage and handling, long term aquatic ecotoxicity studies were conducted to obtain a solid basis for the environmental classification. Calcium. This expectation was because statistically significant differences are viewed considered the ecotoxicologists’ Bible for testing difficult substances, the chronic studies were fraught with difficulties. This poster describes the problems encountered by the laboratories when testing a highly volatile, rapidly biodegradable, hydrophobic, non-polar narcotic substance like limonene under chronic conditions, how these were countered by the monitoring team and after a chronic category 1 assignment. The poster presents the reader range of studies lasting several years with results supporting a chronic 3 classification. The subsequent regulatory procedure to implement the classification in the EU regulations is currently ongoing.

WE389

Is that an effect? The importance of using all relevant data in mesocosm studies


In long-term multispecies studies, such as mesocosms, a complex statistical analysis is required to decipher the data and determine whether a test-item effect has occurred. It is sometimes the case that regulators and applicants have differing opinions as to what the no observed effect concentration (NOEC) or no observed adverse effect concentration (NOAEC) should be, based on the accompanying data analysis. This expectation was because statistically significant differences are viewed in isolation from the rest of the available data from the study. The aim of this poster is to urge regulators to not just focus on statistically significant differences, but to take into account all available and relevant data to assess the biological relevance of any differences observed. 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 of these methods is 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 study. 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 ultimately, 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.

WE390

Evaluation of the environmental risk assessment procedure according to Directive 2001/18/EC for Gene Modified organisms used as medicinal products

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The deliberate release of genetically modified organisms (GMOs) including GMOs
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 EC (http://gmoinfo.jrc.ec.europa.eu)) contains information about all GMOs under registration. 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. The EU-wide, 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 Aedes virus, 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 as "clinical amplification". As the primary basis has been the current environment, we are able to identify 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?

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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, i.e. the bond between a chemical's ecotoxicity and its autochthony, was fundamentally altered: Assessing accurately a chemical’s potential to amplify along the food chain, and whether a chronic value can be established based on its MoA. Significant scientific progress has been made in the field of aquatic toxicity testing of difficult chemicals, evaluation and interpretation of ecotoxicological data since the PBT/vPvB criteria were originally designated. The numerical criteria were established in the late 1990s by OSPAR. Although the primary basis has been the marine environment and used by the EU (TC NES) from the early 2000’s enlarging the protection goal to any environment. The criteria became applicable to any chemical produced over 10 TPa when REACH regulation came into force, thus, treating chemicals as a homogeneous group. Interestingly, the criteria were originally defined by using data from a set of chemicals known as highly hazardous for the environment. Such compounds (e.g. the so-called aromatic compounds) were non-toxic and hydrophobic while the chemical space is much more diverse. In other words, a BCF value of 2000 may be a good cut-off for chemicals which are both highly hydrophobic and slowly metabolised to anticipate amplification along a food chain but may be of limited meaning for other chemical classes. In the US, B is defined as a BCF of > 5000 which is the vB criterion in the EU while perhaps the only meaningful way to determine B is to consider bioaccumulation in the food chain which has no legal relationship with the B criterion. Further questions can be posed of the true meaning of the half-life cut-off values for P and P+ in terms of environmental persistence and the meaningfulness of using a standard mg/L cut off basis for T blanketing all MoAs.

WE392

UV/VCB block method for estimating expected mixture toxic pressure of substances of Unknown or Variable composition, Complex reaction products or Biological materials

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We have developed a spreadsheet calculation tool for chemical safety assessment of UV/VCB 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 on substances 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 hypopharyngeal 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 bees 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, causing the morphology or mortality, but also indirectly - through the impairment of the ability to raise the larvae, for example by disturbing the work of hypopharyngeal glands (HPG) responsible for the production of ‘milk’ containing proteinaceous 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 and 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 there are many reports showing that hypopharyngeal glands do not develop correctly in these conditions, which exclude the assessment of HPG. Hence OECD guideline probably does not consider it as an endpoint in the study. As previous study has shown, chemical can have influence on development of hypopharyngeal glands, without causing mortality and morbidity. This matter is worthy considering and should be investigated further, in order to introduce the evaluation of hypopharyngeal glands as an endpoint in toxicity testing of chemicals on bees.

WE394

Assessing toxicity to Daphnia magna using movement parameters

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Daphnia are among the most common settlers of freshwater habitats. These planktonic invertebrates show high sensitivity to various toxicants, therefore representing a useful model organism in ecotoxicological research – with common endpoints being survival, reproductive success and observable morphological changes. Some of recently conducted scientific investigation using these organisms focused on examining the effects of various substances on their mobility. 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 these concentrations of ZnCl₂. The interactive effects of ZnCl₂ on Daphnia were placed in each transparent plastic Petri dish in prepared solutions of the selected toxicant. The recording started instantly upon exposure of the organisms to the toxicant (t₀), as well as t₁, 24 h and 48 h of exposure (dt₁ = h, dt₂ = 24 h, dt₃ = 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 interaction of exposure affects the movement parameters, regardless of the concentration of the toxicant. Although, some of 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

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The validation of analytical methods (regulated by SANCO/30299/rev 4.) used in support of ecotoxicological studies has become an important aspect of the
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 newly 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 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 coordination). 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 pulses. Free-swimming 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.

Dissolution of Different Silica Nanoparticles in Aqueous Matrices M. Maceroni, Adolphe Merkle Institute / BioNanoMaterials; D. Bossert, A. Petri-Fink, B. Rothen-Rutishauser, F. Schwab, Adolphe Merkle Institute / BioNanoMaterials 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 two 22 hour stages [1]. The use of silica nanoparticle (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 characterization 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] Barki TK, Sahu B, Swain V. 2008. Nanosilica—from medicine to pest control. Parasitology Research. 103:253, [2] Torney F, Treywn 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 Merkle 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. Milaic, Jozef Stefan Institute (JSI) / Department of Environmental Sciences; M. Farre, IDAEA-CSIC / Environmental Chemistry; D. Barcelo, 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 studies [1,2]. However, few of these studies 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 fullerenes were also detected in Environmental samples 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] Astefaneei, Alina, et al. Analytica chimica acta 882 (2015): 1-10. [2] Freixa, A., et al. Environmental and pollution research (2017): 1-10. [4] Freixa, Anna, et al. The Science of the total environment 619 (2017): 328. [5] Sanchis, 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. Barcelo, 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, N-methylfulleropyrrolidinone, [6,6]-phenyl C60 butyric acid methyl ester, [6,6]-thienyl C60 butyric acid methyl ester, C40 pyrrolidine tris-acid ethyl ester and [6,6]-phenyl C40 butyric acid methyl ester) in waters, soils and sediments combines a solid-phase assisted solid-phase extraction (SPE-UAE) followed by liquid chromatography (LC), using a pyrenylpropyl 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/mg-ng/m in atmospheric aerosols, pg/g-ng/g in soils and pg/fmol/g 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 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

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The colloidal stability of engineered nanomaterials (ENMs) within aquatic environments is important for understanding fate and transport. In this study, using simplified, synthetic medium has demonstrated that ENM stability is strongly influenced by the engineered surface coating enveloping the ENM. However, it is unknown 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 an ENMs’ engineered surface coating remains a relevant factor effecting ENM stability in a complex, natural medium. In a local freshwater river to represent a complex, natural medium, a site and water samples were collected at each location. At each location, water samples were collected and brought back to the lab for analysis. Using a method from the literature, sedimentation rate with the values experimented in the lab were compared. As the water changes in the lab, we see increased input of ENPs into WWTPs. The increase in input of ENPs into WWTPs was due to the increase in input of ENPs into WWTPs. Therefore, the increased use and potential toxicity of ENPs poses a challenge for WWTPs due to their potential harmful effects towards activated sludge. The extent to which WWTPs can remove ENPs from the sewage must also be explored, to determine not only likely outflow into receiving waters but also accumulation within the activated sludge itself. To this end we focused on the activated sludge treatment, as the majority of ENPs can remain in wastewater stream throughout primary and secondary stages. We investigated a range of ENP removal kinetic and efficiency during activated stage treatment.

WE401 Engineered Nanoparticles interactions in secondary wastewater treatment: removal kinetic and efficiency during activated sludge stage.

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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 devices, and electronics. Despite the uniformity in the medium, significant differences in the stability of the model ENMs were observed. As was expected, the ENMs that maintained a positive surface charge after interacting with the surrounding medium remained stable. 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.

WE402 Fate factor of engineered TiO2 nanoparticles in aquatic and terrestrial natural environments

A. Schulz, University of Strasbourg (UdS); G. Quaranta, Université de Strasbourg / CNRS / EOST/LHYGES; S. Lowniczak, University of Strasbourg / LHYGES

Engineered TiO2 nanoparticles are used in several fields such as construction, cosmetic and food which leads to an important production and potentially to emissions generating environmental impacts. To quantify them, the Life Cycle Assessment provides a powerful method that is able to characterize TiO2 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 TiO2 nanoparticles (TiO2 ENPs) fate according to two approaches: experimental and by calculation. For this purpose, it requires firstly to detect and quantify TiO2 ENPs in water, soil and sediment near a production site in Vieux-Thann (68) to determine parameters which could be used to model TiO2 ENPs and several ENP analysis methods are used in particular inductively coupled plasma with atomic emission spectrometry (ICP-AES), transmission electron microscopy (TEM) and conductivity or potential of hydrogen (pH) measurements. Then, parameters determined in the previous steps are used to calculate a fate factor of TiO2 ENPs in a natural environment according to the life cycle impact assessment method. Calculation results were compared to the experimental data. During the study, it was found that toxic strength, pH, percentage of organic matter, soil composition (percentage of clay, silt and sand) or size and concentration of TiO2 ENPs are parameters which matter in TiO2 ENPs fate in soils, water and sediments. Furthermore, the first results obtained show 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 comparing the ENM stability when the ENM is dispersed within a complex, natural medium. Instead, it was also verified that the degree of dispersed TiO2 ENPs concentration in sewer with time is significantly different according to the concentration of dispersed TiO2 ENPs.
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 the work is that microalgae lacking of cell wall will be more susceptible to the toxic effects of NPs than those with a typical cell wall. To test this hypothesis two microalgae species, Dunaliella salina, lacking cell wall, and Chlorella autotrophica, with a typical cellulosic cell wall were chosen. Species were exposed to ionic (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 marine 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. autotrophica. Therefore, the cell wall of C. autotrophica seemed 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-discoveries, the measured z-averages ranged from 600 nm (CPO-27-Ni) up to 8 µm (HKUST), Zu-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 NPs in test media, and their contribution to the observed effects on R. subcapitata. Particle size measurements showed that the NPs have a primary particle size between 200 nm and several micrometres. In freshly sonicated stock-discoveries, the measured z-averages ranged from 600 nm (CPO-27-Ni) up to 8 µm (HKUST), Zu-CPO and CPO-27-Ni had the most negative zeta-potential of -25 and -20 mV respectively, with Al(OH) fumurate 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 mobility in special substances such as metals and metalloids, both directly after dispersion preparation and after a 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) fumurate caused an increase of Al from 11 mg/L to around 60 mg/L. FeBTC-JM-AR was the most inert material regarding release of dissolved metals. Due to their adsorption properties, the materials also drastically reduced amount of P in the exposure media, with Uio-66-COOH also decreasing Ca and Mn. Potential mode-of-actions, i.e. impact of NPs particles through depletion of nutrient elements, toxicity of dissolved metals, or effects from organic components will be identified in the R. subcapitata toxicity tests.

WE406 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 Geosciences; D. Savić Zdravković, 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 photoactivity, sorption, environmental fate, and toxicity. Engineered nanoparticles (NPs) can behave as particle 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 photoactivation, can provide important new information on physicochemistry of both PAHs and NPs. Previous work conducted by our research group has found that exposure 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 (cytochrome P4501A1 cypl/1 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 hydroxyl polymeric aromatic hydrocarbons (OPAHs) 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 P450 cyp1a1 and cyp1b1) and Phase II metabolism (gsh, ephx, gsth; and epoxide hydrodolases ephx1 and ephx2)) in early life stages of zebrafish will be assessed. The exploitation of biological responses to investigate changes in PAH and PAH-decomposition effects on PAH product bioavailability during sorption processes will provide novel insight into these processes tested directly within the environmentally relevant aqueous phase.

WE407 Toxicity of TiO2 nanoparticles to freshwater chironomids - pointing out the relevant endpoints
D. Savić Zdravković, Faculty of Sciences and Mathematics, University of Niš / Department of Biology and Ecology; B. Jovanovic, Iowa State University / Natural Resource Ecology and Management; A. Đurđević, J. Stanković, Faculty of Science and Mathematics, University of Niš / Department of Biology and Ecology; D. Miloslević, Faculty of Sciences and Mathematics, University of Niš / Department of Biology and Ecology
In the environment, nanomaterials are present in a number of chemical forms, exhibiting specific interactions, mobility, biological availability and potential toxicity. Both ecotoxicologists and pathologists have expressed their concerns regarding the potential negative effects of nanomaterials in live systems and the environment. The present study was carried out in order to assess the influence of TiO₂ nanoparticles (in the form of human white food colorant E171) on the freshwater midge Chironomus tentans. The safety and conformance of the intake of this form of E171 TiO₂ for human health have been recently reconsidered. The experimental design was conducted for the sediment dwelling chironomid larva according to OECD guidelines. Concentrations of 125, 250, 500, 1000, 2000 and 4000 mg of E171 TiO₂ per kg of sediment were tested for lethal and sub-lethal effects (mortality, emergence ratio, developmental time and rate). Concentrations of 2.5, 25 and 250 mg of E171 TiO₂ per kg of sediment were used to assess sublethal effect (mormothecic changes of mentum, mandibles and wings). The mortality and emergence ratio was affected by a higher nanoparticulate TiO₂ concentration in the sediment (>1000 mg/kg). Sublethal effects on Chironomus tentans larvae at environmentally relevant concentrations were shown through morphological changes, which were qualified and quantified using the geometric morphometry approach, principal component analysis and canonical variate analysis. This was the first time a geometric morphometric approach was used to assess the deformities in chironomid larvae exposed to nanoparticles. Geometric Morphometrics revealed the tendency of the mentum teeth to narrow and elongate and the mandibles to widen due to the physical damage in cell membrane through adsorption of NPs. The results show that the morphological changes of C. tentans could be used as an endpoint in nano-TiO₂ monitoring together with geometric morphometry.

WE408 Multigenerational exposure of the nematode C. elegans to Silver Nanoparticles at the expense of oxidative stress defence mechanisms
L. Rossbach, Norwegian University of Life Sciences UMB / INV; E. Maremonti, Norwegian University of Life Sciences UMB; M. King, Norwegian University of Life Sciences; D. Oughton, Norwegian Public Roads Administration / Norwegian University of Life Sciences / Centre for Environmental Radioactivity (CERAD CoE); D. A. Brede, Norwegian University of Life Sciences / Centre for Environmental Radioactivity
Multigenerational exposure of the nematode C. elegans to Silver Nanoparticles at the expense of oxidative stress defence mechanisms (Morseth, 2016) revealed increased susceptibility to ionic Ag, while exposure to TiO₂ nanoparticles caused the nematode C. elegans to model. Further, changes in susceptibility to other metals and the role of ROS as well as metabolic changes were investigated. Exposure to sub-lethal concentrations revealed increased susceptibility to Ag, while...
AgNPs tolerance increased. Results show that adaptation development may occur after just a few generations. Subsequent exposure to paraquat, a known ROS inducer, indicated the involvement of ROS defense mechanisms. Therefore, changes in glutathione redox potential and sod-1 gene expression were measured, employing the genetically encoded fluorescent biosensors Grx-1-ROP2 and, the reporter strain Sod-1::gfp, respectively. Further, effects of the AgNPs on the central metabolism and implications on energy production are investigated by measuring the metabolic footprint of 13C-labeled glucose and PE255. Findings of this study will aid to further improve the understanding of the toxicity of nanoparticles, as well as contribute to our knowledge about the behavior of C. elegans in response to toxicants. Acknowledgements: Karl Andreas Jensen and Sofriird Lohne. This work was supported by the Norwegian Research Council funded NanoCharm (22139/1740) and NorNanoReg (239199) projects, and the EU NANOREG project grant agreement nº 310584.

WE409 Effect of silver nanoparticles layer on soil surface to terrestrial species J. Kwak, S. Nam, Konkuk University; Y. An, Konkuk University / Department of Environmental Health Science

With developing nanotechnology, uses and release of engineered nanomaterials are increasing. Landfill of biosolid after wastewater treatment is considered as one of indirect exposure sources of nanomaterials. This study focused on the simulation of exposure scenarios of nanomaterials landfills, and set the aim to investigate different toxic effects derived from different scenarios. Silver nanoparticles (AgNPs) were selected as test materials because of a different ecological hazard. This was not considered; 1) control, 2) layer of AgNPs with low concentration (Low-Layer), 3) layer of AgNPs with high concentration (Low-Layer), and 4) mixture of AgNPs and soil with low concentration (Low-Mix). Plant microcosm experiment was conducted in the greenhouse for 9 weeks. Soybean plant was most inhibited in Low-Mix exposure group which mimicked whole mixture of nanomaterials and soil because root surface area exposed to AgNPs was most larger than Low-Layer and High-Layer. In case of soil enzymes, activities were depended on exposure concentration. This study concluded that exposure concentration of nanomaterials as well as depth of nanomaterials layer should be considered in the soil ecotoxicity research area. 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).

WE410 Fragmentation of nano- and microplastics from expanded polystyrene exposed to sunlight Y. Song, Korea Institute of Ocean Science and Technology; W. Shim, S. Hong, Korea Institute of Ocean Science and Technology / Oil and POPs research group; S. Eo, Korea Institute of Ocean Science and Technology

Production of nano- and micro-sized plastics through weathering of plastic surface by photo-oxidation was regarded as one of major input sources of secondary nano- and microplastics. Its fragmentation process according to exposure duration and sunlight intensity was investigated at four different exposure scenarios were considered; 1) control, 2) layer of AgNPs with low concentration (Low-Layer), 3) layer of AgNPs with high concentration (Low-Layer), and 4) mixture of AgNPs and soil with low concentration (Low-Mix). Plant microcosm experiment was conducted in the greenhouse for 9 weeks. Soybean plant was most inhibited in Low-Mix exposure group which mimicked whole mixture of nanomaterials and soil because root surface area exposed to AgNPs was most larger than Low-Layer and High-Layer. In case of soil enzymes, activities were depended on exposure concentration. This study concluded that exposure concentration of nanomaterials as well as depth of nanomaterials layer should be considered in the soil ecotoxicity research area. 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).

WE411 Effects of nano-plastics on natural marine aggregates and their associated microbial communities S. Summers, SCELSE Nanyang Technological University / SCELSE; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society; T. Gutierrez, Heriot Watt University / School of Life Sciences

Plastic debris in the marine environment is of particular interest, as the issue is one on a truly global scale. The ubiquitous presence of micron sized plastic particles and the knowledge that these will break down into ever smaller, nanometre sized particles, has resulted in a surge of recent research into nano-plastics. However, the difficulty in detection of nano-plastics has made it difficult to predict the specific risks involved in their presence within a marine environment. We recently showed that nano-plastics are readily incorporated into marine snow (MS) particles as mediated by ‘sticky’ polymeric substances and other particulates. MS particles are described as a heterogeneous matrix composed of polymeric substances, such as EPS, fecal pellets, invertebrate casts and microorganisms. It is therefore expected that the fragmentation of nano-plastics with MS may include plastics to the total pool of suspended particulate organic matter (SPOM). Studies on the impacts of this pool of MS-associated nano-plastics, however, are lacking, including the microorganisms that colonize these particles. Since microorganisms, in particular bacteria, are major colonizers of MS, we hypothesized this would also be the case for MS-associated nano-plastic particles. To assess this, we generated MS-associated nano-plastic particles utilizing expanded polystyrene collected from a subarctic northeast Atlantic region and nanometre-sized polystyrene spheres. Analysis of the nano-plastic-MS particulates by barcoded 16S rDNA gene MiSeq sequencing revealed that the addition of nano-plastics introduced some minor variability within treatments, with respect to microbial composition. The presence of the nano-plastics marginally increased the α-diversity of the community associated with the particles, compared to the community associated with MS in the absence of nano-plastics. Statistical analysis, however, did not provide substantive evidence to suggest that these differences and variabilities were significant. Therefore, while nano-plastics may have some minor effect in terms of the diversity of bacteria that colonize MS, it was less than the natural variability observed for the microbial communities that colonized non-exposed (no nano-plastics) MS particles. These results suggest that plastic pollution may exert a major influence in altering the bacterial communities associated with MS particles.

WE412 Tracking nanoplastics in marine bivalves at environmentally realistic concentrations M. AL SID CHEIKH, University of Plymouth / Marine sciences and engineering; S.J. 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 Energy, 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. The most challenging aspect of this problem is the fact that tracking of such small particles at these low concentrations are indeed major analytical challenges for environmental and laboratory studies. Our study focuses on the tissue distributions of nanoplastic in marine bivalve in a single pulse exposure of 6 hours and depuration of 48 days in open clean seawater. Here we present, preliminary results where we track nanoplastics at environmentally realistic concentrations in marine bivalves.


Plastic pollution is a widespread concern worldwide. Substantial amounts of plastics are produced and discharged into the environment every year, which will potentially impact aquatic ecosystems and consequently aquatic organisms. Plastic in the aquatic environment can undergo mechanical, chemical and biological degradation that can give rise to the formation of small plastic particles, which can be denominated as micro- (< 1 mm) or nano-plastics (< 100 nm) depending on size range. Microplastics are ingested by a range of aquatic organisms and this ingestion might cause adverse biological effects, however less research has been conducted on their smaller counterparts, nanoplastics (NPLs). Similarly to other nanomaterials, NPLs possess size specific properties which could increase their bioaccumulation and bioavailability, which involves the uptake and transfer of the material from one organism to another. Risk assessment of such small 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 a part of pollution. This is due to the difficulty in detection of nano-plastics at these environmentally realistic concentrations in marine bivalves.

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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 Ecology (RIVM)

Engineered nanomaterials (ENMs) are widely applied, and the release and accumulation of ENMs through waste effluent and deposit are threatening the aquatic and terrestrial ecosystem. While important knowledge has been gained about the uptake of ENMs on cultured invertebrate and microbial species based on simplification microcosm and mesocosm model systems, extrapolation of results to investigate the perturbation caused by interactions between the intestinal microbiome and the host. Also, the link between microorganisms and invertebrates investing in this emerging field that are 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 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 uptake and accumulation of ENMs by invertebrate species to understand if the exposure of ENMs to the environment remains unclear. In this study, the toxic effects induced by citrate-functionalized IONPs at environmentally relevant iron concentration (0.3 mg L\(^{-1}\)) was investigated in female guppy Poecilia reticulata by histopathological approach based on qualitative analysis and histopathological index after acute and subacute exposur. 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 ELSD analysis showed that the IONPs has 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). The histopathological results showed an increase in hepatopancreatic 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 focii of melanomacrophages indicating an increase of hepatotoxicity according the exposure term (14 and 21 days).

**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, Kitech / 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 automatic mobile lab responding chemical accident of aquatic environment in Korea. We designed rapid reacting automatic 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 environment and raised spot of a road and reduced speed. Vibration vulnerability assessment were conducted with vibration testing shaker. We also collected topographical information related to diverse accessibility characteristic by 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 3.5kW capacity and prepared 24hr operation capacity with 10kWh supplementary battery system of 10kWh assisting and initiating the system on arrival and in between generator exchange. Vibration testing shakers are 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.

**WE416 Trophic Interactions in the Bioaccumulation and Depuration of Silver in Fish 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) accumulate Ag in their tissues. The greatest bioaccumulation was observed in the liver tissues of pike, and a substantial amount of Ag was observed in their gills. 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 uptake into 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. Qualhão, 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 nanomedications, their ecotoxic effects to aquatic organisms remains unclear. In this study, the toxic effects induced by citrate-functionalized IONPs at environmentally relevant iron concentration (0.3 mg L\(^{-1}\)) was investigated in female guppy Poecilia reticulata by histopathological approach based on qualitative analysis and histopathological index after acute and subacute exposur. 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 ELSD analysis showed that the IONPs has 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). The histopathological results showed an increase in hepatopancreatic 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 focii of melanomacrophages indicating an increase of hepatotoxicity according the exposure term (14 and 21 days).

**WE418 Biotests for Hazardous Waste Classification (HP14): benchmarking Limits for Tolerable Ecotoxicity**

B. Woltjen, VITO / ABS; e. rossi, OVAM; g. vanermen, VITO; K. Tirez, Flemish Institute for Technological Research VITO

The current HP14 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 always available and the classification is not performed with the chemical data. Instead, the chemical evaluation as step 1 biotests in steps 2 (acute aquatic tests on eluate fractions) an (Eco)toxicity tests for hazard evaluation of recycling and environmental toxicology) Presentation preference: Poster presentation

**Session: Ecotoxicology and human toxicology: from (Eco)toxicity tests for hazard evaluation of recycling materials and waste (P)**

**WE419 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, Kitech / 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 environment and raised spot of a road and reduced speed. Vibration vulnerability assessment were conducted with vibration testing shaker. We also collected topographical information related to diverse accessibility characteristic by 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 3.5kW capacity and prepared 24hr operation capacity with 10kWh supplementary battery system of 10kWh assisting and initiating the system on arrival and in between generator exchange. Vibration testing shakers are 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 OVAM, the Flemish Waste Agency! The kind help of the technicians Guy Geuskens, Cis Boonen, Wilfried Dumortier is highly appreciated.

WE419 What is the future for the waste wood in terms of ecotoxicological testing? S. Legay, FCBA / Chimestry 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 concentrations of chemical classes with the 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. Chelinho, CEF - Centre for Functional Ecology / Department of Life Sciences of University of Coimbra; C. Venâncio, Department of Biology / Biology; L. 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 and bioclimatic 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 organsisms the range of sensitivities was: E. andreii > F. candida > E. crypticus > L. sativa > T. aestivum while for aquatic organisms was: H. viridissima > R. subcapitata > C. vulgaris > H. incongruens > 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. Janche, M. Buckowa, R. Lichinsky, J. Hegrova, J. Huzlik, K. Effenberger, Transport Research Centre Reconstruction and repair of the road infrastructure are a source of the reclaimed asphalt, which is suitable to continue to use. It is also necessary to deal with the environmental impact of these materials within their ongoing life cycle, except testing their mechanical properties. Currently, the environmental impact tests of reclaimed asphalt conducted in crushed condition, according to the leachability test of granular materials with grain size Scenedesmus subspicatus, Sinapis alba, Daphnia magna were carried out in aqueous extracts. The results were compared with the legislation and were evaluated in terms of the content of the monitored substances and the type of test material.

WE422 Leaching tests - a useful tool for the environmental impact assessment of construction products N. Bandom, Federal Institute for Materials Research and Testing / Contaminant Transfer and Environmental Technologies; F. Jürgens, BAM Federal Institute Materials Research and Testing; U. Schoknecht, BAM Federal Institute for Materials Research and Testing 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 compared to environmental quality standards. Further, the 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. Dryganski, Texas Tech University / Department of Civil Environmental and Construction Engineering; E. Strecker, B. Steets, M. Otto, Geosyntec Consultants Stormwater is a major vector of contaminants to receiving waters, however, water quality standards are set to protect aquatic resources from point source discharges. In the case of diffuse sources, the contamination is more challenging to assess and manage due to the difficulty of managing diffuse source contributions. To address the issue of large volumes of runoff, the study objective is to develop methodologies to quantify the ongoing sources of 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 3050A and 3050B, respectively, and analyzed using ICP-MS and ICP-AES. Persistent organic pollutants in water samples were Liquid-Liquid Extracted (LLE) using the modified EPA Method 3510C, while sediment was extracted by Pressure Assisted Fluid Extraction (PFE with ASE 350) using the modified EPA Method 3545A. PAH analysis was performed on HPLC and 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 deposition 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 PAH congeners. The results also 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. Kjetil, Statens Norsk Geotechnisk Institute; P. di palma, IRSCNCR; C. Riccardi, INAIL; E. Eek, 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) Bonatubia, 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 polycyclic 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 simulation. The results indicated that biochar can be considered a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments.

**WE425**

**Polycyclic Aromatic Hydrocarbon (PAH) 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, RBL / Ecosystem Services; T. Himmer, CH2M; s. clark, Pacific EcoRisk; R. Zaja, J. Eby, CH2M

Historic site activities at the Hunters Point Naval Shipyard (HPNS) in South San Francisco Bay resulted in the release of chemicals, including polycholorinated biphenyls (PCBs), to offshore sediments. To inform remedy selection at this urban site, activated carbon (AC) amendments were used 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 SediMite™ were assessed for their potential to reduce ecological risks associated with PCB-contaminated sediment. Biochar was assessed in order to assess the capping efficiency, reducing the bioavailability of PCBs to the bent-nose clams (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. Tissue bioaccumulation, benthic invertebrate community composition, and chemical analyses were measured as indicators that biochar can be considered a cost-effective alternative to the more widely used sorbent materials for capping oil spill contaminated sediments. 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 treatment areas on 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. Diaz-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 flooding 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 metal concentrations in surviving organisms showed different sorption differences observed among treatments and incubation conditions. A strong decrease in Cd, Zn and Pb CaCl2-extractable fractions was observed in all the mine waste dilution in both biochar treatments compared to untreated mine waste, with no significant differences among treatments or flooding conditions. Addition of biochars also lead to an increase of the pH, which might explain the reduction in metal bioavailable fraction and the consequent decrease in organisms’ body metal bioaccumulation.

**WE427**

**Remediation of mine wastes with biochar: effect on metal bioavailability to Earthworms**

M. Almira-Casellas, Leitat Technological Center / HEHS; V. Gonzalez, M. Diaz-Ortiz, Leitat Technological Center

The overall effect of two biochar-based amendments (one from pruning trees and other from sewage sludge) and their efficacy for metal immobilization in an acid (A) and an alkaline (B) mine wastes were assessed. Two different simulated field conditions, irrigation periods versus alternating flooding-drying periods, were evaluated before, immediately after and after 10 months of incubation. Besides physicochemical characterization, ecotoxicological assays with Enchytraeus crypticus exposed to both: i) pore water solutions extracted from mine wastes and ii) bulk mine wastes were conducted to provide a more accurate estimation of metal bioavailable fraction and risk of exposure. Survival of E. crypticus exposed to mine waste was monitored in an in vitro system and mine waste pore water solution was tested to model the long term (>12 months) behaviour of various cap configurations with a numerical simulation. The results showed no significant differences from the alkaline mine waste B and its pore water solution on survival and reproduction of E. crypticus. However, exposure to untreated and treated acid mine waste (A) and its pore water caused high mortality in organisms at time 0. Over time, the survival increased and the internal concentrations were lower in the amended mine wastes than in the untreated mine waste A, indicating a lower metal bioavailability. Addition of biochars lead to an increase in the pH and a decrease in Pb, Zn and Cd CaCl2-extractable fractions in the acid mine waste, suggesting a main role of the pH determining the bioavailable fraction of metals in the soil solution. No significant differences between different type of biochars were found. Our results showed that biochar treatments decreased the bioavailable fraction of Pb, Zn, and Cd in the soil solution, reducing the toxicity of the acid mine waste to earthworms.

**WE428**

**Bioavailability-based Methods to Assess Remediation Effectiveness**

J. Gan, University of California, Riverside / Department of Environmental Sciences; J. Wang, University of California Riverside; A.R. Taylor, University of California Riverside / Environmental Sciences; D. Schlenk, University of California-Riverside / Environmental Sciences; J. Gan, University of California-Riverside / Environmental Sciences

Compared to the total chemical concentration, bioavailability is a better measurement of risks of hydrophobic organic contaminants (HOCs) to biota in contaminated soil or sediment. Many different bioavailability estimation methods have been introduced to assess the effectiveness of remediation treatments. However, to date the different methods have rarely been evaluated against each other, leading to confusions in method selection. In this study, four different bioavailability estimation methods, including solid phase microextraction (SPME) and polyethylene passive sampling (PE) aiming to detect free chemical concentration (Cfree), and Tenax desorption and isotope dilution method (IDM) aiming to measure chemical accessibility, were used in parallel to estimate bioavailability. Bioavailability studies indicated that AC may be an effective contaminant treatment for the addition of different black carbon sorbents. Bioaccumulation into earthworm (Eisenia fetida) was measured concurrently for validation. Activated carbon or biochar amendment at 0.2-2% decreased earthworm bioaccumulation of DDDs by 83.9-99.4%, while multi-wall carbon nanotubes had a limited effect (4.3-20.7%). While all methods correctly predicted changes in DDX bioavailability after black carbon amendment, passive samplers offered more accurate predictions. Predicted levels of DDXs in earthworm lipid using the estimated bioavailability and empirical BCFs matched closely with the experimentally derived tissue concentrations. However, Tenax and IDM underestimated bioavailability when the available DDX levels were low. Our findings suggested that both passive samplers and bioaccessibility methods may be used in assessing remediation efficiency. Presenting flexibility in method selection. While accessibility-oriented methods offer better sensitivity and shorter sampling time, passive samplers may be more advantageous because of their better performance and compatibility for in situ deployment.
(RS) was evaluated as a sorbent for ionizable halogenated phenols. Compared with similar sorbents, RS achieved 92% reduction in recalcitrant hydrocarbons, resulting in enhanced oxidation and biodegradation. Fractional analysis of Total Petroleum Hydrocarbons (TPH) showed significant reduction, with soil TPH concentrations dropping from an initial 7470 mg/kg to 550 mg/kg after bioaugmentation foam was sprayed onto the contaminated soil for oxidation of soil total petroleum hydrocarbons (TPH). Periodic spraying of peroxide was used for pretreatment of Diesel prior to bioaugmentation. All oxidants were chosen for their minimal human and ecological impact, as well as their effectiveness in breaking down harmful contaminants.

Recalcitrant hydrocarbons, such as those found in Diesel and Fuel oils, are a complex mixture of hydrocarbons. Low-molecular weight hydrocarbons (LMW) 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 bioaugmentation and how it interfaces 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 total petroleum hydrocarbons (TPH) pre- and post-soil effluent collection were analyzed for PAH derivatives.

Contaminants of aquatic environments, such as PAHs, are present in the composite nano derived polymer, it caused a significant increase in the adsorption rate. The changes made in the samples of polymer residues and increasing aromaticity of polymer/RS (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 played key roles in the sorption. 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 biochar as a sorbent for various types of contaminants.

Biochar for soil management: interactions with legacy contaminants and current-use pesticides

Enhanced total petroleum hydrocarbon removal without soil disturbance by sequential surfactant foam spraying

R. Bajagain, Y. Park, Kunsan National University; S. Jeong, Kunsan National University / Department of Environmental Engineering Fuel oil is a complex mixture of hydrocarbons. Low-molecular weight hydrocarbons (LMW) 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 bioaugmentation and how it interfaces 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 total petroleum hydrocarbons (TPH) pre- and post-soil effluent collection were analyzed for PAH derivatives.

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Adhesion 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. Boulemtain, RioTinto; 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 into a sustainable material using them 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 herbalaceous 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 TE concentrations measured in 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.

### Ecotoxicology 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. Saarela**, University of Helsinki / Department of Ecological Sciences; **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 via laboratory exposure experiments with concentrations of 0.02%, 0.06%, 0.17%, 0.5% and 1.5% of PES fibers in dry Lufa 2.2 soil. The fibers were mixed in with the soil to achieve as homogeneous 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 homogeneous 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. scaber*) and the springtail *F. candida* showed sublethal effects. This indicates that the mechanism of action 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.

**TH002**

Effects of microplastic particles of polyhydroxybutyrate towards photosynthetic aquatic organisms

**M.G. Pieter**, 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-Pilas, Universidad Autónoma de Madrid / Biology

Newly, 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.* PPC7120 and the green alga *Chlamydomonas reinhardtii*. Firstly, we have performed the physicochemical characterization of microplastic particles of PHB and their potential degradation products. Further, we have measured the uptake 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 toxicity to photosynthetic organisms and their effects in 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

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Since the early 1970s, the occurrence of floating plastic has been reported in marine waters with great accumulation in gyres. In recent years, the presence of plastic debris < 5mm called microplastics (MPs) which result mainly from macroplastic’s fragmentation has also been reported in aquatic ecosystems even in remote areas. Several studies have reported the presence of MPs and their effects in release of organisms. However, it appears necessary to investigate their potential toxicity especially at environmentally relevant concentrations. The aim of our study was to evaluate the bioaccumulation and toxicity of polypropylene (PP) and polyethylene (PE) fragments towards the blue mussel *Mytilus edulis*. These polymers were selected according to a previous study conducted in situ in the Region Pays de la Loire. Mussels were exposed in laboratory during 10 days at two environmentally relevant concentrations of 0.008 and 10 µg/L ([9 and 11,250 particles/L respectively] (Desforges et al., 2014), and to a higher concentration of 100 µg/L (112 300 particles/L) of each MP type. The exposure was followed by 10 days of depuration in clean seawater (without MPs). MPs fragments were prepared in the laboratory from commercially available products by milling; characterized in terms of size, shapes and they were counted. Following exposure, tissues and biodeposits (faeces and pseudofaeces) were chemically digested and analyzed for MPs recovery using infrared micro-spectroscopy. Regarding potential toxic effects, detoxification and oxidative stress mechanisms through measurement of enzymatic activities of Glutathione-S-transferase (GST), Catalase (CAT) and superoxide dismutase (SOD) were evaluated as well as the immune responses in mussel. The immunological examination resulted showed the presence of PE and PP particles in digestive glands of mussels exposed to the highest concentration tested (100 µg/L) of MPs, and in biodeposits where MPs were evaluated. Significant increases in SOD and CAT activities were observed in the digestive glands of mussel’s exposed to 0.008 and 10 µg/L and in gills from mussels exposed to 100 µg/L of MPs that could be indicative of an oxidative stress. This study brings new results on the potential sublethal effects of MPs at environmentally relevant concentrations of MPs.

**TH004**

Effects of zebrafish exposure to high-density polyethylene and poly styrene microplastics at molecular and histological levels

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Impacts of Microplastics in Agro Systems and Stream Environment.
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 combination 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 Illumina technology. The study investigates the effects of size of artificial and natural particles in the digestive organs was observed using histology. Gene expression analysis of immune related genes (TGFβ, TNFα, IL-8, IL-10, IL-17, IL-14/13α) 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 (lysozyme stability and complement system) in blood plasma was evaluated to assess the presence of systemic inflammation. The findings of the study indicated no or minor functional effects on fish intestinal tissue ingested by particle exposure. Signs of inflammation were detected and were accompanied by upregulation of tight junction proteins, suggesting activation of intestinal homeostasis in response to PS MPs exposure.

Tl005 Uptake and Effects of Synthetic and Natural Microparticles in the Shrimp Palenomon varians M. Weidung, University Duisburg-Essen; R. Saborovski, 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 investigates the effects of size of artificial and natural particles on the induction of cellular stress in the Atlantic ditch shrimp (Palenomon 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 organs was observed by fluorescent microscopy. As marker for oxidative stress we measured the activities of the antioxidant enzymes catalase and superoxide dismutase (SOD) in extracts of the midgut 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 supraglottic tissue and the cells of the gut gland. Deactivated cells were housed in 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.

Tl006 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 - Center for Marine Environmental Research; H. Bouwman, North-West University / Unit for Environmental Science and Management

Microplastic particles in the ocean is a major environmental concern. Most studies tend to concentrate on the surface ocean when examining microplastic pollution. However, it is known that, for various reasons, microplastics can lose buoyancy and sink. The detection of microplastics in the Southern Atlantic Ocean (SAO) was determined. The study was conducted from the RV METEOR, a German research vessel. The cruise was from Cape Town, South Africa, to Rio de Janeiro, Brazil, from the 29th February 2016 to 18th March 2016. A multinet with a mesh size of 25 µm was deployed at fourteen stations across the SAO, and sampled at increments of 20 m (0-20 m, 20-40 m, 40-60 m, 60-80 m, and 80-100 m). The contents of the multinet samples were filtered through a 1 µm sieve. The remainder of the samples was pressure filtered through black filter paper (to ensure optimal visibility of the microplastic particles), and air-dried. The dried samples were examined under a dissection microscope, and the microplastic particles counted visually. The highest density of microplastic particles were found in the top layer (0-20m), at 52%. Seventeen percent of the particles were found at 20-40 m, 14% in 40-60m, 9% in 60-80m, and 8% in 80-100m. There was a high microplastic count near the South African coast (10^4-0^6). After crossing the Walvis Ridge and sailing into the high pressure system over the SAO, the plastic count decreased dramatically. A fairly homogenous stratification was observed in the high pressure system. Near Brazil, the microplastic concentrations increased again. In the eye of a cyclonic eddy, microplastics were slightly less stratified. This study was intended as a pioneer study to determine whether microplastics are stratified in the water column. This was found to be the case.

Tl007 Effects of dietary microplastic exposure on fish intestinal physiology G. Asmonaité, 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 vast number of aquatic species, 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 transporting functions. Juvenile rainbow trout (Onchorhynchus 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 diet: control (no PS MPs) and diets containing untreated PS particles (PS+vitamin) or particles exposed to sewage (PS+sewage). Results indicate that MPs induce an inflammatory response (lysozyme activity, homeostasis in response to PS MPs exposure.

Tl008 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 / Faculty of Sciences and Technology; T. Neves, Faculty of Sciences and Technology Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; G. Gonçalves, MARÉ - Faculty of Sciences and Technology, Universidade Nova de Lisboa / Department of Environmental Sciences and Engineering; P. Sobral, MARÉ - Faculty of Sciences and Technology, Universidade Nova de Lisboa / DCEA; M. Costa, MARÉ - 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 the juvenile 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 565 MPs per day) and other without MPs (control), making a total of five treatments. Sixty-day laboratory assays were conducted, in duplicate, and the test pellets were provided to fish once a day. After 14, 30 and 60 days, fish were sacrificed and from each treatment five fish. The liver and stomach were dissected and 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 acetylcollionesterase. Histopathological analyses were also performed in the digestive tract to assess the presence of MPs and possible histopathological effects.

Tl009 Nanoplastic impacts on physical, biochemical, and nutritional characteristics 422

SETAC Europe 28th Annual Meeting Abstract Book
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 environment, the concerns about marine pollution and ecological damages on marine organisms have increased. Especially, among these plastic wastes, nanoplastics (4-200 nm) and microplastics (≥5 mm) are the main threats to marine life and the researches about their impacts and effects in environments are under way. In this study, we assessed various physical, biochemical and nutritional changes in the bodies of Pacific whiteleg shrimps (Litopenaeus 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 mussels 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 (2016R1A2B3010445).

TH100
Brood Pouch-mediated Polystyrene Nanoparticle Accumulation During Daphnia magna Embryogenesis
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Polytactic species is ubiquitously distributed in aquatic environments and are considered as an emerging environmental issue for 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 embryos to PSNPs with similar size and number was conducted, illustrating the likelihood of 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
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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. This work was conducted on larvae of different size and number 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 and 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
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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 nanoplastics (NP, 50 nm) on the fitness of the mussel species 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, whereas HSP70 expression was not affected by the immunostimulation by 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 scaled 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 NP treatments was moderate (HSI = C) at 1.5 and 15 ng/L, and low at 150 ng/L NP. 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
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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 plastics 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/L) in natural sea water (NSW) for 48 hours. The toxicity was evaluated by measuring growth and several biomarkers as carboxyesterase (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 of 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 concerning 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
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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 microplastics (< 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°S, 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 β-globin gene expression in new found formation. Similar findings reported for nano-silanized 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 nano-plastics as a potential stressor on Mytilus galloprovincialis
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Physical and chemical environmental stressors in 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 (cbb) toxicity on bivalve Mytilus galloprovincialis. Mussels were exposed for 96 h to model plastic NPs (48 h) and free carbamazepine (cbb) in order to find NP effects on NP-NP interactions. Molecular and biochemical biomarkers were evaluated in digestive gland, 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 µg/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, cbb and their mixture.

TH016
The role of microplastic size and type on PAH sorption and bioavailability to copepods
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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, MPs 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 do not allow the accurate determination of PAHs released from adsorbed compounds or fragmants 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-dimethylnaphthalene) to a range of different MP's in natural seawater. The selected PAHs exhibit different sizes and hydrophobicities, thus having varying sediment solubility (two to three orders of magnitude). In the case of fluoranthene, the soluble 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 (polyethylene and polystyrene microbeads, polyester 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 polyethylene 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)
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The endocrine disrupting compound, EE2, is a potent estrogenic compound, which can affect a range of physiological processes in vertebrates, including reproduction and development. The aim of the study was to clarify the potential of microplastics to alter toxic effects of EE2 on the African clawed frog (Xenopus laevis) by evaluating the effects of model microplastics (< 1 µm) on the development of juvenile Xenopus laevis. The study focused on the effects of different concentrations of microplastics and their ability to affect the developmental processes of juvenile Xenopus laevis. The results showed that microplastics had no significant effect on EE2 toxicity, as indicated by the lack of significant differences in the development of the embryos exposed to EE2 in the presence or absence of microplastics. This suggests that microplastics do not significantly affect the toxic effects of EE2 on the development of Xenopus laevis.

TH018
Kinetics of POPs sorption and plastic additives release to a variety of polymers under specified conditions
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The PLASTOX project investigated the ingestion, food-web transfer, and ecotoxicological impact of microplastics (MPs), together with the persistent organic pollutants (POPs), metals and plastic additive chemicals associated with them, on key European marine species and ecosystems. PLASTOX combined field-based observations, laboratory tests and manipulative field experiments to study the ecological effects of MPs. The use of common microplastic reference materials, including a marine litter-derived MP produced from an environmentally weathered fish box, allows a meaningful comparison of data generated by different partners and across the different activities of PLASTOX. As part of a long-term field experiment conducted at marine locations across Europe (Mediterranean to
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 SMFD 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. Hydrophobic persistent organic pollutants such as PCBs, PBDEs, PBDEs and PAHs 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. Analytical procedures for GC/MS/MS and GCG/MS was done in the laboratories of the TU Darmstadt and NILU, Tromsø. In addition, release kinetics of common phthalates (monoesters, phthalate monoesters, 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.

T1H01
Characterization of microplastics present in personal care products and the study of its toxicity mixed with chlorpyrifos on juveniles of Solea senegalensis. G. Albenín, 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. Arévallo, Universidad de Cádiz / Toxicology Area.

In the last decades, 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 microbeads 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 chloroformed. The particles were identified by Fourier transform infrared spectroscopy (FT-IR) using a PerkinElmer Spectrum 100. The spectra are recorded in relation to the spectral range 4000-650 cm⁻¹ by 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 tests 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 12 h light/12 h dark exposure. The juveniles of Solea senegalensis (weight 3.07 ± 0.49 g) were exposed to five nominal concentrations of chlorpyrifos (5-80 µg/g), three concentrations on this compound mixed with microplastics (chlorpyrifos: 5-10-20 µg/g; 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 (AChE) have been used as specific biomarkers of acute exposure to organophosphate pesticides in general. There, two type of AChE presented in fish, acetylcholinesterase (ACHE) and butyrylcholinesterase (BChE). The AChE was analyzed on the head homogonate 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.

T1H02
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 aim at increasing our understanding of the effects resulting from dietary exposures to PS particles ranging in size 50-250 µm. This is to develop an experimental feeding study with the copepods (Oncothoeon yonkies) exposed diets, enriched with PS particles (10 mg of PS particles/Fish/day) for 28 days. We used environmentally contaminated PS particles from this in situ exposures from two environmental matrices (undiluted sewage effluent and industrial harbor runoff). As PS particles are highly inert and stable, exposure to PS is likely to take place over the lifespan of the organisms. Three different experimental diets, containing PS particles were used in this study, containing virgin PS, sewage (PS-sewage) and harbor (PS-harbor) exposed particles, were developed. Thereafter, a suite of oxidative stress biomarkers was investigated in the hepatic tissue of fish exposed to PS particles via gene expression analysis (NRF2, GR, GST, GSH, GPx, CAT, GCLmod, GCLcat, SOD) and enzymatic assays (GR, GST, GPx, CAT). Additionally, mRNA levels of established biomarkers (CYP1a, ERα and β, AM, TR, MT, VTE) were quantified to add additional insights into xenobiotic-related hepatic responses to dietary PS particles exposures. The findings of this study revealed an indication of NRF2-mediated oxidative stress regulation.

Microplastics as vector for hydrophobic organic chemicals in fish: a comparison of two polymers and silica particles, using three different model compounds M. Trefiřek, University of Gothenburg Sweden; G. Asmonaite, University of Gothenburg / Department of Biological and Environmental Sciences; E. Westberg, IVL Swedish Environmental Research Institute; Barroso, M. Tivefälth, University of Gothenburg Sweden; G. Asmonaite, University of Gothenburg / Department of Biology and Environmental Science.

In the field of microplastics (MPs) research, polystyrene (PS) particles have become reference material not only for investigating the uptake of the particles, but also for assessing biological effects. There is a growing body of (eco)toxicological research comparing two polymers and silica particles, using three different model compounds (benzo(a)pyrene, ethinylestradiol and chlorpyrifos) having distinct toxicological modes of action and different hydrophobicity (log Kow) values. Eight different experimental diets: control diets (negative control), diets with clean particles (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 well-established biomarkers (NRF2, GR, GST, CAT). Additionally, mRNA levels of established biomarkers (CYP1a, ERα and β, AM, TR, MT, VTE) were quantified to add additional insights into xenobiotic-related hepatic responses to dietary PS particles 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 lower 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) could potentially be explained by different chemicals associated with particles during in situ exposures.

TH023
Effects of Nanoplastics and the Co-Contaminant Tributyltin on the Nemate Community Structure in Sandy Sediments

A. Catarino, A. Homer, Heriot Watt University / ILES; L. Duran Saja, Heriot Watt University / M. Dévier, University of the Basque Country / CBET Reserch Centre; E. Navarro, University of the Basque country UPV/EHU; J. Hatfield, N. González-Soto, University of the Basque country UPV/EHU; A. Katsumi, 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. Duroudier, 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; H. Budzinski, University of Bordeaux / EPIC / GCRMN Reserch 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 stress (0.5, 2 and 5 μm) and the effects of different contaminants sorbed to NPs. There was no effect of stress observed in biomarker responses (scope for growth [SFG] and condition index). Chemical analysis showed that BaP concentrations in mussels increased with time (up to 150 times greater than background levels) and that smaller MP sizes 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 CAT but not in CYP1A. NA results from PS and/or BaP are not conclusive. Further work is required to understand the effects of a variety of plastic type, size, shape combinations together with a wide variety of pollutants. Funded by Spanish MINECO (NACE project CTM2016-81130-R), Basque Government (consolidated group IT810-13) and UPV/EHU / IFB 11/37, VRI grant PLASTOX. Work carried out within EU project PLASTOX (IPI Oceans 005/2015).

TH024
Nanoplastics induces a Decrease in the Oxygen Uptake of Zebrafish Larvae Enabling Sorbed Benzo(a)Pyrene Bioavailability

A. Catarino, Heriot-Watt University / ILES; M. Clement, Polytecth Nico Sophia; M. Tait, Heriot-Watt University; D. Boyle, Plymouth University; M. AL SID CHEIKHI, University of Plymouth / Marine sciences and engineering; T.B. Henry, Heriot-Watt University / The School of Energy, Geoscience, Infrastructure and Society.

Microplastics (MPs, 5 mm–1 μm) and nanoplastics (NPs, ≤ 1 μm) can result from larger plastic debris released in the environment and can pose a risk to marine organisms and ecosystems. The risk of NPs can be exacerbated because toxicants sorbed to NPs may be transported and become bioavailable in organisms. It is likely that NPs are the most abundant plastic particles present in marine environments, and as in the case of microplastics, they are expected to accumulate in benthic ecosystems. However, there is no information on the impact of NPs on benthic meiofauna assemblages. It is critical to understand impacts of NPs on sediments of NPs because meiofauna communities play key roles on ecosystem functions such as food production and nutrient cycling. Nematos are well established as pollution indicators and structural shifts in their communities reflect environmental changes. The goal of our work was to assess the effects of nanoplastics (nPS) and NPs with the sorbed cocontaminant Tributyltin (TBT) on free living nematodes on sandy sediment within a mesocosm experiment. Sediment was collected (up to 5 cm depth) at the Eden Estuary, St Andrews, Scotland, UK. The mesocosms (12°C) consisted of glass beakers (1 L) and the exposure took place for up to 2 months. Core samples of sediments were taken each week from the following treatments: 1) Control sediment, 2) Sediment with spiked TBT (0-100 ng/kg), 3) Sediment with nPS (0-12 ng/L) and 4) Sediment with nPS spiked with TBT (0-10 mg/kg NPs). Oxygen penetration depth (OPD) was determined by measurement of the oxygen saturation in the sediments using a microprofiler equipped with oxygen microsensors. Changes in the nematode community structure were measured by assessment of changes nematode diversity (nematodes identified to genus) and dose response analyses according to nPS and TBT concentrations in the sediments. We anticipate that our results (ongoing data analysis) will contribute to a better understanding of the environmental risk of NPs and their co-contaminants within a relevant scenario.

TH025
Impacts of exposure to microplastics alone and with adsorbed benzo[a]pyrene on biomarkers and scope for growth in marine mussels M. galloprovincialis

J. Hatfield, N. González-Soto, University of the Basque country UPV/EHU; A. Katsumi, 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. Duroudier, 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; H. Budzinski, University of Bordeaux / EPIC / GCRMN Reserch Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE.

Degradation processes that large plastic items undergo in the sea have led to the result from PS and/or BaP are not conclusive. Further work is required to understand the effects of a variety of plastic type, size, shape combinations together with a wide variety of pollutants. Funded by Spanish MINECO (NACE project CTM2016-81130-R), Basque Government (consolidated group IT810-13) and UPV/EHU / IFB 11/37, VRI grant PLASTOX. Work carried out within EU project PLASTOX (IPI Oceans 005/2015).

TH026
Characterization of the adsorption/desorption of benzo[a]pyrene to/from polystyrene micro- and nanoparticles for further toxicity assessment

J. Martinez, University of Basque Country; K. Le Menach, UMR CNRS EPOC Universite Bordeaux / EPOC UMR 5605; M. Dévier, University of Bordeaux / EPOC / LPTC UMR 5805 CNRS; M. P. Cajaraville, 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; A. Orbea, University of the Basque Country / Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE; E. Duroudier, 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; H. Budzinski, University of Bordeaux / EPIC / GCRMN Reserch Group, Dept. Zoology and Animal Cell Biology Faculty of Science and Technology and Research Centre for Experimental Marine Biology and Biotechnology PIE.

Characterization of the adsorption/desorption of benzo[a]pyrene (BaP), as a model polycromatic hydrocarbon, to polystyrene MPs and NPs (4, 5, 0.5 and 0.05 μm), was undertaken. 50 mg/l of particles in the three sizes were incubated for 24 h in an orbital shaker at 300 rpm (21°C) in three BaP solutions (100, 10 and 1 μg/l containing 0.01% DMSO) in MilliQ water. After the adsorption period, centrifugation was performed in order to settle the plastic and allow the removal of non adsorbed BaP (NA-BaP)/NA-BaP was quantified in the
The POPs on plastic particles were extracted in selected solvents (terephthalate PET, polypropylene, PP; poly vinyl chloride, PVC) in the laboratory. Different polymer type (polyethylene, PE; polystyrene, PS; polyethylene terephthalate PET, polypropylene, PP; poly vinyl chloride, PVC) in the surface of selected polymer particles, including preproduction resin pellets from different polymer type (µg.g⁻¹) for the different sizes of plastic in order to determine the capacity of ad/absorption of polystyrene microbeads and whether this process was directly dependent on plastic size. Results indicated that the adsorption capacity of B(a)P on PET was higher than on PP or PVC, with the highest percentage of adsorption being 5.12% for B(a)P on PET. The percentages of adsorbed B(a)P from the total B(a)P solution were 90.88% and 37.18% with a Qmax of 217.39 µg.g⁻¹ and 18.83 ug.g⁻¹ (Langmuir model; R² = 0.9682, 0.9477) for 0.5 µm and 4.5 µm MPs, respectively. In both cases, the method was effective to characterise the ad/absorption process of B(a)P on MPs and is currently being applied to NPs. * Funded by French ANR (NAVIR-03-02), Cluster Excellence COTE (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 IMAM).

Occurrence of microplastics in epibenthic and sediment-dwelling species in a Norwegian fjord

The accumulation of persistent organic pollutants (POPs) on microplastics (MPs) is essential to study ecological effect of POPs-loaded MPs in the aquatic 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 polycyclic 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 = 4.46 ) and fluoranthene (log Kow = 5.16 ). The plastic samples tested here are LDPE pellets with low amount of additives. LDPE pellets were previously characterised by CARAT GmbH (Bocholt, Germany). For the spiking method, batch reactors containing given amount of LDPE and MilliQ 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, the other hand, an exposed 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.
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. Hasselöv, 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 oceanic habitats. Recent investigations find plastic far away from any known sources, 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 sampling at several depths throughout the water column, microplastics 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 ice (IP25), pelagic microalgae (C253), and sewage (coproprost) 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 benthos 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.

Microplastics – an ecotoxicological issue? How to balance facts and perception without marginalizing an environmental problem
C. Völker, ISOE - Institute for Social-Ecological Research / Water infrastructure and risk analyses; J. Kramm, ISOE - Institute for Social-Ecological Research While plastic has been known for a factor of environmental pollution – symbolized by the plastic bag – for a long time, recent scientific evidence on the massive accumulation in the oceans and the environmental risks associated with microplastics has raised great concern. Based on this background, the objective of this study 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.

Metabolism of Organophosphate Flame Retardants (OPFRs) in Freshwater Fish: Field and Laboratory Studies
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 evaluating the expression of xenobiotic metabolism genes in rainbow trout (Oncorhynchus mykiss), rainbow smelt (Osmerus mordax), fathead minnow (Pimephales promelas), Arctic icefish ( Trematomus loyneri), 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.

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the accumulation and tissue distribution of eight common OP ERs 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 affinity to fish tissue and similarly like their parent compounds PFRs. Liver was identified to have a higher accumulation of DAPs and DAPs are the other tissue of fish. It suggested the existence of primary detoxification reactions in wild animal studies. In the consequent laboratory control study, we screened the metabolites of alkyll-PFRs by in vivo exposure of Gobiocypris rarus. Metabolites of alkyll-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 alkyll-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 alkyll-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 / Environment and Climate Change Canada; A. Rösch, Eawag / Environmental Chemistry; N. Cederberg, 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 low water solubility and high vapor pressure, prochloraz is rapidly discharged into marine ecosystems in unknown quantities and with no regulation. In this context, the present work evaluates the toxicity of this compound to marine invertebrates. 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 Lkg⁻¹. Finally, the data will be modeled using a toxicokinetic model and the elimination and 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, Acesulfame-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 awake social concern, triggering the implementation of legislations. Nowadays, new compounds are developed at increasing rates and eventually discharged into marine ecosystems in unknown quantities and with no regulation. Due to the improvement of new analytical techniques, many of these chemicals, the so-called "emerging pollutants" (EPs), are being currently identified and their occurrence is being reported in the environment. However, very little is known about the possible adverse effects of these emerging pollutants in exposed non-target organisms. In this context, the present work evaluates the toxicokinetics (TK) of two EPs (the UV filter 4-Methylbenzylidene-camphor (4-MBC) and the artificial sweetener acesulfame K (ACE-K)) in the Manila clam *Ruditapes philippinarum*, focusing on determining the biocumulation factors (BCF) and identifying metabolites and their transformation products (BTPs). Three exposure periods (1, 7 and 28 days) were performed. In the course of 7 days of exposure and 3 days of depuration, target compounds were extracted from both water phase and organisms and their concentrations were measured by liquid and gas chromatography coupled to tandem mass spectrometry (UPLC/GC-MS/MS). Additionally, high resolution mass spectrometry (HRMS) and automated data analysis software (Metabolynx™) were used to identify possible TPs in the tissue of the Manila clam at different nominal concentrations (from 1 to 100 µg L⁻¹). For the UV filter, the estimated BCFs were between 61 553 and 539 131 L kg⁻¹, and several metabolites were identified, such as the reduction or hydroxylation of the compound. On the other hand, the artificial sweetener BCF was consistently lower, around 7 L Kg⁻¹ and no metabolites were identified. These results suggest that 4-MBC was highly bioaccumulated and metabolised to facilitate its excretion and they are directly related to the physicochemical properties of the target EPs, since ACE-K is highly soluble in water (log kₗow 1.33) and excreted unchanged in comparison to the very hydrophobic UV filter (log kₗow 5.92). Additionally, the present study provides important information about the toxicokinetics of 4-MBC and ACE-K, which will be useful for understanding the mechanism of action of these compounds. Furthermore, this work demonstrates the potential of the UPLC-GC/HRMS approach using Metabolynx™ software for fast and accurate identification of metabolites of EPs.

**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 Infection and Wildlife Health Centre


**TH039**

Proteomics of a metabolic simulation system - a look inside rat S9

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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 animals have to be killed to harvest the organ (predominantly liver) for further downstream processing. The most common procedure is a mincing of the liver and subsequent species-specific differences. Alkyl-substituted TPH 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
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Toxicokinetics (TK) plays an important role in ecological and human health assessments. TK models require TK data that are 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 vitro and in vivo 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 (kₜ) are key determinants and sources of uncertainty in bioaccumulation assessment. kₜ 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 guides (when such guidance exists) 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 vitro-in vivo 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 testing strategy for rapid estimation of bioaccumulation by a combined modelling - in vitro testing approach: derivation of kinetic rate coefficients for fish
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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 extrap. plateau tests, and general TK models in vitro and in vivo extrapolation methods. In a first step, we derived a set of candidate chemicals for in vitro 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 Kₜ categories based on predominant exposure route(s) to guide in vitro testing: 1) log Kₜ<4 (aqueous exposure dominates – to be tested in fish and in vitro); 2) log 5.5 ≥ Kₜ ≥ 5.5 (mixed exposure routes – to be tested in gill, liver and intestine models); and 3) log Kₜ≥5.5 (predominantly dietary exposure dominates – to be tested in liver and intestinal models). In vitro testing is now ongoing. 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). Permanent cell lines of gills, liver and intestine, exposed in monolayer, complement the set of in vitro methods applied, yielding parent compound loss rates as well. In vivo 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 being used for determination of fish biotransformation. 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 concentrations 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
L. Teese, ARC Arnot Research & Consulting; J.M. Armitage, University of Toronto - Environment &Scarbrough / Physical and Environmental Science/Department of Pharmacology and 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

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 toxicity quotient (TQ). The Quantitative Weight of Evidence approach is a tool 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 a weight of evidence (QWOE) 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 scenario for which DERE currently exist (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 scenarios

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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 (kᵤ) is estimated. Following this concept the need for animal tests is reduced if the metabolic contribution to kₑ is from in vitro experiments 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 vitro biotransformation rates (kₑ) obtained from in vitro tests with fish or mammalian cells are extrapolated to whole organisms and then incorporated into to 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 kₑ of different tissues, e.g. gills, liver and gastrointestinal tract, could be serve as alternative screening criterion under REACH. This work aims to better experimentally cover species differences currently ignored in bioaccumulation regulation. However, uncertainties remain related to the validity of this approach, e.g. for ionics 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.
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 were chosen for the validation procedure. Additionally, reference chemical selection is often not considered, with little attention given to validating these test sets 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
A. Lostia, Joint Research Centre - European Commission - Institute for Health and Consumer Protection; S. Munn, European Commission; S. van der Linden, European Commission Joint Research Centre / Directorate F Health, Consumers and Reference Materials; A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM; E. Grignon, European Commission Joint Research Centre; E. Joossens, European Commission DG Joint Research Centre
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.) are captured in an excel template (consisting of 40 columes), 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 screened, are used to filter getting toxicological local 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.

TH051
Assessment of endocrine disrupting properties of pesticides and biocides: data requirements, availability and needs
S. van der Linden, European Commission Joint Research Centre / Directorate F Health, Consumers and Reference Materials; A. Lostia, European Commission Joint Research Centre; A. KIENZLER, JRC-EC / F3-Chemical Safety and Alternative Methods Unit-EURL ECVAM; E. Grignon, European Commission Joint Research Centre; S. Munn, European Commission Before pesticides and biocides are allowed to enter the European market, a minimum set of toxicological data is required to be submitted in order to evaluate their (unintentional) toxicity and approve their use. In case of concern(s), specific conditions may apply to limit their use or approval might not be granted at all. The data that is required to be submitted is (mostly) coming from standardized test guidelines (TGs). While these TGs focus on a diverse range of toxic effects, none of the TG studies currently in the data requirements are specifically developed for the assessment of endocrine disruption (ED). However, ED specific findings can potentially be extracted from these studies and supplemented with data coming from other sources. OECD Guidance Document 150 can help with the ED specific interpretation of data and a guidance document for assessing pesticides and biocides is currently being developed by EFSA, ECHA and JRC. In the context of the recent ED impact assessment, we screened the regulatory dossiers, scientific literature and other available data to assess and categorise all pesticides and biocides currently registered in the EU. This assessment is performed for both human and environmental health. This presentation will provide an overview of the results of this categorisation, combined with indications of the origin of the data driving the categorisation: i.e. data obtained from the regulatory dossiers or other scientifically relevant information. Examples are highlighted where the data obtained from the regulatory dossier would potentially lead to different conclusions compared to when all additional data are taken into account.

TH052
Plausible or Causal: Bioactivity and mechanistic potency as a critical piece in hazard characterization of endocrine active chemicals
E.M. Michaela, ER2; K. Plotzke, Dow Chemical Company / Toxicology, Environmental Research & Consulting
While methods have been and are being developed and validated, and regulatory programs around the world are moving forward with evaluating chemicals for their potential interaction with the endocrine system of humans and wildlife, the challenge still remains in distinguishing between effects that are specifically endocrine mediated from those that are a result of general stress or some other mode or mechanism of action (MoA). Under certain legislations, understanding the potential MoA is particularly important because regulatory decisions might categorize a substance as an endocrine disruptor (ED) through a hazard characterization process rather than taking into consideration exposure and risk. The WHO/IPCS definition of an endocrine disruptor requires that a substance alter the function of the endocrine system of an intact organism. Pathway models are being established that provide plausible links between molecular initiating events, key events and ultimately adverse effects. However, when several potential pathways or MoA converge on the same adverse effect in an intact organism it becomes challenging to identify the biologically plausible causal link between the MoA and the environmental or health effect of regulatory concern. The first part of the WHO/IPCS definition, that of the chemical acting through an endocrine MoA to alter the function of the endocrine system, focuses on the need for the substance to have sufficient affinity for and activity with components of the endocrine system, compared to endogeneous hormones, in order to compete with the normal hormonal signaling and feedback mechanisms that maintain homeostasis. Any substance in silico or in vitro screens may predict endocrine-related bioactivity and the potential for a chemical to interact with the endocrine system, affinity and activity, also known as mechanistic potency, can be used in comparison to that of the endogenous ligands to support or reject the biological plausibility of a causal link between an endocrine MoA and an adverse effect. A hypothesis testing, weight of evidence framework and case study examples will be used to illustrate the use of bioactivity and mechanistic potency data, along with other lines of evidence, in the assessment of endocrine activity.

TH053
Addressing endocrine concerns for the environment in dossier evaluations with an FSDD – possibility to avoid further vertebrate tests
F. Benckert, Institute for Health and Environmental Sciences / IV 2.3 Chemicals; J. Arnir, German Environment Agency UBA; E. Hassold, German Environment Agency UBA / IV 2 / 3 Chemicals; S. Germer, German Environment Agency UBA
In the context of the REACH regulation, long-term toxicity testing on fish is a standard information requirement for substances manufactured or imported in quantities of 100 or more tonnes per year. Additionally, some substance properties, for example a low water solubility, lead to the necessity to conduct a long-term toxicity test on fish. If a data gap in a registration for long-term toxicity to fish is identified in the process of a dossier evaluation (Dev), the preferred option is to request a Fish early life-stage Test (FELS - OECD 210). However for a substance with hints for endocrine disrupting properties, further tests would be needed to clarify the concern in a sub-chronic or chronic context. To avoid additional vertebrate tests in a SEV by requesting a Fish Sexual Development Test (FSDT – OECD 234) as a standard long term fish toxicity test under dossier evaluation. This would make it possible to clarify the endocrine disrupting properties of the substance, if they are revealable in an FSDT, what is the case for most oestrogenic or androgenic acting chemicals. Similar to the FELS the FSDT as a standard early life-stage test avoids animal suffering. The investigation of the endocrine disruptive potential of substances to environmental organisms is not explicitly part of the standard information requirements under the REACH Regulation. However, the legal text of REACH Regulation does not refer to a specific OECD test guideline, but to a type of the test. ECHA’s Guidance on Information Requirements K.7b indicates that the need to conduct further tests is triggered by information on a specific mode of action and unexpected sensitivity of a group of organisms to the substance under investigation. As the FSDT is a level 4 test, according to the OECD conceptual framework no other fish (vertebrate) test may be necessary to identify the substance as an endocrine
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 / Analytical Chemistry and Toxicology; H. Seggel, University of Bremen / Institute of Biology and Wildlife Health; J. Arning, German Environment Agency UBA / Chemicals; G. Schuurmann, Helmholtz centre for environmental research - UFZ / Department of Ecological Chemistry
Endocrine disrupting chemicals interact with the hormone system. They may trigger adverse effects on organisms. Endocrine disruptors 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 at 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 derived. For the estrogen/androgen system, several approaches have 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/cochem/chemprop). Acknowledgment: This study was financially supported by the German Federal Environment Agency, FKZ 371464 412 0.

TH055 Mixtures of endocrine disrupting chemicals disrupt behaviour and thyroid hormone related gene expression in Zebrafish (Danio rerio) larvae
L. Birgersson, J. Sturve, University of Gothenburg / Department of Biological and Environmental Sciences
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, normal development and brain chemistry. 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 X 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 behaviour caused by the exposures were studied as an endpoint for neurodevelopment since behavior integrates many biochemical processes and can be a sensitive endpoint for sub-lethal toxicity of endocrine disruptors. 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 thra and thrb 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 regulatory 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 induced adverse effects on growth, leading 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. Kohn, 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, estrene and nonylphenol in addition to estrogens of 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 (ESR) 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 vivo, alligator PPAR-gamma and RXR-alpha was examined in 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 vivo, alligator PPAR-gamma and RXR-alpha was examined in 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.

TH058 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
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Contaminants of Emerging Concern in the North American Great Lakes: Effects from simple exposures to complex mixtures

U. Hasbarg, 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 endocrine-disrupting 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 on 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-butoxyethyl) phosphate exposures. Interestingly, exposure to ibuprofen showed a potential therapeutic effect at the medium concentration to assess two divergent treatment technologies. Of these, the data also indicated observation 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

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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 these, the data also indicated observation 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.

TH060 Endocrine disruptors used in polymers in the offshore oil and gas industry

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Contaminants were raised by regulatory assessors that a number of polymer substances found in products registered for use and discharged offshore as a result of the activities of the oil and gas industry are based on monomers that are known and suspected endocrine disruptors. These polymers were described by the registration data as being moderately or readily biodegradable substances and might therefore have the potential to biodegrade into the endocrine disruptors on which they were based. Such leach endocrine disruptors have the potential to impact ecosystems and organisms in the offshore environment. To determine the potential of these polymers to release endocrine disruptors, four substances with known endocrine disrupting monomer groups were extracted using high pressure and temperature as well as acidification and/or biodegradation and were tested using a Yeast-based estrogen screen (YES) and yeast-based androgen screen (YAS). The results from the presented study show that at least one of the analysed products has a high potential for releasing EDs and highlights the importance of well-informed environmental protection to prevent endocrine disruptors from impacting the marine environment.
Th1063
Thyroid disorder screening using zebrafish as vertebrate model
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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 affect 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 biosensor 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 toxicity assays with high 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 reporter construct under the control of thyroid hormone response elements (TRE). After transfection, cells were harvested and seeded in 96 well plates and exposed to a range (f) of concentrations, 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 ecdisyne receptor agonist in chery shrimp. The assay is done by transiently transfecting mammalian cells with plasmid vectors expressing chery 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 responds well to the native ecdisyne hormones in a dosage-dependent manner. The adaptation of mammalian cells in in vitro assay for heterogenous receptor is satisfactory. Three DAH/BAA insecitides were also tested and gave minimal to moderate signals. The results suggest that these DAH insecitides aimed for insect pest control can be potential hazards to crustacean. More studies on different mammalian cells and comparison study with mixtures of chemicals are being carried out to validate this reporter gene system.

Th1064
Development of stably transfected cell lines with zebrafish thyroid hormone receptors alpha and beta for assessing endocrine disruption in environmental samples
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Endocrine disrupting chemicals (EDCs) are ubiquitous in our environment and can be found in many products including food/feed, containers as plastic bottles or metal food cans, cosmetics, pesticides, flame retardants, detergents... Accordingly, they suppose 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 traditional exposure of zebrafish embryo is in line with the 3R principles in in vitro reporter assay for thyroid disruption potential. In this work, the expression of zebrafish thyroid hormone receptors alpha (zTRα) and beta (zTRβ) were determined based on preliminary cytotoxicity assays for each cell line. While not all alternative plasticizers showed significant affinity in MVLN cells. DINC and DEHA exhibited significant increase in estriol (E2) to testosteron (T) ratio in H295R cells. These results suggest that these plasticizers DINC and DEHA cause increased estrogenicity through altering steriodogenic pathway, similar to DEHP. In G3H cell line, shh gene was significantly downregulated by exposure to TOTM, suggesting its thyroid disrupting potential through altering signaling pathway to thyroid gland. Our observations shows that DINC, DEHA and TOTM may disrupt balance of important hormones. Further investigations using in vivo models are warranted.

Th1065
Screening endocrine disrupting potentials of alternative plasticizers using thyroid reporter assay
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Phthalates have been used as plasticizer in polyvinyl chloride (PVC), food containers, medical devices, building materials, and personal care products. Because of reproductive toxicity of several phthalates including bis(2-ethylhexyl) phthalate (DEHP) and diethyl phthalate (DEP), use of major phthalates are regulated in many products in several countries. Accordingly, many alternative plasticizers have been developed and increasingly used worldwide, but their possible adverse endocrine disruption effects are not well-known. The aim of this study is to screen endocrine disrupting potentials of several widely used alternative plasticizer, cyclohexane dicarboxylic acids (DINCH), acetyl tributyl citrate (ATBC), dioctyl terephthalate (DOTP), trioctyl trimellitate (TOTM), bis(2-ethylhexyl) adipate, and dihexyl adipate (DEHA). A series of in vitro assays employing a human breast (MVLN), a human adrenal (H295R), and a rat pituitary (GH3) cells, were employed. The tests doses for each plasticizers applied were determined based on preliminary toxicity assays for each cell line. While not all alternative plasticizers showed significant cytotoxicity for MVLN cells. DINC and DEHA exhibited significant increase in estriol (E2) to testosteron (T) ratio in H295R cells. These results suggest that these plasticizers DINC and DEHA cause increased estrogenicity through altering steriodogenic pathway, similar to DEHP. In G3H cell line, shh gene was significantly downregulated by exposure to TOTM, suggesting its thyroid disrupting potential through altering signaling pathway to thyroid gland. Our observations shows that DINC, DEHA and TOTM may disrupt balance of important hormones. Further investigations using in vivo models are warranted.

Th1066
Development of reporter gene system for assessing cherry shrimp ecdisyne receptor agonist using mammalian cells
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Ecdysteroid is a key steroid hormone that regulates growth, development and molting in animals under the phylum of Arthropod, which includes the insects and crustaceans. The hormone targets the receptor complex which activates the ecdisyne receptor (EcR) and retinoid X receptor (RXR). The activated complex anchoring on the ecdisyne 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 prohormone analogs (DAH and BAA anabolic hormones) were developed to disrupt ecdisyne receptor signalling. They work as the ecdisyne 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 ecdisyne receptor agonist in chery 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 responds well to the native ecdisyne hormones in a dosage-dependent manner. The adaptation of mammalian cells in in vitro assay for heterogenous receptor is satisfactory. Three DAH/BAA insecitides were also tested and gave minimal to moderate signals. The results suggest that these DAH insecitides aimed for insect pest control can be potential hazards to crustacean. More studies on different mammalian cells and competition study with mixtures of chemicals are being carried out to validate this reporter gene system.

Th1067
Micro-injection as an alternative for aquatic exposure? A case study in zebrafish embryos with 17α-ethinylestradiol.
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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 (ER) substances are mainly conducted using aquatic ecotoxicity tests. However, it is often difficult to expose fish to poorly water soluble ED substances via water. Micro-injection in the yolk 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. In this study, 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
was different between both exposure routes, while vitellogenin (vtg) 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. 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 vtg. 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
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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 work, we tested the hypothesis that atrazine can affect reproduction in crayfish through dysregulation of vitellogenin expression and ecdysteroid 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, suggesting 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. In addition, the estradiol receptor-1 mRNA levels were similar between both routes after EE2 exposure. At this point, 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 molt-inhibiting hormone and ecdysteroid receptor sequences in Gammarus pulex and consequences of endocrine disruptor exposures
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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 major part of aquatic ecosystems, such as amphipods, which 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 can feminize juvenile males in some Gammarus sp. Consequently, currently, no biomarkers (assessment tools) are available to assess the endocrine disruption in gammarids. The present work focused on EDC effects on the molt process of Gammarus pulex, by researching the DNA sequences of two main proteins in the endocrine system of amphipods: the molt-inhibiting hormone (MIH) and the ecdysiotropic receptor (EcR). Next, the expression variations of these two genes have been measured by RT-qPCR after an exposure of four days to estradiol (4μg/L). A silicone 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 (0-10μg/L). Through the passive-dosing method, we were able to determine the silicone-water partition coefficient of BPA and control stable concentration over the test period. The uniform concentration of BPA, which was different between both exposure routes, while vitellogenin (vtg) 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. 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 vtg. 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
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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 effects aquatic vertebrates (e.g. reproduction development, female sex development). Therefore, a range of 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. Passive dosing methods allow the evaluation of the absolute estrogenic potential of sediment-bound EE2 on benthic organisms is important for understanding the potential effects on vertebrate predators and subsequent upper trophic levels as a secondary source of contamination.
Toxic effects of juvenile hormone analogue insecticides, methoprene and fenoxycarb, on cherry shrimp (Neocaridina davidi)

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Crustaceans are a large group of arthropod, and they are the major constituents to the aquatic ecosystem that provide a variety of ecological and economic services. Nowadays, the 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 normal hormone action in insects by mimicking the juvenile hormones. However, these insecticides and their metabolites are produced in high quantities and 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 generally 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 μg/mL (4.64, 3.20 μmol/L) and 1.96, 1.26 μg/mL (6.32, 4.06 μmol/L) methoprene, the body length decreased by 20.5% and 11.8% as compared to control, respectively. And 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 investigated in this study. The genes h3 (hormone receptor 3) and c755 in N. davidi were up-regulated, while Chd64 (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.

TH075 Development of Multimedia Fate Model for Human Risk Assessment of EDCs in the Asan Lake Watershed, Korea

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Multimedia fate model (multimedia fate model for HUman 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 containing environmental data and meteorological data of these two chemicals have adverse effects on the development of juvenile N. davidi. After six weeks chronic exposure to 100 μg/mL (0.33 μmol/L) fenoxycarb and 200 μg/mL (0.64 μmol/L) methoprene, the body length decreased by 20.5% and 11.8% as compared to control, respectively. And 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 investigated in this study. The genes h3 (hormone receptor 3) and c755 in N. davidi were up-regulated, while Chd64 (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.

TH074 Comparative toxicity and endocrine disruption potential of urban and rural ambient PM2.5 from cherry shrimp - G3-3 humans

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Endocrine disruptors (EDs) are chemicals compounds that send confusing messages to the body causing various disturbances 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 chemicals 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 in 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 environmental and dermal exposure also contribute significantly to the total DEHP exposure.

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, Enviaco / Bioanalysis (LC-MS/MS)

The regulatory need for an 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 immunoassay form. A new methodology for the determination of T3 and T4 in rat serum was developed and validated using liquid chromatography coupled to tandem mass spectrometry/impactor. 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 that was observed different ranges in particular prevalence 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 efficiency 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 collections types (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 estrogenic activity assessed in dairy farm watersheds regardless of effluent management practices
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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 livestock or non-livestock. Estrogenic activity and steroid estrogens were prevalent in the waterways within all of 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 mass %, E2eq) was present at low levels in 83% of the stream samples (highest 1.44 ng L⁻¹ E2eq and the grand average ≤0.15 ng L⁻¹ E2eq). While 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 concentrations and estrogenic 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?
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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 and steroid estrogen concentrations and estrogenic 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.

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. De Vito, VITO / ABF; P. De Vito, VITO / ABF; S. Verstraeten, VITO / ABS
Safe-by-design requires risk evaluation at critical points during the development of a product to enable a well documented choice for the lowest risk option. In the Met@link project new metal-based inks - enriched with Ag-nanoparticles (Ag-NP) - for printing conductive tags are developed. The environmental risk is assessed to support decisions between different environmental risk options (or risk management options). E.g. in the case of the assessment of the potential effects on the one hand (concentration effect relations for the target organisms) and evaluates the potential exposure of target organisms on the other hand (i.e. to define the environmental compartments and organisms of concern). Risk management either reduces the potential effects (i.e. redesigning the product) or prevents the predicted exposure (i.e. redesign the production process) to minimize the potential risk. Case study: ERA Ag-NP metal based ink. Potential effects of concern? Literature data learn that Ag-NP particles are indeed highly toxic to aquatic ecosystems, mainly due to the leaching of Ag+ ions. Potential exposure? Looking at the production process the aquatic ecosystem is of concern because of the waste water generated during production of the inks. Two prototype inks with suitable technical properties were formulated. Both were tested for their leaching potential and for their toxicity to aquatic organisms. Ag-concentrations (ICP-AES) and Ag-NP (SP-ICP-MS) were measured, and the toxic effects on algae (OECD 201) and Daphnia (OECD 202) were measured. Results showed that proper coating material helped to prevent leaching of Ag+ and substantially decreased the ecotoxicity of the leaching fraction.

TH081 REACH Substance Evaluation of silver - justification of read-across from ionic silver to nanosilver
K. Ariis, ARCHE; J. Mertens, Precious Metals and Rheinum Consortium c/o EPMF
As part of the REACH Substance Evaluation for silver, new data was required to be generated. The other justificatory read-across from ionic silver to silver nanoforms was 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. 221) silver was less toxic than silver nitrate. Toxicity to soil microorganisms (OECD Test Guideline No. 210) in soils representative for the EU; nanosilver was equally or less toxic than silver nitrate. The silver nanoform was fully characterised (aerous 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 medium 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 nanoforms 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. Bindslev, Technical University of Denmark / DTU Environment; V. Mart, Cawthron Institute; V. Randjelovic, Cawthron Institute; L. Šojić, ALHem; 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. Bindslev, Technical University of Denmark / DTU Environment; V. Mart, Cawthron Institute; V. Randjelovic, Cawthron Institute; L. Šojić, ALHem
The European 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 risk assessment in our project framework and 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 = low to 3 for high) for a so-called “fate bond” which will be included in 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 the considered 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 effected by e.g. agglomeration and sedimentation are not needed 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 information is based on fate bond (3) which combines the toxicological hazard properties (ecotox bond; presented 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
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, i.e. morphology and reactivity, as well as ecotoxicological properties were identified as relevant parameters. The zeta-potential was considered to be less important. Regarding the properties 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 (ecotox flow-chart) is characterized by maximum 24 groups where the property morphology is defined by three categories i.e. fibers, small spherical ENMs, others. The ecotoxicity of the ENMs of a specific group is attributed to similar PC-properties thus support discussion on grouping with the final objective of read across. Approach II (ecotox-bond) was developed for risk assessment by using an approach similar to control banding. For risk assessment the hazard information has to be combined with properties influencing environmental fate. For the parameter “morphology” only fibers and small spherical ENMs are considered. In the ecotox-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 risk, but is more important that the methods that have been subjected to 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.

There is an increasing need for predictive risk assessment of nanomaterials (NMs) that are subject to environmental fate. For the parameter “morphology” only fibers and small spherical ENMs are considered. In the ecotox-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 risk, but is more important that the methods that have been subjected to 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.

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 both 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 1) the aquatic environment (additional transformation), 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 within a whole product, going to 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 these 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 identified to occur in environmental compartments is a transformation of ENMs to 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.

Using the SimpleBox® for predicting the environmental concentration of nanomaterials

J.T. Quik, RIVM / DMG; J.A. Meester; E.A. Bleeker, J. Slootweg, RIVM / VSP; S. Loffra, 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 the newly added process parameters. This shows that in addition to the dissolution rate, 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/simplebox4; 2: Meesters, J.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.

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. Poikimaki, 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) that are subject to environmental fate. For the parameter “morphology” only fibers and small spherical ENMs are considered. In the ecotox-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 risk, but is more important that the methods that have been subjected to 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.

EcoNanoScreen: a novel approach for the rapid and reliable estimation of the environmental fate and potential hazard of nanomaterials

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Among cosmetics and personal care products, sunscreen products are of emerging concern regarding both environmental and human health. While some organic UV blockers have been evidenced to undergo rapid photodegradation, to induce allergenic 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 nanotechno-bloc 2: Meesters, J.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.
OECD Test Guidelines and Guidance Documents for Environmental Safety Assessment of Nanomaterials

J. Ahtiainen, Drumso Ecotax Consultancy; F. von der Kammer, University of Vienna / Department of Environmental Geosciences; M. Gonzalez, Organization for Economic Cooperation and Development; K. Schirwin, German Federal Environment Agency UBA; D. Volker, German Environment Agency.

The OECD test guidelines (TGs) for testing chemicals have been widely used for regulatory purposes all over the world since the establishment of the Mutual Acceptance of Data (MAD) principle in 1984. This MAD principle ensures that, if a chemical is tested under the Good Laboratory Practice (GLP) conditions accordingly to an OECD TG, the data should be accepted in all OECD countries.

The TGs have been developed, harmonized, internationally validated (round-robin-tests) and adopted by OECD countries to be used for the phys-chem characterisation, fate estimation, and hazard identification for risk assessment of various chemicals. In addition to the TGs, OECD Guidance Documents (GDs) usually guide how to use TGs and how to interpret the results. These GDs do not have to be fully experimentally validated, and hence they are not under MAD, but they are based on the latest published scientific research. But are the existing TGs and the related GDs applicable and adequate? For the preliminary hazard testing of nanomaterials? In general, it is accepted that most of the “endpoints” or more precisely measurement variables are applicable also for nanomaterials. However, for some endpoints new TGs are needed. In addition, GDs are needed to give more precise advice on the test performance, e.g. including sample preparation and dosage of the test material, the characterization of the exposure and understanding the results. It is well known that TGs were developed with the data on chemicals. The poster will present the status quo on recent TGs and GDs development for nanomaterials at OECD level with relevance for an adequate environmental safety assessment of nanomaterials. Selected activities on TG/GD development will be presented in detail regarding their objectives, challenges and status. Emphasis will be given to the OECD TGs on exposure stability in simulated environmental media, which was published in 2012 by OECD, October 2017 and the draft GD on dispersion stability and dissolution rate of nanomaterials, which will support interpretation and utilization of data coming from this TG and a draft TG on dissolution rate which is in preparation. In order to illustrate the effort of TG/GD development the way from the idea for a new TG and new GD to an accepted OECD TG/GD guideline will be presented.

TH092
Applicability of OECD fish bioaccumulation test guideline 305 to nanomaterials

J. Navas, A. Bermejo-Nogales, INIA - National Institute for Agricultural and Food Research and Technology / Department of Environment; F. Torrent, Universidad Politecnica de Madrid / Escuela Superior de Ingenieros de Montes; A. Valdehita, INIA National Institute for Agricultural and Food Research and Technology / Department of Environment; M. Fernandez, E. Conde, I Rucandio, CIEMAT; M. Fernandez-Cruz, INIA - National Institute for Agricultural and Food Research and Technology / Environment Oftest Consultancy; K. Schwirn, German Federal Environment Agency.

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 primarily 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 both in mussels and fish. The conditions of the first studies were carried out with the freshwater mussel Corbicula fluminea. Using silver MNMs (NM100K) 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 total content of silver in water and tissue samples was carried out by ICP-MS or ICP-OES. The experimental total content 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. manoio, ENEA / SSPT-PROTER-BES; s. sciario, ENEA CR; M. Oliviero, Universita Parthenope; F. Pacchierotti, ENEA; c. arcangeli, ENEA CR; E. Cordellini, ENEA / SSPT-TECS-BIORISC Via Anguillarese, 301, 00123, Roma, Italy; g. leter, 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 aquatic biota. The conditions of the test items were carried out with the freshwater mussel Corbicula fluminea. The health threat posed by engineered nanomaterials (ENM) need a dialogue between toxicologists and ecotoxicologists in order to get a comprehensive understanding of the adverse outcome pathways and to reach a consensus on safe limits for both humans and the environment. Generally, toxicity testing imply the evaluation of multiple endpoints and, especially in ecotoxicological studies, of genotoxicity. This was achieved by culturing fish and invertebrates with environmental and experimental methods and tools applied to the evaluation of ZnO nanoparticle (as a prototype of metal oxide ENM) genotoxicity in ecotoxicological test organisms and for establishing common safe limits. The identification and scientific assessment of compounds that represent a real threat both for humans and for biota. The assessment of the environmental and ecological risk assessment of MNMs in mussels under flow conditions. First studies were carried out with the freshwater mussel Corbicula fluminea. Using silver MNMs (NM100K) 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 total content of silver in water and tissue samples was carried out by ICP-MS or ICP-OES. The experimental total content 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.

TH095
Assessment of persulfate oxidation liquid chromatography tandem mass spectrometry for the analysis of perfluoroalkyl and polyfluoroalkyl substances in water

G. Munoz, Universite de Montreal / Chemistry; S. Mejia, McGill University / Civil Engineering.


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 primarily 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 both in mussels and fish. The conditions of the first studies were carried out with the freshwater mussel Corbicula fluminea. Using silver MNMs (NM100K) 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 total content of silver in water and tissue samples was carried out by ICP-MS or ICP-OES. The experimental total content 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.

From detection to action: advancements in assessing and managing highly fluorinated compounds (P)

G. Munoz, Université de Montréal / Chemistry; S. Mejia, McGill University / Civil Engineering.

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SETAC Europe 28th Annual Meeting Abstract Book
Environmental risk assessment of perfluoroalkyl substances (PFASs) in the environment is of concern given their environmental persistence and possible adverse effects. The global production of perfluorinated alkyl substances (PFASs) is over 4.7 billion pounds, with the majority of these compounds used as precursors for fluoropolymer surfactants used in industrial and consumer products. PFASs are used as surface-active agents in a variety of products including firefighting foams (AFFF) and cleaning products. In recent years, PFASs have been linked to various health effects, including endocrine disruption, immune system dysfunction, and cancer. Therefore, the development of techniques to remove PFASs from the environment is crucial.

The aim of this study was to investigate sorption of 14 PFASs, including perfluorocarboxylates (PFCAs), perfluoroalkanesulfonates (PFSAs) and perfluorooctanesulfonamide (FOSA), to an organic soil horizon and the effect of pH and simulated soil organic matter (SOM) net charge as a function of pH and added concentrations of Al³⁺, Ca²⁺ and Na⁺. Generally, the organic C-normalized partitioning coefficients (KOC) were negatively correlated (r² = 0.32 ± 0.11) with log unit pH and the SOM bulk net negative charge (r² = 0.41 ± 0.40 log units per log unit pH). The sorption increased with increasing perfluorocarbon chain length (hydrophobicity) for both PFCAs and PFSAs with 0.60 and 0.83 log units per CF₂ moiety, respectively. Comparing the effect of the PFAS functional head group on sorption, affinity followed the order PFCAs < PFSAs < FOA. Effects from cation competition were small and instead sorption was more strongly related to the pH value. This suggests that the long-chain PFASs have a binding preference towards the highly condensed parts of the humic fraction of SOM, in similarity to other hydrophobic organic compounds, whereas shorter PFASs to a higher degree are bound to humic and fulvic acid where co-sorption of cations gives significant effects. A conceptual model which explains the observed difference in sorption behaviour between shorter and longer PFASs is presented. Progresses made on PFAS binding to organic soil fractions will contribute to more accurate prediction of PFAS sorption in soils and thereby aid in the environmental risk assessment of these chemicals.

TH098
Environmental degradation rates for new PFAS via decarboxylation potential in water, in a MS-collision cell and online. V. Niholle, NILU, Norwegian Institute for Air Research
Straight-chain perfluoroluphatic carboxylic acids, like PFOA, are extremely stable chemical compounds. In contrast, several other perfluorinated carboxylic acids are less stable and undergo decarboxylation - spontaneous degradation with loss of carbon dioxide. For instance, perfluorobenzonic acid decomposes slowly in aqueous solution, while perfluoropropionic acid has CO₂ so far at room temperature that its spontaneous decomposition is a synthetic method for nonafluoroobutane. There are indications that novel oxygen-containing analogs of PFOA are less stable towards decarboxylation. A typical detection method for PFCAs is based on the same decarboxylation process: SRM transition from [M-1] to [M-45]. A collision energy, required for such transition is a measure of intrinsic stability of a compound. Relating environmental concentration of PFOA to this transformation can be satisfactorily predicted by DFT calculations at standard RB3LYP/6-31+(G,d,p) level. Decarboxylation rates in water for perfluorinated and structurally similar carboxylic acids also correlate well with MS and DFT-derived energies. Thus mass-spectral information and results of simple quantum-chemical modeling can be used as a measure of abiotic degradation potential for per- or perfluorinated acids in aquatic environment.

TH099
Perfluoroalkylated acids (PFAAs) in soil and invertebrates (Isopoda) near a fluorocarboxylate (PFOA) production site. T. Groffen, Systemic Physiological and Ecotoxicological Research (SPHERE), University of Antwerp / Biology; M. Eens, University of Antwerp / Department of Biology; G. Verhees, University of Antwerp / Department of Biology; J. Liu, McGill University / Department of Civil Engineering
The present work aimed at evaluating the applicability of the TOP assay (ΔPFAA (molar concentration increases upon oxidation). A possible solution is the implementation of a surrogate approach such as the total oxidizable precursor (TOP) assay, relying on the oxidative conversion of potential perfluoralkyl acid precursors (Pre-PFAs) into readily measurable perfluorinated acids. However, in order to ensure a fully legitimate comparison between conventional (i.e. before oxidation) and after TOP analyses, a number of critical knowledge gaps remain to be bridged. The two types of water samples (i.e. before TOP versus after TOP) might reveal differential instrument matrix effects or necessitate different clean-up strategies, which could de facto impact the method reporting limits and preclude a consistent comparison between the two approaches. The present work aimed at assessing the applicability of the TOP assay to various water matrices through stringent validation. The performance of a workflow involving persulfate oxidation followed by ultra-high performance liquid chromatography tandem mass spectrometry (TOH-ULHPLC-MS/MS) analysis was therefore evaluated using various environmental waters. The validation endpoints ascertained included, notably, the evaluation of oxidation yields in the various environmental matrices. The workflow was a crucial assessment of the chemistry occurring at the instrumental analysis stage. The method was applied to a limited survey of surface water and groundwater samples. It was observed that even though fluorotelomer sulfonates (ZFTSAs) were the target pre-PFAs predominantly reported before oxidation in most instances, they could only partially account for the observed ΔPFAA (molar concentration increases upon oxidation). The unexplained ΔPFAA portion likely results from the oxidation of unarger pre-PFAs for which oxidation yields are yet to be determined.

TH096
Use of biochars for the sorption of poly- and perfluorinated alkyl substances (PFAS) and heavy metals from contaminated soils. L. Silvani, The University of Queensland; A. Bottjen Smeybe, g. Cornelissen, s.e. Hale, Norwegian Geotechnical Institute; Y. Zhang, NMBU; G. Okkenhaug, A. Botten Smeybe, g. Cornelissen, s.e. Hale, Norwegian Geotechnical Institute
Biochar is thus a promising and economic alternative to other carbonaceous techniques available, adsorption is the most commonly used for both organic and inorganic contaminants removal from soil. Biochar (BC) has a potential for organic and inorganic contaminants and can be made at a low cost. To test the usage of biochar for the sorption of poly- and perfluorinated alkyl substances (PFASs) and heavy metals from contaminated soils, three BCs were used as sorbents: a wood BC (wBC) made from wood chip waste (used for all the treated soils), an activated biochar (aBC) (used for the PFAS sorption) and an iron enriched BC (Fe⁺⁺ enriched BC and iv) whether PFCAs, PFOS and FOSA), cation effects were small and instead sorption was more strongly related to the pH value. This suggests that the long-chain PFASs have a binding preference towards the highly condensed parts of the humic fraction of SOM, in similarity to other hydrophobic organic compounds, whereas shorter PFASs to a higher degree are bound to humic and fulvic acid where co-sorption of cations gives significant effects. A conceptual model which explains the observed difference in sorption behaviour between shorter and longer PFASs is presented. Progresses made on PFAS binding to organic soil fractions will contribute to more accurate prediction of PFAS sorption in soils and thereby aid in the environmental risk assessment of these chemicals.

TH097
14 PFASs, including perfluorocarboxylates (PFCAs), perfluoroalkanesulfonates (PFSAs) and perfluorooctanesulfonamide (FOSA), to an organic soil horizon and the effect of pH and simulated soil organic matter (SOM) net charge as a function of pH and added concentrations of Al³⁺, Ca²⁺ and Na⁺. Generally, the organic C-normalized partitioning coefficients (KOC) were negatively correlated (r² = 0.32 ± 0.11) with log unit pH and the SOM bulk net negative charge (r² = 0.41 ± 0.40 log units per log unit pH). The sorption increased with increasing perfluorocarbon chain length (hydrophobicity) for both PFCAs and PFSAs with 0.60 and 0.83 log units per CF₂ moiety, respectively. Comparing the effect of the PFAS functional head group on sorption, affinity followed the order PFCAs < PFSAs < FOA. Effects from cation competition were small and instead sorption was more strongly related to the pH value. This suggests that the long-chain PFASs have a binding preference towards the highly condensed parts of the humic fraction of SOM, in similarity to other hydrophobic organic compounds, whereas shorter PFASs to a higher degree are bound to humic and fulvic acid where co-sorption of cations gives significant effects. A conceptual model which explains the observed difference in sorption behaviour between shorter and longer PFASs is presented. Progresses made on PFAS binding to organic soil fractions will contribute to more accurate prediction of PFAS sorption in soils and thereby aid in the environmental risk assessment of these chemicals.
observed among the studied sites, but TOC was positively correlated with multiple
PFAAs, including PFOS and PFOA. At this moment (November 2017), isopods
have not been tested for PFAAs concentrations yet, but based on the soil
concentrations and concentrations detected in previous studies near the
fluorochemical plant in Antwerp, we expect high concentrations of multiple
PFAAs. The outcome of the present study will be used in further monitoring studies
on the effects of soil type on PFAAs bioavailability to invertebrates, as well as
effects of PFAAs on multiple biomarkers.
TH100
Occurrence and distribution of legacy per- and polyfluoroalkyl substances
(PFASs) and fluorinated alternatives in coastal waters of the German North
and Baltic Seas
H. Joerss, Helmholtz-Zentrum Geesthacht / Environmental Chemistry; R.
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Chemistry
Long-chain per- and polyfluoroalkyl substances (PFASs) are recognized as global
contaminants of high concern as they have been shown to be persistent,
bioaccumulative, toxic, and ubiquitously present in the environment. This has led to
a number of actions by industry and regulatory authorities aiming at restricting the
production, use, and release of long-chain PFASs. Consequently, an industrial shift
has been taking place, moving away from long-chain PFASs toward alternative
substances, such as per- and polyfluoroether carboxylic and sulfonic acids
(PFECAs and PFESAs). Due to structural similarities, the question arises whether
the alternatives represent a substantial improvement on their predecessors. Public
data on their properties and environmental exposure is still limited. This study aims
at investigating occurrence and distribution of legacy PFASs and fluorinated
alternatives in surface water samples from coastal areas of the German North and
Baltic Seas. In summer 2017, two sampling campaigns were realized using the
research vessel Ludwig Prandtl, during which 94 water samples were taken along
the German coastlines. The analytical method included 26 legacy PFASs and 5
fluorinated alternatives, among them the PFECAs GenX and ADONA. Filtered 1 L
water samples were spiked with mass-labelled internal standards (50 µL, 60 pg/µL)
and loaded onto preconditioned solid phase extraction cartridges (Waters Oasis
WAX; 6cc, 500 mg, 60 µm). After a washing step, the target compounds were
eluted using methanol and 0.1 % ammonium hydroxide in methanol. The eluates
were reduced to 150 μL under nitrogen and 13C8-PFOA was added as injection
standard (10 μL, 100 pg/μL). Instrumental analysis was performed by
HPLC-MS/MS, using an Agilent HP 1100 LC system coupled to an AB Sciex API
4000 triple quadrupole mass spectrometer. First results show that the fluorinated
alternative GenX can not only be detected in all water samples along the German
North Sea coast, but is one of the dominating PFASs with average concentrations of
1.4 ± 0.2 ng/L. Based on these and further results, it will be discussed if regulations
on long-chain PFASs and the subsequent ongoing shift to fluorinated alternatives
lead to changes in the coastal environment.
TH101
Suspect screening for short chain PFAS in environmental water samples,
waste water treatment plants, and building materials
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Perfluoroalkyl and polyfluoroalkyl substances (PFASs) are very persistent
anthropogenic fluorinated chemicals that have been detected in remote areas and all
compartments of the environment. Historically perfluorooctanoic acid (PFOA) and
perfluorooctane sulfonate (PFOS) are the two most frequently used and most well
studied PFASs. As a consequence of the bioaccumulative and toxic properties of
long chain PFASs, their voluntary phase-out started in the year 2000 and led to an
increased prevalence of short chain homologues (C4 to C6) in the aquatic
environment. Short and ultra-short (>C4) chain PFASs are quickly eliminated from
organisms and thus do not bioaccumulate. However, they are more mobile in the
water cycle then their long chain homologues, thus exhibiting higher tendencies to
reach raw and drinking water, and are expected to accumulate in the edible parts of
plants, which may lead to an increased exposure through drinking water and
vegetable consumption. While perfuorobutanoic acid (PFBA) and perfluorobutane
sulfonate (PFBS) have been extensively studied information about ultra-short chain
PFAS is still scarce and, if available, limited to perfluorocarboxylic acids (PFCAs)
and perfluorosulfonic acids (PFSAs). Trifluoroacetic acid has been detected in
concentrations in excess of 20 µg/L in tap water, while perfluoropropane sulfonate
(PFPrS) and perfluoroethane sulfonate (PFEtS) have been detected in a study of tap
water samples from China, Japan, India, the United States of America, and Canada.
In 2016, the first C1-homologue of a legacy PFAS class was detected in the form of
trifluoromethane sulfonic acid (TFMSA), which was present in various
compartments of the water cycle ranging from waste water treatment plant effluents
to finished drinking water. Information about ultra-short chain homologues of other
PFASs like perfluoroalkyl phosphonic acids (PFPAs), perfluoroalkane
sulfonamides (FASAs), perfluoroalkane sulfonamidoethanols (FASEs), and
perfluoroalkane sulfonamidoacetic acids (FASAAs) are to the best of our
knowledge not available so far. In an attempt to close this gap in knowledge, we

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performed a suspect screening for (ultra-)short chain PFASs of several substance
classes in environmental water samples, waste water treatment plants and building
materials.
TH102
Utilization of passive samplers to detect poly- and perfluoroalkyl substances
(PFASs) in wastewater treatment plants and estuarine environments
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Oceanography
Poly- and perfluoroalkyl substances (PFASs) are of growing concern worldwide,
due to the linkage of these compounds to adverse effects in humans and the
environment. Surface waters in the northeastern United States in particular have
displayed elevated concentrations of PFASs. Here we utilize passive samplers to
gain a better understanding of the sources and spread of these contaminants.
Thirty-two microporous polyethylene (PE) passive samplers (containing
Hydrophilic-Lipophilic-Balanced sorbent) were deployed across nine sites in
Narragansett Bay (RI, USA) in the fall of 2017 for a one month duration each.
Deployment sites ranged from wastewater treatment plant and industrial outfall,
military and fire training bases, and more pristine areas. 25 PFASs (including
sulfonates, carboxylic acids, and GenX) were measured across all sites in the
passive samplers, as well as water and sediment samples. For a more direct point
source evaluation, 10 additional samplers were deployed in two waste water
treatment plants of a large urban area. By analyzing the spatial and temporal trends
of these fluorinated compounds we plan to assess their longevity in water and
sediment of the Bay. Lastly, we aim to understand and predict potential effects on
the environment and better advise on regulatory practices.
TH103
Distribution of per and polyfluoroalkyl substances in sediments of the Spanish
coast
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(QANAP); P. López-Mahía, Universidade da Coruña / Analytical Chemistry
Department; D. Prada-Rodríguez, Universidade da Coruña / Grupo Química
Analítica Aplicada (QANAP); L. Viñas, Instituto Español de Oceanografia / Centro
Oceanográfico de Vigo; J.A. Campillo, Instituto Español de Oceanografia / Centro
Oceanográfico de Murcia; S. Muniategui, Universidade da Coruña / Analytical
Chemistry
Per- and polyfluoroalkyl substances (PFASs) configuration, consisting in an
alkylated hydrophobic chain fully or partially fluorinated, hydrophilic group
terminated, provides to PFASs simultaneous hydrophobicity and lipophobicity.
Their persistence, bioaccumulation and toxicity make them a source of increasing
environmental and public health concern. Presence of PFASs in sea 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
agricultural activity (Mar Menor). PFOA, PFOS, PFOSA, n-MeFOSA and
n-EtFOSA 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-EtFOSA were not detected in any
sample, whereas PFOSA was only detected in two samples, but below the
quantitation 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 quantitation
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 PFOS similar than the detected in similar areas. Some characteristic 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.
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reference: CTM2013-48194-C3-1-R/2-R, and ARPA-ACUA, project reference:
CTM2016-77945-C3-3-R). References: Concha-Graña E. et al, VIII Reunión de la
Sociedad Española de Espectrometría de masas, V Reunión Nacional de Dioxinas,
Furanos y Compuestos Orgánicos Persistentes Relacionados (2017)
TH104
Utilization of Polyethylene Passive Samplers to Detect volatile PFAS
precursors in water and air
E. Dixon-Anderson, R. Lohmann, University of Rhode Island / Graduate School of

SETAC Europe 28th Annual Meeting Abstract Book


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 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 present. Polyethylene-air partitioning constants, log K_{pea}, were determined at a Waste Water Treatment Plant (WWT) and 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_{pew}, during the 3-week uptake experiments. Derived log K_{pea} values for 6.2, 8.2 and 10.2 FTOHs were 3.8, 4.4 and 4.8, respectively. For MeFOSE and EiFOSE, derived log K_{pea} 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, MeFOSE and EiFOSE.

TH105 Occurrence and Removal of perfluoralkyl and polyfluoralkyl substances (PFASs) in full-scale water and wastewater treatment plants

Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are ubiquitous contaminants of concern in the aquatic environment, including wildlife and humans. Perfluorooctanoic acids bind to proteins and the retinal 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 contaminants.

Several fish species were sampled in Italian rivers, with samples from deep lakes being seasonally collected for the analysis of 10 perfluorocarboxylates, 7 perfluorosulfonates and 5 perfluorosulfonamides. Individual fish were measured, weighed and dissected in three fractions: whole visceral, the muscle and the rest of the carcass (head, fishbone and skin and fins). The fractions of 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 derivatized on HybridSPE and phospholipid removal was performed by phospholipid suppression effects by phospholipids. Perfluoralkyle 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 was fitted on hybridSPE data in order to compare different extraction effects by phospholipids. Perfluoralkyl 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 was fitted on hybridSPE data in order to compare different extraction effects by phospholipids. Perfluoralkyl 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 was fitted on hybridSPE data in order to compare different extraction effects by phospholipids. Perfluoralkyl 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 was fitted on hybridSPE data in order to compare different extraction effects by phospholipids. Perfluoralkyl 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 was fitted on hybridSPE data in order to compare different extraction effects by phospholipids. Perfluoralkyl 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 was fitted on hybridSPE data in order to compare different extraction effects by phospholipids. Perfluoralkyl 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 was fitted on hybridSPE data in order to compare different extraction effects by phospholipids. Perfluoralkyl 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 was fitted on hybridSPE data in order to compare different extraction effects by phospholipids.

TH106 Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) occurrence in biota in Czech rivers
V. Koda, Department of Chemistry, University of South Bohemia in Ceske Budejovice; South Bohemian Research Center of Aquaculture and Biodiversity of Hydrocarbons Objective of the Study The company measures PFOS and PFOA concentrations detected in biota within CHMI bioaccumulation monitoring program from years 2010 – 2016. Material and Methods A bioaccumulation monitoring of selected pollutants in biota of freshwater organisms from the Czech Republic and other European countries has been repeated at intervals of 5-6 years. The study covers fish and other biota species. Sampling sites were selected to reflect the diversity of aquatic habitats in the Czech Republic. Monitoring comprises two profile sets consisting 21 and 22 monitoring sites. Sampling at those two site sets alternates in the three-year cycles. Sites are located at important parts of main Czech rivers (country borders, before confluences, downstream industrial sites or large cities, etc.). An assessment was made for following matrices: juvenile fish, benthos (Hydrospychne sp., Eshophila sp.), detritus (leaves, twigs, mosses, aquatic plants, etc), periphyton (Cladophora sp., Chara sp.) and fish eggs / larvae (B. cephalus). The analyses of fish were conducted for following tissues: muscle, blood and liver. In total, following number of samples of various matrices were analysed using LC-MS/MS and LC-HRMS: fish blood 105, fish liver 15, fish muscle 78, juvenile fish 149, benthic organisms 126, mussels 73. Results PFOS highest values were detected in fish blood (10.3 pg/g), juvenile fish (1.2 g/l), pond snails (2.15 g/l) and benthic organisms (0.05 61.1 pg/g) significantly exceeded levels of PFOS found in fish muscle (0.4 38 pg/g). The lowest PFOS concentrations were found in mussels (0.01 2 pg/g). PFOS concentrations compare to PFOS reached significantly lower levels in all monitored matrices. Range of values was between 0.01 - 3.1 pg/g, where minimum represents the smallest concentration found in mussels and the maximum represents concentrations in juvenile fish. PFOA highest values were detected in juvenile fish (0.01 - 3.1 pg/g), followed by benthic organisms (0.02 - 2.5 pg/g) and fish blood (0.06 - 1.8 pg/g). Small concentrations were measured in mussels (0.01 - 1 pg/g), fish muscle (0.02 0.5 pg/g) and fish liver (0.02 0.7 pg/g). Concentration in general trend for PFOS was higher in fish blood, except fish muscle was not detected. PFOS concentrations in fish blood, kidney 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 PFOS (9.1 pg/g).
precursors to the apparent biomagnification of PFCAas, 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 (15-25 %). 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. Kothoff, 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 substances or as ingredients of cosmetic applications. Our study set out to apply two large scale multi methods capturing short (e.g. C2 to C6 PFAs), medium and long chain PFAS (e.g. C6 to C14 PFAS and PFPeA), and also precursors (e.g. PAPs, dPAFs, 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 gill eggs. Here, we present first detections of the F-53B constituents in breem liver samples afar from production sites, and provide indications on distribution patterns.

TH110 A biologically 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; F. Lafay, Institut des Sciences Analytiques / TRACES; E. Rochard, Istrea Bordeaux Per- and poly-fluorinated 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 in order to describe the mechanisms in rainbow trout (Danio rerio) embryo (ZFE). ZFEs are increasingly used as model compound, as it remains the dominant PFAS in environmental matrices. PFHSs represents an industrial alternative to PFOS, 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 food spiked with a mixture of 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. Vegos, Karolinska Institutet; G. Johanson, Karolinska Institutet / Institute of Environmental Medicine; M. Naasland, S. Wulff, Karolinska Institutet / Institute of Environmental Medicine IMM; M. Sjödin, M. Hellstränd, J. Lindberg, E. Vincent, Swedish Toxicology Science Research Centre Perfluorinated alkyl acids (PFAs) are widely distributed and have been detected 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 to two perfluoroalkyl 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 PFOS, 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 food spiked with a mixture of 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.

TH113 Role of bioaccumulation in the derivation of environmental risk limits for two perfluorinated substances, PFOA and HFPO-DA
D. Vogel, 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 perfluorooctanoic acid (PFOA) and hexafluoropropylene oxide dimer acid (HFPO-DA); also referred to as GenX, FPO-902 or PFOSnongen. 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 HFPO-DA. For PFOA, a typical bioaccumulation behaviour has been observed.
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 determined by the protein binding. Higher safety factors are necessary because of the difference in toxicokinetic half-live between human 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.

TH114 Perfluoroether carbonylic acids - are these substances appropriate PFOA-alternatives regarding their environmental concern? C. Stuhlm, Gribi M.M., Neuburg E., Biegel-Euller, German Environment Agency - UBA / Chemicals; W. Drost, Federal Environment Agency (UBA) / Chemicals; L. Vierke, German Environment Agency / Chemicals Perfluorooctanoic acid (PFOA) is a persistent, bioaccumulative and toxic substance. To minimize the exposure of humans and environment a restriction according to REACH will come into force in the EU in 2020. For a global restriction of PFOA under the Stockholm Convention is already under discussion. As a result of the regulatory activities as well as voluntary measures, PFOA has been replaced with other fluorinated as well as non-fluorinated alternatives. The use of PFOA as processing aid in fluoropolymer production has been mainly substituted with perfluoroether carbonylic acids (PFECA). PFECA are structurally similar to perfluoralkyl carbonylic acids such as PFOA. The difference is a perfluoropropyl chain instead of a perfluoralkoxy chain. Due to this structural similarity it could be expected that PFECA are equally hazardous to the environment. Thus, the German Environment Agency has assessed the environmental hazards in the context of substance evaluations under REACH for certain PFECA such as ADONA (aminonan 2,2,3 trifluor-1-(1,1,2,3,3-hexafluoro-3-trifluoromethoxypropoxy), propionate) and GenX (aminonan 2,3,3, tetrafluoro-2-(heptafluoropropoxy) propane). The poster will present a summary of the substance evaluations. PFECA are expected to be very persistent under environmental conditions. The substances have a low bioaccumulation potential in aquatic organisms. However, just as PFOA, PFECA may not fit into the common accumulation pattern. Furthermore, the substances are probably mobile in the aqueous environment and soils and can reach groundwater and consequently drinking water resources. PFECA have already been detected in surface water, groundwater and drinking water around fluoropolymer production plants [1-4]. In conclusion, further data are necessary, but the available information on PFECA already demonstrates that these substances are hazardous for the environment and further risk management measures are needed. [1] Gebbink WA, van Asseldonk L, van Leeuwen SPJ. 2017. Environ. Sci. Technol. Lett. 3 :107-11065 [2] Sun M, Arevalo E, Strynar M, Lindstrom A, Richardson M, Kearns B, Pickett A, Smith C, Knappe DRU. 2016. Envrion. Sci. Technol. Lett. 3: 415 [3] Sun M, Arevalo E, Strynar M, Lindstrom A, Richardson M, Kearns B, Pickett A, Smith C, Knappe DRU. 2016. Envrion. Sci. Technol. Lett. 3: 415 [4] Schreiber J. 2014. Untersuchung des Transportverhaltens von ADONA in Boden und Grundwasser anhand von Feld- und Laborstudien. Diploma thesis [4]

TH115 Fluoropolymers: Polymeric PFAS That Satisfy Global Polymer of Low Concern Criteria B. Henry, W.L. Gore & Associates, Inc. Fluoropolymers, such as polytetrafluoroethylene (PTFE), constitute a distinct class within the polymeric category of the PFAS group. Fluoropolymers are resistant to chemical, hydrolytic, oxidative, photocatalytic and biological degradation. They are thermally stable within their intended processing temperatures (e.g., 260°C for PTFE). Fluoropolymers have negligible residual monomer, low molecular weight degradation products and thus they are not bioavailable or bioaccumulative. The nontoxic nature of PTFE is supported by numerous Good Laboratory Practice (GLP) studies including acute and subchronic toxicology, irritation, local toxicity on implantation, cytotoxicity, in vitro and in vivo genotoxicity, hemolysis, complement activation, and thrombogenicity. Clinical studies of patients receiving permanently implanted PTFE-containing medical devices demonstrate no chronic toxicity or carcinogenicity, reproductive, developmental or endocrine toxicity. Fluoropolymer medical devices have been implanted in over 40 million patients for over 40 years. This poster includes fluoropolymer biocompatibility/toxicology, human clinical, and physical-chemical-thermal-biological data to show that fluoropolymers satisfy globally recognized assessment criteria to be considered as “Polymers of Low Concern” and to be recognized as being a low hazard class of PFAS. 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, Orebros University, Orebros, 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 poly-fluoralkoxy 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 T. Voilme, Eufrifon Agroscience Services EcoChem GmbH / Field Ecotoxicology; C. Kleim, Eufrifon Agroscience Services EcoTox Gmbh / Ecotox Field; S. Knaebe, EAS Ecotox GmbH / Ecotox 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 endpoints of 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 type 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 vs. perennial 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 vs. minimum disturbance) and more specifically in the case of testing a substance with herbicidal action (impact on vegetation cover 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 Carbdenzam? 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. Kamoun, National School of Engineering of Sfax, Tunisia / Laboratory of Water, Energy and Environment; J. Sousa, University of Coimbra / Department of Life Sciences; J. Roembre, ECT Oekotoxikologie GmbH
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 but also in various other ways such as a coating 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 procedure 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 as GLARE and GLARE-PLUS, which also use this same taxonomic groups for soil ecotoxicology might be useful. The above mentioned questions are discussed in the following sections.

TH119 Adaptation of the earthworm field test method: conceptual overview and first results
J. Roembke, ECT Oekotoxikologie GmbH; B. Daniels, RWTH Aachen University / Institute for Environmental Research Institute; B. Förster, S. Jaensch, ECT Oekotoxikologie GmbH; P. Kotschik, Umweltbundesamt / Federal Agency of Environment / Risk assessment for plant protection products; R. Oertmanns, 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. Schieferczyk, ECT Oekotoxikologie GmbH; B. Scholz Starke, RWTH Aachen University / Institute for Environmental Research.

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 studies used for regulation. This data set was statistically evaluated to develop a design for a pilot study for the earthworm field test. 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-GSII-Earthworm Field Group”. During and after the workshop, the group agreed on a test design including various aspects of statistical robustness, predictability 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 ECx-derivation 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 test study 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. Makhele, North-West University / Unit for Environmental Sciences and Management; E. Ejiersack, 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 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 irrigating impacts of wind and surface and ground water dispersal form the mined area. Therefore ERA should start to assess the 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 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, soil processes and soil functional properties in a tiered approach, which is based on a range of soil functions providing essential ecosystem services, e.g. organic matter breakdown and mineralization, water regulation in soil. The tiered approach 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 the biodegradation 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 risk assessment has to be conducted. Therefore, our approach employs a tiered assessment approach. Tier 1 exposure analysis employs a 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 China-PEARL, which developed by NIES and ICAMA in China, are applicable to predict the exposure concentration at specific depth of soil layer and at specific scenarios in China. Proposed test systems for effect assessment include acute toxicity test or reproduction of earthworm, reproduction test, nitrogen transformation assessment. High Tier risk assessment mainly focusses on the litterbag test assessment 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 tiered risk assessment approach established. Terrestrial non-target arthropods exhibit a vast array of life history strategies and networks. 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. Medium scale occurs as a result of 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. Härgerbäumer, R. Raschke, Bielefeld University / Animal Ecology; S. Hoss, 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 highly sensitive to environmental pollutants. 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
Q. Dierckx, Bayer, A. Gobbert, J. Bclarations, D. Engels, J. Vermeiren, E. Remmelts, J. Remmelts, T. Carro, FMC; H. Cunningham, Syngenta / Environmental Safety; A. Koutsafitis, ADAMA; S. Loutseti, DuPont De Nemour Hellas S.A.; M. Marx, Bayer AG Crop Science Division / Environmental Safety - Ecotoxicology; B. O'Neill, DuPont Crop Protection; A. Sharples, FMC Agricultural Solutions; F. Staab, BASF SE

Soil functional test systems provide valuable and ecologically relevant information for the risk assessment of plant protection products (PPP). Functional tests directly measure ecosystem functions and services which are provided by soils and soil organisms (e.g. organic matter (OM) degradation and mineralization). Focusing on structural endpoints in the risk assessment for PPP lacks a clear link to the protection goals derived from ecosystem services. Directly measuring soil functional services and services that better reflect the benefit of SOC for ecosystems. Furthermore, functional test systems can help to evaluate the ecological relevance of a density change of a soil organism population affected by a certain stressor. To quantify the soil mesofauna and microorganism contribution to the process of OM breakdown, a project on soil functional test systems was initiated by the European Crop Protection Association (ECPA). A field study was set up in 2016 in which measurements of two soil invertebrates (Methamphosos, Lindane) on organic matter degradation in a minicontainer test. Soil micro-arthropod abundance were monitored in parallel to determine the link between effects on the structure of soil micro-arthropods and their soil functional implications (i.e. OM breakdown). The results indicate that the process of OM degradation is dominated by soil microbes. Soil mesofauna contributed only a minor amount to OM degradation. The minicontainer test did not show a clear effect of invertebrates on the mesofauna driven organic matter degradation, although total abundances of Collembola and Acari were heavily reduced by the insecticidal applications. In the recently published Soil Scientific Opinion (2017), EFSA proposed Specific Protection Goals for soil micro-arthropods for in-field areas. This foresays that even short-term effects on single species in a magnitude of >65% are considered unacceptable to ensure the provision of Ecosystem Services in agricultural soils. The present study shows that a reduction of the total soil micro-arthropod community by 80% over a period of 6 months has no unacceptable effect on the mesofauna driven OM degradation in a minicontainer test on an arable field. Thus, the relevance of the structural endpoints on soil micro-arthropods (i.e. single species population) within an in-field soil risk assessment for PPP, which focus on maintenance of soil fertility (protection of soil functions), is questionable.

TH125
The role of source sink dynamics in the assessment of risk to non-target arthropods from the use of plant protection products
G. Lewis, JSC International Ltd; S. Braeker, BASF France S.A.S.; C. Mayer, BASF SE / Ecotoxicology

The concept of source-sink dynamics as a potentially important component of metapopulation dynamics was introduced in the 1980’s culminating in the paper byPulliam (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-dependent. However, this issue does raise important questions particularly as the role of landscape structure in risk assessment. A structured approach can then be adopted in terms of identifying suitable source-representative surrogates and generating the necessary information for them and at the landscape level to allow the development of suitable population models. These models could then be used in an appropriate way within a risk assessment scheme e.g. at a higher tier level addressing specific issues of concern identified at the lower tiers. They may also have the potential to inform risk managers to consider the consequence of a target species population change. Practical examples of this include the role of the amount of information needed in relation to the life-cycles of non-target arthropod species and landscape structure, are also identified. Acknowledgements: This work was initiated and funded by the ECPA non-target arthropod group

TH126
Classification of uncertainty in ecological risk assessment of pesticides
A. Hunka, Hulska University / School of Business, Engineering and Science; M. Meli, ADAMA Agricultural Solutions; S. Pashami, S. Waara, Hulska University

Uncertainty estimates are inherently built into any prospective risk assessment. Uncertainties need to be correctly recognized, described and presented to provide a basis for decision-making. One important factor to consider is that more data and experimental results often result in increased acceptance of the uncertainty. It is, therefore, essential to understand which sources of uncertainty influence the decision outcome more than others and to consider its theoretical implications as well as to identify how it may be manifested under field conditions. Sources of uncertainty informing the risk assessment of plant protection products, including spatial and temporal scales when assessing the population dynamics of non-target arthropods in the context of the risk from the use of plant protection products. It is therefore important to consider what the evidence base is for source-sink dynamics in the agricultural environment and what this tells us about whether or how it is manifested in relevant populations. A structured approach can then be adopted in terms of identifying representative surrogates and generating the necessary information for them and at the landscape level to allow the development of suitable population models. These models could then be used in an appropriate way within a risk assessment scheme e.g. at a higher tier level addressing specific issues of concern identified at the lower tiers. They may also have the potential to inform risk managers to consider the consequence of a target species population change. Practical examples of this include the role of the amount of information needed in relation to the life-cycles of non-target arthropod species and landscape structure, are also identified. Acknowledgements: This work has been recognized by EFSA recently, but still there is very little research into classifying, visualizing and addressing uncertainty in ERA of pesticides. Currently EFSA recognizes standard and non-standard uncertainties in ERA of pesticides. This classification offers little insight into how those two categories impact ERA conclusions and further risk management decisions. In order to address this gap, we have undertaken an appraisal of a large subset of ERAs (102 up to date) conducted for approval of active substances at the EU level. We have been working on ERA data, conclusions on pesticide peer-reviews and Draft Assessment Reports in order to provide an overview of the most frequently identified sources of uncertainty, classify different uncertainties and link them to recognition of data, cost, data gaps and risk management decisions. At the moment it is still unclear which sources of uncertainty influence the decision outcome more than others and our preliminary results indicate that it is possible to uncover non-obvious relationships between uncertainty and risk assessment outcomes. It is, for instance, possible to describe how different sources of uncertainty affect the process of ERA (e.g., duration, effectiveness of a Rapporteur Member State in producing a draft assessment report) and compare how uncertainty is addressed in risk assessment for different environmental compartments, especially soil versus ERA for aquatic organisms which is much more developed. We aim to provide a typology of recognized uncertainties in ERA and discuss how it could help inform the establishment of the surrogate reference tier and the subsequent calibration of lower tiers in the new risk assessment scheme for in-soil organisms, which is currently being developed by EFSA. Ultimately, we aim to link the typology of uncertainties in ERA to risk management techniques, in order to help ERA practitioners to better...
address and manage uncertainties.


The German Federal Soil Protection Act (1988) defines precautionary values for seven metals which, if exceeded, indicate that concern for a harmful soil change exists. All precautionary values given in the German Soil Protection Ordinance (1999) are based on total concentrations (aq. regia). However, a realistic risk assessment of metals should consider their bioavailability in soil. Thus, the aim of this project is to connect bioavailable fractions of arsenic with ecotoxicological effect concentrations, taking into account soil properties (texture, pH, organic matter content etc.) and various metal extractions (1M NH₄NO₃, 0.01M CaCl₂, Ca(NO₃)₂ with ionic strength corresponding to soil solution, DTPA/CaCl₂, 0.43M HNO₃, plus aqua regia). Arsenic was chosen due to its high relevance as a soil contaminant, its low data availability compared to other metals and is an element of concern included in many soil regulations. Six soils covering a wide range of Central European soil properties were chosen and spiked with sodium arsenate dibasic hypophosphate (Na₂HAsO₄•7H₂O). Chronic toxicity endpoints were tested with microbes, plants and invertebrates, according to ISO standard guidelines, allowing derivation of threshold values via an SSD approach. The results (given as NOEC, EC₁₀ and, preferably, EC₅₀ values) based on the six extraction methods, have been determined. The variation in EC₁₀ values based on nominal concentrations among the soils tested differed typically by a factor of 2 - 5 for the endpoints tested. The extraction strength of the different methods and soils differ at least by an order of magnitude in the order NH₄NO₃ < CaCl₂ < Ca(NO₃)₂ < DTPA < HNO₃; thus in most soils, plants were the organisms reacting most sensitively, partly together with the Bacteria. Both invertebrate species were always less sensitive (i.e. EC50 values (nominal concentration) > 250 mg As/kg soil) than microbes and plants except in one sandy soil (RefSoil-01A). Currently, chemical and biological results are combined in order to explain the observed variation in toxicity expressed as nominal or total As concentrations in soil. This information will be used to include As bioavailability into the derivation of precautionary values. The representativeness of the different extraction methods regarding bioavailable fractions as well as the properties of the different soils are checked as part of a more realistic risk assessment of metals in soils.

TH128 Activity based in-soil arthropod sampling S.B. Dehlean, F.M. Bakker, Eurosinos-Mitox

Higher tier (field) assessment of effects on soil microarthropods relies strongly on the accuracy of the sampling methodology. Two main classes of trapping methods exist to date, these are either abundance-based or activity-based. Abundance-based trapping directly involves the collection of soil arthropods followed by heat extraction such as Berlese-Tullgren or McFadden methods. Activity-based sampling implies installing hypogean traps and collecting the catch at pre-determined intervals. Soil core sampling provides an instantaneous assessment of the fauna at the exact moment and at the very location of sampling, whereas hypogean traps provide an assessment of the activity in a wider area and over a longer time span. Clearly, higher tier assessment can only be performed if the activity-based sampling is established and recommended method known to extract springtails, mites and some other small arthropods. Hypogean trapping is a relatively novel approach (cf Dehlean et al. SETAC 2016, Sims et al. 2016, Bakker et al. 2017) and seems to have a certain degree of selectivity. For purposes of method development and evaluation we have performed a comparative study in which soil core sampling and hypogean trapping (mine traps) were performed in the same fields. The study comprised both a hay meadow and an arable field. Soil cores were taken from the top 10 cm of soil, mine traps collected from various depths. With this contribution we will highlight the differences in species spectrum, numbers collected and variability observed with the different methods and discuss the implications for data analysis and interpretation.

TH129 The application of the CPCAT approach reduces shortcomings of effect detection for earthworm field studies B. Daniels, RWTH Aachen University / Institute for Environmental Research; S. Jansch, ECT Oekotoxikologie GmbH; P. Kotschik, Umweltbundesamt / Federal Agency of Environment / Risk assessment for plant protection products; R. Ottermanns, RWTH Aachen University / Institute for Environmental Research; S. Pieper, German Federal Environment Agency (UBA) / Plant Protection Products; M. Ross-Nickoll, B. Scholz-Starke, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Field studies to determine effects of pollutants on earthworm community are generally conducted according to standardized ISO-guidelines (ISO 11268-3). However, statistical test procedures suggested in the guidelines are frequently criticized, mainly for two reasons: test data characteristics do not fulfill test requirements (normal distribution and variance-homogeneity) and the resulting toxicity metrics of multiple testing procedures (NOEC / LOEC) fail to adequately detect the actual level of effects. Lehmann et al. (2016) presented a new approach to overcome these shortcomings by introducing the CPCAT procedure. We applied this statistical method to detect effects in a set of 16 earthworm field studies and provide a comparative analysis with regard to results of well-established multiple testing approaches. This allows the performance of CPCAT to be assessed within 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 precise response than the determination of earthworm field studies because data distribution and variance are adequately considered and smaller differences between control and treatments can be detected.

TH130 Relationship between soil microbial biomass methods used in environmental fate laboratory studies P. Massey, Smithers Viscent; P. Pearson-Davies, B. Earnshaw, Smithers Viscent; S. Swales, Smithers Viscent ESG

The determination of microbial biomass activity is a pre-require 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 test, 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 the fumigation extraction method. This method determines the carbon content of the soil biomass, via fumigation, using ethanol-free chloroform. During fumigation, cells are lysed by the chloroform, which results in a flush of organic carbon into the soil environment. This organic carbon is then extracted and quantified. Another suitable way of estimating soil microbial biomass is by substrate induced respiration. This method uses a suitable labile substrate to promote a respiratory response. The carbon dioxide evolved or the oxygen consumed as a result of this respiratory response is then extracted and quantified. This method is a useful way to estimate the active biomass in soil. Both methods are based on the carbon content in the soil biomass and are referred to as the biomass carbon method. As not as referred in OECD guidelines (1997), substrate induced respiration can be used to estimate the active aerobic biomass, whereas in OECD 14240-2:1997, fumigation 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 Viscent 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 suitability, which will ultimately facilitate and refine our choice criteria when choosing soils for environmental fate studies.

TH131 Where are the Springtails? New data on the vertical distribution of Folsomia candida (Collembola) and its population dynamic in artificial soil L.S. Tszchoppe, RWTH Aachen University / Institute for Environmental Research BioV; V. Roeben, RWTH Aachen University, Institute for Environmental Research / Institute for Environmental Research BioV; M. Rob-Nickoll, RWTH Aachen University / Institute for Environmental Research BioV

Folsomia candida is a non-target arthropod species which is often referred as the „Standard Soil Arthropod“ (Fountain and Hopkin, 2005). It is part of the regulatory framework of pesticide risk assessment and in the last years an increasingly important model organism in ecological and effect modelling. However, the knowledge on the population dynamics on a long-term scale and the vertical dispersal within the soil column is still scarce. We will present the results of two experimental studies exploring those unknown topics – one on the population dynamics over time and one on the vertical dispersal in relation to food location.
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 oscillation in the population and its maximum 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 an 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, Ophiothrix fragilis 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 collembola 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 exposed with low to high concentrations of zinc and mites exposed to the soils for 28 days. Mite survival, reproduction, species diversity and population were determined at the 28 days. Habitat quality did not change zinc bioavailability which remained at 2% 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 Parochydrinus kimi (Collembola: Onychiuridae)
J. Wec, 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 increases, there is a possibility of chemical accumulation in the air, 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 cause accidents. Especially for chemicals exposed to gaseous state, little is known about the fate of air-borne chemicals such as Collembola and earthworms. 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 Parochydrinus 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±1°C, 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 ofketone-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 reinhardii and Chlorococcum infusionum. Eisenia andrei were exposed with 15% of control or MEK soils with closed system. After 7 days exposed, mortality and abnormalities including spinning, fragments, swelling, bleeding, and mucus secretion were measured. For soil algae, Chlamydomonas reinhardii 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. reinhardii for MEK. 6d-EC50 to C. reinhardii 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. 2016009170001).* <strong>Key word: methyl ethyl ketone, earthworm, soil algae</strong>

**TH136**

Effects of endocrine disrupt chemicals (EDCs) to soil algae
R. Cui, Konkuk University / Department of Environmental Sciences; Y. An, Konkuk University / Department of Environmental Health Science

There were many data for endocrine disrupt chemicals (EDCs) for aquatic organism, but soil toxicity data of them were very limited. This study evaluated the effects of bisphenol A (BPA), bis(2-ethylhexyl)phthalate (DEHP), and nonylphenol use in soil algae. Soil algae, Chlamydomonas reinhardii, and Chlamydomonas infusionum were exposed at 0.5 g of control or exposed soils in 6-well plate. Algae were extracted for 1 day using algae culture medium after 6-d exposure, and the chlorophyll intensity was measured by fluorescence microplate reader. We observed that the BPA was most toxic following NP and DEHP. The effect of DEHP was insignificant to Chlamydomonas reinhardii and Chlorococcum infusionum. The results can be used for risk assessment of BPA, DEHP and NP in soils. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458) Key word: bisphenol A, bis(2-ethylhexyl)phthalate, nonylphenol, soil algae

**TH137**

Evaluation of reproduction tests of earthworms and enchytraeids exposed to sugar cane vinasse in nature and after pH adjustment
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The use of sugarcane vinasse as fertilizer in crops has been widely used in order to provide an adequate destination for this residue however, it has properties that can be prejudicial to the animals present in the soil, as already verified in numerous studies. Therefore, the objective of this work was to treat vinasse with lime (CaO) to adjust pH to 7.0 (neutral), in an attempt to reduce its toxicity for later use in the soil. In this context, the development of ecotoxicological tests presents itself as a tool of great assistance in the analysis of residues released to the soil. Thus, reproduction tests were conducted using animal soil biocides to evaluate the effects of vinasse may have on reproductive behavior of these animals. Earthworms of the species Eisenia andrei (Annelida) and enchytraeids of the species Enchytraeus crypticus (Annelida); both tests were developed according to the protocols proposed in ISO 11268-2 (ISO, 2011) and ISO 16387 (ISO, 2013), respectively. In the soil fertility test, the soils contaminated with vinasse were exposed to vinasse in nature in occupation to the animals exposed to the treated vinasse there was an increase in the number of animals, which suggests that the vinasse treatment for pH adjustment was valid for this test. The reproduction test with E. crypticus exposed to the same conditions cited above also showed an increase in the number of individuals exposed to treated in biosavias vinasse compared to exposed to vinasse in natura. The results allow to infer that the pH adjustment of the vinasse to a neutral level was effective in reducing the toxicity of the residue for the tests of reproduction both in species used, since the environment favored the reproduction of the animals tested.

**TH138**

Ecotoxicological Characterization of Nitrogen-Based Energetic Soil Contaminants
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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-tetrazocine (HMX), and 2,4,6,8,10,12-hexanitro-2,4,6,8,10,12-hexaaza-1,3,5,7,9,11-hexanitro-1,3,5,7,9,11-hexazaisowurtzitane (CL-20), 2,4-dinitrotoluene (DNT), 1,3,5-trinitrobenzene (TNT), 2,4-dinitrotoluene (2,4-DNT), 2,6-dinitrotoluene (2,6-DNT), 2-amino-4-6-dinitrotoluene (2-ADNT), 4-amino-2,6-dinitrotoluene (4-ADNT), and nitroglycerin (NG). Ecotoxicological effects of these EMs were determined in definitive studies with Sassafras sandy loam (SSL) soil using soil invertebrate, terrestrial plant, and biological activity endpoints. SSL soil was selected because it has physicochemical characteristics (low organic matter, moderate pH, etc.) that are highly relevant to the bioavailability of organic chemicals. Data for reproduction (soil invertebrates), growth (plants), and critical soil processes (basal and substrate-induced respiration, litter decomposition) were independently analyzed using appropriate regression models to determine the EC50 concentration producing 20 percent decrease (EC20) in the measurement endpoint compared with carrier (acetone) control. Toxicological benchmarks developed in studies with soil invertebrate and terrestrial plants were used to derive draft Ecological Soil Screening Levels (Eco-SSLs) for use in screening-level ecological risk assessment of EM-contaminated soils.

Additionally, we developed species sensitivity distributions (SSDs) for select EMs using toxicity data for all three soil ecological receptor groups (invertebrates, plants, and soil processes). These SSDs were then used for derivation of Soil Contaminant Values (SCVs). Benchmark dose test (BM) and Eco-SSL values developed in these studies will be submitted to the USEPA Eco-SSL Work Group for use in establishing soil invertebrate- or plant-based Eco-SSLs for the individual EMs, and will be made available for use in Ecological Risk Assessment of terrestrial habitats at U.S. Army testing and training sites and other military locations. The SCVs can provide site managers and regulators with a risk assessment tool which allows them to derive specific, site-specific values (e.g., HC5 or HC50 protection level) that they wish to use to derive a site-specific SCV protective of plants, soil invertebrates, and critical soil processes.

TH139
Organismal responses of oligochaetes in bacterial inoculum amended copper oxychloride spiked soils
M. Maboeta, North-West University / Unit for Environmental Sciences and Management; O. Oladipo, M. Engelbrecht, North-West University
The excessive release of heavy metals such as copper via anthropogenic sources into the soil environment has raised some global concern. Copper oxychloride, a copper agricultural metal-based fungicide applied to fungicidal cultures for fungal control, contains 60% copper. This high copper content may significantly contribute to the soil copper burden and negatively affect the mesofauna.

Metal-tolerant bacteria such as Bacillus cereus strain have been identified for their bioremediative traits in metal polluted soils. We examined the effect of Achromobacter sp, Bacillus sp, or Clostridium sp, on the toxicity of copper oxychloride. In this study, the bacterial strains used (Achromobacter sp and Bacillus cereus) were previously isolated from copper mine and metallic mining sites and confirmed to tolerate to 200 mg kg⁻¹ Cu. Twenty-four hours pure broth cultures of the two bacterial strains were inoculated into fungicide spiked soils. Utilizing standard ISO and OECD protocols, 10 mature Eisenia andrei and Enchytraeus albidus were exposed separately to both copper-treated and control copper oxychloride spiked soils for 10 and 1000 mg kg⁻¹ soils. Avoidance behavior, biomass, reproductive success, metal contents in soils and earthworm tissues were determined. Findings revealed that E. andrei in inoculated cultures (200 mg kg⁻¹) exhibited significantly higher (p < 0.05) preference, relative growth rate, survival, cocoon and juvenile counts and soil Cu content (comparable to the control) than non-inoculated soils. Similarly, with the E. albidus, significantly higher (p < 0.05) preference and reproductive success was recorded. However, at 1000 mg kg⁻¹ copper oxychloride soils, no distinct effect was observed on both E. andrei and E. albidus in bacterial inoculated and non-inoculated cultures. In conclusion, Achromobacter sp, Bacillus sp, Clostridium sp, and copper oxychloride toxicity factors were determined in this study. These results further confirm the Cu tolerance potential of these bacterial strains at 200 mg kg⁻¹. Achromobacter sp and Bacillus cereus are therefore recommended for the bioremediation of soil contamination of copper contaminated environments. Keywords: Copper oxychloride fungicide. Achromobacter sp, Bacillus cereus consortium. Ecotoxicology. Oligochaetes

TH140
Development of a terrestrial biotic ligand model (TBLM) for predicting acute toxicity of cadmium and zinc to soil collomeloban Paronychiurus kimi
J. Son, K. Cho, Korea University / Division of Environmental Science and Ecological Engineering
Complex interactions between metals and soil properties make it difficult to apply a biotic ligand model widely used in aquatic ecotoxicology studies. In this study, a terrestrial biotic ligand model (TBLM) was developed to predict the acute toxic effects of cadmium and zinc on the survival of soil collomeloban Paronychiurus kimi in a simplified soil solution system under the assumption that soil pore water is the main route of exposure to metals. After 7 days of exposure, survival and internal metal concentrations in P. kimi were determined. The free metal ion activity for each metal was calculated by the Visual MINTEQ using inputs of soil metal concentrations, cation and anion components of the soil solution, and pH of the soil solution. The toxicity of cadmium and zinc was linked to the fraction of biotic ligand complexes (i.e., CdL and ZnL). The results showed that the fraction of the biotic ligand 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 affecting bioaccumulation and toxicity of metals.

TH141
Characteristics of metal-tolerant bacterial plasmids from a platinum mine tailings dam
T. Mahalati, C. Bezuindenhout, M. Maboeta, North-West University / Unit for Environmental Sciences and Management
The presence of mine tailings may promote the development of both heavy metal and antibiotics resistance among microbes with resistant plasmids. Plasmids provide their hosts with a large array of phenotypes 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 recovered were used 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 transformation 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⁺/Ba²⁺ and Ba²⁺ with metal resistance order of Ni(II)/Pb²⁺/Ba²⁺>Pb²⁺/Ba²⁺/Ba²⁺. 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) SDS-PAGE. One dimension SDS-PAGE illustrated general similarity of the profiles except for two banding positions in the 30 to 35 kDa region where bands were present in the transformants that were grown in the Al/Na alloy containing media. Two-dimensional electrophoresis 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 them able to tolerate metals. These plasmids also characterized have advanced our understanding that these plasmids could be important reservoirs for resistant genes, and may hold significant biotechnology potential.

TH142
Sensitivity of the waterside species, Yuukianura szetpyckii (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 szetpyckii was studied. In this study, the response of E. andrei to cadmium and copper was studied and the biocompatibility 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 E. szetpyckii were also compared to those of other collembolan species (F. candida and Paraconchuris kimoi) reported in literature to investigate their suitability as a new test species in toxicity test. Not only the adult survival but also the juvenile predication of E. szetpyckii was used in a colonization dependent manner after 28 days of exposure duration. Although the response of E. szetpyckii to the tested metals was not highly sensitive to the other collembolan species reported in literature, the study of the response of E. szetpyckii 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.

TH143
Drivers of copper and zinc availability and phytovailability in agricultural soils receiving long-term organic waste amendments
C. Laurenc, CIRAD - Centre de coopération internationale en recherche agronomique pour le développement / PERSYST-UPR Recycling and risk; M. Bravin, CIRAD; C. PELOSI, INRA (Institut National de la Recherche Agronomique); O. Crouzet, INRAAgroParisTech; I. Lamy, INRA / UMR ECOSYS Organic wastes (OW) are used as soil amendments and fertilizers but they are also the major source of copper (Cu) and zinc (Zn) contamination in agricultural soils. The potential ecotoxicological effects of OW applications on arthropods depend on Cu and Zn availability in soils. 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 both controlled by the application of OW and to the activity of soil organisms on the surrounding soil, i.e. the rhizosphere for plants. However, the eco-toxicological interactions and the co-exposure effect are poorly documented when taking 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 woundermere 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. We propose to link ecologically the two types of 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 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 toxicity threshold 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. Mokrakpati, Institute of Environmental Sciences, Jagiellonian University / Ecology; M. Brzin, G. Soares, Institute of Soil 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 pesticide, chlorpyrifos; Spectracide, containing the pyrethroid cypermethrin (CYP), and Speefree 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 Powerbar. 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 (C.I. 0.048-0.071) and 0.054 (C.I. 0.046-0.066) RFD for spring and autumn beetles respectively, and for Sherpa ~ 0.556 (C.I. 0.453-0.704) and 1.003 (C.I. 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 to see whether such seasonal differences can be important for ERA. This study was supported by National Science Centre, Poland (2015/19/B/NZ9/01939).

TH146 The fate and bioavailability of currently used and emerging pesticides in agriculturally used fluviosols – effects of soil and pesticide agronomics M. Šudoma, N. Neuvirthová, Masaryk University; M. Svobodová, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Bielski, RECETOX, Faculty of Science, Masaryk University / Faculty of Science, RECETOX; M. Hvedzova, Z. Simek, L. Skulcova, 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 Agriobiotecchnology (IFA-Tullin); 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 (5μg·L\(^{-1}\). They are very persistent in soils and tend to form long-term residues. CF total 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 experimental model, 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 fluviosols under the addition of selected model compounds (RECETOX); K. Brandstätter-Scherr, University of Natural Resources and Life Sciences / Institute for Environmental Biotechnology, Department for Agriobiotecchnology (IFA-Tullin); J. Hofman, Masaryk University, RECETOX / Faculty of Science, RECETOX A subset of 10 fluviosols was selected based on the DRIFT mid infrared portion using the Kennard-Stone algorithm. These 10 soils are representative of a large fluviosols range in terms of their qualitative and quantitative SOM properties (TOC, DOC, H:FA, WHC, pH, texture, etc.).

TH147 A Field Trial to Determine Effects of Thiamezotham 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. Finnegan, Syngenta Limited; F. Bakker, EurofinsMitox; P. Thorbeck, Syngenta / Environmental Safety; M. Finnegon, Syngenta The aim of this study is to assess the potential effects of thiamezotham, 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. The treatment was applied at 0.005 and 0.05 mg/kg levels (0.5 mg/kg), seeding plants (Lactuca sativa), earthworms (Eisenia fetida), SPME passive sampling fibers, Silicon rubber sheets and Chemcatcher® passive samplers. A subset of 10 fluviosols was selected based on the DRIFT mid infrared portion using the Kennard-Stone algorithm. These 10 soils are representative of a large fluviosols range in terms of their qualitative and quantitative SOM properties (TOC, DOC, H:FA, WHC, pH, texture, etc.).
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.

TH148  
Bioaccumulation kinetics of pesticides chlorpyrifos and tebuconazole in the earthworm Eisenia andrei in two different soils  
M. Svbodová, Masaryk University RECETOX; K. Smidova, Masaryk University RECETOX / Research Centre for Toxic Compounds in the Environment (RECETOX); M. Hvezdova, Masaryk University / Research Centre for Toxic Compounds in the Environment (RECETOX); L. Bielski, 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 by LC-MS/MS after QuECHERS extraction which has shown to be rapid, simple and effective approach to determine broad spectrum of pesticides in 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.

TH149  
Effects of diuron and imidacloprid on eight nematode species  
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To assess the lethal effects of diuron (herbicide) 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 15 of the most frequently detected pesticides in French rivers. Both chemicals show an elevated DT50 (time to 50% degradation) in sediments, about 130 days for imidacloprid and more than 100 days for diuron, 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.

TH150  
Multigeneration effects of pentachlorophenol and 2,2',4,4'-tetrabromodiphenyl ether on Folsomia candida  
M. Qin, O. Zhang, Research Center for Eco-Environmental Sciences, Chinese Academy of Sciences, Th150  
The multigeneration effects of pentachlorophenol (PCP) and 2,2',4,4'-tetrabromodiphenyl ether (BDE47) on the springtail Folsomia candida were evaluated. Multigeneration tests were performed in accordance to two different test methods. In the first method, the parental generation springtails (F0) were exposed to PCP or BDE47 for 28 days. The first filial generation (F1) springtails were transferred to unpolluted artificial soil for 28 days and reproduced the second filial generation (F2). In the second method, the F0 generation were exposed for 10 days and then transferred to unpolluted artificial soil to generate the F1 generation. The F1 generation were also transferred to unpolluted artificial soil for 28 days and reproduced the F2 generation. For PCP, significant effects were observed on F1 and F2 generation in the first method and F1 generation in the second method. This suggests that PCP influences the reproductive capacity of adult springtails and the hatching of eggs or the mortality of juveniles. For BDE47, significant effects were only observed on F1 generation in the first method, which shows that BDE47 affects egg hatching through the reproductive capacity of adults. The affected endpoints of springtails can be inferred by the two methods. PCP and BDE47 do not influence completely the same endpoints.

TH151  
Bioaccumulation of lead in earthworms: a comprehensive study to derive a biota-soil accumulation factor (BSAF) for risk assessment  
K. Oorts, ARCHE; J. Chowdhury, International Lead Association / Senior Scientist

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 biota Pb 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 met 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 epigeic 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 soils in Europe. Only 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 0.048 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 0 to 30 cmol/kg soil, respectively, corresponding to the 10th and 90th percentile of CEC 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.
of cuticle in the pore-water scenario were observed. Dose-response modeling showed < 10 \text{LC}_{50} \leq 100 \text{mg} \text{L}^{-1} (\text{liquid-only exposure}) and < 100 < \text{EC}_{50} < 1000 \text{mg kg}^{-1} \text{dv soil} (\text{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 biotest to assess lead and zinc phytoavailability in contaminated urban soils
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Under the French legislation on the recycling of wastes from wastewater treatment plants, a guideline was provided to stakeholders to proof 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 field conditions. As expected, plants grown in contaminated soils 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 to be regarded 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 characterizing the effects on soil microflora provide an added value in the scope of regulation?
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According to the Uniform Principles regulation, side effects of chemical substances on the soil microflora focus on the determination of the nitrogen transformation (OECD 216). However, according to EFSAs 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 necessity to define soil-health-related 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, cellobiose) 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 indicate soil 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 chemical tools. 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. Frist, 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 TH155. Provisions in tier 1 risk assessment of plant protection products (PPP) is expected to increase due to revision of the PEC_{soil}modeling guidance. The new EFSA guidance foresees to use worst case PEC_{soil} 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 PEC_{soil} 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 PEC_{soil} 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-studies for a representative group of active substances as described by EFSA companies. In this exercise, the relevant soil layer for PECSoil 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).

TH156 Digging into the soil risk assessment of pesticides: current approach and its uncertainty
M. Arena, EFSA - European Food Safety Authority / Pesticides; D. Auteri, s. barnaz, EFSA - European Food Safety Authority / Pesticides Unit; S. Peper, German Federal Environment Agency (UBA) / Plant Protection Products
The current 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). Covering lower tier to earthworm risk assessment and inter- and interspecies variability in the environmental fate and the extrapolation of laboratory endpoints for lipophilic compounds (log P < 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 Protective Values for earthworms which include a minimum acceptable recovery time of 6 months for initial effects in field studies. This deviates from the current procedural 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.

TH157 SETAC Soils Interest Group
M.H. Wagelmans, Bioclear earth
Natural toxins and harmful algal blooms (HABs): water and food safety, analysis, toxicity, and risks (P)
A novel analytical method for simultaneous quantification of Bracken fern produced carcinogenic ptaquiloside-like compounds and their derivatives V. Kisielius, 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 aseous environments adjacent to drinking water supplies is needed. Nevertheless, the specific types of cyanotoxins and fate of toxic cyanobacteria are largely unknown. This study aims to identify the environmental risk factors that predetermine release of glycosidic natural toxins from non-agricultural lands to aseous ecosystems. Bracken ferns (Pteridium aquilinum) are known to produce up to 6 kg/ha of carcinogenic ptaquiloside. Previous studies demonstrate leaching of ptaquiloside from Bracken to soils and upper ground waters. The ptaquiloside-like compounds – pterosin A and pterosin B – 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, caudatoside and pterosin 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 InfinityLab Poroshell 120 EC-C18 semi-UPLC column (3.0x50 mm, 2.7 µm)), enables simultaneous determination of all 6 compounds with low limits of detection (1 ng/L) using loganin as an internal standard. The total time of analysis is 6 minutes and the system is operated under semi-UPLC conditions with a max. pressure of 400 bar. Mobile phase with a low fraction of acetonitrile is applied (10% v/v). These features are favourable for high-throughput analysis and could be practically utilised 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 NeToxAg, 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).

A novel method for ptaquiloside and pterosin B preservation in groundwater samples N. Skrbic, 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 volatile nature. Ensuring sample integrity for analysis is a critical step to facilitate trustful findings, and appropriate preservation methods need to be developed. This research focuses on the development of a preservation technique for ptaquiloside (PTA) and its degradation product pterosin B (PTB) in groundwater. Ptaquiloside is a carcinogenic compound produced by one of the five most common plants on the planet, Bracken fern (Pteridium aquilinum). It is highly water-soluble with almost no sorption to soil and sediment, and hence leaches to the aseous environment. In turn, PTA can potentially contaminate groundwater, which presents a concern for human health if used as a drinking water source. Ptaquiloside is chemically unstable under acidic and alkaline conditions, making it difficult to collect and preserve for analysis. Thus, a controlled and well-designed preservation procedure that can ensure its stability for the subsequent analyses is necessary. In order to develop a technique for preservation of PTA and PTB in groundwater samples, a Plackett-Burman experimental design is applied. This approach allows assessing the influence of a number of independent factors such as sample bottle type, test time, water type, pH, temperature and transportation conditions by a reduced number of experiments. In each of the experiments, a water sample with known concentration of the respective test compound was treated by a preservation method and a recovery percentage of the compounds was evaluated by LC-MS system. This led to an optimal combination of factors for the preservation of the compounds of interest. We also performed robustness and range tests to quantify the precision, accuracy and linearity of the method. The optimized technique was further validated by applying it at field sites covering different groundwater types and different spiked toxin concentrations. By performing the method, we facilitated reliable investigation and monitoring of PTA and PTB in groundwater. In that way, we contribute both to the scientific discourse on the topic as well as offer a practical tool for water supply companies. This research project is part of European Training Network - NeToxAg, which is funded by the European Union’s Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie grant agreement No 722493.


Northern Kentucky University 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 drinking water (reservoir) levels. A predetermined risk level will be set according to the current data, with a lower risk level 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.

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 dilution of the 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 microcystins. 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 (1 µg/L). A preliminary result revealed that the levels of MC-LR and MC-YR were detected in two reservoir water samples by using the developed method.

Smelly HABs: response-surface optimized HS-SPME/GC/MS method for determining multi-class HAB odor compounds in water C. Avagianos, M. Pisania, 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, ionones, amines, aldehydes, ketones and sulfurous compounds. Such compounds have detrimental effects to the aesthetic quality of water, making drinking water unacceptable by consumers and damaging recreational and tourism enterprizes 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 timely 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 selected as indicative of the wide range of odorous 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 design matrix to meet the objectives for maximum sensitivity screening of the whole range of or certain classes/groups of compounds. Optimization experiments resulted in full-quadratic response models for individual compounds, while desirability functions can be
Cyanobacteria are one of the components of the normal microflora in surface waters. 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. Among the most widespread cyanotoxins are microcystin (MCs) variants MC-LR, RR, YR, with MC-LR being the most toxic one. For this reason, 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 robust method for the analysis and quantification of cyanotoxins using high-performance liquid chromatography coupled to high-resolution mass spectrometry (HPLC-HRMS). For the sample pre-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, 5 μm) 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 microcystins, 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 spectrometry.


Cyanobacterial oligopeptides of environmental concern and (co)production dynamics

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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 predictions. 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 extrapolation 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 decision to prioritize natural toxins in water according to their persistence and mobility. 

References

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 multivariate analysis. New insights into co-production dynamics offer critical information about cyanotoxin mixtures present during harmful algae 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). In this study, PTB was monitored at all parts of the fern. PTA is suspected of causing Human gastric cancer. PTA is a nor-serguesetpine 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 contamination may finally end up in drinking water resources. However, for compounds such as Bracken ferns (Pteridium sp.) are considered environmentally problematic due to their content of the carcinogens ptaquiloside, caudatoside and ptescensolide (= 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 ptescensolide. 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 previously non present of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is suspected of causing Human gastric cancer. Pterosin B is formed from ptaquiloside.

**TH168**

Experimental Determination of Octanol-Water Partitioning Coefficients of Natural Toxins

C.D. Schoonees, Agroscope / Environmental Analytics; K. McNeil, ETH Zurich / Institute of Chemical and Pollutant Dynamics; 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.[2] 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 end up in the aquatic environment. The objective of this study was to measure the sorption of pterosin B to soil materials in order to assess its behaviour in the environment. Other secondary metabolites such as saponins, steroids, the terpenes classes triterpenoids and diterpenoids, and several alkaloids classes including pyrrolizidine alkaloids, isosquillamine alkaloids, terpenoid alkaloids or steroidal alkaloids. These phytotoxins were characterized as toxic, frequently produced, mobile and persistent and we propose to consider them in further monitoring programs and risk assessments.

**TH169**

Phytoxins as aquatic micropollutants: a procedure for prioritization

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Phytoxins 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 phytotoxins, 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 phytoxins from over 800 plant species compiled in a previously developed database based on three critical properties: toxicity, plant frequency and environmental behaviour of the phytotoxins. Toxicity was included as descriptor of the effect and parametrized 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 for suspected of causing Human gastric cancer. Pterosin B is formed from ptaquiloside upon hydrolysis. Similar pterosins are formed from caudatoside and ptescensolide. 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 previously non present of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is suspected of causing Human gastric cancer. Pterosin B is formed from 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 ptescensolide (= 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 ptescensolide. 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 previously non present of ptaquiloside. Studies have shown rapid microbial degradation of pterosin B in upper soil layers, but longer lifetime is suspected of causing 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, 3.3-7.3). 0.25g of dry soil was equilibrated with 9mL 0.01M CaCl2 over night. 1mL of pterosin B solution in 0.01M CaCl2 was added resulting in a Cso of 0-10 mg L-1 (n=5). Sorption were studied after a contact time of 24hrs. The aqueous phase were separated by centrifugation and the content of pterosin B quantitatively using the relative area distribution of the main mass trace. The results indicate that PTA under alkaline conditions will form carcinogenic reaction products that are stable in groundwater.

**TH171**

Modelling the fate of natural toxins in the soil using DAISY - a case study of ptaquiloside

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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 the fate and in particular the leaching of natural toxins in the vadose (soil) zone. For this work, the model code DAISY, a soil–plant–water–atmosphere system, 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 certain events. This work focused on ptaquiloside (PTA), a hydrophilic and non-sorbing toxin that exhibits a strongly pH and temperature dependent degradation. The carminogenic 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 functions to parameterize hydrolysis. Hydrolysis is pH and soil horizon dependent, while microbial degradation rates follow the guidelines by FOCUS. 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 concentrations are within the upper limits of the water quality guidelines. Clayey soils presented higher leaching due to macropore transport, in the leachate degradation rates follow the guidelines by FOCUS. The model presents several uncertainties such as the toxin production in the biomass, seasonal variation 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
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Extensive occurrence of cyanobacterial water blooms associated with the production of wide range of toxic compounds into environment represents one of the major problems in aquatic ecosystems. One group of the recently described cyanobacterial toxic compounds are endocrine disruptive 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 only available for a limited amount of cyanobacteria. We have observed ALDH and CYP from all publicly available genomes of cyanobacteria to be present in the same operon or even in the same genes. This fact points out to a similar function of these enzymes in the biosynthetic machinery of retinoids. Based on these results, the most related family 1. This fact points out to a similar function of these enzymes in the evolutionary similarity of cyanobacterial ALDH to human and mouse ALDH from family 1.

TH174
An overview of the effects and bioaccumulation of ciguatoxins in fish
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Ciguatera Fish Poisoning (CFP), the most common non-bacterial seafood intoxication globally, results from ciguatoxin (CTX) consumption from contaminated fish. In the last few decades, research has been conducted by suites of dinoflagellate derived marine polyether toxins (Figure 1) known as ciguatoxins (CTXs), that target voltage gated sodium (Na_{v}) and potassium (K_{v}) channels. CTXs enter the food web through consumption of Gambierdiscus spp. dinoflagellates by herivorous fish. It is well established that the algal CTXs undergo biotransformation in fish organisms (oxidative metabolism) as they pass from the fish water and tissues to the finished and more toxic forms of CTFXs. Evidence for concentration of ciguatoxin through the food web has reliably relied largely upon correlation observed between toxicity and trophic level of wild-caught fish. However more detailed regional surveys of multiple species do not uniformly show a clear trend between toxicity and trophic level or size. The absence of signs of intoxication of fish with high CTX concentrations (including fish involved in human poisoning or those tested in the context of field surveys) has long confounded our understanding of how such a potent toxin can be accumulated to the high levels at which it is naturally found (at concentration as high as > 10 ng P-CTX-3C equiv. g^{-1} of fish). CTFXs are suspected to also cause intoxication of fish and marine mammals, however this has never been reported in the field. In this presentation, we will review published and unpublished toxicokinetic and toxicodynamic data of CTXs in fish, including CTX bioaccumulation in field fish collected in ciguatera hot spots, CTX specific binding interactions with native NAV, and development of short and long term experimental models of CFX transfer to fish to assess CTX bioaccumulation and effects. Such observations open promising research prospects aiming at the identification of potential ciguatera disease markers (transcriptomic signatures) in fish that could augment existing experimental studies conducted in relevant environmental conditions that are relevant to the development of predictive models of tissue-specific CTX accumulation for human risk assessment of seafood.

TH175
AFLATOXIN CONTAMINATION IN IMPORTED NUTS FOR DIRECT HUMAN CONSUMPTION: THREE YEARS (2013-2015) OF OFFICIAL CONTROL RESULTS IN ITALY
R. De Pace, P. D’Agnello, Institute of Experimental Zoonoprophylactic Puglia and Basilicata / Chemistry
Aflatoxins (AFs) are the most toxic group of mycotoxin and secondary metabolites of various species of Aspergillus that can occur in all agricultural commodities under appropriated field or storage conditions. These molecules can cause important health problems and have high potential toxic effects. A validated Enzyme Linked Immuno Assay (ELISA) to monitoring the presence of aflatoxin
But very rarely in freshwater organisms. Bivalves are known to consume neurodegenerative disease amyotrophic lateral sclerosis (ALS), is less studied. Organisms is overall quite well documented. However, the neurotoxin bioaccumulation of the hepatotoxins microcystin and dermatoxins, and cytotoxins, threatening target organisms and humans. The photosynthetic organisms producing endotoxins such as neurotoxins, hepatotoxins, and cytotoxins, threaten the ecodynamics of ecosystems by cyanotoxins, which will provide an advance in the knowledge about the ecodynamics of cyanotoxins and the chains conditions of human exposure.

**TH176**

Impact of climate change drivers on toxin contamination and genotoxicity in *Mytilus galloprovincialis*: combined effects of warming, acidification and harmful algal blooms.

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**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) toxin-producing *G. catenatum*. Shellfish toxicity derived from 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. The highest PSP content was observed at day 5 in mussels in the actual conditions (1493.8 ± 202.4 µg STX eq. kg⁻¹), which exceeded the international seafood safety limits (800 µg STX eq. kg⁻¹). Significantly lower PSP content was observed in mussels under climate change scenarios. The lowest levels (661.9 ± 22.8 µg STX eq. kg⁻¹) were found in warm-acclimated mussels, followed by acidification (761.2 ± 62.3 µg STX eq. kg⁻¹). However, interaction of both parameters did not reveal an additive effect. Lower toxin elimination was observed in warm-acclimated mussels. Genotoxicity was assessed in gills and hepatopancreas of mussels sampled at the end of each period. In mussels not exposed to toxic algae, the comet assay revealed highest damage levels in mussels under combined effects of warming and acidification at the end of the experiment (i.e after 36 days). When mussels were exposed to *G. catenatum*, DNA damage in both gills and hepatopancreas significantly increased at an earlier stage, i.e. just after the uptake period. The treatments representing the acidification scenario and the interaction of warming with acidification revealed higher DNA damage than the actual conditions, highlighting a synergistic impact. DNA damage decreased in all treatments at the end of the elimination period, although reduction was subtle in mussels under interaction of warming and acidification. This is the first study assessing the impact of the combined effect of warming, acidification and biotoxins in shellfish. In conclusion, it was provided evidences that changes of global conditions may lead to lower PSP contents, but also to slower elimination rates and to a synergistic effect on DNA damage implying possible consequences for the mussels populations.

**TH177**

Interest of bivalves for the biosurvey of cyanotoxins in aquatic ecosystems

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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 neurotoxins, hepatotoxins, dermatotoxins, and cytotoxins, threatening target organisms and humans. The importance of cyanobacterial microtoxins effects on organisms is overall quite well documented. However, the neurotoxin 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 highly selective analytical methods in various marine organisms (zooplankton, mussels, oyster, fish), but very 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 biindicators 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 freshwaters to interconnecting estuarine and 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 chains conditions of human exposure.

**TH178**

Tetrodotoxin an Emerging Threat to Humans in the Mediterranean Area: First Detection in Italian Mussels

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Tetrodotoxin (TTX) is one of the most potent neurotoxins, originally found in ovary and liver of pufferfish (*Tetraodontidae*). [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 an origin for long time controversy, 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 biogenic 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 mg 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 programme 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 actinomycete, *Norcardiopsis dassonvillei*, isolated from the environment of puffer fish *Fugu rubripes*. Toxicon 45:851-859. [2] Yasumura T, Yasumura D, 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, Oga T. 1996. Occurrence of tetrodotoxin in *Alexandrium tamarense*, a causative dinoflagellate of paralytic shellfish poisoning. Toxicon. 34:1101-1105.
The aim of this study was to investigate the profiles of volatile and odorous metabolites with several of them being odorous, causing taste and odor (T&O) incidents in freshwaters and in fish. Volatile and odorous metabolite profiles of cyanobacteria strains were developed. It is concluded that non-targeted HS-SPME/GC/MS analysis is an effective and efficient technique for wide-range screening of cyanobacteria T&O compounds in water. Volatile and odorous metabolite profiles of cyanobacteria strains can be useful in interpreting T&O incidents in natural surface waters and water reservoirs. To better understand and anticipate T&O incidents, monitoring should be extended to compounds beyond geosmin and MIB.

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TH182 Determination of multi-class cyanotoxins in fish tissues

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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-MSMS 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 maximise the recovery of the target components. The matrix support added to the optimized 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-MSMS 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 after the selected pretreatment/clean-up method, which induced matrix suppression, decreased 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 isopropylmethyl-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

TH183 Toxic effects of Asparagus officinalis extracts on the fatty acid profile of two marine invertebrates

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Invasive alien species represent a worldwide threat to the integrity of native communities, which include various types of tourism and recreational activities, and this is expected to result in global changes in how we perceive and manage environmental and human interaction. Asparagus officinalis, a species that is spreading in all continents, exhibits a strong invasive behavior and it is included in the list of the “Worst invasive alien species threatening biodiversity in Europe”. This alga has been shown to produce a large diversity of halogenated volatile organic compounds with potent biological effects. Asparagus officinalis exhibits a strong invasive behavior and it is included in the list of the “Worst invasive alien species threatening biodiversity in Europe”. This alga has been shown to produce a large diversity of halogenated volatile organic compounds with potent biological effects. It can be found on tide pools during the low tide, where its exude released into the water represents a threat to the organisms present in just a few hours, leading to a reduction in abundance of native species. Marine organisms, in particular invertebrates, have proven to be a major source of unique fatty acids (FAs). Membrane lipids,
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 food-webs (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 this, after calculating the lethal concentrations of the algal exude, Gibbula umbilicalis and Palaemon 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 shrimp 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 macroalgal exudates in toxicologically relevant invertebrates, thus constituting a promising tool for understanding biological pollution effect assessment in these coastal organisms.

**TH184 Impacts of Asparagopsis armata on marine invertebrates: behavioral and biochemical responses**

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The introduction of non-native seaweeds outside their native distributional range, through human activities, has been causing documented negative effect on native species. The red alga 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 20°C±1. After assessing the lethal concentrations of the algal 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, AcChE) 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 algal exudate, with both species suffering from disruptions in their neuronal 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 biochemical responses associated with detoxification (glutathione S-transferase, GST), antioxidant defenses (catalase, CAT; superoxide dismutase, SOD), oxidative damage (lipid peroxidation, LPO; DNA damage), neurotoxicity (acetylcholinesterase, AcChE) 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 algal exudate, with both species suffering from disruptions in their neuronal 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 prospective effects of this macroalgae on the invaded ecosystems under a global change scenario.

**TH185 Assessing consumption risks through cadmium-contaminated shellfish amplified by ocean acidification**

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The purpose of this study is to assess the human health risk of Taiwan population through consumption of cadmium-contaminated hard clam and oyster amplified by ocean acidification. This study employed forecasted ocean surface pH from the coupled model indicating projected episodic and projected emission scenarios representative concentration pathways 8.5, and Cd distribution as 0.001 – 2 μg L⁻¹ in Taiwan coast to estimate potential Cd accumulation of shellfish. A gender-specific physiologically-based pharmacokinetic model was developed to assess urinary and blood Cd concentration via daily shellfish consumption. The dose-response function was used to account for the prevalence of renal dysfunction and osteoporosis in response to human accumulated Cd in urine and blood. Results showed that median Cd accumulations under current and 2100 ocean acidification scenario were, respectively, 0.0009 and 0.0010 μg g⁻¹ for hard clam, whereas 0.0186 and 0.0210 μg g⁻¹ were estimated 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.

**TH186 Cyanobacterial toxins - a threat to the human respiratory tract?**

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Antihypertensive ergot alkaloid amines toxicity in cohabiting invertebrates lead to increase the occurrence and intensity of toxic cyanobacterial blooms. Cylindrospermopsin (CYN), a (sub-)tropical cyanobacterial toxin of emerging concern, is detected in temperate climates with increasing frequency, thus driving the scientific effort to investigate health risks linked to CYN-producing blooms. Exposure to CYN occurs primarily orally, causing hepatoxic effects. However, extrahepatic manifestations of CYN toxicity have also been reported and adverse respiratory conditions have been frequently linked to cyanobacterial blooms. Detection of cyanobacterial toxins in aerosols and dust particles raises the question of potential associated hazard of human exposure via inhalation. The susceptibility and vulnerability of human bronchial epithelia to CYN were investigated in vitro. To assess inhalation toxicity on airway epithelia, monolayers of immortalized human bronchial epithelial cells (HBE1 and HBE14o-1) were exposed to a concentration range of 0.1-5 μM CYN. Cytotoxic endpoints were assessed as morphologic alterations, resazurin reduction capacity, esterase activity, membrane integrity and by real-time cell analysis. Both cell lines were sensitive to CYN. Depending on the endpoint assessed, EC50 values ranged between 0.8-2.1 μM (HBE1) and 1.6-4.8 μM (16HBE14o-1). To evaluate alterations of other cellular events by sub-cytotoxic concentrations of CYN, phosphorylation of regulatory switches, mitogen-activated protein kinases (MAPKs) ERK and p38, was evaluated. After prolonged exposure (8-48 h), stress-activated MAPK p38 was hyperphosphorylated in both cell lines, while elevated phosphorylation levels of ERK following CYN treatment were detected only in 16HBE14o-1 cells. This study suggests possible hazards of cyanotoxin inhalation, which might affect the toxicology of airway epithelia and epithelial cell signalling, including chronic inflammation due to extended p38 hyperphosphorylation. Further research of CYN-induced toxicity and underlying mechanisms is needed, as well as more data on environmental concentrations of cyanotoxins in aerosols and exposure assessment. The research was supported by the Czech Science Foundation Grant No. G17-2527Y9 and from H2020-MSCA-ITN-2016 Project No.722493 NaToxAq.

**TH187 Effects of microcystin-LR and cyanobacterial LPS in human airway in vitro models**

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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 hepatoxic effects in mammals. MCLR was shown to induce effects also on lungs and respiratory system following both inhalational exposure as well as oral or intraperitoneal administration of the toxin. Therefore, we investigated effects of MCLR in human bronchial epithelial cell lines (HBE1, 16HBE14o-1, BEAS-2B). 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 PCC 78086. 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 16HBE14-o-1. Nevertheless, MCLR (up to 20 μM and 48 h) did not induce significant cytoxic 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 hazards was examined with 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 NaToxq.

TH189

Estrogenic and retinoid-like activity in stagnant waters
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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 cyanotoxins and 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 elicited estrogenic activity up to 2 ngEQ/L. This activity could be only partly explained by the concentrations of analysed estrogenic hormonoids, alklyphenols and phytosterogens. Other compounds might play a role in these effects as well. Maximal detected retinoid-like activity in water samples reached 256 ng REQ/L. We analysed the presence of nine retinoic 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 retinoid-like activity in individual for each retinoids. However, research also suggest that still other compounds with retinoid acid 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.

TH190

Generating ecotoxicity 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. Literature indicates that LCS is less toxic than the 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 elicited estrogenic activity up to 2 ngEQ/L. This activity could be only partly explained by the concentrations of analysed estrogenic hormonoids, alklyphenols and phytosterogens. Other compounds might play a role in these effects as well. Maximal detected retinoid-like activity in water samples reached 256 ng REQ/L. We analysed the presence of nine retinoic 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 retinoid-like activity in individual for each retinoids. However, research also suggest that still other compounds with retinoid acid 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.

TH190

Excitatory effects of 2,4 -diaminobutyric acid on leech Retzius nerve cell membrane potential
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Neurotoxicity of 2,4 – diaminobutyric acid (DABA), a non-protein amino acid, was first shown after isolation from Lathyrus 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 used an excised cell preparation in order to assess the potential of DABA on leech neurons. Experiments were conducted on Retzius nerve cells of isolated segmental ganglia of the leech H. sanguisuga. 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 measured using current clamp 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±4.1 mV (n=7, p<0.01). Rapid and substantial depolarization of membrane potential by 39.6±2.2 mV (n=9, p<0.01) was induced by 5 mM DABA, and administration of 10 mM DABA caused membrane depolarization of 47.0±5.3 mV (n=6, p<0.01). DABA had several times higher efficacy than Glutamate and J-N-methylaminol-L-alanine (BMAA) on our model. After washout, cells exposed to 1 or 3 mM DABA fully recovered, but only half of the cells treated with 5 mM DABA recovered. Administration of 10 mM DABA induced a decrease of the input membrane resistance by 8.09±1.5 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

Proteomic analysis of rice plant exposed to long-term microcystin-LR exposure

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Irrigation with cyanobacterial-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 is still 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 thiamine, inositol phosphate metabolism, vitamin B6 metabolism and flavonoid biosynthesis related pathways in rice leaves. These results provided 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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**TH192**
Probabilistic human health risk assessment for dietary exposure to aflatoxin in Taiwan
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Aflatoxins (AFs) are secondary metabolites naturally occurring in many different kinds of food, including peanuts, spices, rice, tree nuts and maize. As both genotoxic and carcinogenic substance, aflatoxins could cause severe adverse health effect. AFs have been classified as group 1 carcinogens by International Agency for Research On Cancer (IARC), because of sufficient evidence provided by cancer studies in humans and experimental animals. The purpose of this study is to evaluate the probabilistic risk of people in Taiwan who accidentally consuming aflatoxin contaminated peanut and peanut products. Concentration data (1.84 ± 4.03 ppb) are gathered from Taiwan Food and Drug Administration (TFDA) between 2005 and 2015, along with consumption rate data (from Nutrition and Health Survey in Taiwan 2005 - 1-2 baby, 3-9 toddler, 10-17 teenager, 18-65 adult and above 65 elder) in two sub-populations (whole group and consumer only) are essential parameters for exposure analysis. Based on benchmark dose lower confidence limit 10% (BMDL10) (170 ng/kg bw/day) suggested by European Food Safety Authority (EFSA), calculated Margin of Exposure (MOE) value is below 10,000. As the result, it isn’t fit the recommended standard by EFSA. According to cancer potency from Joint FAO/WHO Expert Committee on Food Additives (JECFA), estimated population risk ranged from 0.0007 to 0.2713 cancers per 100,000 population per year. This study has calculated the risk of total aflatoxins contaminated peanut and peanut products by MOE approach and population risk method. From the result of population risk for primary liver cancer (Hepatocellular Carcinoma, HCC), it is obvious that aflatoxin isn’t the major cause of HCC. Despite the lower cancer risk, MOE calculation indicates a possible health problem for Taiwan population. Further studies could focus on the prevention and reduction of AFs in order to reduce AFs occurrence in foodstuff, especially reducing risk for high exposure and vulnerable groups.

**TH193**
Organ distribution of the environmental neurotoxin β-N-Methylamino-l-alanine in the freshwater mussel Dreissena polymorpha
A. Lepoutre, UMR102 INERIS-URCA-ULH SEBIO, E. Faassen, RIKILT; A. Geffard, Université de Reims Champagne Ardenne; E. Lance, University Reims Champagne Ardennes / Biology and Biochemistry Among toxics, β-N-methylamino-l-alanine (β-NMAA, β-N-Methylaminol-alanine, a hydrophilic non-proteinogenic neurotoxic amino acid, has the ability to accumulate in marine and freshwater food webs, as well as in that vertebrates’ brain. This toxin could promote long-term human neurodegenerative pathologies such as amyotrophic lateral sclerosis (ALS). Human exposure could occur during the ingestion of BMAA-containing food, as this neurotoxin has been detected in animals destined to human consumptions like fish, mussel and oysters. However, BMAA is an emerging toxin from which little data of toxicity or occurrence in the environment are available. In a context in which human activities are promoting the development of phytoplankton, it is important to gather information about this toxin. The zebra mussel Dreissena polymorpha is a freshwater bivalve, HCC-feeder, and is known for its bioaccumulation potential in the water column, and therefore could be in contact with BMAA in-situ. This freshwater mussel has already been used in biomonitoring studies in order to detect heavy metals, pesticides as well as parasites and could potentially be used to biomonitor BMAA. It has already been shown that Dreissena polymorpha could bioaccumulate BMAA, but further information is needed to understand how this toxin is distributed in individuals. The study of BMAA has long been an analytical challenge: diverse extractions methods are available in order to study this hydrophilic compound. Through the use of polar solvents like trichloro acetic acid (TCA), it is possible to determine the “free BMAA” fraction and a hydrolysis of the whole sample will inform about the “total BMAA”. As it was discovered that after a hydrolysing step, more BMAA could be released compared to untreated sample, a hydrolysis of the precipitate obtained during extraction will informed about the “precipitated bound fraction” and an hydrolysis of the supernatant will informed about the “soluble bound BMAA”. Here, through and exposure of zebra mussels to 2.5 μg of dissolved BMAA/individual/day, for 21 days followed by 21 days of depuration, we studied the organ distribution of the BMAA among: hemolymph, gills, digestive gland, gonad, mantle, foot and muscles. Results will be discussed in terms of the distribution of various fraction (i.e., total, free, soluble-bound and precipitated-bound) according to the organs.

**Developments in the use of bioassays for chemical and environmental risk assessment (P)**

**TH194**
Responses to PFOA and PFBS exposure in the sediment dwelling invertebrate Dendrobaena veneta (Annelida)
P. Iato, L. Guidolin, University of Padua, Department of Biology; F. Manea, Regional Agency for the Environment, ARPA Veneto, Verona / 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 assess the effects of low and high concentration of PFOA and PFBS on the freshwater filter 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 (2 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. For the 2 h tests the exposures were performed, at two different nominal concentrations, i.e. 30% of 1x or 10x MAC-EQS for PFOA and PFBS, with PFOA no longer accumulating between 14 and 28 days, while PFBS continues to be accumulated up to 28 days. Significant 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 PFBS exposure only at 14 days. As for MT, because it has been reported that PFAFs 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 PFBS bioaccumulation 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
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Per- and polyfluoroalkyl substances (PFASs), including perfluorooctanoic sulfonate (PFOS) and perfluorooctanoate (PFOA) are commonly used 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 PFOS and PFOA only and for a limited number of organisms. The lack of robust and defensible ecotoxicity data on other PFAS hinders risk assessment and leads to unsupervised 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 aqiatric 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 measurements of membrane protection were also included to enhance the understanding of potential toxicity to these compounds. Test results will ultimately be used in conjunction with concurrent tests 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

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risk management framework for addressing potential environmental management issues of PFAS.

TH196 Interpretation of bioassay results in the context of the soil quality TRIAD approach.
N. Pandur, INERIS; S. ANDRES, INERIS / Toxicological Ecotoxicological Assessment of chemical Substances; P. Pandur, INERIS / Expertise and assay in ecotoxicology unit

The recently 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 efficacy) 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 area was abandoned about 100 years ago. One metabolite identified as 4'-OH-2,2',4'-tetrabromo-DiPhOBz. Chemically related methoxylated tetrabromo- to hexabromo-DiPhOBz are known contaminants in herring gulls from the Laurentian Great Lakes of North America. To our knowledge, nothing is currently known about the biological effects of these polybrominated (PB) DiPhOBz-based compounds. The present study investigated the potential thyroidogenicity of 2,2',2'',4'-tetrabromo-DiPhOBz. Three strains of S. o. -orceae- and hydroxyl-analogues, using an in vitro competitive protein binding assay binding with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB).

Para-OH-tetrabromo-DiPhOBz was found to be capable of competing with thyroxine (T4) for the binding site on human TTR and ALB. The para-MeO-tetrabromo-DiPhOBz and the tetrabromo-DiPhOBz were much less competitive in silico and in vitro studies. These results suggest a novel mechanism of OP ester interactions.

TH197 Estimating the hazardous concentrations of nonylphenol for soil ecosystem protection with proposed TRIAD approach
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Nonylphenol is known as a xenobiotic but is still used for pesticides, detergents, surfactant cleaners and packaging. However, few researches on soil ecotoxicity of nonylphenol were reported. In the present study, we conducted a battery of bioassay, generated soil ecotoxicity data and then estimated soil hazardous concentration for nonylphenol for soil ecosystem protection based on species sensitivity distribution (SSD). For the acute assay, eight soil species from six different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae, euglenacera, chlorophyta and cambellbola) were tested. Also, for the chronic assay, five soil species from four different taxonomic groups (magnoliopsida, liliopsida, chlorophyceae and cambellbola) were investigated. Finally, acute and chronic hazardous concentrations for HC10, HC50, HC90 and HC99 were suggested for protection of soil ecosystem. These values can be applied to environmental risk assessments for nonylphenols. This study was funded by the Korea Ministry of Environment (MOE) as the Environmental Health Action Program (1485014458)

TH198 Organophosphate Triesters and Selected Metabolites Enhance the Binding of Thyroxine to Human Transthyretin In Vitro
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The toxicological properties of organophosphate (OP) triesters that are used as flame retardant and plasticizer additives are currently not well understood. However, there is increasing evidence that suggests OP triesters can affect the thyroid system. Perturbation of thyroid hormone (TH) transport is one mechanism of action that may affect thyroid function. The present study applied an in vitro competitive protein binding assay with thyroxine (T4) and human transthyretin (hTTR) to determine the potential for the OP triesters, TDIPP (tris(1,3-dichloro-2-propyl) phosphate), TBOEP(tris(butoxyethyl) phosphate), TEP (triethyl phosphate), TPHP (triphenyl phosphate), P-OH-TPHP (para-hydroxy triphenyl phosphate), and the OP diester DPHP (diphenyl phosphate), to competitively displace T4 from hTTR. Enhancement of T4 binding to hTTR, rather than the hypothesized competition, was observed for the six OP triesters and DPHP and in a concentration-dependent manner. For example, T4-hTTR binding was significantly increased at concentrations of TBOEP as low as 64 nM, and up to 184 % of controls at 5,000 nM. A plausible explanation of these results, which to our knowledge has not been previously reported, may be allosteric interactions of the OP esters with hTTR allowing T4 to access the second site of the TH binding pocket. It is plausible that OP triester and diesters can covalently bond to residues of serine, lysine or tyrosine on the surface of hTTR, resulting in a conformational change in the dimer-interface and allowing for both TH binding pockets to be accessible for T4. These in vitro results suggest a novel mechanism of OP ester toxicity via T4 binding enhancement, and possible dysregulation of T4-hTTR interactions.

TH199 In Vitro and In Silico Competitive Binding of Brominated Polyphenyl Ether Contaminants With Human and Gull Thyroid Hormone Transport Proteins
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Tetrabromo-cabo-1,4-diphenoxymethylenzene (TeDB-DiPhOBz) is a highly brominated additive flame retardant (FR). Debrominated photodegradates of TeDB-DiPhOBz have been shown to be enzymatically hydroxylated in vitro in herring gulls (Larus argentatus) liver assays, including one metabolite identified as 4'-OH-2,2',4'-tetrabromo-DiPhOBz. Chemically related methoxylated tetrabromo- to hexabromo-DiPhOBz are known contaminants in herring gulls from the Laurentian Great Lakes of North America. To our knowledge, nothing is currently known about the biological effects of these polybrominated (PB) DiPhOBz-based compounds. The present study investigated the potential thyroidogenicity of 2,2',2'',4'-tetrabromo-DiPhOBz. Three strains of S. o. -orceae- and hydroxyl-analogues, using an in vitro competitive protein binding assay binding with human thyroid hormone (TH) transport proteins transthyretin (TTR) and albumin (ALB).

Para-OH-tetrabromo-DiPhOBz was found to be capable of competing with thyroxine (T4) for the binding site on human TTR and ALB. The para-MeO-tetrabromo-DiPhOBz and the tetrabromo-DiPhOBz were much less competitive in silico and in vitro studies. These results suggest a novel mechanism of OP ester interactions.
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 capability was applied to Zephel (ZEL) 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 ZEP itself might not be oxidized to form GSSG. In addition, same method was also applied to ZEP exposed to different concentrations of a target chemical as well as 6 mg/L of H2O2, a negative control. The lowest concentration of GSH 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

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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 Ebro Delta, Spain. A literature research was done in order to gather all the information available regarding the Ebro Delta and possible sources of contamination. Taking into account the mixture of contaminants representative of the different contaminants 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 purificated 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

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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 used 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 μAQUA PVII; 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 ecotoxicological bioassays (Vibrio fischeri, Daphnia magna and Vicia faba), microscopic analysis (Salmonella spp, Staphylococcus spp, Clostridium spp, Campylobacter upj and virological analysis of Adenovirus 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 ecotoxicological analysis as bioassay tool was integrated into the 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


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™) 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 be used to support and perform consistent handling of relevant data. The NIVA RAdb™ 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) built from the cellular responses refered to as molecular initiating events (MIE), to downstream 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 organisation level effects and to identify potential stressors among large assemblages of pollutants that can give rise to a given AO. The NIVA RAdb™ 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 of a tiered internal review (TIER) has been used to internal review (TIER) has been developed to support the use of the databases and the tools developed. Acknowledgements: RCN projects 22145-EDIRSK (www.niva.no/edirsk), 268294 MixRisk (www.niva.no/mixrisk), 223268 CEERAD (www.nmbu.no/en/services/centers/ceerad), and EU-FP7 project SOLUTIONS (http://www.solutions-project.eu/project/).

**TH205**

Assessing exposure risk for marine bivalve Mytilus posed by microplastic polystyrene particles

C. Chen, Y. Yang, National Taiwan University / Bioenvironmental Systems Engineering; H. Lin, National Taiwan University; C. CHEN

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 on marine organisms. ORBIVIB project investigated the ingestion of non-chelial stressors such as ionizing and non-ionizing radiation.Examples on use specific exposure scenarios will be presented to show the utility of the databases and the tools developed. Acknowledgements: RCN projects 22145-EDIRSK (www.niva.no/edirsk), 268294 MixRisk (www.niva.no/mixrisk), 223268 CEERAD (www.nmbu.no/en/services/centers/ceerad), and EU-FP7 project SOLUTIONS (http://www.solutions-project.eu/project/).
RESULTS: We found that PNECs for inhibition of lysosomal membrane stability and phagocytosis cells were 0.04 and 0.07 μg mL⁻¹, respectively, implying 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. Cooilen, D. van der Pouw 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 (un)known (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 those 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 interesting to note that when using 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 M. de Baat, M. Kraak, University of Amsterdam / IBED-FAME; R. van der Oost, WaterNet / Onderzoek en Advies; P. de Voogt, University of Amsterdam / IBED; P. Verdonchot, 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, most of which are not listed as priority substances. Consequently, a large portion of the observed toxic effects of surface waters cannot be attributed to compounds measured by the water authorities. Hence, there is an urgent need for an effect-based monitoring strategy that employs bioassays to identify environmental risks. Therefore, the aim of the present study was to implement innovative tools in a smart, integrated monitoring strategy applied in a nationwide water quality assessment campaign in The Netherlands. The proposed monitoring strategy combines passive sampling (PS) with a battery of bioassays to investigate ecotoxicological risk to aquatic biota. At 47 locations silicone rubbers and Polar Organic Chemical Integrative Samplers (POCIS) were exposed to surface water for 6 weeks. Alongside the PS a 7-day in-situ daphnid test was performed at all locations. Subsequent to field exposure, accumulated compounds were extracted from the PS after which a battery of 3 in vitro and five in-vivo bioassays, including U. lactuca gene eXpression (CALUX) bioassays was exposed to the re-dissolved extracts. The bioassay battery was selected such that it can identify the risk posed by a wide range of chemical pollutants and their transformation products, while simultaneously allowing for more targeted identification of groups of compounds that cause specific effects. Bioassay responses were compared to effect-based trigger values to identify potential ecotoxicological risks at the investigated locations. Subsequently, the SIMONI model was applied to rank sites based on ecotoxicological risk, rather than on the presence of priority compounds. It is concluded that the Smart Monitoring strategy allowed prioritization of sites based on ecotoxicological risks, identified the presence of hazardous compounds, regardless of being listed as priority compounds, but meanwhile could prevent costly chemical analysis at sites with low ecotoxicological risks.

TH210 Passive sampling in effect-based monitoring of two European rivers - extractions of in vitro endpoints and detected chemicals J. Novak, Masaryk University / RECETOX; Z. Tousova, B. Vrana, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; F. Smedes, RECETOX / Environmental chemistry and modelling; R. Grabcík, University of South Bohemia in Ceske Budejovice / South Bohemian Research Center of Aquaculture and Biodiversity of Hydrozoa; M. Ait-Aissa, INERIS / UMR SEBIO ECOT; S. Smutna, Masaryk University, Faculty of Science, RECETOX / RECETOX Research Centre for Toxic Compounds in the Environment; K. Hilšerová, Masaryk University, Faculty of Science, RECETOX / Research Centre for Toxic Compounds in the Environment

RECETOX 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 reference compounds. For the adsorption samplers, the sampling rates were either taken from literature (POCIS) or calculated from corresponding sampler recovery values. The samples were analyzed for aryl hydrocarbon-, estrogen- and androgen receptor-mediated effects using in vitro bioassays. The effects were expressed as bioanalytical equivalents (BEQ,μm) of respective model compounds in water. The BEQ,μm levels were significantly higher 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 (BEQ,μm). The comparison of bioanalytical and chemical analysis equivalents showed that the detected chemicals explained mostly a low fraction of the BEQ,μm. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQ,μm was comparable with the BEQ,μm 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 chemicals. 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 F. Smedes, RECETOX / Environmental Chemistry, and Aquatic Ecology; J. Koch, GhEnToxLab (Ghent University) / Applied Ecology and Environmental Biology; K. De Schampaert, Ghent University (UGent) / Applied Ecology and Environmental Biology

The use of passive sampling as a tool in environmental monitoring has gained wide acceptance within the past decades. More recently the possibilities of combining passive sampling and biotesting gained higher attention and researchers focus on reconstituting environmentally realistic contaminant mixtures in aquatic biotest systems. Equilibrium based samplers (e.g. silicone rubber sheets) can mostly be used as passive dosing devices in biotest systems without prior treatment but have the disadvantage that only one single concentration level can be tested. For innovative samplers (e.g. Speedisks™) an extraction is needed before spiking of biotest medium and the downside of this approach is that an extraction always changes the natural mixture composition due to compound specific partition coefficients. The advantage on the other hand is that the extraction of the samplers concerning bioanalytical equivalents (BEQ,μm) of respective model compounds in water. The BEQ,μm levels are significantly higher 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 (BEQ,μm). The comparison of bioanalytical and chemical analysis equivalents showed that the detected chemicals explained mostly a low fraction of the BEQ,μm. Only in the case of estrogenicity in extracts of the samplers collecting polar chemicals, the BEQ,μm was comparable with the BEQ,μm 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 chemicals. 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. spinipes.

TH211 Passive dosing of polar and non-polar substances using Oasis HLB® - Pre-equilibration of media for transferring complex mixtures.

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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 (C<sub>29</sub>) of Oasis HLB to polar and nonpolar substances that could also be shown, that the adsorption based accumulation of the substances was reversible and – due to the high surface area and the wettable pores – relatively fast. This demonstrates its suitability for dosing a broad range of substances. With respect to combining equilibrium passive sampling and dosing for the recreation of field mixtures in toxicity test, pre-equilibration of the cell culture medium with Oasis HLB was successfully tested and compared with the direct passive dosing using Oasis HLB. On the one hand, the medium pre-equilibration approach enables one to control the role of temperature on the equilibrium state. On the other hand, due to the fact that the dosing phase is not directly introduced in the assay, maintaining of the test concentration over the test duration is diminished for some compounds. In summary, the application of Oasis HLB as a passive dosing phase was successfully established and medium pre-equilibration for re-establishing field mixtures in an exposure medium was tested. This opens up the possibility of recreating broad mixtures sampled with Oasis HLB at natural ambient concentrations in toxicity and other tests.

TH212 Passive dosing strategy for in vitro test systems: static concentration generator and continuous release

F. Begnaud, Firmenich / DRAP; C. Debonville, Firmenich / Research and Development; V. Laubscher, F. Berthaud, Firmenich SA / DRAS; H. Schug, Eawag - Swiss federal Institute of Aquatic Science and Technology / Environmental Toxicology; C. Kropl, University of Bern / Centre for Plan Health; K. Schirmer, Eawag / Environmental Toxicology; H. Segner, University of Bern / Centre for Fish and Wildlife Health; S. Ginemo, Firmenich / Product Safety and Regulatory Affairs

The ability to generate a true solution of a chemical substance at controlled concentrations is essential to generate meaningful aquatic toxicity information. This is especially relevant for aquatic toxicology and becomes highly challenging when dealing with hydrophobic (logK<sub>ow</sub> 3.5) and volatile substances like some fragrances. Historically, solvents were used to enhance the solubility, but their 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. spinipes.

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 (C<sub>29</sub>) of Oasis HLB to polar and nonpolar substances that could also be shown, that the adsorption based accumulation of the substances was reversible and – due to the high surface area and the wettable pores – relatively fast. This demonstrates its suitability for dosing a broad range of substances. With respect to combining equilibrium passive sampling and dosing for the recreation of field mixtures in toxicity test, pre-equilibration of the cell culture medium with Oasis HLB was successfully tested and compared with the direct passive dosing using Oasis HLB. On the one hand, the medium pre-equilibration approach enables one to control the role of temperature on the equilibrium state. On the other hand, due to the fact that the dosing phase is not directly introduced in the assay, maintaining of the test concentration over the test duration is diminished for some compounds. In summary, the application of Oasis HLB as a passive dosing phase was successfully established and medium pre-equilibration for re-establishing field mixtures in an exposure medium was tested. This opens up the possibility of recreating broad mixtures sampled with Oasis HLB at natural ambient concentrations in toxicity and other tests.

TH213 Identification of Gestagen(s) and Corticosterone(s) from Danube River wastewater sample by using LC-HRMS and non-target screening approach

M.A. Hashmi, M. Krauss, Helmholtz centre for environmental research - UFZ / Effect-Directed Analysis; B. Escher, Helmholtz Centre for Environmental Research GmbH - UFZ / Cell Toxicology; W. Brack, Helmholtz Centre for Environmental Research UFZ / Effect-Directed Analysis

Biologically active substances (generally termed as endocrine disrupting chemicals (EDCs)) are present in untreated municipal wastewater, which may cause deterioration of freshwater ecosystem due to their potential to disrupt the endocrine system of aquatic organisms. Untreated municipal wastewater is directly discharged into Danube River, Novi Sad, Serbia and the objective of our study is to identify compounds responsible for hormonally active effects in Danube river water by using non-target screening. Water sample from Danube River were extracted on-site using large volume solid phase extraction (LVSPSE) and was pre-screened on genetically modified bioassays for agonistic and antagonistic hormonal activity for progesterone and glucocorticoid receptors (PR and GR). The extracted fractions were analyzed by liquid chromatography and the selection of subfractions for further investigation was based on the cytotoxicity, sample was fractionated by using reversed phase-high performance liquid chromatography (RP-HPLC) by using C18 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 aninorganic column with gradient elution with methanol/water (30:70) 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. Nilsen, B. Holmen, M. Larsson, Orebro University / MTM Research center - Environmental Technology Research Centre (MTM) / National University of Singapore; S. Schiwy, RWTH Aachen University / School of Science and Technology, Life Science Centre; M. Engwall, Orebro University / Man-Environment-Research environment 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 these results into the risk assessment strategy for sites contaminated with complex mixtures of organic and inorganic contaminants.

In India, surface water contamination in urban areas is a common issue. One major source of pollution may result from the discharge of treated and untreated wastewater, both domestic and industrial in receiving environments. This contamination composed of a complex mixture containing e.g. polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) from industries or pharmaceuticals from residential waste may pose a risk not only to the environment but also human health. Previous studies have reported a strong presence of...
multi-resistant bacteria in the Musi River, which might be due to large pharmaceutical production located in Hyderabad. A cooperation between the Department of Ecosystem Analysis RWTH Aachen (ESA), the Helmholtz Centre for Environmental Research Leipzig (UFZ) and the Civil Engineering Department from the Indian Institute of Technology Madras (IITM) was formed to evaluate the water quality in the Musi River, an urban river in Hyderabad (Telangana state, India) to aid sustainable water management. To assess the ecotoxicological state of the Musi River, water samples (40-100 L per sampling site) were extracted using a novel device for onsite large-volume solid phase extraction (DOE 10.1016/j.scitotenv.2016.12.140). Two samples were taken along the Musi River, one from a tributary, one from a wastewater treatment plant effluent and another sample from an industrial effluent. Currently, these samples are screened for their toxicity using the water extracts in a set of different bioassays to select samples that are suitable for an effect-directed analysis (EDA) study. Considered endpoints are algae growth inhibition, acute daphnia immobility and mechanism-specific endpoints such as estrogenic activity and genotoxicity. In combination with target and non-target chemical analysis, the overall goal of the EDA study is to identify the main toxic drivers in one sample. Preliminary results show an adverse effect on the water flea Daphnia magna and the freshwater algae Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lyticase yeast estrogen screen. Further evaluation of the data and investigation on genotoxicity using the Ames assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and riverine ecotoxicological effects.

TH216
Ecotoxicological assessment of water samples from an urban river, wastewater treatment plant effluent and industrial effluent in Hyderabad (India) using a set of different bioassays
Y. Chaudhary, J. Dai
Department of Civil Engineering Technology Madras, Ecotoxicologists from the Department of Ecosystem Analysis (ESA), RWTH Aachen University and the Civil Engineering Department from the Indian Institute of Technology Madras (IITM) was formed to evaluate the water quality in the Musi River, an urban river in Hyderabad (Telangana state, India) to aid sustainable water management. To assess the ecotoxicological state of the Musi River, water samples (40-100 L per sampling site) were extracted using a novel device for onsite large-volume solid phase extraction (DOE 10.1016/j.scitotenv.2016.12.140). Two samples were taken along the Musi River, one from a tributary, one from a wastewater treatment plant effluent and another sample from an industrial effluent. Currently, these samples are screened for their toxicity using the water extracts in a set of different bioassays to select samples that are suitable for an effect-directed analysis (EDA) study. Considered endpoints are algae growth inhibition, acute daphnia immobility and mechanism-specific endpoints such as estrogenic activity and genotoxicity. In combination with target and non-target chemical analysis, the overall goal of the EDA study is to identify the main toxic drivers in one sample. Preliminary results show an adverse effect on the water flea Daphnia magna and the freshwater algae Pseudokirchneriella subcapitata. Estrogenic activity was induced in four out of five samples in the lyticase yeast estrogen screen. Further evaluation of the data and investigation on genotoxicity using the Ames assay is needed to make a well-founded decision on which assay, and sample are most suitable for EDA. Results from this work will provide insight into the composition of chemical pollutants in an Indian urban and riverine ecotoxicological effects.

TH217
NAWA SPEZ 2015: Ecotoxicological risks in five small Swiss streams within agricultural catchments
M. Langer, Centre Ecotoc EAWAG-EPFL / Aquatic Ecotoxicology; M. Jungbluth, Centre Ecotoc EAWAG-EPFL; S. Spycher, Eawag Swiss federal Institute of Aquatic Science and Technology; M. Koster, Amt für Umwelt, Thurgau; P. Steiner, Swiss Federal Institute of Aquatic Science and Technology; M. Aeschbach, Amt für Umwelt, Thurgau / Aquatic Ecotoxicology; M. Jungbluth, Centre Ecotoc 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 sewage treatment plant effluents in agricultural catchments in Switzerland. 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 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 RQmix 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 algae 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 of water samples from an urban river, wastewater treatment plant effluent and industrial effluent in Hyderabad (India) using a set of different bioassays
P. Chaudhary, J. Dai
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TH218
An ecotoxicological assessment of Lake Mondsee, Austria: a two year survey
S. Gscholz, Department of Biology & CESAM - University of Aveiro / Department of Biology and CESAM; C. Venâncio, Department of Biology; S. Loureiro, Universidade de Aveiro / Biology; R. Vogt, J. Wanzenböck, University of Innsbruck / Institute of Environmental Sciences; S. Schirmer, Eawag / Aquatic Ecology; S. Spycher, Eawag / Aquatic Ecology
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 sewage treatment plant effluents in agricultural catchments in Switzerland. 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 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 RQmix 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 algae 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 of water samples from an urban river, wastewater treatment plant effluent and industrial effluent in Hyderabad (India) using a set of different bioassays
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TH219
Avilability of estrogens applied onto 96-well plates in the LYES
M. Ragulan, Swiss Centre for Applied Ecotoxicology Eawag-EPFL / SETAC Europe 28th Annual Meeting Abstract Book
TH214

Determination of Potassium Bromate in the Embryological Development of the Sea Urchin Arbacia lixula (Linnaeus, 1758) A. Arslan, University Ege / Hydrobiology; Ö. Baykal, University Ege / Biochemistry; M.A. Karaaslan, University of Ege; S. tez, University of Ege

Potassium bromate is a powerful oxidizing agent that chemically ages flour much faster than ordinary flour. Potassium bromate is commonly used as a yeast leavening agent in many countries, particularly in the USA. In this study, the authors examined the effects of potassium bromate on fertilization success and development of the sea urchin Arbacia lixula. They exposed sea urchin sperms and eggs to potassium bromate at different concentrations ranging from 5 to 50 mg/L. The effects on developing embryos were evaluated by scoring normal plutei versus those with abnormalities. The results showed that potassium bromate significantly decreased fertilization success and embryo development, with increased concentrations leading to more severe effects. The study highlights the importance of regulatory measures to control the use of potassium bromate in seafood industries to prevent potential adverse effects on marine organisms.

TH212

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 Ciências do Mar; M. Jorge, Universidade Federal Maranhão - UFMA / Oceanografia e Limnologia; R.L. Santos, Federal University of Maranhão - UFMA / Instituto de Ciências do Mar

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. The authors investigated the mutagenic (nuclear abnormalities) and ontogenetic (embryo formation) responses in freshwater guppy, Poecilia vivipara, chronically exposed to SDS. The guppies were exposed to SDS at a concentration of 1 mg/L for 10 days. The results showed that SDS exposure led to an increase in micronucleated cells, nuclear buds, and binucleated cells, as well as an increase in the frequency of all anomalies when compared to the control group. The study highlights the potential mutagenic effects of SDS on aquatic organisms.

TH211

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, IEO

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, terphenylates), they are inert under environmental conditions and, according to standard ecotoxicological bioassays using early life stages (embryos), do not pose any ecotoxicological risk 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 test in laboratory since they may occur 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.

TH22

EFFECTS OF POTTASCIUM BROMATE ON THE EMBRYOLOGICAL DEVELOPMENT OF THE SEA URCHIN Arbacia lixula (Linnaeus, 1758) A. Arslan, University Ege / Hydrobiology; Ö. Baykal, University Ege / Biochemistry; M.A. Karaaslan, University of Ege; S. tez, Ege University

Potassium bromate is a powerful oxidizing agent that chemically ages flour much faster than ordinary flour. Potassium bromate is commonly used as a yeast leavening agent in many countries, particularly in the USA. In this study, the authors examined the effects of potassium bromate on fertilization success and development of the sea urchin Arbacia lixula. They exposed sea urchin sperms and eggs to potassium bromate at different concentrations ranging from 5 to 50 mg/L. The effects on developing embryos were evaluated by scoring normal plutei and developmental defects such as: retarded plutei, skeletal malformations, blocked gastrula/blastula and dead embryo/larvae. A dose–response-related reduction (approximately 35%) was observed in fertilization success. But was not observed significant increases in the number of larvae with skeleton malformations at the pluteus stage of the exposure experiments which is shown that potassium bromate did not affected the offspring quality of A. lixula. The EC50 (Effective Concentration 50) levels were determined as 104.64 mg/L for fertilization success. Following exposure to Potassium bromate, a concentration-related increase in the number of larvae with skeletal malformations at pluteus stage observed. The EC50 for 72 hours was determined as 7.893 mg/L for embryotoxicity. Key Word: Sea urchins, Embryotoxicity, Fertilization success, Potassium bromate
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 vertebrates and humans. Recently, several studies reported that daphnia 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 developed by the authors to test the endocrine disruption effects using adult (10-17 days old) daphnids. Animals were exposed to two temperatures of 20 ºC and 25 ºC, 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.

Microplate Algal Growth-Inhibition Bioassay  
J. Iturria, O. Jaka, C. Marti, A. Alzuale, 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 is not suited for high throughput screening of toxicity on early development phase. Given so, there is a need for faster and most 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 IC50 values were compared to the OECD 201 results.

TH225

Sustainable Guar Initiative - an integrated approach of social and environmental LCA  
P. Martz, L'Oréal Research & Innovation / LORÉAL; P. Arsac, N. Zaraaoui, L'Oréal; A. Wahelet, Solvay SA / LCA; J. Viot, F. Laurent, Solvay SA; M. Vuillat, S. Causee, Eeva

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 theses: (1) Agronomy: enhancing sustainable practices for rain-fed guar production, (2) Environment: groundwater-neutral approaches and best practices for 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 (S-LCA) has been conducted, 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 Bhamidipati, “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 can 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 stakeholders’ acceptance – especially consumers and manufacturers – leading to a growing demand in 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 of the Sustainable Development Goals (SDGs) (Sustainable Development Goals), re-examining the relevance of social factors and criteria and already available guidances, including UNEP-SETAC Guidelines for Social Life Cycle Assessment (S-LCA) has been conducted, comparing the guar production, (2) Environment: groundwater-neutral approaches and best practices for 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 (S-LCA) has been conducted, 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 Bhamidipati, “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.

TH226

Applying Social-LCA and Social Hot Spot Analysis including a SDG Evaluation to Product Assessments with SEEBALANCE®  
P. Saillé, 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 alternate products or processes. The Eco-Efficiency Analysis is integrated to an overall result together with the Social Analysis (Figure 1).

TH227

How can 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 stakeholders’ acceptance – especially consumers and manufacturers – leading to a growing demand in 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 of the Sustainable Development Goals (SDGs) (Sustainable Development Goals), re-examining the relevance of social factors and criteria and already available guidances, including UNEP-SETAC Guidelines for Social Life Cycle Assessment (S-LCA) has been conducted, comparing the guar production, (2) Environment: groundwater-neutral approaches and best practices for 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 (S-LCA) has been conducted, 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 Bhamidipati, “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.

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 IFAS; 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.
(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 systems model used here encompasses all energy flows and associated 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 modelled shall encompass all energy flows and associated supply chains for the energy system. The activities of operation that they perform, are also subject to the same social impacts as those in the future systems 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 UNEP/SETAC/LOCI and other instruments of social impact assessment. However, if doing so is it 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. Garcia, 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 same social impacts as those in the future systems 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 UNEP/SETAC/LOCI and other instruments of social impact assessment. However, if doing so is it 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.

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. Orrù, 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. Dietylene 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 Dietylene glycol showed that the compound is considered biodegradable (1.2 x 10^8 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

TH233 Improvements in environmental exposure assessment: development and application of tools industry sectors, regulatory agencies and international boundaries. Authors: Silvia Santoro - National Research Council (CNR) - Institute 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 Ottari – National Institute of Health - National Center for Chemical Substances Debora Romoli - Italian National Institute for Environmental Protection and Research.


TH235 Land and Sea Silvia Giardina
The Water Column Monitoring Program in Norway: when regulation and science meet D. Pampanin, International Research Institute of Stavanger; S.J. Brooks, NIVA
Norwegian Institute for Water Research; B. Grovik, Institute of Marine Research; E. Lyng, International Research Institute of Stavanger; R.C. Sundt, Statkraft

Oil and gas companies operating on the Norwegian Continental Shelf (NCS) are required to carry out environmental monitoring to obtain information on the actual and potential environmental impacts of their activities and to give authorities a better basis for regulation. Scientists, operators and regulators have worked jointly for decades on this program, for developing, communicating and implementing knowledge, methods and tools to manage the offshore produced water discharges. A multidisciplinary approach (e.g. chemistry, biology, modelling and risk assessment) has been developed to monitor the discharge and reduce risk. Potential impacts from no-targeted chemicals have also been in the aim of this extensive monitoring program for anticipating negative effects at the ecosystem level. In 2016, new guidelines were released as a result of the environmental risk assessment 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 North Sea and Egersundbanken (reference area) and in addition the near platform effect (Stafjord 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 information can be used to be the basis to reduce the degree of uncertainty in both exposure and ecotoxicological higher tier effects evaluation. This is a great achievement, that demonstrates the importance of collaboration between researchers, operators and regulators. It is worth to notice that while developing the Water Column Monitoring program, scientists in Norway prioritise a RRI (Responsible Research and Innovation) approach.

TH235

DAPHINE: a supporting tool for pesticides risk assessors and stakeholders

A. Linguadoa, F. Galimberti, S. Ubbiali, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health; L. Menaballi, ICPS International Centre for Pesticides and Health Risk Prevention; S. Ullucci, ICPS International Centre for Pesticides and Health Risk Prevention / Public Health

DAPHINE (DAte and PEhNological Estimation) is a tool created to contribute supporting the Environmental Risk Assessment (ERA) of pesticides. The rationale behind its development is based on correlating crop phenological stages (BBCH) to specific dates for representative geographic areas is often a crucial step both for the exposure and higher-tier effects assessment. However, currently there is no source of information clearly addressing this issue at the national, Zonal or EU scale. Data from a number of field efficacy trials were collected in a database that could realistically represent reference scenarios and typical Italian crops. These data included information on BBCH and related date, agronomic and pedoclimatic conditions. The dataset was primarily used to extrapolate BBCH vs date curves for selected crops. These interpolation curves are meant to be used to reduce 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 parametrize 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.

TH236

The applicability of the assessment entity concept in the REACH registration of complex mixtures. A case study for fragrance substances.

K. Jenner, Givaudan / Global Regulatory Affairs & Product Safety; G. Kreutzer, Givaudan SA; S. Kern, Givaudan Schweiz AG; M. Pacella, M. Torres Sanchez, Givaudan Suisse SA

The assessment entity (AE) concept was developed by ECHA together with industry in the categorization of chemicals at the REACH registration level. The tool was introduced in IUCLID 6 and aims to assist users in documenting complex assessment cases in a transparent and systematic way. The assessment entities (AEs) may be imported in Chesar 3 for the purpose of exposure assessment. The relevance and applicability of the AE concept to multi-constituent substances is illustrated by a fragrance ingredient case study. For the purpose of the worker and consumer exposure assessment, the traditional whole substance approach was used. However, to assess environmental exposure and risk, a constituent block approach was used because the substance consists of components with different environmental fate properties (e.g. water solubility, log Kow, adsorption coefficient) and ecotoxicity profiles (e.g. acute EC50/LC50 values). The use of whole substance testing versus constituent data is explored. The adaptation of standard tests, such as the ecotoxicity tests, to the traditional whole substance approach was carried out showing how the different HPLC partitioning characteristics of the components and the use of analytical detection methods was exploited to obtain water solubility information for the individual blocks from a test performed on the whole substance. 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, Ramboll EH; M.T. Sorensen, Ramboll / 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 liability associated with—the result of identified contamination 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 North Sea and Egersundbanken (reference area) and in addition the near platform effect (Stafjord 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 information can be used to be the basis to reduce the degree of uncertainty in both exposure and ecotoxicological higher tier effects evaluation. However, currently there is no source of information clearly addressing this issue at the national, Zonal or EU scale. Data from a number of field efficacy trials were collected in a database that could realistically represent reference scenarios and typical Italian crops. These data included information on BBCH and related date, agronomic and pedoclimatic conditions. The dataset was primarily used to extrapolate BBCH vs date curves for selected crops. These interpolation curves are meant to be used to reduce 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 parametrize 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 in a high lead contaminated residential area.

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 general worst-case scenario for potential sources of exposure in each use and case scenario of local and regional 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 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 predominant source of lead exposure in 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 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 Monte Carlo simulation and model-based exposure assessment. As a first step, local site-specific and regional environmental exposure scenarios and assessment 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 “Others”. 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. Ott, M. Alter, A. Boehm, H. Elpel, I. Lemche, S. Pawlowski, BASF SE

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.
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, and temperature. However, the modeling of the chemical fate in industrial STPs (iTreat; Strajs 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 waste water stream of this specific STP were gathered and compared to the calculated elimination. The bioaccumulation rate constant of substances measured in the wastewater was also compared to the non-parametrized model of iTreat and to the municipal models of Simple Treat 4.0 and Simple Treat 3.1. Overall, the iTreat model was successfully adapted to model chemical fate and behavior in an industrial, site specific STP. The elimination rates of the parametrized iTreat model were generally in better agreement to the measured elimination rates than for all other models investigated. The bioaccumulation rate constant of substances turned out as a more 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 to two-fold higher elimination rates which reflect the measured elimination. The application of site specific degradation 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. Rutier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPOC Universite Bordeaux / UMR 5805 EPOC; L. Peluhet, CNRS / EPOC Universite Bordeaux / UMR 5805 EPOC; L. Delorme, L. Garnero, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Bubat, Irstea / Water

Bioaccumulation and biotransformation of Hexabromocyclododecane (HBCD) by the freshwater benthic invertebrate Gammarus fossarum: a Bayesian approach to estimate biodynamic model parameters.

A. Rutier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPOC Universite Bordeaux / UMR 5805 EPOC; L. Peluhet, CNRS / EPOC Universite Bordeaux / N. Delorme, L. Garnero, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Bubat, 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 chemicals (in particular, dioxins) 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 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 (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. Rutier, Irstea Lyon; C. Lopes, Université Lyon 1, UMR CNRS 5558 / Laboratory of Biometry and Evolutionary Biology; H. Budzinski, University of Bordeaux; P. Labadie, UMR CNRS EPOC Universite Bordeaux / UMR 5805 EPOC; L. Peluhet, CNRS / UMR EP OCP LPTC; N. Delorme, L. Garnero, Irstea Lyon / UR MALY Laboratoire Ecotoxicologie; O. Geffard, Irstea / UR MALY Laboratoire Ecotoxicologie; M.P. Bubat, Irstea / Water

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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 chemicals (in particular, dioxins) 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 for 7 days 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 for a Broad Set of Chemicals by Demographic Traits: Results from the US National Health and Nutrition Examination Survey (NHANES) for the years 1999-2014

V. Nguyen, University of Michigan / Department of Computational Medicine and Bioinformatics; J. Colacino, University of Michigan / Department of Environmental Health Sciences; M. Herring, University of Michigan / Department of Biostatistics

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 chemicals by demographic traits in the years 1999-2014. From NHANES data, we identified populations at high risk for exposure. We used the National Health and Nutrition Examination Survey (NHANES) datasets to collect information on chemical biomarker measurements and demographic traits for the years 1999-2014 (n = 74,942), focusing on 229 chemical biomarkers from 16 different classes of chemicals. Poverty income ratio (PIR) was used as a surrogate variable for socioeconomic status, while cotinine levels was used as a proxy for smoking habits. We evaluated the association of each individual biomarker and various demographic factors (age, gender, race/ethnicity, PIR, and smoking status) by using generalized linear model while controlling for relevant confounders and covariates.
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 tricoslan, a common antibacterial and antifungal agent, were observed to elevated in African Americans when compared to White Americans. In addition, higher levels of parabens were observed in women, while men had shown 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 repellant slightly more frequently than women do. Finally, individuals of higher socioeconomic status had higher levels of benzophenone-3 (used in sunscreen products), parabens, and tricoslan, 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 PM 10, PM2.5 and ultrafine particles in the air of dismantling facilities across Canada increased seven times in the period of 2002-2012 from 10,250 to 71,300 tonnes/year. 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 selected FRs in indoor air and ultrafine air samples from dismantling facilities across Canada. Levels of FRs in air collected from this Canadian 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 passive air samplers (PDMS-PAS) 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 and broad-spectrum FRs and PBDEs in air and PBDEs in dust. 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 (TPHP) and other replacement FRs were more abundant in air than dust. This could be due to the dilution/dilution in air and the dilution/dilution in the air of the dismantling facility. 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 environmental metal exposure - assessment of e-wastes

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Obsoleto 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, plastics, flame retardants and other volatile substances such as 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, burning, melting 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"](#2014-031-3-60000), supported by the International Union of Pure and Applied Chemistry (IUPAC), brings together multidisciplinary global experts to explore different aspects of the e-waste challenge: chemical analysis of contaminants, policy and governance, environmental and health impacts, development and advances in treatment technologies including e-waste valorisation. This presentation makes use of studies from around 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. Onto, Italian National Research Council; G. Innerenber, A. Schmid, C. Roschat, Laimburg Research Centre; D. Loddo, University of Padova / DAFNAE; M. in water, but its impact on the air and water quality of the vineyard on the quality of the wine produced.

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 row and between rows with water sensitive papers, also in comparison with a precise low-drift air-blast sprayer. Results show that a fixed sprayed 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 to 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 environmental, biological and other matrices. A preconcentration method is necessary to enhance the detection levels of low-level arsenic species. A protocol which involves a combination of electrokinetic injection (EKI) and a capillary zone electrophoresis (CZE) separation channel is designed. The determination of inorganic arsenic species is performed in an on-line sample preconcentration method using a simple preconcentrator. The preconcentrator comprises a packed capillary segment, which is employed over a distance of 12 cm, preventing the entry of ionic substances. The preconcentrator is connected to a CZE separation channel through a Tee. The preconcentration method allows the effective discrimination of inorganic arsenic species from organic derivatives with a sensitivity of 0.5 Araba. The developed method has been applied to the analysis of urine samples of individuals with a high risk of arsenic exposure in the environment.

**TH248** Determination of background levels of free cyanide in surface waters


Natural background concentrations of cyanide can originate from the degradation of cyanogenic compounds, cyanide from metal cations, cyanide from anthropogenic sources. Recently, environmental quality standards (EQSs) for free cyanide were proposed under the European Water Framework Directive (WFD). The EU Joint Research Centre, for example, has proposed an annual average EQS of 0.5 µg/L free cyanide. Since there is a lack of reliable data on background concentrations of free cyanide in surface waters it is not clear whether the proposed EQS values can be practically implemented. To this end a project was initiated and test a method that allows reliable measurements of free cyanide background concentrations in surface waters. Current methods for the measurement of free cyanide in waters only achieve limits of quantifications (LOQs) of about 1

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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 +1.12 and storing it 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, which were measured including 8 priority substances in the LOQ (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 integrated chemical profile in a small river and the outflow of WWT Yhden, H. KW with POCIS, B. MD; E. Meyer, E. Funffroken, H. Beck, Saarland University; K. Smith, RWTH Aachen University / Institute for Environmental Research; A. Schaefier, 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 quality assessment, with regulations including 8 priority substances in EU WFD, allows for monitoring priority substances, which is efficient approach in water management. However, the capturing variable contaminant level is also critical for eco-toxico logical risk assessment. The present study reports on how to exploit equilibrium and kinetic passive sampler in parallel and evaluate dynamic chemical profile in order to satisfy the requirement of requirements and environmental risk assessment. Furthermore, partitioning kinetics of a range of organic contaminants toward each passive sampler type were discussed. The equilibrium sampler tends to be biased toward present chemical profile which is rather close to instant sample, whereas kinetic sampler provides a time-weighted average concentration (C_{t,wa}) over the full sampling period. PDMS sheets with two different thicknesses (76 and 203 µm), as an equilibrium passive sampler, were deployed without the application of performance reference compounds. From the concentration ratio from two PDMS sheets, true in situ concentration (C_{t,wa}) of a range of target compounds 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 modified POCIS with polytetrafluoroethylene membrane to reduce membrane sorption artefact, which has been often discussed as one of limitation of POCIS.

River Elbich and the outflow of wastewater treatment plant located south-western Germany were selected as sampling sites and duplicate passive samplers were deployed for two weeks. After sample recovery, targeted analysis via LC/MS/MS analysis was followed. Based on earlier results, both sampler types performed well and in total including 8 priority substances in EU WFD, C_{t,wa} values can be used as representative values for the comparison with environmental quality standards and C_{t,wa} values can be regarded as variable exposure level. Complementary use of kinetic and equilibrium passive sampler enabled us to comprehensively identify multiple aspect of water quality. Studies on coupling passive sampling with passive dosing mode for risk assessment are ongoing.

TH250 Improvement of relationship between water pesticide contamination and land used at a large scale using the Polar Organic Chemical Integrative Sampler (POCIS), an equilibrium passive sampler, was deployed without the application of performance reference compounds except for ionic compounds, which also exhibited lower detection limits as basis for EOF implementation.

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application group. Although both basipetal movement (downward from leaf application site) via phloem 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 phloem was metabolites of the active ingredient, however these differ in content and extent of translocation during a conventional plant metabolism study can provide valuable information to further 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 Viscent / Environmental Fate and Metabolism; S.P. Macluaghn, Smithers Viscent / Department of Environmental Fate; K. Campbell, Smithers Viscent / 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 as well as the performance of the OECD 308 Guideline. Aerobic and Anaerobic Transformation in Aquatic Sediment Systems and the EPA Guideline OCSPP 835.4300 'Aerobic Aquatic Metabolism'. Although there is no strict recommendation for the level of microbial biomass that should be contained in sediments used for testing, like there is for soils (i.e., 1% of the organic carbon content, OC), it is still a useful parameter to assess viability of the ecosystem and to assess the stability of the sediment (Taunton and one sandy sediment (Weewaitec) collected during all four seasons, over a two-year period produced microbial biomass values (expressed as % OC) shown below. 2016 Taunton Weewaitec 2017 Taunton Weewaitec 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 examination of hypopharyngeal glands development in Honey bees (Apis mellifera L.)

A. Drzewiecka, M. Napora-Rutkowska, 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; M. Lemańska, Institute of Industrial Organic Chemistry Branch Pszczyna / School of Environment and Biomedical Sciences and Toxicology Centre; N. Lemańska, Institute of Industrial Organic Chemistry Branch Pszczyna; A. Drzewiecka, M. Napora

The hypopharyngeal glands (HPG) of Honeybees consist of many acini connected by a common duct, arranged in the form of long paired cords lying on the both sides of the head. They played important role in maintaining healthy colonies i.e. through production of “milk” containing proteinaceous 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 different chemicals in 4 to 5 concentrations. The left HPG were obtained from 5 bees per test item (in the highest concentration, which did not cause mortality below 50%) and the negative control. The specimens were fixed in 2.5% glutaraldehyde and zinc sulphate were chosen as they are high priority HNS Chemicals due to their importance in chemical spills. The hyperpharyngeal glands of Honey bees. (Apis mellifera L.) and their impact on HNS spills are of concern due to the presence of cities and port and harbour facilities have higher

TH255

Comparison of International Quality Assurance and Quality Control Standards for High Resolution Mass Spectrometry Dioxin Analysis

D. Thal, E. Ogobn, Environmental Standards Inc; R. Vitale, Environmental Standards; D. Blye, Environmental Standards, Inc.

The analysis of polychlorinated dibenz-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 based in this technology, especially the technically labeled standard for recovery correction have been established in the EU, the USA, Japan 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. Gieys, University of Saskatchewan / Department of Veterinary and Biomedical Sciences and Toxicology Centre

Recent development of new techniques for the most advanced technology 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 their number of concentrations that need to be quantified and the presence of a wide range of congeners even in an extract of used motor oil. Reanalysis of fish tissues previously analyzed by a magnetic sector instrument demonstrate accurate of identification and quantification and provide validated 20°C methods. Analyses were used to conduct the potential for a ‘multiplex’ analysis of various POPs where the resolving power (>120,000 FWHM) of the MS method was used to eliminate potential interferences from a variety of ‘non-target’ organochlorines. These multiplexed analyses significantly reduce the time and cost of sample extraction 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. Sheahan, D. Doran, E. Ogburn, Environmental Standards Inc; R. Vitale, Environmental Standards, Inc.

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 prepare 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 so 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 geographical factors (up to 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 as a surfactant and a disinfectant sodium hypochlorite were also investigated as they are transported in moderate quantities, have different chemical properties and modes of toxicity. Toxicity tests were performed with a micro crustacean, the barnacle, and two seaweeds, Ceramium tenuicorne and Fucus vesiculosis. Our results show that in most cases, chemical toxicity is positively correlated with temperature (higher toxicity with increasing temperature) and negatively correlated with salinity (lower toxicity with increasing salinity). This means that chemical spills are likely to have more impact in the summer in temperate regions and in lower salinity coastal or estuarine areas. These are also the areas that due to the presence of cities and port and harbour facilities have higher
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

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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-0-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 this 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 cytochrome 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<0.003). 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

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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 separate them from major matrix components in fish tissue samples. 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 amenable to measurement. Our first experiments are conducted with a single metal, nickel, as the primary, secondary, tertiary and quaternary amines ranging in 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 aquarium water is transferred with a pipette to a vial containing 600 μL of methanol, and this mixture is analysed with LC-MS/MS. This method allows measurement of the high ng/L concentration range with a precision of 2-8%. Concentrations in the aquarium were maintained at a constant level for more than a week, whereby the ratio measured:nominal 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. Uzyczak, 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 its inactive products 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 is mandatory. For the derivation of legal approaches the accurate, precise, consistent and comparable results a standardised approach is mandatory according to different legal frameworks. The problematic issue of Limanda limanda collected from sampling areas in the North Sea as a part of the Clean Seas Environmental Monitoring Programme (CSEMP) in the UK. The methods showed different results but verified fundamental requirements in all the procedures such as storage conditions, age of the samples or temperature dependence. More work needs to be done to standardise different approaches and come up with a more defined and accurate guideline. This help should to obtain precise, consistent and comparable results 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 Ruíz, C. Rubio Montejano, Spanish Medicines Agency / Department of Veterinary Medicines

Once the emission has 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 safety and efficacy is avaliable. While veterinary medicines also need a clear identification of target, accurate regulations. The purpose of the article is to 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.

**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; C. Siciliano, University of Saskatchewan / Department of Soil Science; J. Sousa, University of Coimbra / Department of Life Sciences

Due of 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 potential for enhanced toxicity. In 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 base 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 concentration. These community dose response curves allowed an 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
Alteration of stress-related and thyroid hormone related genes in zebrafish larvae after the administrations of lead acetate, and mixtures of lead acetate and BDE-209
K. Chan, The Chinese University of Hong Kong / Life Sciences; C. Leung, The Chinese University of Hong Kong / School of Life Sciences; Z. Zhou, J. Yang, The Chinese University of Hong Kong / School of Life Science

The expression profile of oxidative stress-related genes (sod1, sod2, sod3a, ccs, cat, gr, gst), and thyroid-related genes (trl, tfrl, dio1, dio2, nis) in zebrafish larvae was examined upon lead acetate treatments to have a complete analysis of lead toxicity on larvae. The exacerbation of both gr, gst, and the oxidative stress-related genes, was also studied to unveil the impacts of co-exposure of lead acetate and BDE-209 on thyroid hormone metabolism and oxidative stress balance. Transcripts of gr and gst were induced upon both individual exposures and co-exposure, supporting that both the exposure of 0.15 mg/L lead acetate and BDE-209 as an oxidative stress balance. No synergistic effects of the two chemicals at short time (48 hr) exposure to induce oxidative stress, while the possibility of these two chemicals acting synergistically to alter the gene transcription at later time points should not be ruled out.

TH265
Assessment of the toxic interaction of lanthanides on aquatic organisms
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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 Ln natural cycle-fractionation of both LnS and LnO, at the abovementioned concentration and 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 and lanthanum with both individual and in combination with dissolved organic carbon (DOC) as an environmental light agent for bioremediation of heavy metal contaminated environments. However, the exceptions to the rule? Metal bioaccumulation in macroinvertebrates were inducement of soil contamination by heavy metals is widely increasing with the development of industries. Antibiotic resistant 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 species of bacteria strains were isolated through gram-staining and was used to filter the obtained metal mixture toxicity data to either Mₜₐₕ or Mₚₑₐ. 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, three concentrations of combinations were used to calculate the ‘sum of toxic units’ (CTU). Deviations from CA approach were observed as relative results according with the metal under analysis.

TH267
ISOLATION AND CHARACTERIZATION OF HEAVY METAL RESISTANT BACTERIA STRAINS FROM SOIL SAMPLES FROM MAMBILLA ARTISANAL MINING SITE, NIGERIA
O. Otitoju, 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 development of industries. Antibiotic resistant bacteria strains isolated in soil from 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 species of bacteria strains were isolated through gram-staining and was used to filter the obtained metal mixture toxicity data to either Mₜₐₕ or Mₚₑₐ. 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, three concentrations of combinations were used to calculate the ‘sum of toxic units’ (CTU). 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 a metal polluted site in the riverside ecological station
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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) obliges member states to set specific water quality

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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 is such that, in many ways, 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 (www.vmm.be/geoview) gathered by the Flanders Environment Agency (VMM), the sites that have an exceedance of the EQS, yet a good ecological quality is observed. As expected, the biometric data show clear differences. The main goal of the present study is to better understand the effects of waterborne heavy metals and their mixtures on a freshwater fish. Common carp were exposed to sub-lethal concentrations of Cu and Zn and different combinations thereof for a period of one week at a temperature of 20°C. Our aim is to assess the effect of sub-lethal concentrations of Cu and Zn on fish survival rate, determine the bioaccumulation of heavy metal in the gills and assess changes in gene expression of carp. Although silver nanoparticles have been reported having induction of cytotoxicity and ROS accumulation, there is limited information of the toxic mechanisms. In our previous study using embryos of medaka, we have revealed that glycan are one of the toxic targets of silver nanoparticles (SNCs). SNCs is a kind of SNPs and nano-sized particles composed of aggregated silver ions; SNCs keep balance with dissociated silver ions. Glycans have roles of cell-protective, stabilizing and barrier function, we assumed SNP would disrupt glycanic function. Beyond medaka research as a vertebrate model in nanotoxicology, in order to evaluate toxic effects of SNPs on humans, we evaluated cytotoxicity of SNPs using human cell line. The relevance of mixture toxicity of herbicides in surface water based on long-term and high-resolution monitoring data has been assessed in an intensively used catchment in Belgium under real agricultural conditions with significant diffuse and point source entries. Twelve herbicides and one metabolite were monitored in a watershed of 992 ha size for 3.5 years with (sub-)daily sampling intervals. Mixtures toxicity was evaluated using hazard quotient (HQ), hazard index (HI) and maximum cumulative ratio (MCR) calculations based on regulatory acceptable concentrations and daily averaged measurements of the site-specific cumulative herbicide exposure. Combined effects of two or more herbicides on algae and Lemma were only relevant in < 2% of samples. Mixture toxicity can therefore be considered of relatively minor relevance and does not seem to be a major concern. A single substance risk assessment would have been sufficient in the vast majority of situations to assess the risk rather than a cumulative risk assessment. Further analysis of the time course of exposure revealed that cumulative effects predominantly occurred in narrow time intervals during the application season in combination with high rainfall intensity causing run-off entries into surface water. Hence, the minor cumulative effects observed can be managed by effective mitigation measures such as vegetated filter strips, conservation tillage practices or green cover crops in addition to reducing point source pollution. 

TH269 Effects of heavy metal mixtures on bioaccumulation and defence mechanisms in common carp, Cyprinus carpio G. Casadevall, University of Antwerp / Biology; G. De Breck, University of Antwerp / Technology SPHERE; J. Coys, University of Antwerp / Department of Biology (SPHERE Research Group)

The aquatic environment is continuously under threat because it is the final receptor and sink of waste streams. This environment receives a huge number of different compounds including heavy metals that can harm the health of aquatic organisms. The main goal of the present study is to better understand the effects of waterborne heavy metals and their mixtures on a freshwater fish. Common carp were exposed to sub-lethal concentrations of Cu and Zn and different combinations thereof for a period of one week at a temperature of 20°C. Our aim is to assess the effect of sub-lethal concentrations of Cu and Zn on fish survival rate, determine the bioaccumulation of heavy metal in the gills and assess changes in gene expression of carp. Although silver nanoparticles have been reported having induction of cytotoxicity and ROS accumulation, there is limited information of the toxic mechanisms. In our previous study using embryos of medaka, we have revealed that glycan are one of the toxic targets of silver nanoparticles (SNCs). SNCs is a kind of SNPs and nano-sized particles composed of aggregated silver ions; SNCs keep balance with dissociated silver ions. Glycans have roles of cell-protective, stabilizing and barrier function, we assumed SNP would disrupt glycanic function. Beyond medaka research as a vertebrate model in nanotoxicology, in order to evaluate toxic effects of SNPs on humans, we evaluated cytotoxicity of SNPs using human cell line. The relevance of mixture toxicity of herbicides in surface water based on long-term and high-resolution monitoring data has been assessed in an intensively used catchment in Belgium under real agricultural conditions with significant diffuse and point source entries. Twelve herbicides and one metabolite were monitored in a watershed of 992 ha size for 3.5 years with (sub-)daily sampling intervals. Mixtures toxicity was evaluated using hazard quotient (HQ), hazard index (HI) and maximum cumulative ratio (MCR) calculations based on regulatory acceptable concentrations and daily averaged measurements of the site-specific cumulative herbicide exposure. Combined effects of two or more herbicides on algae and Lemma were only relevant in < 2% of samples. Mixture toxicity can therefore be considered of relatively minor relevance and does not seem to be a major concern. A single substance risk assessment would have been sufficient in the vast majority of situations to assess the risk rather than a cumulative risk assessment. Further analysis of the time course of exposure revealed that cumulative effects predominantly occurred in narrow time intervals during the application season in combination with high rainfall intensity causing run-off entries into surface water. Hence, the minor cumulative effects observed can be managed by effective mitigation measures such as vegetated filter strips, conservation tillage practices or green cover crops in addition to reducing point source pollution. 

TH270 Silver nanoparticles exposure inhibits glycans synthesis and induces cytotoxicity in human cell line K. Shimizu, Toyo University; M. Horie, Advanced Industrial Science and Technology; S. Kashiwada, Toyo University / Graduate School of Life Sciences Silver nanoparticles (SNPs) are used in industrial products worldwide. Hence, there are growing concerns about environmental pollution risks. Although silver nanoparticles have been reported having induction of cytotoxicity and ROS accumulation, there is limited information of the toxic mechanisms. In our previous study using embryos of medaka, we have revealed that glycan are one of the toxic targets of silver nanoparticles (SNCs). SNCs is a kind of SNPs and nano-sized particles composed of aggregated silver ions; SNCs keep balance with dissociated silver ions. Glycans have roles of cell-protective, stabilizing and barrier function, we assumed SNP would disrupt glycanic function. Beyond medaka research as a vertebrate model in nanotoxicology, in order to evaluate toxic effects of SNPs on humans, we evaluated cytotoxicity of SNPs using human cell line. The relevance of mixture toxicity of herbicides in surface water based on long-term and high-resolution monitoring data has been assessed in an intensively used catchment in Belgium under real agricultural conditions with significant diffuse and point source entries. Twelve herbicides and one metabolite were monitored in a watershed of 992 ha size for 3.5 years with (sub-)daily sampling intervals. Mixtures toxicity was evaluated using hazard quotient (HQ), hazard index (HI) and maximum cumulative ratio (MCR) calculations based on regulatory acceptable concentrations and daily averaged measurements of the site-specific cumulative herbicide exposure. Combined effects of two or more herbicides on algae and Lemma were only relevant in < 2% of samples. Mixture toxicity can therefore be considered of relatively minor relevance and does not seem to be a major concern. A single substance risk assessment would have been sufficient in the vast majority of situations to assess the risk rather than a cumulative risk assessment. Further analysis of the time course of exposure revealed that cumulative effects predominantly occurred in narrow time intervals during the application season in combination with high rainfall intensity causing run-off entries into surface water. Hence, the minor cumulative effects observed can be managed by effective mitigation measures such as vegetated filter strips, conservation tillage practices or green cover crops in addition to reducing point source pollution. 

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 exposure to 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 mixture types, the positive b5b points of both model indicates a decreased toxicity (antagonism) when the mixture effect was due mostly by AgNO3. In the end the MIXTOX model was applicable for the prediction of combined effects of toxic compounds. Keywords: ZnO, AgNO3, MIXTOX model, nanoparticle

TH272 How relevant is mixture toxicity of herbicides in surface water? R. Su, Bayer AG / Crop Science Division / Environmental Safety; A. Weyers, Bayer AG / EnSa. Ecotoxicology; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team; D. Baets, Bayer AG Crop Science Division / Sustainable Operations

The relevance of mixture toxicity of herbicides in surface water based on long-term and high-resolution monitoring data has been assessed in an intensively used catchment in Belgium under real agricultural conditions with significant diffuse and point source entries. Twelve herbicides and one metabolite were monitored in a watershed of 992 ha size for 3.5 years with (sub-)daily sampling intervals. Mixtures toxicity was evaluated using hazard quotient (HQ), hazard index (HI) and maximum cumulative ratio (MCR) calculations based on regulatory acceptable concentrations and daily averaged measurements of the site-specific cumulative herbicide exposure. Combined effects of two or more herbicides on algae and Lemma were only relevant in < 2% of samples. Mixture toxicity can therefore be considered of relatively minor relevance and does not seem to be a major concern. A single substance risk assessment would have been sufficient in the vast majority of situations to assess the risk rather than a cumulative risk assessment. Further analysis of the time course of exposure revealed that cumulative effects predominantly occurred in narrow time intervals during the application season in combination with high rainfall intensity causing run-off entries into surface water. Hence, the minor cumulative effects observed can be managed by effective mitigation measures such as vegetated filter strips, conservation tillage practices or green cover crops in addition to reducing point source pollution. 

TH273 Simplify: reasonable approaches to Mixtox assessment for plant protection products A. Weyers, Bayer AG / EnSa. Ecotoxicology; K. Bender, Bayer AG / Crop Science Ecotoxicology; M. Ebeling, Bayer AG Crop Science Division / Ecotoxicology - Terrestrial Vertebrates Expert Team; A. Gladbach, Bayer AG / Crop Science, Environmental Safety Assessment

The regulatory implementation of risk assessment of mixtures has increased and several guidance documents describe the process. Our suggestions here deal with mixtures of PPP that require an environmental risk assessment (ERA) for cumulative exposure. Depending on the regulatory context, this may include PPP with multi active substances, relevant co-formulants, adjuvants, safeners or metabolites. While publications on mixture toxicity understandably tend to focus on detailed evaluations, therefore a guiding principle in the regulatory process is that in a first tier some over-conservative assumptions can be made, if they allow to correctly identify scenarios of low risk. If formulation studies are available, the measured toxicity of the mixture (and exposure to it) should be used in ERA. When
a calculation of cumulative risk is needed based on active substance endpoints, risk indicators that have already been calculated for single substance ERA such as toxicity exposure ratios or risk quotients should be used to describe the cumulative risk. In a first simple step different endpoints, species and PECs in time and space can be mixed, to show that a given scenario is of low concern. After that first step, a mixture toxicity assessment would describe the cumulative risk more precisely at a given time and place for a defined species and the same endpoint.

**TH274**

Sublethal toxicity of pesticide mixtures on early life stages of non-target aquatic organisms

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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 his 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 groups in the Dutch water system. They are used in agriculture for broad-spectrum effects and at 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 (oysters). 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 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 metachlor 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 der Saag, Archipel, Board of Plant Protection Products and Biocides; G. Arts, Wageningen Environmental Research ( Alterra) / Environmental Risk Assessment; W. Beltman, Alterra Wageningen UR; H. Holterman, Wageningen University & Research / Agro systems Research; L. Wipfler, Alterra Wageningen UR / Environmental Risk Assessment Team; J. Van de Zande, Wageningen University and Research / Agro systems Research

This study reviews a number of screening studies 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 (PPP) 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 Cebg (the Board for the Authorisation of Plant Protection Products and Biocides) in The Netherlands) 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 Acceptable Concentrations 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

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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 model for the 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 doubling and ensuring similar pollution to the 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, it appears that acute and chronic risks of pesticides residues in sour cherries are low. 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.

**TH277**

Environmental and Human Cumulative Risk Assessment of Pesticides Using Local Monitoring Data: A Case Study from the Pucara River Basin, Bolivia

L. Herrero Nogareda, University of Copenhagen / Department of Plant and Environmental Sciences; M. Álvarez Caero, H. Antezana Fernández, Universidad Mayor de San Simon / Facultad de Ciencias y Tecnología; N. Cedergreen, University of Copenhagen / Department of Plant and Environmental Sciences

In Bolivia, pesticides are applied to the potato and other crops, and to control insects and weed species. In this study, we aimed to evaluate the threshold levels of pesticides in the Pucara River basin (South of the country) with data obtained from a monitoring program established in the area. The main objectives were to: (1) assess the pesticides concentrations observed in this basin and their potential impact on the environment and human health at approximately 50% and 20% of the sampling points, respectively. The thresholds were especially surpassed at the discharge zone of the river basin, where SumTU reached values of approximately 0.5 for D. magna, fish and C. riparius, and HI for chronic exposure reached values of 4.70 and 1.57 for children and adults, respectively. The results suggest that pesticide pollution likely impairs the stream system biota in multiple points, while water was not acceptable for a human daily intake in two sampling points, especially for children. The detected pesticides that caused most concern were heptachlor (banned) and dimethoate (approved). Based on these results, risk management strategies should be highly prioritized in order to reduce the risk posed to the ecosystem and the human health in the studied area. However, further studies should analyse the pesticide levels in other times of the year to see if the present results are representative. It is also necessary to analyse a higher number of pesticides which include an even representation of herbicides, fungicides and insecticides, to be sure that risk is not underestimated.

**TH278**

Developing a strategy to improve the environmental risk assessment of mixtures to test multi-component substances: a new HESI Emerging Issues Committee

D.T. Salvito, Research Institute for Fragrance Materials, Inc. / Department of Environmental Science; M.R. Embry, ILSI Health and Environmental Sciences Institute (HESI)

An international workshop was held in 2016 to address challenges in assessing environmental risk safety thresholds for the environment and the human health at approximately 50% and 20% of the sampling points, respectively. The thresholds were especially surpassed at the discharge zone of the river basin, where SumTU reached values of approximately 0.5 for D. magna, fish and C. riparius, and HI for chronic exposure reached values of 4.70 and 1.57 for children and adults, respectively. The results suggest that pesticide pollution likely impairs the stream system biota in multiple points, while water was not acceptable for a human daily intake in two sampling points, especially for children. The detected pesticides that caused most concern were heptachlor (banned) and dimethoate (approved). Based on these results, risk management strategies should be highly prioritized in order to reduce the risk posed to the ecosystem and the human health in the studied area. However, further studies should analyse the pesticide levels in other times of the year to see if the present results are representative. It is also necessary to analyse a higher number of pesticides which include an even representation of herbicides, fungicides and insecticides, to be sure that risk is not underestimated.
environmental risk assessment. Bridging from the workshop discussions and conclusions, a new HESI 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 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.

Environmental Risk Assessment of Technical Mixtures under REACH

E. Hassold, W. Galert, German Environment Agency - UBA / IV 2.3 Chemicals; W. Dres, Federal Environment Agency (UBA) / Chemicals

Abstract: Properties 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 chemical identities of the mixture components as is done under REACH is not sufficient. In a mixture, the fate and toxicity of each component is only one part of the risk assessment. The mixture as a whole substance needs to be considered. This presentation addresses the existing methods and how they can be improved. This will be illustrated by data from real case studies.

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 laboratories. Once the analytical procedure has been developed, the mixture 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.

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. Cerian, M. Fuart-Gatnik, M. Pavan, S-IN Solutioni Informatiche Srl; A. Gissi, European Chemicals Agency; E. Saouter, EU Commission JRC / Sustainable Assessment Unit

The Product and Organisational Environmental Footprint (PEF/OEF) methods form a core 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 requires the most up-to-date dataset 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, 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-TD50 endpoints are not commonly provided under REACH. According to the USEtox methodology, specific fields of the RDT 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. 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 the majority 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.

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. Cerian, S-IN Solutioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs / Scientific Committee and Emerging Risks Unit Department of Risk Assessment / AMU / Environment; E. Saouter, EU Commission JRC / Sustainability and Performance of Products and Systems of chemicals emitted to the environment; IN Soluzioni Informatiche Srl; IN Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs / Scientific Committee and Emerging Risks Unit Department of Risk Assessment / AMU / Environment; E. Saouter, EU Commission JRC / Sustainability and Performance of Products and Systems of chemicals emitted to the environment; IN Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs / Scientific Committee and Emerging Risks Unit Department of Risk Assessment / AMU / Environment; E. Saouter, EU Commission JRC / Sustainability and Performance of Products and Systems of chemicals emitted to the environment; IN Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs / Scientific Committee and Emerging Risks Unit Department of Risk Assessment / AMU / Environment; E. Saouter, EU Commission JRC / Sustainability and Performance of Products and Systems of chemicals emitted to the environment; IN Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs / Scientific Committee and Emerging Risks Unit Department of Risk Assessment / AMU / Environment; E. Saouter, EU Commission JRC / Sustainability and Performance of Products and Systems of chemicals emitted to the environment; IN Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority EFSAs / Scientific Committee and Emerging Risks Unit Department of Risk Assessment / AMU / Environment; E. Saouter, EU Commission JRC / Sustainability and Performance of Products and Systems of chemicals emitted to the environment; IN Soluzioni Informatiche Srl; J. Dorne, European Food Safety Authority
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. van Oije, M. van der Heijden, J. van Klinken, H. van den Berg, Wageningen University and Research / Food Safety and Consumer Health; D. van der Keur, Wageningen University and Research / 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 FCCs 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 FCCs, basic information on migrating chemicals must be available, such as their chemical identity. However, this is often not the case for all migrating FCCs, 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 many FCCs migrate simultaneously, forming the ‘overall migrant’ and resulting in typical and predictable mixture exposure scenarios. One alternative approach to estimating chemical hazards of FCAs is to assess biological effects of the overall migrate. 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 K. van Oije, F. Ellet, D. van der Heijden, J. van Klinken, H. van den Berg, Wageningen University and Research / Food Safety and Consumer Health; D. van der Keur, Wageningen University and Research / General Management

Inspiried by methods and tools developed in the field of life cycle analysis (LCA), we developed an index of toxicity to compare the harm that diverse stable and radioactive materials and wastes 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 radiotoxicity. 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) which was 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 radiotoxicity index, which definitions ultimately allow estimating chemical hazards of FCAs 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 individual urinary excretion and exposure patterns for different population groups. Eighteen phthalate metabolites include monoethyl phthalate (MEP), mono-ethyl phthalate (MEP), mono(2-ethyl-5-oxo-hexyl) phthalate (MEHP), mono(2-ethyl-5-hydroxyhexyl) phthalate (MEHP), mono(2-carboxymethyl) phthalate (MCMHP), and mono(2-ethyl-5-carboxypentyl) phthalate (MECPP) which were analyzed. Among 18 phthalate metabolites, MEHP, MEOP, MEHP, MCHP, MCMHP, MCPP, MEHP, MEP, and MBzP were detected in almost all of the urine samples (detection rate >97%). However, MCHP, MiPP, MiNP, MOP, and MEP were rarely detected in all of the urine samples (<10%). Total concentrations of phthalate metabolites ranged from 3.12 to 6300 ng/mL with a median concentration of 104 ng/mL. Five DEHP metabolites (concentrations measured in the range 63 ng/mL - 8.4 ng/mL), MNPB (6.8 ng/mL) and MEP (5.2 ng/mL) relatively 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 D. Martinez, W. 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-based monitoring tools that can measure integrated biological activity of mixtures have been proposed as one of 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 integrated approach. In SOLUTIONS, the modeling train aims to result in chemical footprints (ChFs). ChFs were developed to summarize and communicate predicted mixture risks in simple units. In the current presentation, 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 potential transfers on one layer of environmental hazard to downstream threatening the information that can be obtained by single-chemical risks, chemical footprints indicate which combination of chemicals and locations require priority for abatement. 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.
plants (WWTPs) and surface waters 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 IUC-PTS, in the Songhua catchment (China) undertaken from June-July 2017, sampling WWTPs and watersheds. Emission estimates were based on product sales data for China and were input into the modelling framework. The hydrobasins in the Songhua catchment indicate the concentration of HPCs are dominated by LAS in WWTPs and rivers. Modelled influential 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: Our 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 representativeness 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. emissions, 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.

TH292

Microcosm experiment evidences complex responses of biofilm communities along a gradient of chemical pollution 1. sabater, CSIC-IDAEA / Department of Environmental Chemistry; A. Ginebreda, 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 any environmental change by initiating a series of ecological changes affecting the biodiversity and trophic structure of the community. The objective of this study is thus to verify how robust and resilient is an ecosystem to WWTP effluents using a microcosm 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 54 days, followed by 22 days of recovery. 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 Communities’ 7th Framework Programme under Grant Agreement No. 603629-ENV-2013-6.2-1-Globaqua

TH293

Risk assessment of chemical mixtures in the Erft river basin M. Thiemann, State North Rhine-Westphalia Environment and Consumer Protection (LANUV NRW) / Department 32 Ecotoxicology; B. Gühli, North-Rhine-Westphalia State Environment Agency (LANUV NRW) / FB 32; U. Rose, M. Trimborn, Erfteverband 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. Toxic Unit (TU) was calculated by considering the observed concentration addition and using acute toxicity endpoints for algae, macrophytes, daphnia and fish. Substances with high TU as well as the taxonomic groups displaying highest added up TU response (SUM TU) were determined. The chemical inventories of WWTP effluents were analysed to gather information on non-detects i.e. potentially ecotoxicologically relevant substances which are present in surface waters in concentrations below the analytical limit of detection (LOD). Additionally, single substance risk assessment was performed by determining risk quotients (environmental concentration/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 WWTW effluents but in surface waters it was only rarely present in concentrations above LOD. Triclosan can be considered to be now a risk factor for the aquatic environment. In waterbodies strongly influenced by WWTW discharges Diclofenac and Buprofen were nearly ubiquitously 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. Pavlakis, University of Aveiro / Department of Biology; J.F. Mousinho, University of Aveiro / Department of Biology and CESAM; A.R. Silva, University of Aveiro / Institute of Marine Sciences; S. Gonalves, Department and 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 used 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-NET (Water JPI- WATERRWORKS2014 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 the groundwater conditions from the University of Aveiro / Institute of Marine Sciences. The acute toxicity of complex mixtures in these synthetic groundwaters was tested in 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 217) to determine acute neuroendocrine behavioral effects. The acute toxic mixtures were used to predict the effects of the ternary mixtures. Deviations from the Concentration Addition reference model indicated interaction between the contaminants in D. magna and D. rerio.

TH294
Mixtures effects of Dibutyl phthalate and Sodium dodecyl sulphate on a mesozooplankton community from the Swedish west coast
C. Jönander, University of Gothenburg; I. Dahlöf, University of Gothenburg / Biological and Environmental Sciences; T. Backhaus, University of Gothenburg / Department of Biological and Environmental Sciences
In the coastal ecosystem nanoparticles are not present on their own but in mixtures. A chemical monitoring survey detected more than 60 organic chemicals 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 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 dye 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 (SDS) and 0.32 µmol/L (DBP), respectively. The identification of structural endpoints as well as toxic 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.
E. Seispils, University of Gothenburg / Dept of Biological and Environmental Sciences; M.S. Varne, 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 of 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 these pesticides on the 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. We used the concentrations of more than one pesticide to assess the combined toxicity burden of the pesticide mixture. We found that 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. Taghali, Heriot Watt University / Institute of Life and Earth Sciences; S.J. Armstrong, Heriot-Watt University / Institute of Life and Earth Sciences; T.F. Fernandes, Heriot-Watt University / Institute of Life and Earth Sciences
Analysis of the Mixture Toxicity Burden in 17 Rivers in North Eastern Australia - Implications for the Great Barrier Reef.
Inorganic sunscreens are common ingredients in sunscreen formulations and it is independent of the tested individual sunscreen. A common component of inorganic sunscreen are titanium dioxide nanoparticles (TiO2) 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 component in sunscreen and not by the nanoparticles in it. A series of short-term (5 days) experiments was carried out to compared effects of these sunscreens on corals, by studying coral photosphysiology, 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.
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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; 1.2; 2.4; 5.3 and 11.7 mg L\(^{-1}\) of abamectin and 0.2, 0.5; 1.0; 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 aims 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 mixtures. Similar results have been described in other studies with monocultures 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. Letchon, CIEMAT / Energy Dpt Energy Systems Analysis Unit

REELCOOP, an EU-FP7 funded project which stands for RENewable ELectric COOp (www.reelcoop.com), aims to develop and test novel prototypes of 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

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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 to develop this LCA, following the Adage for Supply and Efficient Use of Resources (SHARE) approach. 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), using a large amount of 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

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-octane and p-xylene; From 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 impacts of the scenario, a simulation of the chemical 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 particular route at each stage of the process. The key stage of the analysis is that of the environmental weight associated with the entire life cycle of a product, in our case one ton of terephthalic acid. The model was validated by the use of SimaPro software 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 only the alternative way from orange peels has lower 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
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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 storing electrical energy on a broad scale. Due to the independent scalability of system power and energy capacity, a variety of industrial applications is possible from small systems for residential use to large systems for industrial applications. 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 impacts of the scenario, a simulation of the chemical 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 particular route at each stage of the process. The key stage of the analysis is that of the environmental weight associated with the entire life cycle of a product, in our case one ton of terephthalic acid. The model was validated by the use of SimaPro software 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 only the alternative way from orange peels has lower 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.

TH309 Towards the Life Cycle Assessment of engineered nanoparticles production: a comparison between batch and continuous flow synthesis
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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 natural 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, with particular focus on nanostructured Cu Inks and iron oxide. 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. Sánchez, LEITAT / Sustainability Division; C. Hidalgo, Leitat Technological Center / Sustainability Division; M.R. Riera, LEITAT / Sustainability Division; S. Vazquez, ACONDICIONAMIENTO TARRASENSE (LEITAT TECHNOLOGICAL CENTER) / Sustainability Division

BASMATI is an ambitious project which main goal is to develop active nanomaterial and electrochemical inks for printing technologies to transfer and upscale to pilots at SMEs and industry facilities. This project is co-funded by European Union under The Framework Programme for Research and Innovation HORIZON 2020. The project is developed by 10 different partners, where LEITAT is in charge of the Life Cycling Assessment. For that task, the environmental impact has been performed during the whole life cycle considering synthesis, formulation and display of printed batteries. The LCA has been focused on assessing the potential impacts of CuInP₂O₅ and NMC (Ni-Mn-Co) nanoparticles synthesized, the inks which contain these nanoparticles and the batteries printed with these inks. The LCA applied in the study is based on the standard ISO-framework for LCA (ISO 14040:2006 and ISO 14044:2000). Calculations have been done using the software GABI, and taking as a basis the GABI Database, Electric, Electric Database and the Impact Assessment method. The functional unit has been defined as “a printed flexible battery to be used for power source” and the scope has been based on the “cradle to grave” approach. Primary data have been prioritised and secondary data from databases and literature have been used when needed. The inventory process has been completed with the information of inputs and outputs gathered from partners. Then, the impacts related to inventory flows have been calculated for ten impact categories. Results show that the impact of nanoparticles synthesis is mainly dominated by raw materials. Moreover, for the inks comparative, and results it can be seen that inks with NMC nanoparticles have higher impacts in most of the impact categories. Specifically, NMC inks represent the highest weight due to raw materials used during NMC synthesis. In addition, the highest impacts in climate change and resource depletion are dominated by Cu Inks. An highlighting difference of NMC inks in comparison with the Cu Inks is the production of NMC synthesis. After that, the manufacturing of the printed lithium-ion batteries has been analysed. The stack and interdigitated battery has been chosen as demonstrators to develop the LCA. Landfill and recycling have been assumed as end of life scenarios. Finally, the conclusions take into consideration the new generation of technologies and their environmental performance.

TH311 Life Cycle Assessment (LCA) applied to new and advanced material solutions in Concentrated Solar Thermal technology
A. Charee, 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 concentrating plants. Nevertheless, the construction and production cost of this promising technology have to be improved. The aim of IN-POWER project is to develop high efficiency solar harvesting CSP architectures based on holistic materials and innovative manufacturing processes while reducing the environmental impact associated to CSP architectures and the energy production cost. To achieve this objective IN-POWER develops a set of advanced solutions: Photonic Smart light mirrors with high optical and mechanical performance. An optimized and lighter mirror support structure. High-performance-temperature absorber coating in new vacuum-free-designed receiver. A novel modular solar field architecture and design reducing the land use requirements by 4 times.
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, designing a process looking for high performance components 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; higher 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 Eisenazer, Austria. The case of RICAS2020 PROJECT.
A. Claret, Leitat Technological Center / Sustainability Division; G. Ferrer, Leitat Technological Center / Quantitat Analyse and social impacts division; M.R. Riera, LEITAT / Sustainability Division; S. Vazquez, ACONDICIONAMIENTO TARRASENSE (LEITAT TECHNOLOGICAL CENTER) / Sustainability Division

European society has a highly 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 producing 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 CO₂ 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) to carry out a life cycle assessment (in the laboratory scale, 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 aluminum 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 and future renewable energy policies - an environmental assessment
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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 not 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 that consists in a new wastewater treatment scheme, i.e., (i) a first stage of modified 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
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Technological innovation is a crucial for sustainable development but at the same time it can cause unfavorable consequences to environment and society.
Environmental assessment of the technologies is usually performed when they have already been launched in the market with a low possibility to transform their development towards better environmental performance. Anticipatory Life Cycle Assessment (LCA) has been evolved to assess the environmental impacts of the technological innovation when the technology is in the stage of design. In this paper, we present the application of Anticipatory LCA in the assessment of the anti-reflective greenhouse glass coatings. The light intensity is essential for the crop growth in the greenhouses. A portion of the light is lost when it reaches the 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 a greenhouse. The experimental coating were assessed 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 considering the different environmental aspects associated to the conventional coatings, and this could be due to the simplicity of the coating method applied by TNO. Also, it was revealed that the coatings do not bring significant environmental benefits rather they bring economic benefits in terms of increased yield of tomatoes. Finally, the sensitivity analysis showed that electricity used for the production of glass has higher impacts than transmittance or degradation time of the coatings.

TH315
Combining process simulation with Life Cycle Assessment method in polyurethane rigid foam production
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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 production 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 algorithms and the experimental work by coupling the experimental data and the models 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 analysing the overall 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 understanding the characteristics and the implications of the 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 end of life scenario 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.
Catlow, Cardiff University / School of Chemistry; P. Lettieri, University College London / Chemical Engineering

As a way to address the climate-related CO₂ emissions from fossil fuel power plants, photocatalytic methanol production using a novel form of CO₂ conversion process has been investigated within the research project “Low Carbon Fuel”. The primary goal of this study is to evaluate the environmental performance of photocatalytic CO₂ fixation in comparison to conventional fossil-based technologies for power generation and methanol production. Life cycle assessment (LCA) is used to determine and compare the environmental performance of the methanol production systems. In the LCA study, cradle to gate system boundaries are used because the downstream processes and properties of methanol are similar for CO₂-based and fossil-based systems. Since the main environmental motivations for CO₂ utilisation are reducing CO₂ emissions and establishing an alternative carbon source, this study compares the CO₂-based and fossil-based methanol production systems with respect to global warming and fossil resource depletion. The CO₂-based methanol production system consists of the following three stages: CO₂ source including CO₂ capture, electricity compensation, and CO₂ utilisation for methanol production. The fossil-based methanol production system serves as benchmark and is divided into electricity generation and fossil-based methanol production. The main functions of the CO₂-based and fossil-based systems are production of methanol, and supply of electricity to the UK electricity grid. To quantify the main functions, we choose 14.3 MJ methanol (655 g) as reference for the function “methanol production”. The second function “electricity supply” can be quantified through the amount of CO₂ that is captured to produce equivalent amount of methanol. CO₂-based and fossil-based methanol production processes are analysed and compared based on life cycle assessment. Our analysis reveals that CO₂-based methanol production system using photocatalytic CO₂ conversion is not always mandatory to achieve CO₂-based system with lower environmental impacts than the fossil-based system. However, CO₂-based methanol production has the potential to reduce impacts for global warming and fossil depletion if the environmental performance of the intermediate steps are increased, compared to the corresponding fossil-based route. Furthermore, additional environmental benefits can be obtained from environmentally friendly hydrogen production from photocatalytic water splitting process.

Advancing the Adverse Outcome Pathway Framework - An International Horizon Scanning Approach (P)

TH317

Linking failed swim bladder inflation of larval Japanese medaka (Oryzias latipes) after embryonic exposure to 17α-ethinylestradiol, levonorgestrel and diclofenac, both alone and in combination, to gene expression during early embryo development.

L. Margiotta, Norwegian Institute for Water Research; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

Leuven minor is an aquatic plant commonly used in laboratory phytotoxicity 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 standardisation organisations using this species as an ecological model. Although being highly useful for regulatory purposes focusing on traditional adverse endpoints, these test systems provide limited 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 causing growth inhibition and lethality in primary test species. 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 font 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 molecular, cellular and apical adverse effects occurring in chloroplast and mitochondria. Endpoints such as uncoupling of oxidative phosphorylation, lipid peroxidation, DNA damage, apoptosis, reduced mitochondrial membrane potential and health already mandatory to achieve CO₂-based system with lower environmental impacts than the fossil-based system. However, CO₂-based methanol production has the potential to reduce impacts for global warming and fossil depletion if the environmental performance of the intermediate steps are increased, compared to the corresponding fossil-based route. Furthermore, additional environmental benefits can be obtained from environmentally friendly hydrogen production from photocatalytic water splitting process.

TH318

Linking mode of action of the model respiratory and photosynthesis uncoupler 3,5-dichlorophenol to adverse outcomes in Leuven minor

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Leuven minor is an aquatic plant commonly used in laboratory phytotoxicity 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 standardisation organisations using this species as an ecological model. Although being highly useful for regulatory purposes focusing on traditional adverse endpoints, these test systems provide limited 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 causing growth inhibition and lethality in primary test species. 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 font 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 molecular, cellular and apical adverse effects occurring in chloroplast and mitochondria. Endpoints such as uncoupling of oxidative phosphorylation, lipid peroxidation, DNA damage, apoptosis, reduced mitochondrial membrane potential and health...
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 for 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 vivo* 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**

J. Moe, Norwegian Institute for Water Research (NIVA) / Section for Catchment Processes; W.G. Landis, Western Washington University / Institute for Ecology and Environmental Toxicology; L. Xie, NIVA - Norwegian Institute for Water Research; K. Tollefsen, NIVA / Ecotoxicology and Risk Assessment

AOPs have 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 (lipo 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 data used in this BN version. The BN was run by changing DCP concentrations 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 Effectcopedia**

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 leading to serious breathing problems. Several substances are identified as inducer of PF, but high cost of inhalation toxicity studies refrain to conduct systemic studies of all those substances. Hence, the regulations of these substances become obscure. To solve this problem, Adverse Outcome Pathway (AOP) concept has been emerged. AOP is a framework that organizes existing knowledge about linkage between molecular-level perturbation and an adverse outcome. To facilitate the development of AOP, OECD launches AOP knowledge-base (KB). In recent years, 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 epithelial cell (Beas2B). Beas2B cell was exposed to CMIT/MIT (a biocide which possess potential risk to respiratory systems) at various doses from 0 mg/L to 2 mg/L for various time for 1 to 72 hr. Cytotoxicity and apoptosis was analyzed using various available assays at mid to high through put condition. While, quantitative analysis of the KEs was performed using Effectopedia platform of AOP-KB. For further study, we are planning to do various dose- and time-response test (using qPCR and ELISA) for each potential KEs, so that we can integrate data for building qAOP model with the network between MIE-KEs-AO. Acknowledgment: 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-trillion 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 - 78%. 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 evaluated by running effective training deep learning models with knowledge curated in databases such as The Comparative Toxicogenomics Database, ECOTOX and iCSS ToxCast Dashboard.

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Fish model species in human and environmental toxicology (PC)

MOPC01  Fish caging experiment as a tool for in situ assessment of neurotoxic effects of untreated wastewaters

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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) has been selected for the experiment, as one of the most common species in the Middle Danube, genetically 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 genes was studied: tachykinin 3a and tachykinin 3b (involved in neuroendocrine regulation of reproduction), GABA a1 receptor (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 a 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

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The alcaline 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 fertirrigation 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 impairs 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 promote detoxification 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 mucous 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 (Gobioides broussonetti - Gobidae) from one of the most productive estuaries in Brazil

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The estuarine-Lagoon Complex of Iguape (São Paulo - Southern 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 (Gobioides broussonetti - 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. broussonetti the studied area. Fishes were sampled near Cananéia, Subaíma 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 Subaíma in winter. Hepatic and renal GPx and GST activities, GSH concentrations and LPO damage in liver were similar. However, it was observed genotoxic effects (chromosome aberrations 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 stress this species. The marked seasonality of the region, which consequently influences the temperature, the rainfall regime and the bioavailability of contaminants may interfere in these responses. Norepinephrine anhropic activity was observed near to Cananéia and Subaíma points, similar to 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 analyses 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 biomarkers

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The wastewater from Water Frammersett, a treatment plant, serves to provide a good quality of water at an urban area near the city of Aachen. 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 improvement of the water quality in the field? Caging experiments with juvenile rainbow trout and various biomarkers were conducted. Oncorhynchus mykiss (O. mykiss) were caged near the outlet of the WWTP in an area of low hydrodynamic. Water and sediment chemical analyses are being performed in the studied points in order to support a better understanding of these responses.
during late summer in 2017 to evaluate the status quo of the stream and the performance of the “Aschen Soeiri” 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
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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 groups of chemicals, particularly pesticides, have been identified as acting in the androgenic axis. Several studies have shown that these chemicals can disrupt androgenic signaling pathways in vivo. To address this problem, we have developed a highly sensitive and specific in vitro and in vivo assay for androgen disruptors. The in vitro assay uses a transgenic medaka line harbouring a portion of the spg1el gene promoter driving expression of GFP. The in vivo assay uses a transgenic rainbow trout line, Oncorhynchus mykiss. Both assays have been validated for detecting a wide range of androgenic disruptors. The in vivo assay has been successfully applied to several environmental samples, including sediments from vineyard soils. The results of these studies have provided valuable insights into the potential impact of androgenic disruptors on aquatic ecosystems.

MOPC06
Evaluation of the toxicity of environmental samples collected near vineyard parcels on rainbow trout larvae (Oncorhynchus mykiss) and liver cell line RTL-W1
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New Horizons in Particulate Polymer Analysis: Micro- and Nanoplastics and Tire Rubber Detection, Characterisation and Impacts in the Environment (PC)

MOPC07
Optimization and Automation of Raman Microscopy for Microplastic Analysis
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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) represent one of the main environmental problems globally.[2] In particular, the transport and partitioning of MPs into the aquatic environment through atmospheric deposition from airborne MP particles has been widely reported.[3] This has led to the implementation of guidelines and standards for the analysis of MP in both water and sediments.[4] Recently, the potential impacts of MP on aquatic ecosystems and human health have been recognized as major environmental issues.[5] Consequently, the study of MP in the environment has become a major focus of environmental science.[6] However, the challenges associated with the analysis of MP in the environment include issues such as sample preparation, sample preservation, and the selection of appropriate analytical methods.[7] In particular, the determination of MP in environmental samples is a complex and challenging task due to the diversity and complexity of the available methods.[8] This has led to the development of various methods for the analysis of MP, including those based on optical microscopy, spectroscopy, and mass spectrometry.[9] While these methods offer valuable information about the presence of MP in environmental samples, they are often limited in terms of sensitivity, specificity, and throughput. To overcome these limitations, the development of optimized and automated methods for the analysis of MP is crucial.[10] In this study, we have developed an automated method for the analysis of MP in environmental samples, based on Raman microscopy. The method has been validated using a range of environmental samples, including water and sediments, and has been shown to be sensitive, specific, and robust. The results of this study demonstrate the potential of Raman microscopy for the analysis of MP in the environment.

MOPC08
Preparation of model small microplastics and nanoplastics
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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 (5-500 µm) and potentially nanoplastics (< 1 µm). Recent investigations show that the microbioclastics 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 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 microplastic particles of PE with sizes between 0.7 µm to 3 µm. These particles were obtained by dissolving PE pellets in toluene at high temperatures. After ultrasonication, the solvents 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. A number of reactions were tested (Tween60, Tween80 and a surfactant obtained from an algae culture). The effect of each surfactant on the size, shape and stability of the particles will be discussed. These...
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 and degradation effects and environmental 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 wild life 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, biphenols, 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 nanoparticles 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 these processes do 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 10^7 kg^1 for particles with diameters of 0.5 µm. This circumstance raises concerns as particlesaspectratio. With imaging FTIR this is possible only down to particle sizes of ~10 µm. Electron probe microanalysis suffers from sample preparation and high mortality rates were found for different marion zooplankton species.

MOPC09

Effects on humic substances and sediments on the sorption of anthropogenic chemicals to different MP particles

S. Hippe, P. Zilles, Hochschule Fresenius University of Applied Sciences; T. papers are currently used to optimize strategies of identification by Raman microspectroscopy for particles smaller than 1 µm.

MOPC10

Micronized tire rubber: abundance and distribution within microplastic litter of the Charleston Harbor Estuary, South Carolina, USA

T.P. 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 biodegradability as well as a vector for accumulation of plastic particles 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 adsorbing of oil and fuel components are important factors on the sorption. Humic substances are a complex mixture of breakdown products of biologic matter, representing 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 natural and anthropogenic microplastics (NPMs) were modelled in presence and absence of humic acids and sediments. A liquid-liquid extraction of the aqueous phase was performed to determine the equilibrium concentrations of galactolide. A comparison of sorption isotherms regarding the influence of humic acids and sediments was performed to prove or disprove the following hypothesis. (I) Polymer material does not have an impact on sorption in presence of humic substances, due to the sorption of humic substances to the polymer surface. (II) Polymers do not contribute a significant amount to the overall sorption of organic pollutants as majority 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.

MOPC11

Crumb rubber in sports fields - Advances in environmental chemistry

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experiments were conducted to estimate sampling rates of NNIs and to estimate elimination rates of PRCs. These experiments were conducted using synthetic water at 15°C over 14 days. Extracts were analyzed by liquid chromatography with tandem mass spectrometry (LC-MS/MS) using an AB Sciex QTrap 5500 instrument with electrospray ionization coupled with an Agilent 1100 HPLC. Nine NNIs were detected, but the concentrations varied widely from 2 ng/L to 4.6 µg/L. Fluometuron was detected at concentrations up to 1140 ng/L in watersheds discharging into Lake Ontario. Imidacloprid at concentrations up to 1731 ng/L and thiamethoxam at concentrations up to 625 ng/L were detected in the watersheds discharging into Lake Erie. Overall, these data indicate that NNIs are widely distributed in surface waters in agricultural regions in Ontario within the Great Lakes basin.

MOPC18 Occurrence and removal of antibiotics in municipal wastewater by conventional activated sludge (CAS) and membrane bioreactor (MBR) systems

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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 (CLI), azithromycin (AZT), clarithromycin (CLR), oxytetracycline (OXY), trimethadione (TDS), vancomycin (VCM), and chloramphenicol (CAP), were largely removed by both CAS and MBR systems. In contrast, trimethoprim (TMP), tetracycline (TET) and erythromycin (ERY) 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 target 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–O–CH₃, phenoxy –O–CH₂), or alkyl groups. Conversely, antibiotics containing Carboxyl groups with the environmental engineering groups or the predominance of strong electron withdrawing groups (e.g. halogenated, carbonyl, carbonyl, sulfonamide, etc.) tended to show poor removal efficiencies (<30%) in biological wastewater treatment processes.

MOPC19 The effect of activated sludge conditions on microplastics biodegradation and transformation products formation

L. Gismonari, 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. Nevertheless, several microplastics with the environmental engineering groups or the predominance of strong electron withdrawing groups (e.g. halogenated, carbonyl, carbonyl, sulfonamide, etc.) tended to show poor removal efficiencies (<30%) in biological wastewater treatment processes.

MOPC20 Ciprofloxacin By-Products in Seawater Environment in the Presence and Absence of Gilt Head Bream

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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 biotransformation (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 zwiterionic behaviour. CIPRO by-products (BP) 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 piperazenyl ring (in 2 BPs), and the cleavage of the piperazine 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 piperazenyl ring, also suffered the glycinium 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 glycinium and glutamine conjugation gained importance since 4 of the 10 new BPs had suffered both transformation reactions. Although CIPRO metabolites were searched in gill-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 glycinium nor glutamine conjugates were observed in bile BPs. This work was financially supported by the Ministry of Economy and Competitiveness through the project CTM2014-56628-C3-1-R. H. Ziaurrust 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)


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 ecological 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 impact 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–liquid 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, sulfonyl ureas, uniline, chloroacetanilides, acide herbicides, oxadiazoles, carbamoxides, benzothiadiazines, nitriles, diphyl 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 ng/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 low concentrations.
reliable 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: CTM2016-75587-C2-2-R), and to Merck for the gift of LC columns.

MOPC22
Degradation kinetics and degradation products of diclofenac with persulfate J.M. Montegauado, University of Castilla-La Mancha; H. El-talawy, Aarhus University / Department of Environmental Science; A. Durán, J. San Martín, 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 reduction rates in the ultrasonic persulfate (US/PS) process was observed with excess persulfate as the reagent decomposed via the non reactive $\text{SO}_4^{2-}$ (with no generation of the very effective $\text{SO}_2^{-}$). 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) 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 Biogeo sciences - Fate, Effects and Policy (PC)

MOPC23
Identifying, Characterising and Quantifying Atmospheric Mercury Sources Using Passive Air Sampling Networks

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The Minamata Convention on mercury (Hg) stipulates that complete emissions inventories should be established. Passive air samplers (PAS) produce time-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 mining district in 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 used a PAS for gaseous Hg, which incorporates a sulphur

MOPC24
Building a predictive model for methylmercury photodemethylation in freshwater ecosystems

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Mercury (Hg) entrapment into 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.

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photonemfluid 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 DOC photoreactivity (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 increase spring and summer temperature occurrences and thus lead to browning of freshwaters and further inhibition to the photomedium pathway of MeHg reduction.

MOPC27
Polymer inclusion membranes followed by X-ray fluorescence analysis as a new tool for mercury monitoring in natural waters at low concentration level
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At present, there is a considerable interest in mercury (Hg) monitoring due to its widespread occurrence and high toxicity of most of its compounds. Due to the low concentration levels, the complexity of some natural waters and the poor stability of the metal during sample storage, methodologies overcoming this problems are of main interest. In this context, polymer inclusion membranes (PIMs) can be an interesting tool to help in environmental monitoring. PIMs consist of a polymer, which provides mechanical strength, the carrier, which is the responsible of the extraction process, and sometimes also a plasticizer can be used to provide elasticity. The stability, versatility and easy manufacturing make PIMs as a useful separation technique to be taken into account. In this work, PIMs have been prepared fixing cellulose triacetate as the polymer and the ionic liquid trioctylmethylammonium thiocyanate (TOMATS) as extractant. PIMs were contacted with Hg in natural waters and, once the metal was collected, membranes were rinsed with ultrapure water. The concentration of the metal (EDXRF) system and were directly analyzed. A good correlation was found between Hg concentration in the natural water (0.5-10 ppb) and the peak area obtained in the analysis of the corresponding loaded PIM, and thus, it can be used as a calibration curve. Optimized conditions of the whole methodology allowed a Hg detection limit of 0.2 µg L⁻¹ in water. Moreover, no water matrix effects were observed when testing tap water, river water, sea water and ground water were found. Thus, PIMs can be seen as a global solution for Hg monitoring in all types of natural waters. Additionally, we have investigated for the first time, the possibility of using PIMs as a tool to preserve samples of Hg in environmental waters. PIMs analyzed after 6 months of Hg extraction did not differ from the results obtained the first day of analysis. Hence, PIMs were viewed as an innovative media to extract low levels of metal from different natural waters and to preserve sample information until the determination of the metal can be performed.

MOPC28
Dissolved organic matter as a modulator of Hg bioavailability to phytoplankton
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Mercury (Hg) is a priority toxin of global concern, which concentrates in biota and biomagnifies in the aquatic food webs. However, mercury interaction with phytoplankton, central for its incorporation in the food webs, and in particular the role of DOM in modifying factors such as dissolved organic matter (DOM) is still to elucidate. The objective of this work is to get new insight in the role of DOM on Hg bioavailability to phytoplankton. Since trace metal complexation by DOM is expected to reduce its bioavailability, we hypothesized that the reduction of the Hg bioavailability to Chlamydomonas reinhardtii, chosen as a model phytoplankton, will be proportional to the fraction of the Hg being complexed by DOM. To get insight into the role of DOM in Hg uptake, C. reinhardtii was exposed to two concentrations of Hg in the presence of standard Suwannee River humic acid (SRHA) and in natural water rich in DOM from Onego Lake, Russia. Water was sampled from five sites representing the DOC gradient from River Shuya to open lake. Bioavailability was quantified by determining the adsorbed and intracellular mercury concentrations by Direct mercury analyzer on freeze-dried pellets. Concentrations of Hg in the exposure media were measured with the MERX Automated Total Mercury Analytical System. Chemical speciation of Hg in the absence or presence of DOM was computed with WHAM/model VII. The results showed that adsorbed and intracellular Hg concentrations decreased as compared with exposure in the absence of SRHA only at 0.7 nM Hg, when the ratio between the reduced sulfur concentration and Hg is higher than 100. A significant increase (1.5x) of Hg uptake in C. reinhardtii exposed to 70 nM Hg in the presence of 0.5 and 5 mg L⁻¹ DOC was found. In the DOC-rich water from lake Onega, a decrease of the bioavailability with respect to exposure in the absence of DOM was found. However no specific trends in the Hg uptake by C. reinhardtii were observed over DOC concentration gradients. The effect of the other factors such as the presence and concentration of different major cations and anions, as well as mercury binding to the Al, Mn and Fe colloids has to be taken into account in addition to the role of DOM. The implications of the obtained results are discussed further with respect to the prediction of the mercury incorporation at the base of the food-webs and the impact in the environmental systems.

Fungicides - an overlooked compound group? Fate, effects, risk assessment and mitigation (PC)
TUPC01
Overview of the risks from fungicides for aquatic organisms
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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 information on 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 effects on non-fungal microorganisms, plants, as well as invertebrate and vertebrate animals. We will discuss these effects for several fungicide/mode of action groups 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
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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 different target aquatic organism groups exposed to the standard test species used in the aquatic risk assessment for fungicides. A toxicity database was created that contained acute and chronic laboratory toxicity data for 182 taxa and 139 fungidical compounds. Toxicity data was obtained from the US EPA ECOTOX database and complemented with data contained in EFSA draft assessment reports. The data was selected following strict criteria as regards to the endpoints, measured effect and exposure duration proposed by the EFSA Aquatic Guidance Document for the aquatic effect assessment of plant protection products. Sensitivity differences between non-standard and standard test species were assessed following the relative tolerance (Trel) approach i.e., by dividing the toxicity value of a non-standard test species by the toxicity value of the standard test species. Trel values were calculated on the basis of the standard test species used in the acute first tier (Daphnia magna, Oecetobrychus mykiss) and chronic first tier (Raphidocelis subcapitata, D. magna, O. mykiss) effect assessments. Trel values were averaged per taxonomic group and per antimicrobial toxic mode of action of the evaluated compounds. The results of this study reveal that, on average, annelids, mysids and bivalves have a higher acute sensitivity to fungicides than D. magna, although such trend was not observed in the chronic sensitivity evaluation. O. mykiss was considered to be among the most sensitive fish species to fungicides. Regarding the primary producer evaluation, diatoms were found to be more sensitive than R. subcapitata in the majority of the cases. Sensitivity differences were generally less than two orders of magnitude in the acute assessment and less than one order of magnitude in the chronic assessment, indicating that the assessment factors applied to toxicity values for standard test species encompasses the sensitivity range of most aquatic non-fungal microorganisms, plants, as well as invertebrate and vertebrate animals. We will discuss these effects for several fungicide/mode of action groups 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.
Fungicide effects propagate through the detrital food chain in streams

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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 calcified shredders: Chaetogyrus villosa and Anabola nerosa. 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 highest fungicide treatment. Significant effects occurred in concentrations above 4% of the regulatory acceptable concentrations for the fungicide. Fungicide exposure was significantly lower in the treatments containing highest fungicide concentrations and always highest in the untreated control. Emergence of C. villosa significantly decreased with increasing fungicide concentration from >60% 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 in concentrations above 20% of the ERC0toxic concentrations for chronic algae and 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, supplemental ecotoxicity tests (e.g. based on aquatic fungi) are probably necessary for sufficiently safeguarding stream ecosystems in the risk assessment of fungicides.

Mitigation of fungicide exposure of stream ecosystems within agricultural catchments

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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, run-off, and erosion rills. To mitigate fungicide exposure, a range of management practices 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 run-off, buffer strips have been suggested as a potential measure mitigating fungicide exposure by retaining run-off water and providing sites for adsorption as well as degradation. Under field conditions, however, vegetation density and erosion rills undermine 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.

Towards a better exposure assessment of antifungal azoles

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Antifungal azoles are a class of contaminants of emerging concern since increasing evidence 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
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, O₂-demand, 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, lead to negative effects of particles (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 OCSSP (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 discussions in proposing different test designs addressing mBCA and mBCP requirements.

**TUPC11**

**Microbiological Quantification Methods for MPCAs - Applicability to a Range of Microorganisms and Different Substances**

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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, protozoa, viruses). As for chemical plant protection products, regulatory authorities require an analytical verification of the doses applied in ecotoxicological tests also for mPCAs. Guidance can be derived from SANCO/3030/09 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 methods need to be robust, reproducible and specific. Experimental data will be presented with focus on the applicability of microbial quantification methods considering different microorganisms and substrates.

**When ecotoxicology meets trophic ecology (PC)**

**TUPC17**

**Modelling bioaccumulation of persistent organic pollutants in Arctic food chains**

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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 pose a threat for 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**

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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 Peninsular in King George Island, Antarctica. From December 2013 to January 2014, and included Antarctic cod, icefish, limpet, amphipods, leopard seal, Gentoo penguin, 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 tropic 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, OCPs, HBCDs and highly chlorinated PCBs and PCNs, showed significantly positive correlations, suggesting biomagnification of the chemicals. DPs, however, showed insignificant correlations. After the two years of TFM 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 aroused an uncertainty to evaluate TMFs. The result of this study presented widespread contamination of the Anarctic 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.
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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 filets 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 δ15N) and the influence of trophic parameters using δ13C and body size. Results showed a decrease of PCB burden in fish after the clean-up of the major input source of PCB in the lake and a steady situation since then. Arctic char was found to be significantly more contaminated than whitefish with a mean concentration of 254±132 ng.g⁻¹ w/w and 45±28 ng.g⁻¹ w/w respectively. Individual’s PCB contaminations in both species were not tied to feeding habitats (p>0.05). Trophic position (characterized with δ15N) was also not correlated with intra-species contamination variabilities for the arctic char and was only slightly positively related to concentration variabilities for whitefish (p=0.04), dismissing the importance of biomagnification as PCB accumulation process. However, fish body size seemed to be a potential explanatory variable for individual’s PCB concentration discrepancies in arctic char (p=0.002) and whitefish (p<0.01). This last observation could be explained by fish/white partitioning equilibrium to be reached, where fish would tend to accumulate more PCB through their lifetime, highlighting the effect of the bioconcentration process. A lower clearance rate due to changes in physiological parameters (lower gill/body weight ratio, lower metabolism and/or excretion rate) could also be involved.

TUPC20
The role of diet and age: organohalogen accumulation in an avian top predator
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Occupying a high trophic level, the white-tailed eagle (Haliaeetus albicilla) can accumulate a wide range of organohalogenated contaminants (OHCs), even at an early age. Their diet consists mainly of fish and seabirds; thus, a long food chain 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
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Trophic magnification factors have been extensively assessed for persistent organic pollutants, but remain poorly studied for metabolizable pollutants and their metabolites. Poly cyclic 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)
WEP01
Does pre-exposure to bisphenol A affect the susceptibility of breeding zebrafish upon re-exposure?
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Bisphenol A (BPA) is a commercially important chemical used in the production of widely used epoxy resins and polycarbonate plastics and it is ubiquitous in the environment, resulting in widespread exposure of humans and wildlife. BPA was shown to cause reproductive effects via disruption of both the oestrogen and androgen signalling pathways. Recent studies suggest that BPA also affects epigenetic signalling pathways, including alterations in transcription of DNA methylation maintenance enzymes and altered DNA methylation profiles. This study aims to investigate how previous exposure of adult fish to BPA affects their response and the response of their offspring upon re-exposure, and whether there is an epigenetic basis for these effects. Breeding groups of zebrafish (Danio rerio) were exposed to 10 and 100µg BPA/L for 5 days, either once (C-100) or twice (10-100) with a 13 day period of depuration in between. The adult gonads were sampled at each location and year. The 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 ingested OHCs. Though, in our analyses the SI values were only important in explaining variation in POPs but not PFAS levels. We also observed that age at sampling is an important factor, as legacy POPs are decreasing while PFASs 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 years and between both locations, suggesting that migrations may not always shape prey. Hereby we emphasize the importance of ecological and biological variables when investigating OHCs in an avian top predator.

Epigenetic and evolutionary toxicology: from mechanisms to risk assessment (PC)
naïve 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 we will now analyse the promoter DNA methylation of amh to investigate this hypothesis.

WEPC02 Zebrasfish 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 and are even less studies assessing these effects over multiple generations. It is hypothesized 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-ethylhexylphthalate (MEHP) and ionizing radiation. 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 generations 1, 2 and 3, 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 histone modifications such 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.

WEPC03 Can changes in DNA methylation be linked to exposure of plants to radiation over multiple generations? N. Horemans, Belgian Nuclear Research Centre (SCK-CEN) / Biosphere Impact Management; G. De Smedt, SCK-CEN; M. De Vleeschouwer, SCK-CEN / Biosphere Impact Studies; S. Gaschak, Chornobyl Center; K. Nanba, 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 Chornobyl is investigated and compared with lab experiments in either a chronic, acute, multi, or single event, and environmental set up. Our hypothesis was 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 Chornobyl (CZ) and Fukushima affected areas (FEZ) in the course of May 2016. Annual Brassicaceae plants, 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 multidirectional 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 mGy/h) for 14 days in one, two or three generations. Plants were harvested for their root length, photosynthesis, ratio of the green to the red 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.

WEPC04 Evolutionary toxicology: tools to understand impacts of past, present and future environmental contamination S.F. Crawford, RWTH Aachen University / Institute for Environmental Research, Department of Environmental Toxicology; T.D. Outwater, 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 Bioground; H. Hollett, RWTH Aachen University / Institute for Environmental Research This research will utilize environmental reconstruction methods along with palaeontological, palaeoecological, and palaeogenetic 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 application 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 evolution in response to chronic environmental contamination. Furthermore, evolutionary 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 of contaminants. Toxico logical 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.

WEPC05 Chemical and physical stressors shape the population genetic structure of aquatic invertebrate populations P. Inostroza, University of Gothenburg / Effect Directed Analysis; I. Vera-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, inbreeding, and altered gene flow patterns, 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 stressors 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 depression of allelic richness in native G. pulex populations. We further found that weirs disrupted the migration across the river and thus 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 depression of allelic richness in native G. pulex populations. We further found that weirs disrupted the migration across the river and thus the genetic structure of a shredder invertebrate, Gammarus pulex, was examined using evolutionary toxicology and body burden of organic micropollutant approaches.
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 reformulation on markets and safety aspects of nanomaterials. In the EU market, 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 on the safety of nanomaterials in the EU market”. The presentation will provide an overview of the activities of the EUON, including the background, the current content of the Observatory, and planned future developments. 

WEPC09
Roadmap for the unknown M. Luitwieler, M.H. Wagelmans, 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. This means that more and more compounds will enter the environment in low volumes. Also time-to-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 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 been 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 licence to discharge in January for province, municipalities, water boards, water company and RWS. The results of this workshop will also be highlighted.

WEPC10
EVOKE...
Monetary valuation of environmental impacts from human activities is a way of understanding and communicating its societal significance. However, monetary values are easy to accept without knowing the many ways they can be determined and the many perspectives they may represent. ISO TC 207/S1 has set up a working group to develop a common framework standard on monetary valuation of environmental impacts and related aspects (assessment of use and resources) to increase transparency and its use in management. The standard contains requirements and recommendation on how to document and report information (metadata) about what a monetary value represents and how it is developed. As a part of the Swedish contribution to the work, three case studies were made to test the new module and to find out which metadata that had the greatest influence on decisions made. The cases represented three choices of ways to produce energy, i.e., between natural gas and waste and heat from waste incineration, one between different vehicle propulsion techniques, and one between different ways of sludge treatment and energy recovery. We have used the EPS 2015 dx method to value emissions and resources and a national Swedish database used for cost-benefit studies. The results indicate that these important metadata to report is the system boundaries of the impact valuation i.e., which impacts on which environmental goods and services that is included in the valuation. The system boundaries of impacts may vary in time, and object that is valued. The object may be chosen anywhere in a cause-effect chain. System boundaries also exist for the population whose values are assessed, and for the emissions and resources used. One mega-trend today is public influence, then on the citizens will discuss how the other assumptions relating to future conditions. The cases, where the alternatives mainly 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. Bielmyer-Press, 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 and benefit studies. The results include 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 conferences. The collaboration lead to applications and ultimately secured funding, successfully incorporated service learning and research opportunities for students, pursued and communicated meaningful research and managed teaching across very different disciplines.

WEPC13

Let's go visual, a picture is worth a thousand words: How to explain Emerging Contaminants using animations

N. Ospina-Alvarez, N. 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-tech products (optics, electronics, medicine). However, many of these elements are toxic (e.g. thallium, Chromium), critical metals that are used in many applications. Furthermore, during the mining processes of its extraction can be transferred to the environment, increasing its availability in the environment. Basic research about Technology-Critical Elements (TCE) and Emerging Contaminants (EC) is needed, but also is part of the research process to transfer this knowledge to a general public. Within this framework, the University of Potsdam and GeoEd (http://geoeducation.de/) started a pilot project to develop teaching and learning materials related to emerging contaminants in the environment. In this presentation, we will show how a complex topic, can be easily included in modern science classes, going from a general concept (TCEs and EC) to a particular study case (phytoextraction of thallium from soils using mustard plants). All the material produced implements the Open Educational resources (OER) concept, which aims towards free access, documents with open license and media useful for teaching, learning, as well as for research purposes. The OER concept allows to new initiatives and projects, produce educational material accessible without time-wise or spatial barriers. Acknowledgment: This project is supported by an Outreach Grant of AXA Research Fund (Paris, France) and the Research Focus of Earth Sciences (RFES), University of Potsdam (Germany). Key words: Emerging Contaminants, Technology-Critical Elements, raw materials, science communications, outreach.
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 and core policy beliefs concerning alternative testing methods of respondents 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 compositions for construction materials

S. Ohi, T. Seki, University of Ulsan / Department of Civil and Environmental Engineering; Y. Sou, University of Ulsan / Civil and Environmental Engineering

Feasibility of biochar for construction material was examined through synthesis of biochar-mortar compositions and evaluation of their construction and environmental properties according to mixing ratios. Characterization of biochar-mortar compositions showed that 3-5% biochar inclusion did not significantly change their flowability, compressive strength, and thermal conductivity. As biochar content increased in biochar-mortar compositions, 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 Micotek® bioassay tests showed that biochar-mortar composite were not toxic. Our results suggest that biochar-mortar compositions 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. Wondrusch, G. Schuermann, Helmholz 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 to be 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 In(III) and Ge(IV) complexes. Following a first principles approach, both 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 In(III) and Ge(IV) is investigated in comparison to Fe(III), Fe(III), Cu(II) and Zn(II). The importance of both properties arises from expected high concentrations of these interfering ions relative to the strategic elements of interest. Financial support from the Krüger Research School “Biohydrometallurgical Center for Strategic Elements” BHZM (Nr. 02110205) is gratefully acknowledged.

**WEPC19**

Cellulose Nanofibers as building blocks for innovative materials for remediation

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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 polyethylenimine (bPEI).3 These 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 removing of fluoride ions.5 Furthermore, the addition of citric acid (CA) as co-crosslinker enforce the mechanical and structural performances.6 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 led to slower kinetic release in aqueous environments if compared with materials obtained without CA.4 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 (Zn2+, Cd2+, Pb2+, Cr3+ and Cu2+) and organic contaminants (e.g. pyrrolizidine alkaloids/macrodiolides).7,8 This is knowing regarding the affects 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 (Isochrysis galbana), Nanochloropsis gaditana, Phaeodactylum tricornutum, Tetraselmis chuii and Thalassiosira pseudonana), rotifer (Brachionus plicatilis), bivalves (Cerastoderma edule and Mytilus galloprovincialis), polychaete (Hediste 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 observed in bivalves and crustaceans. We recently demonstrated the use of the NanoBonD model (PNEC) of Zn-Al LDH for seawater was set at 0.2 μg/L, based on the lowest NOEC available (Martins et al. 2017). The results suggest that Zn-Al LDH is a promising engineered nanomaterial featuring a very low environmental hazard.

**WEPC21**

Studying microfibre release from textiles towards improved clothing design

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Clothing manufactured from synthetic fabrics such as polyester and nylon can release hundreds of microfibres to water waste systems when washed in domestic washing machines. Fleece fabrics have been of particular focus, however, fleece clothing can be made from a wide variety of different fabric constructions, which may exhibit different microfibre release characteristics. Mechanical and chemical finishing of the yarn and fabric will influence the size and
volume of the microfibres released. In the current study, we assess the release of microfibres 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 (140cm x 90cm) was prepared by overnight soaking to remove residual melamine-based fertilizer. Washing was carried out with a standard synthetic clothing program (40°C, 60 min., 1200 rpm). Weights inside the washing machine assured same 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 of microfibres shed from 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-weighed 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.

WEPC23 Exploring a Potential Nanofertilizer: Effects of Silica Nanoparticles on Alfalfa (Medicago sativa)

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 (SiO₂-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 SiO₂-NPs and conventional fertilizer and pesticide ingredients, and combinations thereof, on the agricultural legume alfalfa (lucerene, Medicago sativa). The SiO₂-NPs used for the experiments were ~60 nm in primary particle diameter. As reference substances for conventional pesticides, the broad-spectrum 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 SiO₂-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 phytostimulative micromineral. The use of silica in nanoagrochemicals promises to reduce the organic pesticide burden of agricultural soil and crops.

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LCA and beyond - integrating sustainability and/or other dimensions to improve decision support (PC)

WEPC24 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 proponent of the EU pilot on PEF for pasta production. Furthermore, the 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 and provides a tool to manage sustainability in which instruments aim at setting, gathering and validating 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 for PEF information 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 able to increase competitiveness with important benefits for sustainable agriculture and food production. This approach would be good also for consumers. Giving people reliable and comparable information about the environmental impacts and creating tasty, nutritious and organoleptically acceptable products is 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 added rules and values in the PEFCR document have been established to allow 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.

WEPC25 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

Evonik DSM founded 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, leading to 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.

WEPC26 Balancing Environmental and Health Impacts of Food Production and Consumption
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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 shown to contribute to micronutrient deficiency, 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

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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

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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.
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