Comparing chemical analysis with literature studies to identify micropollutants to be treated or upstream source controlled in a catchment of Copenhagen (DK)

Lützhøft, Hans-Christian Holten; Birch, Heidi; Eriksson, Eva; Mikkelsen, Peter Steen

Published in:
Abstract Book

Publication date:
2012

Document Version
Publisher's PDF, also known as Version of record

Citation (APA):

General rights
Copyright and moral rights for the publications made accessible in the public portal are retained by the authors and/or other copyright owners and it is a condition of accessing publications that users recognise and abide by the legal requirements associated with these rights.

- Users may download and print one copy of any publication from the public portal for the purpose of private study or research.
- You may not further distribute the material or use it for any profit-making activity or commercial gain
- You may freely distribute the URL identifying the publication in the public portal

If you believe that this document breaches copyright please contact us providing details, and we will remove access to the work immediately and investigate your claim.
and biochemical responses. For example, a number of highly replicated fish-life cycle and multi-generational tests have examined growth, development, and reproductive success in combination with biomarker endpoints such as vitellogenin, GSI, and gonad histology. Analyses of sperm quantity, gonadal development, V7G, genomic markers, and other non-traditional endpoints have also been reported in the literature, often in isolation of a link with more traditional endpoints. In determining the utility and relevance of these endpoints a number of complicating factors need to be considered, such as endpoints and endpoints in relation to other biomarkers and sublethal findings, which may or may not be adverse, to population relevant assessment endpoints must be established and data quality and reliability must be determined. The evaluation of data, including both traditional and non-traditional endpoints should be done in a weight of evidence approach in order to reach a scientifically defensible risk determination. In so doing, potential adverse effects of the examined chemical may be used as measures of effects that are directly related to assessment endpoints for a sound and robust risk assessment. A case study describing this approach for the evaluation and use of both traditional and non-traditional endpoints will be presented in the extensive aquatic database for BPA.

RA23P - Wastewater effluent discharges: characterisation and understanding potential risks in receiving waters

TH 303
Risk assessment of WWTPs water effluents using fuzzy logic
J. Cabanillas1, A. Gnebre2, D. Guillen1, E. Martin2, D. Barcelo1, L. Moragas1, J. Robust1,* R.M. Darbra1
1University Politecnica de Catalunya, Barcelona, Spain
2CSIC, Barcelona, Spain

The Catalan Water Agency (ACA) conducted three different campaigns with this purpose in 2008, 2009 and 2010. A total of 41 micropollutants belonging to different families (e.g. heavy metals, volatile organochlorine compounds (VOX), Polycyclic Aromatic Hydrocarbons (PAHs)), were analysed in the sampling campaigns and their concentration levels of these pollutants.

The driving force to develop this study has been the increasing need of prioritizing pollutants appointed by different water regulations such as the Regulation 166/2006 [1] concerning the establishment of a European Pollutant Release and Transfer Register. It aims at establishing a Community level register of integrated pollutant release and transfer (IPER/Tr), for certain E-PRTR (or E-PRTR) substances and waste streams. Its application to different wastewater treatment plants (WWTP) with a capacity of more than 100,000 equivalent inhabitants. Data gathered under the E-PRTR regulation provide a valuable source of information regarding the emission of pollutants to air, water and waste from the assessed installations.

The Catalan Water Agency (ACA) conducted three different campaigns with this purpose in 2008, 2009 and 2010. A total of 41 micropollutants belonging to different families (e.g. heavy metals, volatile organochlorine compounds (VOX), Polycyclic Aromatic Hydrocarbons (PAHs)), were analysed in the sampling campaigns and their concentration levels of these pollutants.

TH 304
Simultaneous assessment of biodegradation of cationic surfactants in activated sludge reactors (OECD 303)
R. Geerts, M.G.J. Geurts, C.G. Ginkel van

The Continuously-Fed Activated Sludge (CAS) test is suitable to predict the removal of organic compounds from wastewater in activated sludge plants. However, a method to distinguish between removal by adsorption and biodegradation is not provided in the Guidelines. Accurate knowledge on the relative role of the different mechanisms in the overall removal processes in activated sludge systems is therefore not available.

The main operating parameters i.e. hydraulic retention time (HRT) and sludge retention time (SRT) are strictly maintained during operation of a CAS unit. The following equation was used to calculate the maximum concentration in adsorbed surfactant on the sludge:

$$ C_{surfactant \_max} = \frac{K_{HRT} \times C_{surfactant \_inlet}}{1 + \frac{K_{HRT}}{C_{surfactant \_inlet}}} $$

Biodegradation was assumed not to occur. This maximum concentration of surfactant absorbed on the sludge and the measured surfactant concentrations in the mixed liquid suspended solids allow calculation of biodegradation percentages. The removal of five cationic surfactants is assessed in terms of adsorption capacity (98.8% for dioctadecylmethylamine, 99.9% for dioctylamine, 99.9% for dioctadecylmethylammonium chloride) was assessed in CAS tests. The removal from the wastewater ranged from 98.8% (dioctadecylmethylamine) to >99.9% (dioctylamine). Removal by biodegradation was 69% (dioctadecylmethylammonium salt) to >99.9% (dioctylamine). These removal percentages were compared with modelling results obtained with SimpleTreat. Simple Treat not only predicts the potential of biological treatment systems to remove surfactants from wastewater but also the fraction removed by biodegradation. Especially, biodegradation of surfactants with a high potential to adsorb is not enough is accounted for by SimpleTreat. The expression should be updated in an included in the test guide.

TH 305
Predictive modelling of steroid oestrogens in sewage effluent demonstrates the potential for endocrine disruptive effects in wild fish populations in South Australia
C.J. Green1, A. Kumar2, S. Jobling3
1Brunel University, Uxbridge, United Kingdom
2CSIRO Land and Water, Adelaide Laboratory, Adelaide, Australia
3Environment Australia

Endocrine disruption (ED) has been observed in wild fish populations worldwide and is particularly well characterised in the UK, where the presence of oocytes in the male gonads of several fish species below the spawning season has been linked to sewage containing the natural oestrogens 17β-oestradiol (E2) and oestrone (E1) as well as the pharmaceutical 17α-ethinylestradiol (EE2) originating from human excretion. In contrast, little is known about the presence and effects of these chemicals in Australia, where there is a greater strain on water resources. Oestrogens have been measured in sewage effluents at levels comparable with the UK and there is some evidence of ED effects in fish downstream of sewage treatment works (STW's). It is therefore advisable to determine the potential levels of oestrogens entering Australian rivers and to assess the risk to wild fish populations. This study demonstrates the first use of predictive modelling of oestrogens in Australian STW effluent, creating predicted environmental concentrations (PECs) for a set of STWs in South Australia and comparing them to the UK using a modified version of a model previously for risk assessment in both Europe and Japan. The PEC's were accumulated into an E2 equivalent concentration (EEQ) and were corroborated against measured concentrations from one UK and one Australian STW to determine their accuracy. These were then compared with the UK Environment Agency's predicted no-effect concentration (PNEC) of 1ng/L E2. Predictive modelling was shown to provide a good method for first tier assessment of the environmental impact of effluents. The model overestimated the measured EEQ by an average factor of 1.4 when corroborated with the more robust UK STW data, however the effluent EEQ PEC's for all STW's were 3-31 times higher than the 1ng/L PNEC. The model demonstrated that although Australian STW's serve a lower population, their EEQ's are not significantly different to the UK's, which is likely to be due to the lower flow through Australian STW's which lowers the biodegradation of surfactants with a high potential to adsorb is not enough is accounted for by SimpleTreat. The expression should be updated in an included in the test guide.

TH 306
Inputs of pollutants by urban wet and dry weather pollution in combined sewer systems: pau urban catchment (CDAPP, France)
T. Bersinger1, G. Bareille2, T. Pigor1, I. Le Hecho1, A. Lecomte1
1LaBie, Pau, France
2Egée, Pau, France

Urban inputs that include household effluents, drainage water, business effluents (e.g. car washes, dental uses, other enterprises, etc.), atmospheric deposition and traffic-related emissions, discharge from waste, brake lining, asphalt, transported either to the treated water or treated water plants or directly to the aquatic environment, are expected to represent today important sources of pollution to the aquatic environment. Wastewater treatment plants represent a major threat to the aquatic environment since they are collecting a wide variety of sources from both domestic and industrial activities and they are continuously discharging various polluted effluents. Urban inputs are considered as a transient source may also contain high levels of pollutants directly discharged in receiving streams by Combined Sewer Overflow (CSO). Implementation of the European Water Framework Directive and its affiliated directives requires Member States to improve their understanding of priority pollutants in urban areas and obviously within wastewater systems.

For example, the wastewater treatment plant at Pau urban catchment (CDAPP, France) which is about 50 km² with about 150 000 inhabitants. 4 rain gauges and about 40 flow meters were included in the study area to monitor the combined sewer network. Effluents were followed during about 10 campaigns including wet and dry periods for Suspended Solids (SS), Chemical Oxygen Demand (COD), Total Nitrogen (TN) and trace metals (Cd, Cu, Pb, Zn, Al, Fe, Cr, As, Sn). Emphasis is given to the characteristic, the partitioning and the occurrence of effluents from wastewater inputs during dry periods and wet periods in the combined sewage system of Pau. Concentrations of pollutants were combined with flow rate to assess fluxes that were directly discharged into receiving stream by CSO or carry on to the Waste Water Treatment Plant (WWTP). Following a storm event of about 2 hours we showed that this storm event induces an increase of fluxes by a factor of 1.5 to 3 compared to dry conditions. Half to two thirds of pollutants fluxes were treated by the WWTP during this period. The remaining part of the effluent was discharged in the receiving stream the river Gave de Pau. Fluxes of trace metals followed generally the same percentage than SS, suggesting that metal load is mainly associated to SS.

TH 307
Demiography, economic activities and health equipments as potential sources of pharmaceutical compounds in wastewater and performance of wastewater treatment in two

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
French catchments

V. Brochier, K. Seriki, G. Leroy, V. Boireau, L. Castillo

Veolia Environment - Research and Innovation, Rueil-malmaison, France

Presence of micropollutants in wastewater is threatened by numerous studies. Although important research work is conducted on wastewater treatment plant (WWTP) performances, less is known on the contaminants sources. In fact, this information coupled with the knowledge of treatment efficiency could be very useful to manage WWTPs. In this perspective, the objectives of this work were to assess if pharmaceutical concentrations in wastewater could be explained by urban parameters in two urban catchments and compare their treatment performances.

Only 40 km separate both catchments, which have similar population density and distribution. However, catchment A has a higher number of inhabitants, health equipments and economic activities. Both WWTPs use the same technology (membrane bioreactor) to treat urban wastewater, but have different inflows (catchment A 10 times higher than catchment B). Influent and effluents streams were monitored during 3 campaigns over 3 days with 24 hours composite samples. Pharmaceuticals and hormones were analyzed using LC-MS-MS. Results are shown for 632 studied compounds: acetaminophen (ACT), diclofenac (DIN), carbamazepine (CBZ), sulfamethoxazole (SMZ), isopropyl (IMP) and β-estradiol (E2).

Fluxes were 3 times higher in WWTP-A for ACT, E2, SMZ and DIN, 80 times higher for CBZ and 1350 times higher for IMP. The differences for CBZ and IMP were not only explained by the cities sizes but also by the presence of more potential sources in catchment A than B. Concentrations of DIN, SMZ and E2 were similar in both WWTPs. CBZ and IMP were respectively 10 and 183 times higher in WWTP-A. In contrast, ACT was 2 times higher in WWTP-B. Those concentrations could be explained by a discharge into the sewer network in be. IMP, ACT and E2 showed higher elimination between 76% and 99% in both WWTPs. Therefore, removal efficiencies SMZ was quite stable in WWTP-A due to a dilution effect due to the higher discharge in WWTP-A. Then, in both WWTPs, concentrations of CBZ and DIN in effluents were respectively 0% and 6-42% lower than in influents. In contrast, IMP, ACT and E2 showed higher elimination between 76% and 99% in both WWTPs. Therefore, removal efficiencies SMZ was quite stable in WWTP-A. (74% to 85%) and greatly varied in WWTP-B (0% to 96%).

Results showed the presence of potential pharmaceuticals sources: some were strongly suspected, others needed further investigation. The main perspective could be to develop a methodology to predict the fluxes of compounds entering the WWTP based on urban characteristics to define suitable technologies for the best treatment efficiencies.

TH 308

Wastewater effluents and river sources: sources of organic micropollutants to NW Mediterranean coastal waters. Their characterization, fluxes and potential risks

J. Sánchez-Arúa, R. Tauler, S. E. Ibáñez

IDAEA-CSIC, Barcelona, Spain

This study provides a first estimation on the risk associated with the inputs of organic micropollutants (OMPs) to coastal waters from NW Mediterranean Sea. Pollution sources were wastewater treatment plants (WWTP) effluents and river waters discharged to the sea. Polycyclic aromatic hydrocarbons, polychlorinated biphenyls, organonitrated pesticides, polibrominated diphenyl ethers, phthalates and alkylphenols were analyzed by solid phase extraction and gas chromatography coupled to tandem mass spectrometry (SPE-GC-MS/MS). Eight WWTP effluents and six rivers discharge an estimated amount of around of 25 800 g d⁻¹. The concentration of ZMP in coastal areas ranged from 1.74 to 8942 ng L⁻¹. A summarized overview of the patterns and sources of OMPs contamination on the investigated coastal sea waters of NW Mediterranean Sea, as well as of their geographical distribution was obtained by Principal Component Analysis of the complete data set after its adequate pretreatment. The main OMP sources evaluated were wastewater treatment plants (WWTP) effluents and river waters discharged to the sea. Polycyclic aromatic hydrocarbons, polychlorinated biphenyls, organonitrated pesticides, polibrominated diphenyl ethers, phthalates and alkylphenols were analyzed by solid phase extraction and gas chromatography coupled to tandem mass spectrometry (SPE-GC-MS/MS). Eight WWTP effluents and six rivers discharge an estimated amount of around of 25 800 g d⁻¹. The concentration of ZMP in coastal areas ranged from 1.74 to 8942 ng L⁻¹. A summarized overview of the patterns and sources of OMPs contamination on the investigated coastal sea waters of NW Mediterranean Sea, as well as of their geographical distribution was obtained by Principal Component Analysis of the complete data set after its adequate pretreatment.

TH 309

Chemical characterization and treatment by enhanced coagulation of dissolved organic matter in biofiltration treated effluent of textile wastewater

T.P. Yuan, F. Z. Wu, L. Zuo, J. R. Ni

Peking University, Beijing, China

Characterization of wastewater effluents from a small textile mill was performed to evaluate the potential of dissolved organic matter (DOM) removal by chemical coagulation. The textile mill produces effluents with high COD, BOD, and TOC concentrations. A series of chemical tests were performed to evaluate the composition and structure of DOM. The results showed that DOM is composed of a large number of low molecular weight organic substances. In addition, the effluents were analyzed for metals, pH, and temperature. The results showed that the effluents have a high metal content and high pH. The effluents were subsequently coagulated with a combination of aluminum chloride and polyaluminum chloride and the results showed that the DOM removal efficiency was up to 85%. The study demonstrated that chemical coagulation is a feasible method for DOM removal from textile wastewater effluents.

TH 310

Emerging substances in aquatic phase of landfill leachate

S.K. Kovacevic, M.V. Miloradov, M.D. Dogo, D.M. Milovanovic, I.S. Spanik, M.D. Dimlic, J.R. Radonic, D.A. Adamovic

Faculty of Chemical Engineering, Novi Sad, Serbia

The study evaluated the occurrence of emerging pollutants in landfill leachate from a large municipal landfill in Serbia. The landfill received domestic and industrial waste and has been operational for more than 30 years. The leachate was sampled at different times during the summer, winter, and spring, and analyzed for selected emerging pollutants. The results showed that the concentration of emerging pollutants varied significantly over time and location. Bisphenol A, nonylphenol, and alkylphenols were the most abundant emerging pollutants in the leachate. The study also evaluated the potential risk associated with the presence of these emerging pollutants in the leachate, using a Toxic Unit approach. The results showed that the risk of these substances was assessed using a Toxic Unit approach. In total around 250 substances were analysed on the sheets, and large differences existed between locations, but also between rounds. Surprisingly the largest group of substances, in terms of concentrations, were the pesticides, followed by flame retardants and personal care products (PCPs), flame retardants, industrial additives, anticorrosive compounds and others emerging species). The emerging substances are contaminants that have been recently released to the environment and have the potential to cause adverse effects on aquatic ecosystems. The study evaluated the occurrence of emerging pollutants in landfill leachate from a large municipal landfill in Serbia. The landfill received domestic and industrial waste and has been operational for more than 30 years. The leachate was sampled at different times during the summer, winter, and spring, and analyzed for selected emerging pollutants. The results showed that the concentration of emerging pollutants varied significantly over time and location. Bisphenol A, nonylphenol, and alkylphenols were the most abundant emerging pollutants in the leachate. The study also evaluated the potential risk associated with the presence of these emerging pollutants in the leachate, using a Toxic Unit approach. In total around 250 substances were analysed on the sheets, and large differences existed between locations.
two locations. This was largely caused by a small number of pesticides with very low PNEC values being present at this location. Although not significant, all three wetlands showed a slight decrease in environmental risk from location 1 to 4. In terms of removal of organic micro pollutants, constructed wetlands only show a minor efficiency, and seem to be more efficient in biologically vitalizing the effluent.

TH 313
Assessing the potential of constructed wetlands in reducing environmental impact of STP effluents: the WIFE project
E.M. Foecke, B. Van der Oost, E.W.M. Roex, A.J. Mulk
IMARES, Den helder, Nederland
1Water, Institute for Water Cycle Management, Amsterdam, Nederland
2United, Utrecht, Nederland
3Wageningen University, Sub-department of Toxicology, Wageningen, Nederland

At some pilot locations in the Netherlands, the effluent of sewage treatment plants (STPs) is lead through a constructed wetland (so called "waterharmonica") before being discharged to the nearest water body. This has been shown to be an effective method for treatment of the STP effluent. The WIFE (Waterharmonica Improving Purification Effectiveness) project studied the potential of such constructed wetlands to reduce the environmental impact of STP effluents on the receiving water, with special emphasis on ecotoxicological aspects. The (changes in) effluent quality of three STPs was monitored during the passage through constructed wetlands. This monitoring program, comprising regular sampling, chemical analysis and biological and genetic expression responses of chronically exposed stickleback (Gasterosteus aculeatus), the monitoring was performed between 2008 and 2011 and generated an extensive dataset. In this presentation we will give an overview of how different environmental relevant endpoints were affected during the passage through the constructed wetlands.

To reliably characterize the STP effluent, several different types of analyses were conducted. A wide range of organic chemicals were detected on the passive samplers, but in general these were not affected in a structural way by the passage through the wetlands. Occasionally peaks in toxicity were observed, that indicate a potential risk for the receiving surface waters.

The intensity of these toxicity peaks was reduced after passage through the wetland. No indications were found that the effluents in general affect the reproductive success of the stickleback. The presence of a temporary poor effluent quality can affect survival. Gene expression indicated estrogenic effects on the male fish. This endocrine disruption was less at the end of the wetland where the effluent is about to be discharged on the surface water. This observation is in line with the results from the in-vivo-assays for estrogenic potential and with the observation that the microbial community in the wetland sediments have a high potential to reduce estrogenic activity. Finally, it was found that densities of pathogens in the effluent were substantially reduced during passage through the wetlands. Constructed wetlands can thus help to improve the environmental quality of STP-effluents. Especially by levelling off high peaks in the toxicity and by reducing the density of pathogens.

TH 314
Inventory of emissions of priority hazardous substances in the surface waters in France
A.M.J. Goury, J.M. Brignon
INERIS, Vernouillet-en-halatte, France

Introduction
According to Article 5 of the Directive 2008/105/EC on Environmental Quality Standards in the Field of Water Policy, Member States have to establish an inventory of emissions, discharges and losses of all priority substances and pollutants listed in Part A of Annex I to this Directive. This paper aims at describing the French approach used to revise and to complete this inventory, to give some exemples of calculations carried out on French river basins;
- the general working shem of the methodology and few definitions;
- the input data needed for the french approach;
- some example calculations carried out on French river basins;
- the data compilation process.

Methodology guidelines
Methodology definition was guided by the following key ideas:
- A state-of-the-art methodology in agreement with regimentary requirements, and EU guidance;
- A tool specific methodology. The approach is based on efficient discharges data; in their absence some explicit estimation formulas are proposed.
- A single methodology applicable at different spatial scales.
- A methodology that will work despite scarcity of information and data, and uncertainties.
- Functionality as a management tool for designing strategies for the reduction of the impacts of chemical pollution in watersheds.

The objective of this work was to evaluate possible toxic effects of sludge samples from urban septic tanks and upflow anaerobic sludge blanket (UASB) from a wastewater treatment plant located in the University of Espirito Santo, Vitória, Brazil. The method employed was the acute toxicity test Microtox (Azur Environmental) based on the luminescence inhibition of the marine photobacterium Vibrio fischeri. It is a test with many advantages such as ecological relevance, sensitivity, reproducibility, standardization and simple execution. A series of physical-chemical parameters were also analyzed based on Standard Methods for Examination of Water and Wastewater (APHA - 1998). Sludge from four septic tanks was used in the study. From each tank four samples were collected, each aliquot representing a distinct depth, classified as: 1. superficial liquid, 2. superficial sludge; 3. bottom sludge and 4. mixture from all the previous. From the UASB equivalent fractions were also sampled. The tests were executed according to the Microtox User’s Guide Manual (AZUR Environmental, 1996) and results were expressed in EC50 (Effective Concentration), a value that represents the sample concentration in which 50% of the bacterial luminescence is inhibited. Only in one of the septic tanks, located in a public building toxic effects could be verified executed according to the Microtox User’s Guide Manual (AZUR Environmental, 1996) and results were expressed in EC50 (Effective Concentration), a value that represents the sample concentration in which 50% of the bacterial luminescence is inhibited. Only in one of the septic tanks, located in a public building toxic effects could be verified.

The main aim of the present study was to generate preliminary results on the evaluation of C. fluminea bioremediation potential in the treatment of several effluents with industrial and commercial interest. This study is part of a broader assessment that considers a battery of wastewater effluents such as acid mine drainage, and pulp mill effluent. The toxicity of the initial clams feeding solution and the post-filtration effluent to non target organisms (the bacterio Vibrio fischeri, the microalgae Pseudokirchneriella subcapitata and the cladoceran Daphnia sp.) was assessed through laboratory bioassays. These bioassays were supported by the analytical characterization of the exposure media before and after the clams filtration. Although the Asian clam is an invasive species and problems may arise from the intentional introduction of the discharge environments, controlled systems that allow us to capitalise on their filtration and bioaccumulation capacities may be assembled. Such a wastewater treatment method could bring huge benefits (e.g. output improvement and costs reduction) in the industrial context.

TH 316
Acute toxicity analysis of urban septic tank sludge
B. Miqueletto, R.C. Chagas, C. Veronesi, C.M. Soprani, R. Franci, S.T.A. Cassini
Federal University of Espirito Santo, Vitória, Brazil

The objective of this work was to evaluate possible toxic effects of sludge samples from urban septic tanks and upflow anaerobic sludge blanket (UASB) from a wastewater treatment plant located in the University of Espirito Santo, in Vitória, Brazil. The method employed was the acute toxicity test Microtox (Azur Environmental) based on the luminescence inhibition of the marine photobacterium Vibrio fischeri. It is a test with many advantages such as ecological relevance, sensitivity, reproducibility, standardization and simple execution. A series of physical-chemical parameters were also analyzed based on Standard Methods for Examination of Water and Wastewater (APHA - 1998). Sludge from four septic tanks was used in the study. From each tank four samples were collected, each aliquot representing a distinct depth, classified as: 1. superficial liquid, 2. superficial sludge; 3. bottom sludge and 4. mixture from all the previous. From the UASB equivalent fractions were also sampled. The tests were executed according to the Microtox User’s Guide Manual (AZUR Environmental, 1996) and results were expressed in EC50 (Effective Concentration), a value that represents the sample concentration in which 50% of the bacterial luminescence is inhibited. Only in one of the septic tanks, located in a public building toxic effects could be verified executed according to the Microtox User’s Guide Manual (AZUR Environmental, 1996) and results were expressed in EC50 (Effective Concentration), a value that represents the sample concentration in which 50% of the bacterial luminescence is inhibited. Only in one of the septic tanks, located in a public building toxic effects could be verified.

The main aim of the present study was to generate preliminary results on the evaluation of C. fluminea bioremediation potential in the treatment of several effluents with industrial and commercial interest. This study is part of a broader assessment that considers a battery of wastewater effluents such as acid mine drainage, and pulp mill effluent. The toxicity of the initial clams feeding solution and the post-filtration effluent to non target organisms (the bacterio Vibrio fischeri, the microalgae Pseudokirchneriella subcapitata and the cladoceran Daphnia sp.) was assessed through laboratory bioassays. These bioassays were supported by the analytical characterization of the exposure media before and after the clams filtration. Although the Asian clam is an invasive species and problems may arise from the intentional introduction of the discharge environments, controlled systems that allow us to capitalise on their filtration and bioaccumulation capacities may be assembled. Such a wastewater treatment method could bring huge benefits (e.g. output improvement and costs reduction) in the industrial context.

TH 317
Comparing chemical analysis with literature studies to identify micropollutants to be treated or upstream source controlled in a catchment of Copenhagen (DK)
H.C. Holten Lützhøft, H. Birch, E. Eriksson, P.S. Mikkelsen

Technical University of Denmark, Kgs. lynbyh, Denmark

The European Water Framework Directive aims at obtaining good ecological and chemical status of European water bodies by the year 2015 (EU, 2000). The directive also requires that source inventories be designed and performed monitoring programs as well as to outline strategies to reduce emissions if the environmental quality standards are exceeded (EU, 2008). The aim of this study was to compare two different approaches to identify micropollutants in stormwater from a specified catchment; a literature inventory of potential pollution sources and chemical analysis of urban stormwater runoff. The selected catchment covers an area with roads, a shopping centre, a parking lot, office buildings, an upper secondary school and restaurants in Copenhagen (Denmark). The literature approach is limited to the range of included micropollutants and to how and which information is compiled, whereas the analytical chemical approach is limited to and affected by the sampling procedure, the selection of analysed
TH 318  
Toxicity identification evaluation for wastewater treatment plant working at different industrial and municipal scales  
W.D. Di Marzo¹, M.E. Szems¹, J.L. Alberdi², S. Curitese²  
¹CONCYTEG UNLU, Luján, Argentina  
²UNLU, Luján, Argentina  
A toxicity identification evaluation according international practice was performed taking into consideration the system used for depuration of wastewater. Process control in the WWTPs was monitored and the results were correlated with the toxicity of their liquid effluents. Monitoring cellular retention time (CSTR), dissolved organic carbon (DOC), presence of anaerobic and anoxic selectors, sludge microbiology, and operation index such as Sludge Volume Index (SVI), diluted Sludge Volume Index (dSVI), sludge volume (SV), base and spike Oxygen uptake rate (BOUR and sOUR), Mixed Liquor Volatile Suspend Solids (MLVSS), Mixed Liquor Volatile Suspend Solids (MLSS) and biofilm localization index (BLI) were recorded for each plant. A set of tests, together with the Solid Phase Microextraction (SPME) and Gas Chromatography-Mass Spectrometry (GC-MS) analysis, were performed for characteristic chemical fingerprints of each effluent. Data were interpreted by Principal Component Analysis (PCA) which allowed to classify for the first time, in Argentina, to rank in relation to type of industry, production volume and/ or number of inhabitants, from the data interpretation arise that the high production volume WWTPs (HPVPC) are prevalently charged at the aquatic environments of Buenos Aires province. It is need an urgent update of the parameters that the government and the wastewater operators and the inclusion of their ecotoxicity assessment to allow the download.

TH 319  
Application of delayed fluorescence to estimate the influence of waste water effluent on algae  
M. Katsumata¹, N. Tatarazako², S. Ogin², T. Koike³, K. Kazumura³, A. Takeuchi³, Y. Kobayashi³, Y. Sato³, Y. Sugaya¹  
¹Hokkaido University Photons K.K., Hamamatsus, Japan  
²National Institute for Environmental Studies, Tsukuba, Japan  
Waste water effluent is a major source of chemicals discharge in aquatic ecosystems. Since algae are important primarily producers in aquatic ecosystems, it is necessary to influence the monitoring of effluent not only on animals but also the algae. We are investigating a new method of for evaluating the influence of chemicals on algae by using delayed fluorescence (DF) from algae. The DF is a special type of luminescence; it detects the growth of only those cells that have photosynthetic capability. Since the DF originates from re-excitation of chlorophyll by a reverse reaction of photosynthetic electron transfer, the DF inhibition reflects inhibition of photosynthetic activity that is necessary for survival of algae. The DF is a potential endpoint for the estimation of the influence of chemical substances of aquatic plants in a short time than the conventional 72 hours growth inhibition test (e.g. OECD test guideline 210). The intensity of DF shows also a time decay curve. Chemical exposure changes the decay curve to patterns that have the potential to assist in the identification of contaminants in effluent sample. We have developed a rapid and simple DF test protocol using the green algae Selenastrum capricornutum. (Selenastrum capricornutum). The test algae are prepared by thawing specially prepared -80°C frozen algae in a 1 h pre-incubation. The prepared first algae can be immediately exposed to the test sample prepared in a range of effluent concentration (0, 5, 10, 20, 40, 80 %) in small culture tubes (10ml volume). The DF from algae in the culture tube is directly measured by the ultra-sensitive lumimetre at 1, 4, 8 h, and 24 h after exposure. DF is inhibited through the influence of the effluent. Further, effluent exposure changes the time decay curve of the DF intensity. From the relationship between the exposure concentration and the DF inhibitions could be done the dose-response curve for each effluent or mixture. In addition, the DF decay curve has potential for application to the identification of contaminants in the effluent. We will discuss results of a feasibility study evaluating treatments of industrial and agricultural effluents.

TH 320  
Ecological health assessment and stressor identification using multi-response bioindicators of fish  
J.H. Kim  
Korea Institute of Toxicology, Deajeon, South-Korea (Rep)  
This study was evaluated the effect of environmental stressors using various parameters such as chemical water quality, habitat evaluation, and chemical exposure biomarkers in the Gap stream, South Korea during May-June 2009. We collected the pale chub (Zacco platypus) as sentinel species to evaluate biomarkers and indicators at four sampling sites. The major changes observed were increased detoxification enzymes (EROD), DNA damage, physiological parameters, % of DLT anomalies, impaired reproduction, and reduced fish population structure in the downstream site (GS 7.2) of municipal wastewater treatment plant (MWTp). By the stressor identification (SI) process, five candidate causes of fish population degradation were winnowed including habitat alteration, low dissolved oxygen, nutrient enrichment, ammonia toxicity, and reduced food availability. The results of causal analysis suggest that the probable principal causes of fish population impairment in the downstream site below the MWTp were a combination of effects associated with recruitment failure and size-selective mortality caused by nutrient enrichment, ammonia toxicity, and habitat alteration such as degradation in spawning and nursery space.

TH 321  
Monitoring potential ecotoxicological effects in the effluent of an urban wastewater treatment plant  
A.E. Gerhardt¹, M. Hofer¹, N. Tatarazako², S. Ogino², T. Koike³, Y. Sato³, Y. Sugaya¹  
¹LimCo International GmbH, Konstanz, Germany  
²Unimom, Zurich dietikon, Switzerland  
³Limco, Konstanz, Germany  
Organic micropollutants cannot be completely removed by traditional wastewater treatment technologies. Therefore it is being discussed to add additional treatment steps such as ozonation, active coal filtration, UV-treatment etc. However, there is a lack of long-term studies to clearly prove a direct relationship between micropollutants in wastewater and ecotoxicological effects on the macrozoobenthos fauna in the recipient stream to justify future expensive installations. Online monitoring of the ecotoxicity of wastewater effluents provides a quantitative relation between chemical composition of the waste water and fitness (behavior, survival, biomarkers) of the indicator species. The indicator species is chosen according to pollution-sensitivity, abundance and key-role in the stream ecosystem, in our case gammarids. Gammarids were exposed in the Multiplex Freshwater Biomonitor[TRADEMARK] (MBF) placed in the UniPond[TRADEMARK] flow through system, receiving treated wastewater just before release into the river Limmat. Potential short term responses to episodic pollution pulses as well as long-term effects of the potentially toxic cocktail of the waste water were monitored on real-time basis over several weeks. Different species of gammarids were applied (D. villusus, G. pulex) and their sensitivity compared. These studies establish the baseline toxicity of the waste water in its current treatment before additional treatment steps might be installed in the future in order to record the effluent ecotoxicity prior to discharge. On the other hand, if during long-term monitoring with galactic potential ecotoxicological effects are detected the preparation test algae can be immediately exposed to the test sample prepared in a range of effluent concentration (0, 5, 10, 20, 40, 80 %) in small culture tubes (10 ml volume). The DF from algae in the culture tube is directly measured by the ultra-sensitive lumimetre at 1, 4, 8 h, and 24 h after exposure. DF is inhibited through the influence of the effluent. Further, effluent exposure changes the time decay curve of the DF intensity. From the relationship between the exposure concentration and the DF inhibitions could be done the dose-response curve for each effluent or mixture. In addition, the DF decay curve has potential for application to the identification of contaminants in the effluent. We will discuss results of a feasibility study evaluating treatments of industrial and agricultural effluents.

TH 322  
Implications of wastewater released by the industrial park in the Gap stream, South Korea during May-June 2009  
M. Englert¹, M. Bündschuh², J.P. Zubrod³, R. Schulz³  
¹Institute for Environmental Sciences, University of Koblenz-Landau, Landau, Germany  
²University of Koblenz-Landau, Landau, Germany  
³Limeco, Zürich dietikon, Switzerland  
European streams receive huge amounts of municipal wastewater, which, due to the limitations of conventional secondary treatment (i.e. mechanical and biological), may contain a wide range of micropollutants, like pharmaceuticals and personal care products. As such micropollutants are continuously released into aquatic environments, they may pose a potential risk for the integrity of ecosystems. Hence, the present study assessed adverse structural and functional implications of wastewater released by the municipal wastewater treatment plant (WWTP) in Landau, Germany, on its receiving stream, the Queich. For this purpose several endpoints related to the ecosystem function like leaf litter breakdown (microbial and invertebrate mediated leaf litter breakdown, in bioassays with Gammarus fossarum) and the structure of the aquatic invertebrate community were investigated for six and three weeks during winter and summer 2011, respectively. Macroturbulence related leaf litter breakdown in terms of leaf mass loss was by up to 65 % significantly reduced at sites situated up to 500 m downstream of the WWTP outlet compared to the upstream site during both seasons. This effect may be caused by the fact that the leaf litter degradation was reduced abnormally in the leaf shredding macroinvertebrates such as G. fossarum. Moreover, gammarids exposed in situ exhibited a significantly (up to 80% 100 m downstream during both seasons) reduced feeding rate at downstream sites, indicating lower energy availability and reduced reproductive output. These implications in leaf shredding macroinvertebrates and the ecosystem function of leaf litter breakdown may be on the one hand caused by direct ecotoxicological effects of the released micropollutants containing microorganisms which is supported by the results of the in situ bioassays. On the other hand, indirect pathways (e.g. nutrient enrichment) could be explained by a meaningfully reduced abundance of leaf shredding macroinvertebrates such as Gammarus fossarum.

TH 323  
Water quality investigations in the river Lea downstream a sewage treatment works: preliminary results of a case study  
P. Patroncini, D.M. Rawson, B. Hagger  
University of Bedfordshire, Luton, United Kingdom  
In the east of London the Lea Navigation, a canalised reach of the river Lea, is affected by episodes of very low levels of dissolved oxygen. The problem was detected by the Environment Agency in the stretch from the confluence with Pymmes Brook (which receives the final effluent of Deephams sewage treatment works) to the Olympic channel (Marshgate Lane, Stratford). In this study the river water ecotoxicity to the freshwater alga Pseudokirchneriella subcapitata was tested by algal growth inhibition test according to modified OECD guidelines (Organization for Economic Co-operation and Development, 2006). Results showed inhibited growth rate after 24 hours that was most probably due to the low dissolved oxygen and the pH level of the sampled populations. Rapid acute toxicity tests were carried out using immobilized amperometric whole cell biosensors (CellSense). Results indicated no evidence of acute toxicity in the river water, as no significant differences were detected between pre- and post exposure to river water samples, with an exposure time of 30 minutes. These results indicate chronic pollution of the river, affecting photosynthetic algae during long-term exposure.
In last decade, there has been growing public concern of contamination of water and environment with anthropogenic compounds and their degradation products and possible negative influence to the nature and public health. As a response to this fact, there is an increased interest in more efficient screening techniques of larger number of compounds. Many regulatory agencies are seeking more holistic techniques such as whole effluent toxicity testing (WEA) to supplement existing approaches. However, to ensure that these approaches are capable of indicating potential environmental effects, it is important to test scientifically robust WEA protocols. In general, WEA methodology assesses toxicity to aquatic organisms. WEA has relevance for the protection of the ecosystems although the relevance and interpretation of results ultimately depends on the tests used. In this project direct injection MS/MS spectra have been applied to the screening of anthropogenic sewage pollutants. Different to sample types were elminated, including waste water, receiving water, ground water and drinking water representing different steps within the water cycle of densely populated and intensively agricultural areas. References

Full Scan MS in Comprehensive Qualitative and Quantitative Residue Analysis in Food and Feed Matrices: How Much Resolving Power is Required?

Multi-bioassay approach for assessing the impact of industrial discharges on the water quality in Wallonia, Belgium
T. Nefau, T. V. Juffernholz, D. G. Gildemeister
Veolia Research Environment & Innovation, Châtenay-malabry, France
Thermo Fisher Scientific, Dreieich, Germany

The main objective of the project presented in this paper financed by TOTAL and the CONCAWE, is to show the real distance between WEA methodology which is conservative and in situ impact measurement for risk assessment. In this project, the difference between WEA and in situ impact assessment is measured using dynamic outdoor mesocosms. The project has been designed and realized in three successive steps: (1) Preliminary experiments in Laboratory to test the best solutions of pollutants and to evaluate the capacity of different methods for their separation; (2) Feasibility experiments in mesocosms with one effluent (how to select effluents, to sample the effluent in industrial site, to transport, to store and to inject large volume of effluent; How to measure the ecological impact in mesocosms); (3) Final experiment in successive steps with several effluents sampled in different sites and comparison with WEA methodology. In this presentation the design of the three steps of this project will be presented and discussed.
Characterisation of dissolved organic carbon in effluents and the assessment of its overall benefits in mitigating environmental impacts from metals

D.H. Leverett, A. Wick, T. Ternes, A. Coors
ECT Oekotoxikologie GmbH, Florsheim a.m., Germany

Bundesanstalt für Gewässerkunde (BfG), Koblenz, Germany

Effluent treatment plants (STP) are the most important sources for the entry of emerging pollutants like personal care products into the environment. Only recently, the anti-dandruff agent clotrimazole has been detected for the first time in a German wastewater treatment plant with concentrations around 0.5 µg L⁻¹. In raw wastewater and in activated sludge it was found with concentrations as high as 1.4 µg L⁻¹ and 1.2 µg g⁻¹ TSS, respectively. Clotrimazole is used as an anti-dandruff agent for hair care formulations as acting fungicide by inhibiting ergosterol biosynthesis. Despite its efficacy against moulds and fungi, the possible impact of clotrimazole on the environment has only fairly been studied. The aim of this work was therefore to characterise the ecotoxicological effects of clotrimazole on aquatic and terrestrial organisms of different trophic levels. Assessing the terrestrial toxicity is particularly relevant when treated wastewater or sewage sludge is to be applied in irrigation or as organic fertilizer on arable land.

In single-species tests the toxicity of clotrimazole was determined towards the aquatic organisms water lentsil, diatoms, green algae, fish embryos, daphnias and rotatoria and towards the terrestrial organisms bacteria, collembolans, enchytraeids and higher plants. All tested aquatic organisms were affected by clotrimazole concentrations below 15 mg L⁻¹. In water lentil L1 with the water lentil Lemna minor having the lowest EC50 in the µg per litre range. Among the terrestrial organisms the lowest EC50 was determined for the plants (Avena sativa and Brassica napus) with about 10 mg kg⁻¹ soil dry weight for inhibition of shoot growth. Test results reveal that among the different trophic levels, clotrimazole is most toxic towards primary producers in the aquatic as well as in the terrestrial habitat. Displayed effects were a reduction of shoot length in higher plants and of leaf (frond) size in water lentsil. This suggests an interference with the steroid metabolism of the organisms. Assessing the terrestrial toxicity of clotrimazole is particularly relevant when treated wastewater or sewage sludge is to be applied in irrigation or as organic fertilizer on arable land.

TH 330
Environmental impact of current reserve-antibiotics with increasing incidence of severe infections using modern waste water treatment

J. Bruening, J. Bressling, W. Dott
University Hospital of Aachen, RWTH Aachen University, Aachen, Germany

Antibiotic resistance is increasing since 30 years. Antibiotics previously used as reserve antibiotics, e.g. ciprofloxacin, are found in guidelines for treatment of slight infections. Due to uncritical prescription of broad spectrum antibiotics the amount of antibiotics used rises constantly. Many environmental studies proved the existence of different types of antibiotics in hospital sewage, municipal waste water, sewage disposal facilities and surface water or soil. For some substances critical concentrations with effects on algae, bacteria, daphnias and higher life forms were observed.

At the present Riftaxin, Piperacillin, Doripenem as well as the current reserve-antibiotics Tigecyline, Linezolid and Daptomycin are not classified as relevant to the environment because of their minor application. Hence environmental data for these substances are missing, as well as future schemes of use. Nowadays most environmental studies are focusing on older frequently prescribed substances. As a result of such assessments lags behind the modern pharmacotherapy and the achievements of the pharmacology.

The objective is to study potential effects on the environment of above antibiotics. Ecotoxicological testing is performed in standardised bioassays using 24- and 96-well microplates for algae and bacterial growth inhibition tests. Ecotoxicological testing with algae growth inhibition tests of new antibiotics showed increasing toxicity for Daptomycin and Tigecyline with EC₅₀-values of 14.4 mg L⁻¹ and 1.76 mg L⁻¹. There is no toxic effect for Doripenem and Linezolid at maximum test concentration (EC₅₀ > 100 mg L⁻¹).

Estimating PEC/PNEC-relations of these new substances has to take into consideration the increasing incidence of infections, changes in demographics as well as biodegradability, compartment-distribution-tendencies and additional waste-water treatment techniques e.g. ultraviolet light, ozone and membrane filtration.

TH 331
Comparative study of the ecotoxicity of dishwasher detergents

P. Pandard, N. Manier, F. Gondelle, O. Perczel
INRETS, Vincennes, France
ONEMA, Vincennes, France

This study was aimed at assessing the ecotoxicity of dishwasher detergents. Indeed, despite the high consumption of such products, available information regarding their environmental toxicity is scarce. Thus, twelve different products available on the French market were selected, covering the different dishwasher products categories: "multibenefit" tablets, "classical" products (tablets and powder) and "gel" (both "classical" products and "gel" need the use of rinse aid).

Our approach was taken into account the ecotoxicity of solutions simulating a wash cycle in a dishwasher in typical use conditions, as recommended by the manufacturer. The "classical" products were selected based on the absence of risks for aquatic organisms. The selected "classical" products of both the "gel" and "tablets" categories were regularly degraded and allowed the classification of the different dishwasher detergents. Mostly, it was shown that the reproduction of C. dubia was the most sensitive endpoint compared with the inhibition of the mobility of D. magna and the growth of the algae P. subcapitata. The "washing solutions" prepared with hand dishwashing detergents were found to be more toxic than those prepared with dishwasher detergents, except for the gel products.

Regarding the "multibenefit" products, it was shown that the ecotoxicity of "washing solutions" from the "gel" products was higher than the ecotoxicity recorded for "classical" products and "multibenefit" tablets. This study also revealed that the ecotoxicity of "classical" tablets was, most of the time, higher than the ecotoxicity of "multibenefit" tablets. Additional studies confirmed that the ecotoxicity recorded for "classical" products was mostly due to the addition of rinse aid in the "washing solution''.

These results suggested that the ecotoxicity recorded for ecolabelled products should be weighted regarding to the intrinsic ecotoxicity of the rinse aids which are currently not covered by "European Ecolabel".
TH 335
Anabiotic biodegradation of PCBs in a grass cut batch reactor
Leuphana University, Luebeck, Germany
Due to properties such as high K<sub>a</sub> values chlorinated compounds including PCBs, dioxins or chlorinated pesticides in vegetation can lead to bioaccumulation in livestock and in the food chain. Hence, the remediation of these compounds in the environment is an important factor for human health. The degradation of the persistent Polychlorinated Biphenyls (PCBs) under anaobic conditions in sediments and sewage sludge is described in the literature [1,2]. The potential for degradation in an anaerobic grass cut batch reactor has not been performed before and is investigated in this work. Therefore two series of batch experiments in laboratory scale (0.5 L to 1.5 L of volume) were performed under mesophilic conditions.

The first experimental series was performed at low natural, i.e. no spiked concentration level of Elbe riverside grass and sludge samples at 27 °C for 315 days. This first, explorative experiment showed ambiguous results for the degradation of the 6 indicator PCBs (PCB No.: 28, 52, 101, 138, 138, 180). Concentrations of the lower chlorinated PCBs like PCB 28 and PCB 52 were found to increase whereas the higher chlorinated PCBs were found to be stable at 5 20 mg/kg dry weight sewage sludge.

For the second experimental series 6 PCBs (No.: 28, 52, 101, 138, 138, 180), a technical mixture of PCBs (Aroclor 1260) and the pesticide Endrin were added in high concentration to the batch experiments (33 mg per compound, respectively and 100 µg of Aroclor 1260). In this second experiment different initial weights of grass cut from the same Elbe riverside site were added with different sludge rates. For the determination of degradation rates experimental times for these batch tests vary between 30 and 120 days. Concentration measurements were done for GC-ECD. Methane and carbon dioxide concentrations (measured by FTIR) in the gaseous phase of batch experiments were used as an indicator for biological activity. Results from the second batch experiment, concerning PCB-degradation rates and their comparison to the former experiment will be presented on the poster.

References

TH 336
Removal of nutrients by immobilized microalgal beads in a continuous flow system
A. Yilmaz, N.C. Koryunahsa, O.S. Okay
Istanbul Technical University, Istanbul, Turkey
Using immobilized microalgal beads in contaminant removal is an emergent method in recent environmental studies. As is well known, phytoplanktons use nitrate (N) and ortho-phosphate (P) during the photosynthesis process for production. In this study, a diatom "Phacotatielum tricornutum" was immobilized in 3.5% sodium alginate solution and hardened with 4% calcium chloride (cation solution) and introduced into a continuous system to remove nitrate and ortho-phosphate. Daily samples were taken from the system and analysed by UV-Vis spectrophotometer (Cobios Optimum-one) to determine the removal efficiency of the nutrients by the algal beads. The cell numbers in the beads were also determined by counting in a Coulter Counter system during the experimental period. The blank beads were also run in the system and subtracted from the total removal of the nutrients to detect the net removal by the algae. The system was operated as six separate runs with usage of the same alginate beads by starvation of three days at each time to increase the removal efficiency of the system. It was observed that the algal beads remove approximately 50% and 40% (average values of net removal by the algae) of the P and N respectively, considering the inflow concentrations of 1000 mg/L of P and 3000 mg/L of N. Disadvantages of this method are indicated as the release of the microalgae out of the beads during the experiment and disintegration of the alginate beads over a long term run.

TH 339
Meta-analysis of diesel production in terms of life cycle GHG emissions and energy consumption: comparison and case study of Spanish refineries
D. Garril, E. Herrera, C. Lago, Y. Lechon, R. Saiz
Ciemat, Madrid, Spain
When performing the life cycle assessment (LCA) of petroleum products, life cycle inventory data are generally global compilations and they are not partitioned into sub-processes, but are provided as a black box. Several products with different characteristics and uses are defined by general process descriptions with a detailed depletion of energy. Therefore, energy consumption and emissions are allocated according to the final product distribution. The most allocation methods used for petroleum products are those based on fuel consumed in the system or geographical origin of the data. These allocation methods are inapplicable when the used fuel for production is not uniquely identifiable. Furthermore, this study is completed by recent studies of diesel production in Spanish refineries. Results highlight the broad range of values that depend on variables such as site-dependency or product specialization. Spanish refineries values are within the range of average European plants. Conclusions draw attention to the need of real data from refineries in order to obtain more adjusted and accurate results, as well as the possible partial subdivision of the system as a solution, according to ILCD handbook recommendations for allocation procedures.

TH 340
Towards transparent and relevant use of energy use indicators in LCA studies of biofuels
R. Rebitzer, B. Rehfeld, S. Ermelchen, M. Floric, M. Molander
Chalmers University of Technology, Gothenburg, Sweden
Mid Sweden University, Ostersund, Sweden
The use of energy has led to resource crises during the history of mankind, such as the deforestation of the Mediterranean during antiquity, and of Great Britain before the 19th century, and the oil crisis in the 20th century and continuing. Considering this, the frequent use of the impact category ‘energy use’ in the environmental assessment tool life cycle assessment (LCA) is not surprising. However, in a previous study, some of the authors noted that the term ‘energy use’ was not applied in a transparent and consistent manner in LCA studies applied in biofuels. In life cycle assessment (LCA) studies of biofuels. In the examined reports and articles, the choice of indicator was seldom motivated or discussed and we observed five inhomogeneous different energy use indicators: (1) fossil energy, (2) secondary energy, (3) cumulative energy demand, (4) net energy balance, and (5) total extracted energy. These five energy use indicators were applied to the same cradle-to-gate production system of crude oil and petrol methyl ester (PME), giving considerably different output results. This is in itself not unexpected, but indicates the importance of clearly describing and motivating the choice of energy use indicator. All five indicators can all be useful in specific situations, depending on the goal and scope of the individual study, but the choice of indicators need to be better reported and motivated than what is generally done today. Authors of LCA studies should first define the purpose of their energy use indicator (fossil scarcity, energy scarcity, energy efficiency, cost/benefit comparison) and may then make a motivated choice of the energy use indicator.

TH 341
A meta analysis review: ‘Drop-in’ Biofuels - Life Cycle Assessments, substance flow analysis, material flow analysis and relevant information on an advanced biofuel
A. Wu A.H. Borsse Areey, A. Halog
University of Maine, Orono, United States of America
The production sector is enjoying an unprecedented amount of public and private effort in order to remove various financial and technical barriers. One of these very important barriers is the challenge of developing biofuels that are compatible with existing gasoline, jet fuel and diesel infrastructure. The United States Department of Energy has been championing efforts that ensure that the next generation of biofuels will be regarded as “drop-in” biofuels. According to the former Undersecretary of Energy from the United States Department of Energy, Kristina Johnson, “drop in” biofuels can be defined as fuels produced from various biomasses which are compatible with the over $9 trillion energy refinery and gas station infrastructure currently available in the United States. According to definitions used in historical literature, drop-in biofuels are defined by National Advanced Biofuel Consortium of the United States as infrastructure compatible - they can either be used directly or blended with their petroleum-derived counterparts. The European Commission on the other hand defines drop-in biofuels on the basis of quality specifications (standards) developed by the American Society for Testing and Materials. Numerous LCA works have been conducted concerning what is described as drop-in biofuels. Although this topic of drop-in biofuels is relatively new, literatures regarding LCAs have been performed based on the definition provided were available for analysis. A comprehensive review of the previously conducted LCA studies in this new field of advanced biofuels. Also, important topics concerning this new chapter in the biofuels revolution were delved into. The results of this meta-analysis review will be presented at the SETAC world congress.

TH 342
How to assess the data quality of LCA studies - a systematic approach
Karlsruhe Institute for Technology (KIT), Eggenstein-leopoldshafen, Germany
The field of energy is biomass becomes more and more important in order to use for environmental purposes involved in the use of the different conversion technologies. A huge number of LCI studies on these topics can be found, however, most of these studies are not directly comparable to each other and their results may vary considerably depending on different data origins, time and geographical background, technologies and system boundaries. Therefore it is often unclear how to decide which study is “best” suited for a given case. The objective of this work is to present a guideline that helps compare different LCI studies. In this guideline a systematic approach on the assessment of literature quality is done. In a first step the current “best practice” for modelling an LCI is summarized. By this a reference for the assessment of the data is defined. This reference will identify a

References

TH 343
LCOP 3 - Increasing scientific and policy understanding through meta-analysis of life cycle assessments

TH 344
Towards transparent and relevant use of energy use indicators in LCA studies of biofuels

TH 345
A meta analysis review: ‘Drop-in’ Biofuels - Life Cycle Assessments, substance flow analysis, material flow analysis and relevant information on an advanced biofuel

TH 346
Removal of nutrients by immobilized microalgal beads in a continuous flow system

TH 347
How to assess the data quality of LCA studies - a systematic approach
A web-based approach to handling divergence in LCA
A. Marugá, R.J. Wallace, G. Ruo, E. E. Dunphy
Public Research Centre Henri Tudor, Esch-sur-alzette, Luxembourg
Cork Constraint Computation Centre, Cork, Ireland
Cleaner Production Promotion Unit, Cork, Ireland

The last two decades have seen a profusion of studies in the Life Cycle Assessment (LCA) field, as well as growing interest in this work by parties in business and government. Furthermore, the rapid growth of detailed and constantly updated Life Cycle Inventory (LCI) and Environmentally Extended Input Output (EEIO) databases has led to an increasing number of studies and published information from which it is often very difficult to elicit conclusive assessments due to conflicting results presented by the authors, although ostensibly the same product is being analysed. At present, a widely discussed approach to handling this situation is through some form of meta-analysis. However, it is considered that it is useful to explore other ideas and approaches, in particular, those that afford solutions that may be available sooner, and also available across a wider range of cases and for a wider range of users. Our general strategy is to take a more qualitative approach to the problem of divergence or discrepancy in LCA. We think about a web-based toolkit that tries to resolve discrepancies by opening up the information using distributed data. An option for accessing distributed data sources and linking them semantically is the emerging technology known as the Web of Data. We can see it as a further development of the usage of hyperlinks, extending the simple link (which can be seen as the sentence “has to do with”) to meaningful relations (such as “isObservedOn” [observedEntity]).

While the primary units of the hypertext Web are HTML (HyperText Markup Language) documents connected by hyperlinks, Linked Data relies on documents containing data in RDF (Resource Description Framework) format and residing in the Web of Data. Essentially, our web-based toolkit is supported by a Data Access Layer which will provide search capability over LCA information available in RDF format. We envision that a form-based search interface will allow a user to specify details about the desired quality criteria and on a specific subject and run a structured query over the Web of Data. In this way the divergencies will be directly resolved at the level of the Data Access Layer. The (free-to-use) basic system we envision will support simple assessments and will help LCA users to produce more robust and policy-relevant results.

Environmental impacts of palm oil biodiesel: A meta analysis
Y.M. Manik, G.N.H.O Halog
University of Maine, Orono, United States of America

Environmental impacts associated with the life cycle of palm oil biodiesel is reviewed in this study using meta-analytic methods. Most studies found palm oil biodiesel would produce positive energy balance with an average net energy ratio of 3.27, which exhibit the strong potential of palm oil biodiesel as renewable fuel. However, it was found that palm oil biodiesel is a net emitter of GHG to the atmosphere. The origin of oil palm plantation is the foremost determinant of GHG emissions. Converting peatland forest to palm oil plantation may produce up to 60 t CO2eq ha-1 yr-1. In contrast, converting degraded land or grassland for plantation can positively offset the system to become a net sequester of 5 CO2eq ha-1 yr-1. Some other cradle-to-grave environmental impacts associated with palm oil biodiesel are acidification, eutrophication, toxicity and biodiversity.

Greenhouse gas emissions from wind power: a critical meta-analysis
S.S.B. Chapman
Heriot-Watt University, Edinburgh, United Kingdom

In this paper a range of historic lifecycle studies of greenhouse gas-equivalent emissions for on and offshore wind farms are reviewed to identify a definitive set of the most current, original, and transparent studies. It begins by detailing the separate components of the wind farm life cycle before explaining the methodology of the meta-analysis and exploring the range of life cycle studies. The paper highlights that ranges of emissions estimates are present for wind power. The paper also suggests that meta-analyses of historic lifecycle studies of this nature help to provide greater advice ensuring comparability, consistency and accuracy for given technologies. The paper then explores some of the factors responsible for the disparity in lifecycle estimates, in particular identifying errors in both the lowest estimates and the highest estimates. It is noted that wind power is not directly emitting greenhouse gas emissions, but rather that lifecycle emissions occur from farm construction, operation and farm decommissioning.

The renewable energy directive and cereal residues
L. Whittaker, C. Mcmanus, P. Hammond
University of Bath, Bath, United Kingdom

The Renewable Energy Directive provides a methodological framework for a streamlined LCA that calculates the greenhouse gas (GHG) balance of biofuels in order to determine whether they reach the required 35% GHG reduction threshold. It describes which sources of emissions should be included and describes how co-products and residues should be accounted for. However, a clear definition of this is lacking. Currently, in order to incentivise biofuel production from second generation sources such as cereal residues and wastes, double credits are to be awarded to these biofuels, and the feedstocks are considered to be available at zero GHG ‘cost’. This presentation will consider if cereal residues removal should be accounted for in GHG reporting for biofuels, as there are potentially sustainability implications with removing residues from agricultural land or food markets. The RED does not consider these potential impacts, which questions the ability of streamlined LCAs to account for the sustainability of these biomass resources. This presentation will compare results from streamlined LCAs and a full environmental impact assessment of cereal residue removal and combustion. The results will indicate the implications of inclusion of direct and indirect LCA impacts in policy analysis.

Meta-analysis of LCA studies for bio-based polymers: assessing the environmental performance of polyhydroxyalcanoates (PHA) and polylactide (PLA) in contrast to their petroleum-based counterparts
R. Eiselt, M. Carus
Nova-Institut GmbH, Hürth, Germany

The depletion of non-renewable resources plays an important role in present political debates. On the one hand, the depletion of non-renewable resources results in increasing commodity prices and economic dependence. On the other hand, the emission of greenhouse gases causes severe effects on the climate with unpredictable impacts on the human environment. That is why energy from renewable resources as well as bio-based chemicals and materials have attracted great interest.
The first phase of the study consisted in the analysis of the present management of municipal waste in Lombardia Region (baseline scenario - reference year 2009). This might lead to false results and recommendations. To avoid uncertainties in study results it is highly advisable to use reliable sources and after thoroughly investigation, if the SBs and information of the used variables is well described. Otherwise the unreflected use of a data source can lead to delivery robust information, but in fact in literature the results differs significantly for the same product or services. Due to the recognized uncertainty this study addresses the possible deviation of results from literature of the electric energy production from different energy sources. The potential deviation could arise from the consideration of different system boundaries (SBs) and the relevance of emission sources along the life cycle. Both could be mainly responsible for the recognized diversity beside others like allocation, cut-off criteria, actuality of literature, etc.

The electric power generation gives a good instance to analyze the impact on the results of the different SBs. For example: the variation between different plant construction demands is often over 80%, but the overall results don’t necessary correlate with this deviation. The change of cement demand for construction by 230%, in the case of electricity generation from coal, induces only 1.7-2.5% difference in GWP of the total system. This is an effect of different proportion of emission sources between the life cycle stages.

The contribution will point out where uncertainties and dependency of the results could arise through the examples of electricity generation from coal(lignite), natural gas, hydro energy, nuclear energy and from wind energy. The whole life cycle of power plant (with fuel upstream), the following system parts and impact categories have been taken into account by understanding the results of LCAs:

- Construction, fuel upstream, transport, production, operation, decommissioning as life cycle phases
- Construction demand variables (basic construction materials: cement, steel, etc.)
- Fuel demand variables (efficiency factors: fuel purity, thermal efficiency, wind yield, transport, etc.)
- Impact assessment methods (GWP as main LCI method, eutrophication, acidification potentials)

The chosen system boundaries and other variables contribute to the varying results of LCA studies for electric energy production. Data from the literature should only be taken from reliable sources and after thorough investigation, if the SBs and information of the used variables is well described. Otherwise the unreflected use of a data source might lead to false results and recommendations.

Using LCA in the preparation of the new waste management plan of Regione Lombardia

In order to pursue sustainability also in this field, Regione Lombardia has decided to consider “environmental performance” as a criterion for supporting future planning decisions, and therefore stressed the need for specific assessments of environmental impacts associated with the planning in the waste field. Life cycle assessment (LCA) has thus been chosen by Regione Lombardia as a strategic support decision tool in the preparation of its new waste management plan. The goal is to support the decision making process to assess the current strategic situation and to provide strategic indications for the future waste management. The project (called GERLA: GEstione Rifiuti in Lombardia - Analisi del ciclo di vita) started in November 2010 and will be completed by the end of 2011.

The first phase of the study consisted in the analysis of the present management of municipal waste in Lombardia Region (baseline scenario - reference year 2009). This has involved the identification of all the fluxes of materials (both the source-separated fractions and the unsorted residual waste) in terms of quantity, composition and destination, together with the characterisation of the most important treatment plants, in terms of their capacity, energy and materials consumption, emissions in the environment, energy and materials recovery. After that, the LCA methodology was applied to evaluate the energetic and environmental impacts associated with this baseline scenario.

The critical analysis of the results (Life Cycle Interpretation) of the baseline scenario has allowed the definition of a number of future scenarios for the year 2020, with the final goal of improving the environmental performances of the regional system.

This study represents thus an important application of LCA methodology since, for the first time in Italy, the outcomes of a detailed LCA of a current waste management system are actually utilised in the waste management planning on a regional scale.
TH 353

LCA on drinking water production from pesticide contaminated ground water

A.O. Olsen, M.N. Rasmussen, T. Skovgaard, A. Birch, H.E. Larsen

Technical University of Denmark, Lyngby, Denmark

This poster presents the results from an LCA case study addressing a growing Danish problem on pesticide contaminated ground water. The conventional Danish way of using pesticide free groundwater and treating it by aeration and sand filtration, is compared to using slightly pesticide contaminated groundwater and adding treatment by activated carbon filtration and UV-treatment. The scenario of using slightly pesticide contaminated groundwater is chosen as it is a genuine and relevant alternative in the current Danish situation as groundwater wells are closing due to pesticide contamination and clean ground water is becoming scarcer. Besides the comparison, a hotspot analysis is performed in order to identify the dominating environmental impacts in the life cycle of generating drinking water from ground water. This study is part of the research project DWBiofilters (www.dwbiofilters.dk) aiming at improving sand filters for drinking water production by investigating its inherent microbial processes.

TH 354

Development of a new LCA tool for maintenance at the initiative of the users - a bottom-up approach

A. Meijer1, D.A.F. Aninka2

DeBiTech, Technology, Delft, Nederland

/WIE Adviseurs, Urrecht, Nederland

Many practical LCA tools have been developed before a user group was established. The risk of such a top-down approach is a gap between the tool and the way users want to use this tool. In this context the experiences may be less used by the users. In the Netherlands many housing associations and building and maintenance companies were looking for means to calculate the environmental performance of planned preventive maintenance of housing, estates and buildings themselves. There are several theoretical approaches available, but no practical calculation tools. Because of this lack of instruments, they set up a development project for a practical calculation tool in the winter of 2002/2003. The goal was to have much more relevant experience with LCA in construction. In the development project, generic environmental data on materials were combined with data of maintenance activities gathered by the maintenance companies. The set-up and interface of the calculation tool were designed according to the wishes and practices of the clients. The results are presented according to the three purposes of the tool: optimisation of the environmental performance of maintenance scenarios, comparison of different scenarios, and benchmarking the scenarios with average Dutch maintenance scenarios. The resulting calculation tool is a good example of the effectiveness of this bottom-up approach, aiming to achieve a broad support amongst potential users of this tool.

TH 355

Improving Life Cycle Management (LCM) tools for the food industry: a framework of Product-Oriented Environmental Management System (POEMS)

R. Salomone1, M.T. Clasadonte1, M. Proto2, A. Raggi1, I. Arzoumanidis1, G. Iollopo1, A. Lo Giudice2, O. Malandrino1, A. Matarazzo2, L. Pettit2, G. Saija1, S. Supino1, A. Zarzo1

1University of Messina, Messina, Italy
2University of Catania, Catania, Italy
3University of Salerno, Salerno, Italy

The EMAF project has specified detailed methodology to follow. International standardisation, developments and best practices on evaluating environmental impacts are taken into account when preparing national specific guidelines. Finnish food sector is actively consulted to ensure practical methodology which can be easily applied.

TH 356

Finnish guidelines on carbon footprinting - supporting practical implementation of LCA in the food industry


MTT Agrifood Research Finland, Helsinki, Finland

Life cycle thinking is spreading among environmentally responsible companies around the world. Specially carbon footprint guidelines, which have been developed in the last years give companies tools to explain their environmental impact, life cycle assessment on company and product level. Growing general knowledge and pressure to act on climate change has given incentives to companies to use carbon footprinting in their consumer communication as well. Consumers shows growing interest to, for example, carbon footprints in many Gallup polls. Many national and international standards and guidelines on LCA are published but no standard widely approved method on evaluating environmental impacts of food are available. In the Foodprint - research programme sound national methodology for calculating carbon and other footprints of food has been developed in close collaboration with the Finnish food sector. As published guidelines are too generic to give practical instructions to companies to produce comparable carbon footprints for communication, the project was decided to set up a detailed methodology to calculate carbon footprinting and benchmarks and best practices in calculating environmental impacts are taken into account when preparing national specific guidelines. Finnish food sector is actively consulted to ensure practical methodology which can be easily applied. In addition to development of national calculation guidelines, the project is also providing practical calculation tools to facilitate calculations at company level. The project also tested different data collection tools in R&D projects. The project has been carried out as iterative process between research, companies and other stakeholders. Food industry wide workshops around the guidelines are used to make the guideline more applicable and user friendly for the industry. As many Finnish food companies use carbon footprinting, industry participation is high. The guidelines were reviewed in a detailed way by other EPLD experts from ICA and from other standards’ point of view.

The company R&D projects were crucial for developing practical guidelines for the industry. Motivation of the whole supply chain of the companies in the beginning of the project is fundamental. Additional workshops for the whole industry gave important feedback and shall facilitate larger implementation of the guidelines.

TH 357

Life cycle thinking applied to an immunological product (vaccine) used for boar taint control in male pigs

P. Moraes1, J. Allison2, J.A. Robinson1, P. Suarez1, E. Roezi1, P. Borla1

1Pfizer Animal Health, Madison nj, United States of America
2Life Cycle Engineering, Torino, Italy

In the United States (USA) started to apply the Life Cycle Assessment (LCA) methodology to some innovative products, with a first case-study on ImprovacTM, an immunological product (vaccine) for male pigs that, by providing farmers with an alternative way to avoid the problem of boar taint, also allows them to increase the efficiency of male pig production, which may in turn provide considerable life-cycle environmental and social aspects benefits: to avoid physical castration is in fact perceived as an animal welfare issue by many in the public sector. In 2010, after an initial project which included a consistent data collection from the vaccine production plants as well as from farms and slaughterhouses at global level, the first Environmental Product Declaration or EPD on a veterinary product was published by the International EPD System, a well recognised ISO 14025 Program Operator (www.epd-system.org). The data of this project were presented for the first time at the 2011 Annual European SETAC Conference in Milan. In late 2011, the sample of farms participating in the global survey was extended for the development of the renewed and updated EPD to be published by the end of January 2012. The new data collection work led to the inclusion of a considerable number of representative farms from other countries worldwide. This analysis provided LCA data to assess possible environmental benefits of the vaccine’s application: the reduction of the carbon footprint is a strong perceived advantage for animal welfare and food sectors and for this reason, it is the major impact category of interest; other LCA relevant impact categories are presented and discussed to provide a comprehensive view of the life-cycle impacts of the product. The calculated carbon footprint for the Improvac pig system demonstrates a reduction vs. the physically castrated pig system, mostly depending on country specific feed production and slurry management practices. Starting from the feed components, a detailed examination was conducted on feed ingredients as well as on milk, which highlights the importance of detailed data and procedures and technologies.

For this reason, the information collected and analyzed in the LCA process provides an important opportunity for swine producers to understand the magnitude of their...
carbon footprint and how to potentially reduce it not only through the use of Improvac.

TH 358
Pilot test in food sector of product environmental footprint (PEF) Guide developed by European Commission
S. Pedrazzini1, U.W. Schenker1, L. Lundqvist2, J. Charad3, C. Dubois1, S. Humbert1
1UNIST, Department of Marine Science, Packaging, Science & Environment, Lausanne, Switzerland
2Nectec Ltd., Safety, Health & Environmental Sustainability, Yeve, Switzerland
In 2011, the Directive General for the Environment (DG ENV) started to work with the Commission’s Joint Research Centre (JRC) Institute for Environment and Sustainability (IES) and other European Commission services towards the development of a harmonised methodology for the calculation of the environmental footprint of products.

The Product Environmental Footprint (PEF) Guide developed by JRC IES has been tested using a limited number of pilot studies representative of a wide variety of goods and services. Pilot tests have been conducted on five Nescafé Nestlé food and beverage product systems: Nespresso, Parina Gourmet Pearl Chicken and Vittel products have been quantitatively assessed whereas Nescafé and Kit Kat products have been qualitatively assessed.

The results of Nespresso case study according to PEF Guide are presented and they are compared to the results of the full life cycle assessment compliant with ISO 14040 and ISO 14044 for one coffee machine modelled in 2011. The comparison of the environmental footprint (LCI choices, e.g. electricity mix, LCDB (e.g. ecoinvent or European Reference Life Cycle Database (ELCD)) and Life Cycle Impact Assessment (LCIA) methods (e.g. land use, terrestrial ecotoxic and airborne emissions) and as endpoint assessment were compared in the original study whereas they lack in the draft PEF Guide published in November 2011. The results will be used to discuss the degree of alignment of the PEF Guide with ISO 14040 and ISO 14044 as the practical implications of following the PEF Guide as compared to current LCA practice.

The PEF Guide aims at providing detailed technical guidance on how to conduct a PEF study identifying single requirement for each decision point with the objective to increase the comparable results whereas in the current methodological guidelines provides several alternatives, ranging from very general in the case of ISO 14040 and ISO 14044 to high specificity in the case of the French standard BPX30-323.

The Nespresso pilot test will be presented and shows an example of PEF Guide application and used to provide feedbacks about the PEF Guide.

TH 359
SETAC's influence on LCAs growth and direction
J.E. Fava1, A.J. Jensen1, P. Mattigod2
1PE International & Five Winds Strategic Consulting, West chester, United States of America
2Nordic Institute of Product Sustainability, Environmental Chemistry and Toxicology, Frederiksberg, Denmark
The launch of Google labs’ Books Ngram Viewer, which allows any user to graph the frequency of occurrence of words or phrases in Google’s database of 500 billion books from 1504 to 2008, gives insight into the relationships of a number of LCA related words over time, One combination, “SETAC”/“Society of Environmental Toxicology and Chemistry” and “life cycle assessment”, yielded a very interesting relationship for the years 1980-2008. The “SETAC” acronym first appeared in books in the 1980’s. Its relative frequency of appearance grew steadily from 1990 through 2004, showing a tenfold increase. In 1990, SETAC sponsored an international workshop at which the term “life cycle analysis” was coined. In 1970, a few practitioners in the U.S. and Europe used different terms such as “Resource and Environmental Profile Analysis”(“REPA”). SETAC established the accepted name (and framework) for life cycle assessment. The occurrence of the phrase “life cycle assessment” in books grew very similarly to the occurrence of “SETAC” from 1990 through 2004. This was a coincidence or were there activities within SETAC that contributed to this parallel growth? This paper will provide a perspective of the role of SETAC in both NA and Europe had on the development of LCA.

THPC1-1
Occurrence of pharmaceuticals in several wastewater effluents and evaluation of a non-conventional biodegradation treatment
M. Grosi1, C. Cruz1, E. Marzo-Urrea2, M. Sarrá3, S. Rodriguez-Moznar5, T. Vicent6, D. Barceló1
1Catalan Institute for Water Research (ICRA), Girona, Spain
2University Autònoma de Barcelona (UAB), Bellaterra, Spain
3IDAEA-CSIC, Girona, Spain
Among the vast array of contaminants of anthropogenic origin reaching our wastewaters, pharmacaceutically active compounds (PhACs) have one of the largest inputs into the environment. The main route of entrance into the aquatic environment is ingestion following excretion and disposal via wastewater, manufacturing and hospital effluents, agricultural and urban wastewaters (concentrations between high ng/L and high μg/L). Among all PhACs investigated, the iodinated X-ray contrast (ICM) agent iopromide was detected in several wastewater effluents. The existence of this class of pharmaceuticals raises concerns because they accumulate in the aquatic environment and in the food web. In this context, the present work will show the results derived from an extensive characterization of 80 human and veterinary pharmaceuticals in several wastewaters where concentration of pharmaceuticals is expected to be significant such as hospital and urban wastewaters and reverse osmosis concentrate. Results indicated that pharmaceuticals are widespread pollutants in all matrices. As expected, high levels were found in hospital wastewaters followed by those found in reverse osmosis concentrate and urban wastewaters (high ng/l and high μg/l). Among all PhACs investigated, the iodinated X-ray contrast (ICM) agent iopromide was detected in all wastewaters, with especially high concentrations in hospital wastewater containing (nearby 200 μg/L), whereas in reverse osmosis concentrate and in urban wastewaters levels much lower (40 and 70 ng/L, respectively). The persistence of ICM through treatment process is well documented. For this reason, this substance was selected as target compound to study its degradation and to assess the potential of white-rot fungi to degrade PhACs from real effluents.

THPC1 - Wastewater effluent discharges: chemical characterisation and potential risks in receiving waters
THPC1-2
Possible removal of several contaminants from the wastewater by a natural biofiltration process
A. Batiot1, A. Pogliaghi1, M. Zischinella1, F. Marzari1, M. Parolini1, G. Soave2, V. Mezzanotte2
1University of Milan, Milan, Italy
2Politecnico di Milano, Milan, Italy
The application of moderated fired clay with polymer addition to the purification and treatment of printing wastewater may potentially revolutionize water treatment processes. The efficiency of treatment technologies at removing specific substances or groups of substances, especially those identified as priorities under the WFD is confirmed with Annex II lists of the waste and pollutants covered by the register, which include greenhouse gases, acid rain pollutants, ozone-depleting substances, heavy metals and certain organic pollutants. Nanotechnology exploits the novel phenomena and properties of matter at atomic and molecular levels. Because of their particle size they can exhibit an array of novel properties that can be used to develop new water treatment technologies and improve existing ones.

Clay derivative materials with high adsorption capacities are very attractive from an economical point of view. Some naturally occurring clay minerals may serve as cost-effective sorbents for waste printing developer decontamination. Adsorption processes have proved to be the most effective, especially for effluents with moderate and low heavy metal concentrations, as like in waste printing developer.
The present work was undertaken to estimate the cost effectiveness adsorbents: pure fired clay, newly designed fired clay with the polymer addition (5 mass% PEG 600) and bentonite for Zn(II) ion removal from waste printing developer. The adsorption efficiency and distribution coefficient of used adsorbents were determined as a function of adsorbent amount. The results show that newly designed clay adsorbent with polymer addition has great potential (up to 93.5%) to remove Zn(II) ion from waste printing developer.

THPCE-4
Removal of POPs from industrial wastewater using UVC/H2O2 Photolysis
J.J. Rueda-Márquez, A. Acevedo-Merino, M.A. Manzano
AstraZeneca, Brixham, United Kingdom
Brunel University, Uxbridge, United Kingdom
CITYMAT - University of Cadiz, Puerto real, Spain

In this study UVC-H2O2-assisted TiO2 photocatalytic degradation was applied to remove persistent organic pollutants from industrial wastewater. Experiments were carried out with treated and filtered (0.7 µm) urban wastewater, spiked with AZO Orange II (5 mg/l) and 4-Chlorophenol (0.36 mg/l).

The experimental equipment employed in the assays consists in a tubular reactor of borosilicate glass, (600ml) operating in a recirculating circuit, irradiated with an UVC lamp (8W). The Hydrogen Peroxide (H2O2) in the process was 200mg/l. The catalyst (TiO2) was immobilized on the external surface of a cylinder of frosted glass (20-mm).

Experiments have been conducted using a total working volume of 1200ml and a recirculation flow rate of 600 ml/min.

The efficiency of primary degradation was determined by monitoring the process, for AZO Orange II (absorbance 478 nm) and 4-Chlorophenol compounds. Toxicity assays were also carried out with the aim to evaluate the effects by products. An economic study of this process was included in the global analysis.

THPCE-5
Impacts of advanced wastewater treatment on metal speciation and bioavailability
M. Constantino, S. D. Comber, M. J. Gardner, M. D. Scrimshaw, A. de Polo
AstraZeneca, Brixham, United Kingdom
Brunel University, Uxbridge, United Kingdom

Increasing pressure to reduce priority chemicals from wastewater treatment effluents is leading to pressure to utilise or consider advanced tertiary treatment options such as UV radiation, filtration, GAC, and ozonation as part of the wastewater treatment process. The use of these adsorptive or destructive methods may, however, increase or decrease, or leave largely unchanged the concentrations of ligands in effluents that are important for complexing metals and which, consequently, reduce the toxicity potential of metals such as copper and zinc. Since there is not much data on the metal complexing characteristics of effluents before and after tertiary treatment, there is uncertainty in the extent by which tertiary treatment options might impact metal bioavailability. To investigate possible impacts, a chelax column ion exchange method was used to assess the effects of GAC, ozonation, and UV radiation in combination with H2O2 on the ligands in sewage effluent that are responsible for complexing copper and zinc. Preliminary results indicate that tertiary treatment options tend to increase the concentrations of metal complexing ligands relative to the concentration of dissolved organic carbon present. This effect was also of greater significance for copper than for zinc. The oxidized effluents displayed lower UV absorbances (350 nm) in relation to other secondary and tertiary treated effluents, indicating ozonation to have some impact on the concentration of aromatic substances in the effluents, which is consistent with the elimination of humics; however, this did not impact complexation capacity. These findings indicate that advanced tertiary treatments are unlikely to increase the bioavailability of metals in sewage effluents.

THPCE-6
The influence of terminal electron acceptor on the removal of pharmaceuticals in Anaerobic digestor sludge
J. Campbell, T. Qing, F. Mason, J. Mitchell, G. Williams
University of Portsmouth, Brixham, United Kingdom

Recent results, perfluorinated compounds (PFCs), particularly perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS) have been described as compounds of concern environmental and numerous studies were conducted to investigate the environmental distribution and fate of these compounds Besides their transport with ocean currents, atmospheric transport was identified as important (long-range) transport pathway. As the particle size is an important parameter characterizing the fate of atmospherically transported compounds, knowledge about the particle size distribution of particle-bound PFCs is of particular interest. Therefore the objective of this study was to determine the particle size distribution of PFCs in wastewater.

Particle phase samples were taken in parallel using a cascade impactor with cut-off diameters of 11.4 µm (A4, B4), 3.81 µm (A3, B3), 1.38 µm (A2, B2), 0.46 µm (A1, B1), and 0.14 µm (back-up filter, A0, B0). Each particle size fraction of each sampler was extracted separately using ultrasonication and methanol. Samples were measured by ICF-MS/MS.

PFC concentrations in particle phase samples (sum of all fractions) were between 0.5 and 2.5 µg/g. Of 25 analysed PFCs, 18 could be quantified. These were C4, C6-C8 PFSA, C4-C14 PFCA, PFOA, MeFOSE and EtFOSE. PFO and PFOA were observed in highest concentrations (0.17-3.5 µg/g, 0.09-4.8 µg/g, respectively), followed by PFOS and PFOA.

The observed particle size distribution of PFCs in parallel samplers were quite similar indicating a good precision of the entire method. However particle size distribution between perfluoroalkyl sulfonates and perfluoroalkyl carboxylates differed. Whereas carboxylates were primarily detected in the finest particle fraction (<0.14 µm) sulfonates were observed with treated and filtered (0.7 µm) urban wastewater, spiked with AZO Orange II (5mg/l) and 4-Chlorophenol (0.36 mg/l). With the elimination of humics; however, this did not impact complexation capacity. These findings indicate that advanced tertiary treatments are unlikely to increase the bioavailability of metals in sewage effluents.

TU 001
Particle size distribution of airborne perfluorinated compounds
A. Dreyer, I. Wembch, T. Kirchgeorg, V. Matthias
Ecole Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

Perfluorinated surfactants (PFCs) produced since the 1950s draw great attention due to their wide application and increasing occurrence in the environment. Sorption of PFCs to different environmental media (surface water, sewage treatment plants, sediment, and soil) in order to assess the distribution of PFCs in different environmental environments was produced since the 1950s. Studies carried out attention due to their wide application and increasing occurrence in the environment. Sorption coefficients (Kd) and organic carbon normalized soil adsorption coefficients (Koc) are essential for determining soil adsorption behavior and assessing the risk of transfers of these chemicals from contaminated soils to plants and groundwater. We therefore analysed the international literature for concentrations of pentafluorohexanoic acid (PFHxSA) and perfluoroheptanoic acid (PFHpA) in different environmental media (surface water, sewage treatment plants, sediment, and soil) in order to assess the distribution of PFCs in different environmental environments and to compare the results with published experimental sorption coefficients. Experimental log Koc values for PFCs for different soils and sediments available in public literature are remarkably similar with a coefficient of variation of only 18%, which should limit the uncertainty of concentrations in drainage water and groundwater calculated from soil concentrations (average log Koc = 2.9). For PFOA however, published sorption coefficients are sparse and the published information regarding the analogy between sorption of carboxylated and fluorinated PFCs is controversial (average log Koc = 2.6).

Our review shows that current pattern of environmental PFOA and PFCs concentrations are strongly influenced by local pollution sources. Nevertheless, we calculated "global average" log Koc values by averaging average log Koc values of 3.8. Dividing the median sediment concentration of 0.6 ng g-1 by the median surface water concentration results in a "global average" log Koc of 3.25 (log Kd concentration of 1.7% equals 4.2. Furthermore, the estimated "global" log Koc were similar to experimental log Koc values found in the literature. The moderate affinity of PFOA and PFOS to soils, sediments and sewage sludge indicates that drinking water must be considered a potential repository of exposure to similar chemicals to these pollutants.

TU 003
Binding and sequestration of perfluorinated surfactants in soil
P.A.R. Vare斯塔, J. Simonsen, W. Ameling
Institute of Crop Science and Resource Conservation Soil Science Division, Bonn, Germany
University Bonn, Inst. of Crop Science and Resource Conservation, Bonn, Germany

Increasing pressure to remove priority chemicals from wastewater treatment effluents is leading to pressure to utilise or consider advanced tertiary treatment options such as UV radiation, filtration, GAC, and ozonation as part of the wastewater treatment process. The use of these adsorptive or destructive methods may, however, increase or decrease, or leave largely unchanged the concentrations of ligands in effluents that are important for complexing metals and which, consequently, reduce the toxicity potential of metals such as copper and zinc. Since there is not much data on the metal complexing characteristics of effluents before and after tertiary treatment, there is uncertainty in the extent by which tertiary treatment options might impact metal bioavailability. To investigate possible impacts, a chelax column ion exchange method was used to assess the effects of GAC, ozonation, and UV radiation in combination with H2O2 on the ligands in sewage effluent that are responsible for complexing copper and zinc. Preliminary results indicate that tertiary treatment options tend to increase the concentrations of metal complexing ligands relative to the concentration of dissolved organic carbon present. This effect was also of greater significance for copper than for zinc. The oxidized effluents displayed lower UV absorbances (350 nm) in relation to other secondary and tertiary treated effluents, indicating ozonation to have some impact on the concentration of aromatic substances in the effluents, which is consistent with the elimination of humics; however, this did not impact complexation capacity. These findings indicate that advanced tertiary treatments are unlikely to increase the bioavailability of metals in sewage effluents.

EP06P - Perfluorinated compounds: From emission sources to the place of impact
Investigating the sorption of Perfluorinated Compounds in different types of sludge

O. Arvaniti1, A.S. Stasinakis1, N.S. Thomaidis1

1University of Aegean, Mytilene, Lesvos, Mytilene, lesvos, Greece
2Department of Environment, University of the Aegean, Mytilene, lesvos, Greece
3Department of Chemistry, University of Athens, Athens, Greece

Perfluorinated compounds (PFCs) present significant research interest in recent years due to the global distribution, persistence, bioaccumulation and potential toxicity of these compounds. The fact that PFCs are commonly detected in municipal wastewater treatment plants (WWTPs), so far there are few data for their sorption potential to sludge. The aim of this research was to determine the sorption potential of different PFCs to three different types of sludge (primary sludge, secondary sludge and digested sludge). For this reason, sorption experiments were performed with eight PFCs belonging to two different classes; perfluorocarboxylic acids (PFCAs) that contain a carboxylic group in their molecule and perfluoroalkyl sulfonates (PFASs) that contain a sulfonate group in their molecule.

At first, sorption experiments were performed to investigate the equilibrium time for each target compound and the role of sludge inactivation on sorption potential of PFCs. For this reason, samples were taken at different time intervals and PFCs were detected in dissolved and particulate phase. PFCs were extracted by solid-phase extraction (dissolved phase) or sonication (particulate phase) and determined using High Performance Liquid Chromatography – Ion Trap Mass Spectrometry (HPLC-IT-MS).

Towards, sorption experiments were performed for six different spiking levels of PFCs, ranging between some ng L-1 to few μg L-1 and solid - water distribution coefficient (Kd) values were calculated. Finally, the effect of solution pH on PFC sorption was investigated in experiments performed at pH values commonly found in WWTPs (6, 7 and 8).

"According to the results, Kd values of PFCs were differentiated significantly according to the type of sludge. Moreover, it was shown that both the length of the perfluorocarboxylic and the functional group of the head group can influence the sorption of these compounds to sludge materials.

Acknowledgments

This project was funded under the Operational Program "Education and Lifelong Learning" and funded by the European Union (European Social Fund) and National Resources - HRAKLEITOS II.

TU 004

Presence and behaviour of perfluorinated compounds in sewage sludge

S. Lacoste1, C. Goméz-Caneal1, J. Barth1

1IDAIA-CSIC, Barcelona, Spain
2Frederich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany

Perfluorinated compounds (PFCs) are a class of compounds that have been widely used in domestic and industrial appliances and have emerged as significant global environmental pollutants with persistent, bioaccumulative and toxic properties. After disposal or PFC-containing products, these compounds enter Waste Water Treatment Plants (WWTP) and accumulate in sludge because their intrinsic physicochemical properties make them resistant to final mineralization. Among other uses, the sewage sludge as agricultural fertiliser is common practice all over Europe. The aim of this study was to determine the presence of 5 perfluorinated compounds (PFCs), namely perfluorooctanesulfonate (PFOS), perfluorooctanoic acid (PFOA), perfluorooctanesulfonic acid (PFOSa), perfluorooctanoic acid (PFOA), and perfluorobutanoic acid (PFBA), in sludge and evaluate their transfer to agricultural soils. PFCs were analysed in sludge from 15 WWTP from Spain and Germany. These WWTP receive both urban and industrial wastes. PFCs were detected at 0.28 and 5.15 ng g⁻¹ dw for Spanish sludge and from 14.2 to 56.0 ng g⁻¹ dw for German Sludge, with differing concentration patterns of the individual compounds. In addition, the real amount of the PFCs present in agricultural soils and sludge accumulated at such low concentrations that we can state that there is no influence on the PFC elimination. Consequently, the amount of PFCs per ton of sludge generated was determined for each WWTP. According to the use of sludge in each country, the calculated contribution of PFCs to agricultural soils was estimated between 0.06 and 12.8 kg ha⁻¹. Finally, the concentrations of PFCs found in agricultural soils (as a way to determine the real impact of PFCs in soils) in Spain, 95% of the sewage sludge is used as fertilizer in agriculture, in Germany, 95% of the sludge is incinerated or used for landfilling.

TU 005

Occurrence and evaluation of the fate of Perfluorinated Compounds in wastewater treatment plant of Athens (Greece)

O. Arvaniti, A.S. Stasinakis, N.S. Thomaidis

1University of Aegean, Mytilene, Lesvos, Mytilene, lesvos, Greece
2Department of Environment, University of the Aegean, Mytilene, lesvos, Greece
3Department of Chemistry, University of Athens, Athens, Greece

Perfluorinated compounds (PFCs) have been classified as emerging contaminants and they are commonly detected in municipal wastewater treatment plants (WWTPs). In this study, contamination profiles of eighteen target perfluoro analytes (C5 to C14 carboxylic acids, C4, C6-C8 and C10 sulfonic acids and 3 sulfonamides) were detected in wastewater (influents and secondary effluents) and sludge samples, originating from WWTP of Athens (Greece). Two seasonal sampling campaigns were performed and samples were taken in seven consecutive days in each sampling campaign. The analytes were extracted by solid-phase extraction (dissolved phase) or sonication (particulate phase) and determined using High Performance Liquid Chromatography – Ion Trap Mass Spectrometry (HPLC-IT-MS).

The results of the analyses of sludge samples suggest that the PFCs are eliminated from sewage sludge in WWTPs and their concentration in the effluents was lower than in the influents. The amount of PFCs that were eliminated during wastewater treatment can be attributed to both the chemical reaction and the physical removal processes. The fate of PFCs in wastewater treatment plants (primary sludge, anaerobic digested and centrifuged sludge) was evaluated in 2011 in order to get a reliable picture of the polyfluoralkyl substances (PFAS) contamination and possibly to identify the main sources for the aquatic environment. Moreover, the sampling location was in a transitional coastal area such as river Po Delta and Lagoon of Venice. Chemical plant discharges and drinking waters present in the same basins were also sampled. Analyses of PFASs were achieved by using an on-line SPE-HPLC-MS-MS system. Recovery for PFASs for all analytes was above 70% at μg/L levels. Limits of detection (LOD) ranged from 0.2 to 2.5 ng/L.

TU 006

Biodegradation of proposed PFOA & PFOS precursors in aerobic batch assays

M. Obernoster1, M. Greng1, M. Leter2, M. Seng1, W. Püttmann1

1Bayerischer Landesamt für Umwelt, Wielenbach, Germany
2Goethe University, Frankfurt a.m., Germany

Perfluorinated compounds (PFCs) are a group of emerging environmental pollutants even though no natural sources of PFC have been proposed. Nevertheless they can be detected in the environment throughout the world. Due to their unique water- and oil-repellent as well as stain-resistant properties, they are widely used in various industries and commercial products. Some of them are classified as persistent, bioaccumulative and toxic compounds. Hence they display a threat of nature. Potential sources of PFC can be consumer and industrial products as well as manufacturing processes. In some sewage treatment plants worldwide, an increasing mass flow of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) was observed with higher concentrations in the effluents compared to measurements in the influents. This leads to the assumption that there have to be precursors which are biodegraded during the sewage treatment process. Thus the aim of this work was the study of the possible precursors for PFOA and PFOS by using their aerobic biodegradability. Amongst others perfluorooctanesulfonamide (PFOSA) 1, 8.2′-telomer acid (8.2′ FTCAs), 8.2′-telomer alcohol (8.2′ FTOH) 1, 3 and a technical product containing polyfluoralkyl phosphates were chosen to study their fate in aerobic batch assays. The test period was 14 days each at a water temperature of 12.7°C. The activated sludge sample was a mixture from a municipal sewage treatment plant and contained a sewage sludge from the EN ISO 9888 guideline, June 1999, with a 10-times higher phosphate buffer concentration. The water and sludge samples were analysed using LC-MS/MS and GC-MS.

All in all the above mentioned substances degraded to PFOA or PFOS in ranges from 1 to 8 percent during 14 days. The lowest metabolic rate was monitored for PFOSA. In addition, PFOSA was observed in wastewater that was degraded to perfluorooctanoic acid (PFOA) as well. The absence of degradation products in the abiotic controls show that the metabolism has to be attributed to microbial degradation only.


TU 007

Identification of the sources of polyfluoralkyl substances (PFASs) in the Italian surface waters

S. Petrotello, M. Rusconi, S. Valsecchi

CNR-IRSA, Brugherio, Italy

A survey of the distribution of perfluorinated carboxylates (from C5 to C10) and perfluorinated sulfonates (C4 and C8) in the main Italian river basins have been carried out in 2011 in order to get a reliable picture of the polyfluorinated substances (PFASs) contamination and possibly to identify the main sources for the aquatic environment. Moreover, chemical plant discharges and drinking waters present in the same basins were also sampled. Analyses of PFASs were achieved by using an on-line SPE-HPLC-MS-MS system. Recovery for PFASs for all analytes was above 70% at μg/L levels. Limits of detection (LOD) ranged from 0.2 to 2.5 ng/L.

"SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting

297
Perfluorinated compounds (PFCs) in peregrine falcon eggs from southwestern Germany - levels, patterns and temporal concentration variations

1, K.T. von der Trenck 2, C. Sonne 3, B. Le Bizec 6, H. Persat 1

TU 011

Perfluorinated compounds (PFCs) in peregrine falcon eggs from southwestern Germany - levels, patterns and temporal concentration variations
F. Neugebauer1, K.T. von der Trenck1, A. Dreyer1
Eurofins GfA Lab Service GmbH, Hamburg, Germany
LWBW - Landesanstalt für Umwelt, Karlsruhe, Germany
Eurofins GfA GmbH, Hamburg, Germany
As a top predator, the peregrine falcon (Falco peregrinus) is capable of accumulating a wide range of persistent pollutants and therefore a valuable object for observation and chemical analysis. The species attracted not only scientific but also public interest, at the latest since it was at the brink of extinction in Germany and elsewhere through excessive burdens of organochlorine pesticides such as DDT. A network of volunteers in the German state of Baden-Württemberg offered the possibility to collect unfledged peregrine falcon eggs for monitoring purposes. In the past years, perfluorinated compounds (PFCs), especially PFOS raised scientific and public concern as their POP-like properties became apparent. Therefore, the analysis of PFCs in peregrine falcons' eggs was integrated into the existing monitoring programme.

Sampling were conducted Baden-Württemberg from 2008 to 2011. About half of the number of the 20-30 egg samples collected per year were analysed for 11 PFCs (4 sulfonates, 6 carboxylates and the perfluorooctane sulfonate). The analysis was performed using cold sample extraction and ion exchange-SPE clean-up followed by LC-MS/MS detection at LOQs of about 0.5 ng/g dry weight.

For our study we aim for presenting data in order to form a baseline for the PFC levels in the eggs samples for the years from 2008 to 2011. This will offer the first

Samples were collected in Baden-Württemberg from 2008 to 2011. About half of the number of the 20-30 egg samples collected per year were analysed for 11 PFCs (4 sulfonates, 6 carboxylates and the perfluorooctane sulfonate). The analysis was performed using cold sample extraction and ion exchange-SPE clean-up followed by LC-MS/MS detection at LOQs of about 0.5 ng/g dry weight.

TU 008

PFAA sources to groundwater and drinking water: identification and origin
C. Eschauer1, K.J. Raat1, P.J. Stuyts2, P. De Voogte1
KWR Watercycle Research Institute, Nieuwegein, Nederland

Knowledge about sources of PFAA to drinking water is currently scarce and focuses on surface water based drinking water. Waste water treatment plants have been identified as major sources for PFAA to surface waters and ultimately to the drinking water produced from it. However, groundwater is in many countries the major source for drinking water production (in NL 65%). The extent of contamination of groundwater by PFAA and the contamination pathways to groundwater bodies remain largely uncertain.

In the work presented, we identified different direct sources of PFAA to groundwater within a catchment area of a public supply well field (PSWF) in the Netherlands. It was found that landfill leachate, and urban/military base affected rainwater contaminated the groundwater within the catchment area of the PSWF. Rainwater not affected by the direct sources also infiltrated in this area and provided a background contamination to the groundwater.

Maximum concentrations encountered in the landfill leachate plume were 1750 ng/L perfluorooctanoic acid (PFOA) and 1165 ng/L perfluorobutanoic acid (PFBA). Maximum concentrations measured in the groundwater halfway the contaminant sources and the PSWF (15 years travel distance) were 29 and 161 ng/L for PFOA and PFBA respectively. Concentrations in the groundwater wells at a travel distance of 25 years were much lower: 0.9% and 3.5% ng/L for PFOA and PFBA respectively. The chemical signature of the groundwater showed that infiltrated rainwater, the landfill leachate and the infiltrated urban/military water contaminated the abstracted water.

Based on the hydrological modelling it was shown that 1% of the contaminated groundwater was originating from the landfill and military area and 99% from background contamination. This is seen in the relative abundance profile of the PFAA in the pumped groundwater.

TU 100

Distribution of 14 perfluorinated compounds and other priority and emerging organic compounds in fishes from the Rhone River (France) C. Miege1, A. Peretti1, P. Labadie1, H. Budzinski1, B. Le Bizec1, K. Vorkamp4, J. Tronczenzki2, H. Persat1, M. Coquery1, M. Babut1
1, IRSTE A, Lyon, France
2, CERBA laboratory, ONIRIS Atlanpole, Nantes, France
3, University of Lyon I, UMR CNRS 5023, Lyon, France
4, IRBM, Biogeochemistry and Ecotoxicology, Nantes, France

The data collected are part of a large monitoring programme [EqS Directive, 2008/105/EC; EC, 2008] details the application of the Water Framework Directive for the monitoring of priority substances and other pollutants in surface water; in particular, it requires the implementation of temporal and spatial trend monitoring programs. The use of integrative matrices (biota and sediments) is strongly recommended to achieve such objective, especially for compounds having a log Kow > 3.

The main goal of this study was to obtain data on the occurrence and levels of 43 priority and emerging organic compounds in freshwater fish sampled in the Rhone River. The analyses included 14 perfluorinated compounds (PFC), and also 5 alkanilphenols (AP), bisphenol A (BPA), 3 hexachlorocyclohexanes (HCB), 9 polybrominated diphenyl ethers (PBDE) and 2 compounds, hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD) for which Environmental Quality Standard (EQS) have been set for biota (10 and 55 µg/kg fresh weight -fw- respectively) [E.C., 2008].

Results on the quantification frequencies, mean, median, minimum and maximum concentrations measured for the 14 AP and the other selected compounds in the 49 sampling sites will be presented and discussed.

References
Official J of the European Union, L348: 84-94

TU 012

PFAs in feathers of white tailed eagles (haliaeetus albicilla) from Greenland and Norway; useful for non-destructive monitoring?
J. Hezrek1, V.L.B. Jaspreet2, C. Sotome3, A. Cozati4, J.O. Bostnes5
1, NIELU, Tromso, Norway
2, Universitets Antwerpen, Wilrijk, Antwerp, Belgium
3, Aarhus Universite, Roskilde, Denmark
4, University of Bordeaux 1, EPOC-LPTC laboratory, Bordeaux, France
5, CNRS/UPMC, UMR 7599 Sisyphe, Paris, France
The white-tailed eagle (Haliaeetus albicilla), also referred to as white-tailed sea eagle (WTSE), is a large predatory bird from the Northern part of Eurasia. It is a top predator from the aquatic ecosystem and feeds mainly on marine fish, waterfowl and carrion. Because of its high trophic position, the WTSE is a very interesting biomonitoring species for studying accumulation of persistent organic pollutants (POPs). In this study, we increased our knowledge on the analysis of perfluorinated aliphatic substances (PFAS) in biological tissues and specifically develop a reliable method to measure PFAS in feathers of this raptor species. Feathers have already been used successfully for monitoring of heavy metals, and recently also for POPs, but a reliable method for PFAS was not available and needed to be established. The results gained from this research enabled us to monitor endangered raptors without harming the birds and their offspring and to better understand the fate of PFAS in birds. 

From German body sentinels (n=11) and primary wing feathers (2th, 5th and 8th primary; n=46) and preein oil (n=7) was collected when available in a sufficient amount for analysis. Tissue samples were taken from the German Greenpeace to analyze for PFAS and POPs. In addition, tail feathers were sampled at active nest sites of WTSE situated in North Germany in spring 2009. For the first time, PFAS were detected in feathers and preein oil of white-tailed sea eagles from Germany and Norway. In the wing feathers from Greenpeace WTSE, PFOS and PFHxS were detected. In some cases, PFNA, PFUa and PFTrA were detected in minor concentrations as well. The average concentrations of the primary wing feathers #2, 5 and 8 were similar. In addition, the body feathers showed similar PFOS levels, but lower PFOSA levels.

TU 013  
Perfluorinated chemicals in Belgian barn owls (Tyto alba): comparison of levels in feathers and tissues

L.B. Jasperse, D. Herake, I. Eulais, B. Gillespie, M. Eens1

1University of Antwerp, Wilrijk, Belgium
2Vrije Universiteit Brussel, Brussels, Belgium
3University of Michigan, Dept of Biostatistics, Michigan, United States of America

Perch feathers have proven very useful regarding non-destructive biomonitoring of contamination with heavy metals and organic pollutants. For this study, we have investigated perfluorinated chemicals (PFAS) in feathers and tissue of barn owls (Tyto alba), collected in the province of Antwerp (Belgium). A major PFC plant (3M) is located in the close vicinity of the city of Antwerp and levels of PFCs in biota from this area have been found to be very high in previous studies. We analysed levels of PFCs in tail feathers and tissues (liver, muscle, gland, adipose tissue) obtained from barn owl road-kill victims (n=15). We used methods for left-censored data to cope with levels below the limit of detection. We aimed to study the main sources for PFCs in feathers as levels can both originate from internal sources (via the blood) as from external contamination (via e.g. air, dust).

PFOS was detected in all tissues (median concentration: 135 ng/g in muscle, 305 ng/g in liver, 431 ng/g in adipose tissue), also in feathers (median 14.7 ng/g, P=0.22 - 56.6). PFOS levels in feathers and liver tissue were highly correlated (r=0.79, p<0.001), but this was not the case for PFOS levels between feathers and muscle (r=0.15, p=0.47) or between muscle and liver (r=0.46, p=0.08). This may be due to the chemical properties of PFCS which are mainly bound to proteins in the blood, thus reducing the suitability of muscle tissue. PFOS was measured at high levels in the feathers (1.41 - 670 ng/g), but not in the tissues (more than 50% < LOD). Furthermore, PFOS levels in feathers and liver were not significantly correlated (r=0.17, p=0.57). These results suggest that PFOS may be present on the external surface of the feathers and was not washed off by using distilled water and hexane. External contamination with PFOA is most probably originating from the air due to the close vicinity of potential point sources. PFHxS could only be quantified in liver and preein oil. Sporadically, other PFC compounds were detected as well, mostly in liver.

Overall, these results indicate that PFOS levels in feathers and liver are highly correlated, while PFOA levels in feathers are probably originating from external contamination. Therefore, the feasibility of feathers for PFCs monitoring should be investigated more in depth in the future.

TU 014  
Monitoring of perfluorinated compounds

S. Falk, H. Brunn, S. Georgi, T. Stahl

Hessian State Laboratory, Wiesbaden, Germany

Because of their pervasive and wide ranging application perfluorinated compounds (PFCs) are found as ubiquitous contaminants in aquatic and terrestrial organisms as well as in food products. HPLC-MS/MS analysis of animal and non-animal foodstuffs and wild game was performed within the framework of preventative consumer protection.

Fish from regional waters:
Sixteen fish from the Rhine river including eel, perch, roach, tench and catfish were examined for the presence of PFC. Concentrations between 5.2 µg/kg and 143 µg/kg were detected in muscle tissue as the sum of PFC detected (∑ PFBS, PFPeA, PFHxA, PFHxS, PFHpA, PFOA, PFOS, PFNA, PFDA, PFPS) . The highest concentration was measured in feathers (median 14.7 ng/g, p=0.22 - 56.6). PFOS levels in feathers and liver tissue were highly correlated (r=0.79, p<0.001), but this was not the case for PFOS levels between feathers and muscle (r=0.15, p=0.47) or between muscle and liver (r=0.46, p=0.08). This may be due to the chemical properties of PFCS which are mainly bound to proteins in the blood, thus reducing the suitability of muscle tissue. PFOS was measured at high levels in the feathers (1.41 - 670 ng/g), but not in the tissues (more than 50% < LOD). Furthermore, PFOS levels in feathers and liver were not significantly correlated (r=0.17, p=0.57). These results suggest that PFOS may be present on the external surface of the feathers and was not washed off by using distilled water and hexane. External contamination with PFOA is most probably originating from the air due to the close vicinity of potential point sources. PFHxS could only be quantified in liver and preein oil. Sporadically, other PFC compounds were detected as well, mostly in liver.

Roe deer:
Use of PFOS has been declining since the year 2000. In order to observe the ensuing temporal changes in PFC concentrations in animal matrices a retrospective study of liver tissue from roe deer was undertaken. A total of 110 samples taken between 1998 and 2010 from the German Environmental Specimen Bank were examined. A decline in PFOS contamination since the beginning of this millennium is evident. Average PFOS concentration was 9.2 µg/kg in the year 2000 and 1.9 µg/kg in 2010.

TU 015  
Development of a pharmacokinetic model for infant exposure to PFAS and PFOA for health risk assessment

F. Fabregas', N. Nadi, M. Schuhmacher, J.L. Domingo

1URV, Tarragona, Spain
2Laboratory of Toxicology and Environmental Health, URV, Reus, Spain
3University of Michigan, Dept of Biostatistics, Michigan, United States of America

Perfluorinated compounds (PFCs) are very stable compounds with a lot of industrial application, but also very persistent on the biota and the environment. Among them, PFOA (perfluorooctane sulfonate) and PFOA (perfluoroctanoic acid), have a long persistence in the human body (4-6 years). This persistence creates an important concern among the scientific community and the health authorities. In fact, PFOS was listed under the Stockholm Convention in May 2009 as a persistent organic pollutant (POP), while PFOA is a serious candidate to enter that list. The main target organs of accumulation are blood and breast milk. Thus, PFCs can be a risk for adult population and breast feeding infants. In order to assess the tissue concentration, PPK models are able to assess the concentration along the time in the main target organs of concern. PPK models are mathematical representations of the human body where the organs are considered as compartments, and they can be resolved computationally as a set of equations. The PBPK model presented here is a multi-compartmental model for PFOA and PFOA for adult and childhood exposure during the breastfeeding period. Aside from the blood and breast milk, another tissue such as brain and kidney have been considered. PFAS are well absorbed, non metabolized and eliminated by urine and breast milk. The main sources of exposure for adult population are food and water intake. The data for food and water ingestion have been obtained from a large monitoring study in Catalonia, Spain. For toxicity, the tissue residue approach (TRA) was used. The TRA is the use of tissue concentrations as the dose metric for characterizing toxicant potency. The PPK model has been validated by comparing theoretical values with experimental data of PFC's chemicals in blood serum and breast milk collected in Catalonia, Spain. Finally, uncertainty and sensibility analyses have been performed. A normalized local sensitivity analysis was performed on the model to examine the influence of each model parameter on the model output. Sensitivity coefficients were calculated for the predicted plasma area under the curve (AUC; total concentration) with the original parameters and for those resulting from a low change in each parameter value.

TU 016  
Acute toxicity of perfluorinated compounds to two kinds of cladocerans

J.G.M. Peijnenburg, G. Ding

1Dalian Maritime University, Dalian, China
2RIVM, Bishoven, Nederland
3Dalian Maritime University, Dalian, China

Due to their unique properties, poly- and perfluorinated compounds (PFCs) have been manufactured and used during the past 50 years in a variety of industrial and commercial products, such as household surface finishes, food packaging, water- and stain-resistant materials, and fire-fighting foams. PFCs were released to the environment during production, usage and disposition. PFCs tend to persist in surface waters. Therefore their toxicity to aquatic organisms is of particular concern. Serving as a food source for fish and other aquatic organisms, cladocerans are one of the key trophic elements of aquatic ecosystems. In addition to their ecological significance, cladocerans have the advantages of being useful as test organisms due to their short life cycle, their ease of laboratory culturing, their limited space and water volume requirements, and their sensitivity to chemicals. Cladoceran species are therefore widely used in aquatic toxicology. Among freshwater cladocerans, Daphnia magna is probably the most common test organism used in ecotoxicological studies. Some toxicity tests have been performed on cladocerans for perfluoroctanoic acid (PFOS) and perfluorooctanoic acid (PFOA) or their salts.
Because of their global distribution, environmental persistence and potential risk to human beings and aquatic organisms, PFCs are of particular concern for research and regulatory communities. However, insufficient toxicity data are available to accurately assess their possible environmental hazard. Therefore, the acute toxicity of seven poly- and perfluorinated carbonylic acids and alcohols on two cladocerans, Daphnia magna and Cricothoe sphaerica, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing groups of compounds with the same partition coefficients indicates that PFCs with a sulfonyl group are more toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOS>PFOA>PFBS>PFBA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals.

Embryotoxic effects of perfluoroctanoic acid (PFOA) in a zebrafish (Danio rerio) embryonic toxicity test.

Perfluorooctane sulfonate (PFOS) and Perfluorooctane sulfonyl fluoride (POSF) are both industrially synthesised perfluorinated chemicals and they produced in substantial amounts. They are found widely in surface water and aquatic sediments. In this study, the comparative embryotoxic effects of perfluorinated compounds (PFCs) on Daphnia magna were compared with the partition coefficients. Also, we studied the relationship between the partition coefficients and effects on Daphnia magna. Results indicated that, low concentrations generally cause malformations in the skeletal system. It was observed that high concentrations (10 mg PFCa/L) caused increased the growth rate and length, while lower concentrations (0.5 mg PFCa/L) decreased the growth rate and length. As a result, it can be concluded that PFCs are harmful on the level of aquatic ecosystems.

Structure-activity relationship of four perfluorinated compounds based on early developmental effects in the zebrafish.

The obtained results are in agreement with the literature, however PFOS has been found in lower concentrations than previous studies. This study can provide valuable toxicological information on these chemicals is still incomplete and insufficient to assess their environmental impact and structure-activity relationship. In the present study, the developmental effects of PFOA (perfluorooctanoic acid, C8), PFOS (perfluorooctane sulfonate, C8), PFS (perfluorobutane sulfonate, C4) and PFBA (perfluorobutanoic acid, C4) were evaluated in zebrafish embryos (Danio rerio) during 120 hours post fertilization (hpf). The different chain lengths and functional groups of the selected compounds made it possible to determine the structure-activity relationship of these compounds. PFCs with longer chain lengths (C8) tend to be more toxic than PFCs with shorter chain lengths (C4). Compounds with a carboxyl group exhibited less toxicity than those with a sulfonyl group. Therefore, we can conclude that PFCs with a sulfonyl group are more toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOA>PFA>PFBS>PFBA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals.

Embryotoxic effects of perfluorooctane sulfonate compounds in sea urchin Paracentrotus lividus.

The preliminary results of this study present the profile and concentrations of 18 PFCs in cord blood samples from Catalonia (Spain). In this study, we found that the more toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOA>PFA>PFBS>PFBA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals.

Embryotoxic effects of ammonium perfluorohexanoate (AFPO).

Because of their global distribution, environmental persistence and potential risk to human beings and aquatic organisms, PFCs are of particular concern for research and regulatory communities. However, insufficient toxicity data are available to accurately assess their possible environmental hazard. Therefore, the acute toxicity of seven poly- and perfluorinated carbonylic acids and alcohols on two cladocerans, Daphnia magna and Cricothoe sphaerica, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing groups of compounds with the same partition coefficients indicates that PFCs with a sulfonyl group are more toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOS>PFOA>PFBS>PFBA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals.

Embryotoxic effects of ammonium perfluorohexanoate (AFPO).

The analysis consists in, internal standard addition, protein precipitation with acetonitrile and centrifugation followed by the analysis using turbulent flow chromatography (LC-MS/MS).

Determination of perfluorinated compounds in cord blood samples by an on line method: turbulent flow chromatography LC-MS/MS.

To TLX-1, was used for analytical purposes, and equipped with a Turbo Ion Spray source.

Because of their global distribution, environmental persistence and potential risk to human beings and aquatic organisms, PFCs are of particular concern for research and regulatory communities. However, insufficient toxicity data are available to accurately assess their possible environmental hazard. Therefore, the acute toxicity of seven poly- and perfluorinated carbonylic acids and alcohols on two cladocerans, Daphnia magna and Cricothoe sphaerica, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing groups of compounds with the same partition coefficients indicates that PFCs with a sulfonyl group are more toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOS>PFOA>PFBS>PFBA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals.

Embryotoxic effects of ammonium perfluorohexanoate (AFPO).

The analysis consists in, internal standard addition, protein precipitation with acetonitrile and centrifugation followed by the analysis using turbulent flow chromatography (LC-MS/MS).

Determination of perfluorinated compounds in cord blood samples by an on line method: turbulent flow chromatography LC-MS/MS.

To TLX-1, was used for analytical purposes, and equipped with a Turbo Ion Spray source.

Because of their global distribution, environmental persistence and potential risk to human beings and aquatic organisms, PFCs are of particular concern for research and regulatory communities. However, insufficient toxicity data are available to accurately assess their possible environmental hazard. Therefore, the acute toxicity of seven poly- and perfluorinated carbonylic acids and alcohols on two cladocerans, Daphnia magna and Cricothoe sphaerica, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing groups of compounds with the same partition coefficients indicates that PFCs with a sulfonyl group are more toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOS>PFOA>PFBS>PFBA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals.

Embryotoxic effects of ammonium perfluorohexanoate (AFPO).

The analysis consists in, internal standard addition, protein precipitation with acetonitrile and centrifugation followed by the analysis using turbulent flow chromatography (LC-MS/MS).

Determination of perfluorinated compounds in cord blood samples by an on line method: turbulent flow chromatography LC-MS/MS.

To TLX-1, was used for analytical purposes, and equipped with a Turbo Ion Spray source.

Because of their global distribution, environmental persistence and potential risk to human beings and aquatic organisms, PFCs are of particular concern for research and regulatory communities. However, insufficient toxicity data are available to accurately assess their possible environmental hazard. Therefore, the acute toxicity of seven poly- and perfluorinated carbonylic acids and alcohols on two cladocerans, Daphnia magna and Cricothoe sphaerica, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing groups of compounds with the same partition coefficients indicates that PFCs with a sulfonyl group are more toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOS>PFOA>PFBS>PFBA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals.

Embryotoxic effects of ammonium perfluorohexanoate (AFPO).

The analysis consists in, internal standard addition, protein precipitation with acetonitrile and centrifugation followed by the analysis using turbulent flow chromatography (LC-MS/MS).

Determination of perfluorinated compounds in cord blood samples by an on line method: turbulent flow chromatography LC-MS/MS.

To TLX-1, was used for analytical purposes, and equipped with a Turbo Ion Spray source.

Because of their global distribution, environmental persistence and potential risk to human beings and aquatic organisms, PFCs are of particular concern for research and regulatory communities. However, insufficient toxicity data are available to accurately assess their possible environmental hazard. Therefore, the acute toxicity of seven poly- and perfluorinated carbonylic acids and alcohols on two cladocerans, Daphnia magna and Cricothoe sphaerica, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing groups of compounds with the same partition coefficients indicates that PFCs with a sulfonyl group are more toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOS>PFOA>PFBS>PFBA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals.

Embryotoxic effects of ammonium perfluorohexanoate (AFPO).

The analysis consists in, internal standard addition, protein precipitation with acetonitrile and centrifugation followed by the analysis using turbulent flow chromatography (LC-MS/MS).

Determination of perfluorinated compounds in cord blood samples by an on line method: turbulent flow chromatography LC-MS/MS.

To TLX-1, was used for analytical purposes, and equipped with a Turbo Ion Spray source.

Because of their global distribution, environmental persistence and potential risk to human beings and aquatic organisms, PFCs are of particular concern for research and regulatory communities. However, insufficient toxicity data are available to accurately assess their possible environmental hazard. Therefore, the acute toxicity of seven poly- and perfluorinated carbonylic acids and alcohols on two cladocerans, Daphnia magna and Cricothoe sphaerica, was evaluated in the present study. The adverse effects of the PFCs on these two cladocerans decreased with increasing groups of compounds with the same partition coefficients indicates that PFCs with a sulfonyl group are more toxic potential than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOS>PFOA>PFBS>PFBA. Furthermore, exposure to the different PFCs resulted in some general effects, such as deformations of the tail and an uninflated swim bladder, as well as in more specific effects depending on the structure of the tested chemicals.

Embryotoxic effects of ammonium perfluorohexanoate (AFPO).

The analysis consists in, internal standard addition, protein precipitation with acetonitrile and centrifugation followed by the analysis using turbulent flow chromatography (LC-MS/MS).

Determination of perfluorinated compounds in cord blood samples by an on line method: turbulent flow chromatography LC-MS/MS.
TU 022

Plastic debris and toxin releases in the Pacific Ocean
J.P. Greene
California State University, Chico, Chico, United States of America

Plastics comprised the majority of collected waste in worldwide beach cleanups in 2006, 2007 and 2008. In California, Washington, Oregon, and Hawaii the most common plastic debris items on beaches are cigarette filters, food wrappers and containers, beverage caps and lids, bags, and food service items, e.g., cups, plates, and cutlery. The majority of plastic items are made from four common plastics; polyethylene, polypropylene, polystyrene, and PET, accounting for 75% of the plastic debris. Pre-intervention data account for the amount of plastics in the ocean, but do not contribute to plastic debris in the ocean. The fate of plastics in the oceans can lead to fragmentation and result in plastic debris in the environment. Different types of plastic debris can degrade and release toxic chemicals such as phthalates, flame retardants, BPA, and antimony oxide, heavy metal nicks, and styrene monomer as the plastics break down. Plastics can accumulate toxins flagging the environment from persistent organic pollutants (POPs). POPs can include DDT, hexachlorobenzene, polychlorinated biphenyls (PCBs), polyyclic aromatic hydrocarbons, among others.

TU 023

Micro-plastics in the marine environment - a global assessment
J. Kershaw1, H.A. Leslie1
CEFAS, Lowestoft, United Kingdom

Institute for Environmental Studies (IVM), VU University, Amsterdam, Netherlands

GESAMP has set up a new Working Group entitled ‘Sources, fate and effects of micro-plastics in the environment - a global perspective’. With multi-agency support and with a multi-disciplinary membership, it is reviewing a wide range of information about the supply of plastics and microplastics to the ocean, and the biological, chemical and physical processes by which they are distributed and fate and effects of both microplastic particles and bioaccumulative properties of persistent organic pollutants (POPs), e.g., polychlorinated biphenyls (PCBs). This will provide an evidence base for use by policy makers, regional bodies and other stakeholders, and help to develop research priorities. The poster will describe the Terms of Reference, work programme, membership and intended outcomes of the Group and will issue an invitation to SETAC Europe participants to become involved in this initiative.

TU 024

Marine micro litter under the marine strategy framework directive - science and policy
G. Lindén1, F. Galgani1, S.S. Sadri1, R.C. Thompson1
European Commission Joint Research Centre, Ispra (VA), Italy

University of Plymouth, Plymouth, United Kingdom

The European Marine Strategy Framework Directive 2008/56/EC (MSFD) recognises Marine Litter as one of the indicators for the Environmental State of the European Seas. The Directive requires Member States to develop monitoring strategies and methodologies to ensure good environmental status (GES) of marine waters (Commission Decision 2010/477/EU), lists specific indicators for assessment of Marine Litter for the 2014-19 period (Commission Decision 2014/728/EU) and the next set of GES indicators for the 2020-2030 period (Commission Decision 2015/675/EU). The indicators have been developed to support the 2020 target on reducing the impact of litter on marine environments. The most common plastic types were Polyethylene terephtalate (PET) followed by Nylon and Acrylic but mean abundance was typically less than one item per square metre of sea water. The outcomes will be discussed within the framework of the current knowledge gap and we will describe challenges for future research on this topic.

TU 025

Using the continuous plankton recorder to determine the abundance of microplastic debris in the subsurface marine waters
S.S. Sadri1, M. Edwards1, R.C. Thompson1
University of Plymouth, Plymouth, United Kingdom

Sir Alistair Hardy Foundation for Ocean Science (SAHFOS), Plymouth, United Kingdom

Fragmentation of plastics debris into “microplastic” pieces is an emerging issue of concern. Our knowledge of distribution and accumulation of microplastic debris is patchy and in order to quantify and monitor the distribution and in particular temporal trends there is a need for a broad sampling programme and standardised methods. The aim of this research is to study the spatial-temporal abundance of microplastic debris in ocean surface waters and our preliminary investigation of microplastic contamination in Continuous Plankton Recorder (CPR) samples reported by analysts at the Sir Alistair Hardy Foundation for Ocean Science (SAHFOS) has confirmed the presence of synthetic polymers in several European locations (North Sea, Irish Sea, English Channel and the North Atlantic). We used Fourier Transform Infrared (FT-IR) spectrometry to identify the unknown pieces. The most common plastic types were Polyethylene terephtalate (PET) followed by Nylon and Acrylic but mean abundance was typically less than one item per cubic meter of sea water.

TU 026

Microplastics in personal care products from Brazil: is this source relevant to the aquatic contamination?
G. Fillimann, F. Poleza
FURG, Rio grande, Brazil

Plastics have been recently incorporate into the group of emerging pollutants due to their wide distribution in marine and coastal environments all over the world, as well as their persistence and hazard to the wildlife. Moreover, they have highly diverse diffuse sources and high capacity of distribution. In addition to other sources, microplastic (< 5 mm) debris are frequently identified in paper products, plastic skin cleansers and others personal care products reported in a result, this specific class of plastic has been found contaminating sediments and pelagic zones. Despite the effects related to direct ingestion, microplastic might also transfer adsorbed organic contaminants (OCs) to aquatic organisms. In the current study, particles from 18 of the most frequently used personal care products (soaps and creams) in Brazil were characterized regarding amount, size, form and composition. A decrease in particle size was observed by suspension and filtration of plastic debris, followed by microscopic analysis and weight of the particles. Undergoing chemical analyses by Fourier transform infrared spectroscopy (FTIR) will confirm the apparent predominance of polyethylene in plastics. The amount of plastic ranged from 1.3 to 103.1 mg of product, whereas the distribution frequency ranged from 100 to 400 microns. Due to methodological limitations, only 10 products had their size measured. Most of the plastics have irregular shapes, although spherical particles were also seen in some products. The preliminary results pointed out this as a relevant source of microplastics to the environment. However, this physic-chemical characterization of personal care products is essential to assess their potential to adsorb, concentrate and transfer OCs, improving somehow their bioavailability, from the environment to the organisms.

TU 027

International Pellet Watch: background levels, hot spots, legacy pollution, and temporal trends
H. Takada1, M. Heskett2, R. Yamashita2, M. Yoyama2, M. Inou2, T.B. Geo2
Tokyo University of Agriculture & Technol., Tokyo, Japan

Surfrider Foundation, Oahu, United States of America

International Pellet Watch (IPW) is a volunteer-based global monitoring program designed to monitor the pollution status of the oceans and to understand the risks associated with plastics in marine places. Based on background levels behind pelvis big island Hawaii, background levels of persistent organic pollutants (POPs) have been tentatively determined. By comparison of POPs concentrations in pellets from industrially-developing countries (e.g., Ghana) with the background levels, PCB inputs from e-wastes were suggested. Through global comparison, hot spots of PCB pollution were identified, e.g., Le Havre (France), Athens (Greece), Tokyo Bay (Japan), Sydney Harbor (Australia), Los Angeles, San Francisco, Boston Harbor, New York Bay and Lake Erie (USA), Santos Bay (Brazil). Combination of IPW with passive air sampling indicates that legacy pollution is major contributor to most of the hot spots of PCB pollution. In addition to the spatial variation, pellet watch was applied to reveal temporal trend in POPs pollution in California coast and Tokyo Bay.

TU 028

Partioning between water and plastics of polychlorinated biphenyls in marine animals
L. Golstein, M. De Klerk, A.J. Hendriks
Radboud University, Nijmegen, Nederlend

The presence of plastic debris in the oceans is a potential hazard for marine animal species in several ways. It is not only the plastics themselves that form a potential hazard. Chemicals are adsorbed during plastics production in order to catalyze monomers into polymers and give it different properties. Some of these additives have been associated with cancerogenic and endocrine disrupting effects. Moreover, due to its hydrophobic nature, plastic debris can be a hazardous to marine animal species because of accumulation of organic contaminants. An important hazard are the persistent organic pollutants (POPs), which do not completely dissolve in water and do not degrade into harmless materials in a short timeframe. Exposure to POPs, e.g., polychlorinated biphenyls (PCBs), has been associated with a wide range of health impacts on both wild life and humans. This study focuses on the equilibrium partitioning of polychlorinated biphenyls after ingestion by marine animals. In order to get more insight in the bioaccumulation potential of persistent POPs, we compared plastic-water partitioning, a simplification of the partitioning of plastic additivries in the aquatic fluid, with octanol-water partitioning. The outcomes will be discussed within the framework of the current knowledge gap and we will describe challenges for future research on this topic.
TU 029
Potential for increased exposure to persistent organic pollutants through ingestion of marine debris: the relevance of partitioning coefficients
D.P. Kay, J.L. Newsted, C. Berger, L.E. Phillips
Cardno ENTRIX, Okemos, United States of America

An important step in predicting the availability of plastic-sorbed persistent organic pollutants (POPs) to the marine environment is understanding the plastic:water partitioning coefficient (Kp) for a great number of chemical and plastic combinations. While plastics have the capacity to absorb chemical substances from their surrounding environment, little is known about the factors affecting sorption and desorption of POPs to plastic debris, the abundance and bioavailability of POPs on plastic debris, and the amount of plastics marine organisms consume. One step in understanding the potential for exposure is an evaluation of relevant partition coefficients. An extensive literature search was performed for this presentation. This review summarizes articles that calculated and presented plastic to water partitioning coefficients. Only published, peer reviewed literature was examined. The results of our review identified Kpws for 22 specific types of polymers and 198 individual compounds representing 24 different chemical groups. Analyses of these data showed a wide range of values (e.g., 0.91 to 7.8 log Kpw) among compounds for any given polymer. Of note, our data suggests a strong correlation between Kp and log Kow (octanol-water partition coefficients) for the POPs examined, and that log Kow may act as a surrogate for estimating log Kpw, which could allow for assessment of availability based on known properties of chemicals and plastics.

This finding is of particular importance because of the lack of log Kpw data for a wide array of plastics. A logical next step is to use log Kow to generate log Kpws through modeling approaches in order to evaluate the potential for these plastics to adsorb POPs to their environment. It would also be possible to further substantiate these findings by gathering partition coefficients and related information from other sources such as plastics companies, federal/state agencies, etc.

TU 030
Determination of DEHP in culture media by GC-MS/MS using PCI Ammonia
W. Phillips1, T. Robarge1, J. Butler1, M. Godula1, V. Yargeau1
Thermo Fisher Scientific, Austin, tx, United States of America

McGill University, Montreal, quebec, Canada

This method is a modification of elucidating the target phthalate, bis (2-ethylhexyl) phthalate (DEHP), in culture media by gas chromatography and tandem mass spectrometry (GC-MS/MS) using positive chemical ionization (PCI) with ammonia reagent gas. Phthalates are routinely analyzed in electron ionization (EI) with 149 m/z as the principal ion. Since all phthalates have similar spectra, it is difficult to identify which phthalate is present. By using PCI, the molecular ion is formed. Culture media samples with varying concentrations of DEHP were analyzed on a GC-MS system consisting of an ion-trap mass spectrometer and a gas chromatograph. Structural elucidation was achieved by employing PCI MS/MS on the molecular ion. Next, the fragment ions were compared to those in Mass Frontier software, which predicts fragmentation and the mechanisms of product ion formation by comparing the scan results to existing library data. Ammonia was selected as the chemical ionization reagent gas to increase the yield of the molecular ion.

A calibration curve with points at 0.1, 1, 5, and 10 µM were analyzed. The correlation coefficient for this calibration curve was 0.996. Two unknown samples were analyzed and quantitated against the calibration curve. These were found to contain 4.2 µM and 3.1 µM DEHP.

TU 031
Selective uptake of microplastics by a marine bivalve (Mytilus edulis)
L. van Caavenbergh1, M. Claessens, C.R. Jansen
Ghent University, Ghent, Belgium

University of Siena, Siena, Italy

This study showed the degradation product of larger plastic debris, are accumulating in marine habitats worldwide. Given their small size (< 1 mm) these particles can potentially be ingested by marine animals. Data on the uptake of microplastics in invertebrates is, however, scarce. In this study, we tested the hypothesis that the uptake of microplastics from the gut to tissues is size-selective and has an adverse effect on the energy allocation in the mussel. The hypothesis was tested by a 14 days experiment with three different sizes of microplastics simultaneously (10, 30 and 90 µm). 10 µm particles, as well as 30 µm particles, were added at 50 particles.ml⁻¹ and 90 µm-particles at 10 particles.ml⁻¹, resulting in a total concentration of 110 particles.ml⁻¹. Analysis of the faeces demonstrated that M. edulis filtered and ingested all particle sizes. In the faeces, the 30 and 90 µm-particles were detected in the same ratio as they were added to the seawater (i.e. 5/1). However, microscopy was performed on the faeces, we did not observe any particles, i.e. 8 times less than the 30 µm-particles were observed (even though they were initially present at the same concentration). Although this discrepancy was probably partly due to difficulties in detecting the particles in the faeces, analysis of acid-de destructed mussels and hemolymph samples demonstrated that 10 µm-particles were able to translocate to the circulatory system of the mussel. This is the first time microplastics have been detected from the digestive tract to the Adductor muscle and on average 15.3 ± 3.2 particles (n=15) were found in the hemolymph of the mussels. This uptake accounts for 0.3% of all 10 µm-particles ingested. The ingestion and uptake of microplastics showed no significant effects on cellular energy allocation. Exposure mussels did show a significant increase in energy metabolism, indicating a rise in metabolic activity.

Although microplastics were detected from a very small number of particles in the faeces and the hemolymph, this study showed that microplastics are potentially ingested by marine invertebrates and the energy allocation to the digestive tract is affected by the size of the ingested particles. The results highlighted as one of the global research priorities for these threatened species. The loggerhead turtle (Caretta caretta) and leatherback turtle ( Dermochelys coriacea) are considered two of the sea turtles species ingesting the largest amount of debris, in all their life stages, most likely because of their habitat and feeding behaviour.

TU 032
Presence of plastic debris in sea turtles stranded along the Tuscany coasts
B. Baini1, T. Cantarini1, M. Giannetti1, F. Cancelli1, C. Mancusi1, F. Serena1, M.C. Fossi1, L. Marsili1
University of Siena, Siena, Italy

Accademia dei Fisiocritici, Università di Siena, Siena, Italy

ARPAAT, Regional autonome for the Protezione Ambientale della Toscana, Livorno, Italy

Marine debris is known to have a widespread negative impact on marine wildlife, including physiology-level effects and reduced fitness, reproductive failure, changes in behavior, and potential reduction in species diversity. This is particularly relevant to turtles, as they are considered two of the sea turtles species ingesting the largest amount of debris, in all their life stages, most likely because of their habitat and feeding behaviour.

Mytilus edulis

The loggerhead turtle (Caretta caretta) and leatherback turtle ( Dermochelys coriacea) are considered two of the sea turtles species ingesting the largest amount of debris, in all their life stages, most likely because of their habitat and feeding behaviour.

The first result obtained from this study was that a large number of plastic was found, prevalently into the intestine, in more than 60% of the animals. The main categories of plastics found in the specimens were soft sheetlike user plastics; moreover in some specimens we found little amounts of foamed and fragment user plastics. Debris physical characteristics such as: weight, length, hardness and colour were also noted.

Marine debris is proven to have a widespread negative impact on marine wildlife, including physiology-level effects and reduced fitness, reproductive failure, changes in behavior, and potential reduction in species diversity. This is particularly relevant to turtles, as they are considered two of the sea turtles species ingesting the largest amount of debris, in all their life stages, most likely because of their habitat and feeding behaviour.

The first result obtained from this study was that a large number of plastic was found, prevalently into the intestine, in more than 60% of the animals. The main categories of plastics found in the specimens were soft sheetlike user plastics; moreover in some specimens we found little amounts of foamed and fragment user plastics. Debris physical characteristics such as: weight, length, hardness and colour were also noted.

Marine debris is proven to have a widespread negative impact on marine wildlife, including physiology-level effects and reduced fitness, reproductive failure, changes in behavior, and potential reduction in species diversity. This is particularly relevant to turtles, as they are considered two of the sea turtles species ingesting the largest amount of debris, in all their life stages, most likely because of their habitat and feeding behaviour.

The first result obtained from this study was that a large number of plastic was found, prevalently into the intestine, in more than 60% of the animals. The main categories of plastics found in the specimens were soft sheetlike user plastics; moreover in some specimens we found little amounts of foamed and fragment user plastics. Debris physical characteristics such as: weight, length, hardness and colour were also noted.

Marine debris is proven to have a widespread negative impact on marine wildlife, including physiology-level effects and reduced fitness, reproductive failure, changes in behavior, and potential reduction in species diversity. This is particularly relevant to turtles, as they are considered two of the sea turtles species ingesting the largest amount of debris, in all their life stages, most likely because of their habitat and feeding behaviour.
The southern hemisphere’s elevated UV light exposure encourages the year-round use of UV protective chemicals (UV filters and UV light stabilizers) in personal care and plastic articles. UV filters and preservatives are known to be hormonally active in vitro and in vivo, raising concerns of possible endocrine disrupting effects in the environment. There is little published data of occurrence of those compounds in Australian aquatic environments. This study is the first investigation of UV protective chemicals in environmental waters in Victoria, specifically in one of Melbourne’s estuaries. Waters samples were taken from four sites (A - D). Screened compounds included 11 UV filters (US EPA 2006) and 12 UV stabilizers, 12 preservatives and the metabolite, and one fragrance, including commonly used compounds in Australia such as 4-MBC, EHC, octocrylene, UV-328, HHCB, 2-phenox ethanol, methyl paraben, and propyl paraben. Water samples were extracted for polar and relatively non-polar compounds using two different types of solid phase extraction methods: Oasis HLB (Waters Corp.) for polar compounds, Empore C18FF (3M) for relatively non-polar compounds, then analysed by GC-MS, affecting the composition of the screened compounds. Samples from similar compounds profiles. Site D had a very different contaminant profile, with very high concentrations of the screened compounds. Sites A, B, C are both at the mouth of creeks and rivers flowing into Port Phillip Bay; Site D is about 5 km upstream of site C in Melbourne on the second biggest river entering Port Philip Bay. Although there are several small wastewater treatments located at different levels of HPP, over 80% of domestic and municipal wastewaters. Their removal in conventional WWTPs is generally lower than 50%. No removal for bezafibrate, hydrochlorothiazide, hydroxycarbamide and carbamazepine. Removal rates were also affected by the type of advanced treatments adopted (i.e. disinfection, UV treatment) in the plants investigated. The amounts of pharmaceutical active substances discharged in the environment daily through treated wastewater ranged between 1.2 and 2 kg. The total amounts of the investigated pharmaceuticals in the rivers flowing through the area investigated ranged between 0.9 and 2.7 kg/day respectively before and after the city of Milan. Traces also can be found in untreated ground water. Moreover, the pattern of contamination of ground water was higher in sites closer to rivers, suggesting the contribution of surface water to the contamination. This investigation allows the quantification of the mass flow of these substances flowing through a highly urbanized and industrialized area.

TU 035

A comprehensive study of emerging sources and fate in a highly urbanized and inhabited area in Italy

S. Castiglioni, R. Bagnatti, M. Melis, P. Camporini, E. Zucatto

Mario Negri Institute for Pharmacological Research, Milan, Italy

Pharmaceuticals are used in high quantities in our society. They can be excreted unchanged and/or as active metabolites in urine and feces, and directly conveyed to wastewater treatment plants (WWTPs). If they escape degradation during wastewater treatment, they finally end up in surface water. The present study aimed for the first time to study sources and fate of several selected classes of pharmaceuticals in the most inhabited and industrialized area in Italy (urban and suburban area around Milan). The investigation was conducted in wastewater, surface and ground water. Composite samples were collected, filtered, enriched with internal standards and solid-phase extracted. LC-ESI-MS/MS with multiple-reaction monitoring and stable-isotope dilution assay was used for quantitation. Recoveries were generally higher than 80% and limits of quantification were in the low ng/L range. Ciprofloxacin, ofloxacin, atenolol, furosemide, hydrochlorothiazide, chlorochromyacin, ibuprofen, ketoprofen, diclofenac, naproxen, and carbamazepine were the most abundant residual drugs in urban wastewater. Their removal in conventional WWTPs was generally lower than 50%, with no removal for bezafibrate, hydrochlorothiazide, hydroxycarbamide and carbamazepine. Removal rates were also affected by the type of advanced treatments adopted (i.e. disinfection, UV treatment) in the plants investigated. The amounts of pharmaceutical active substances discharged in the environment daily through treated wastewater ranged between 1.2 and 2 kg. The total amounts of the investigated pharmaceuticals in the rivers flowing through the area investigated ranged between 0.9 and 2.7 kg/day respectively before and after the city of Milan. Traces also can be found in untreated ground water. Moreover, the pattern of contamination of ground water was higher in sites closer to rivers, suggesting the contribution of surface water to the contamination. This investigation allows the quantification of the mass flow of these substances flowing through a highly urbanized and industrialized area.

TU 036

An evaluation of free water surface wetlands as tertiary sewage water treatment of micro-pollutants

M.G. Kröger1, S. M. Näsland2, D. Stråe3, H. Borg4, R. Gråbic5, J. Fick6

1Stockholm University, Stockholm, Sweden
2Water Reuse Systems Uppsala AB, Uppsala, Sweden
3University of South Bohemia in Ceske Budejovice, Vodnany, Czech Republic
4Uméa University, Umeå, Sweden

Increased attention is currently directed towards potential negative effects of pharmaceuticals and other micro-pollutants discharged into the aquatic environment via municipal wastewater treatment works. The number of additional compounds has therefore been supported as promising tools for improving the removal efficiency of pharmaceuticals in existing Sewage Treatment Plants (STPs). Constructed wetlands are also capable of removing a variety of micro-pollutants, including some pharmaceuticals, and could hence be a resource efficient complement to more advanced treatment technologies. The purpose of the present study was therefore to increase the knowledge about the potential use of constructed wetlands as a treatment step to reduce emissions of organic micro-pollutants from municipal sewage effluents. Under cold winter conditions, incoming and outgoing waters from four Swedish free water surface wetlands, operated as final treatment steps of sewage effluent from municipal STPs, were sampled and analyzed for levels of a set of 92 pharmaceuticals and 22 inorganic components as well as assessed using subchronic ecotoxicity tests with a marine alga as a model system. Sixty-five pharmaceuticals were detected in the range 1 ng L-1 to 7.6 µg L-1 in incoming and outgoing waters from the four investigated wetlands. Although the sampling design used in the present study lacks the robustness of volume proportional 24 h composite samples, the average estimated removal rates ranged from 42 to 52%, which correspond well with the mass flow removal (MCRs) in the range of 7.5% to 46% and the crustacean LOECs for OECs (in the range of 11.25 to 90%) could not be assigned to either pharmaceutical residues or metals, but in general showed that these treatment facilities release water with a relatively low toxic potential, comparable to water that have been treated with advanced tertiary sewage treatment option, especially where other treatment is lacking today. To fully remove micro-pollutants from sewage water, however, other advanced treatment technologies are likely needed.

TU 037

Large screening of pharmaceuticals and hormones in sludge based on LC-ToF-MS

E.V. Vuillier1, J. Camilleri2, W.P. Peysson1, C.C. Cren-Olive1

1Institut des Sciences Analytiques, Solaize, France
2US Army Engineer Research and Development Center, Natick, USA

Ecosystems are potentially contaminated by many chemical substances from domestic activities, through the spreading of treated sewage sludge. Indeed during the last thirty years, the application of municipal sludge from urban to agricultural soils is the option favoured internationally for sludge management as it contributes positively to recycling nutrients, fulfilling the concept of sustainable agriculture and contributing to the preservation of soil fertility. The literature data indicate that the removal efficiencies of organic contaminants in sewage treatment plants vary between 24 and 100% depending on the contaminants and treatment processes, which means that significant percentages of products can be present in the sludge. Steroid sex hormones and pharmaceuticals are considered emerging environmental contaminants of particular concern, as many of them display biologically active properties (including endocrine-disrupting). At the European level, few studies exist on the characterization of these emerging substances in sludge or on the assessment of health and environmental risks associated with their use. This is partly explained by the difficulties of detection and quantification of such pollutants in the solid phases. It is, indeed, a real analytic challenge given the diversity of peaks on HPLC, and the complexity of the matrix which makes difficult the extraction step. Thus it appears that the development of the analytical methods sensitive, reliable and robust is an essential step for the characterization of emerging substances in sludge.

In this context, the aim of the study was to develop a method for the large screening of pharmaceuticals and hormonal steroids in sludge. Therefore, nearly two hundred and twenty compounds were analyzed by liquid chromatography/mass spectrometry. The analysis of complex matrices such as sludge needed a rigorous sample preparation to obtain a repeatable and enough sensitive analysis to achieve the detection limits required. For this purpose, an extraction step using the QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) method was set up. This analytical methodology was successfully applied to various kinds of sludge (limed, digested, dried, liquid, composted) collected in several sewage works in France.

TU 038

Assessment of human pharmaceuticals to activated sludge: how many different sludges should be tested for an environmental risk assessment?

U. Memmer

Euroligions Regulatory AG, Rheinfelden (AG), Switzerland

The removal of pharmaceuticals in domestic sewage plant effluent has to be determined, e.g. according to the EMEA Guideline EMEA/CHMP/SWP/4447/00. This guideline focuses on the risk by the use of the pharmaceutical and the entry into the environment via excretion and wastewater effluent to a sewage treatment plant (STP). It is assumed that a substance with high sorption to activated sludge may reach terrestrial ecosystems by land spreading of sewage sludges. The adsorption to sludge has therefore to be tested according to the EMEA Guideline in an adsorption study. A terrestrial risk assessment with the drug if its adsorption coefficient to sludge exceeds a defined trigger value (Koc of 10'000 L/kg or Kd of 3'700 L/kg) and the drug is not readily biodegradable. The sorption of chemicals to sorbents like soils or sediments typically depends on several parameters of the sorbent (e.g. pH, ion exchange capacity, redox potential, organic carbon and content). The question arises how different activated sludges are regarding these parameters, how large the adsorption to sludges varies. In this study, the removal of pharmaceuticals in different sludges by the same analytical method and within the same laboratory will be discussed in the context of the trigger values used in the environmental risk assessment.

TU 039

Analysis of antimarial drugs in water

530

M. Escola Casas, M. Hansen, E. Björklund, K.A. Krogh

Faculty of Engineering, Copenhagen Business School, Denmark

Malaria is a general illness in many countries and therefore antimalarial drugs are prescribed in great quantities. There are more than 20 different molecules being used

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting

303
This method has already been extended to various matrices like rats’ serum and gonads [1] in our laboratory. We developed and validated a multiresidue analytical method for the analysis of antimalarial drugs (artemisinin derivatives and chloroquine) in water or soil. For that reason, the first multi-residue method for the analysis of antimalarial drugs and their metabolites in water has been developed. The analytical process combines SPE with LC-MS/MS and can be further developed to analyze soil samples. The presented method can be used to describe environmental fate profiles of antimalarial drugs in the environment.

TU 040

Matching micropollutant loads of influent and effluent for reliable mass balances in WWTPs

M. Majewsky, J. Farlin, T. Gallé, M. Bayerle

To date, many methods to analyze antimalarial drugs in blood and urine have been published. However, only two methods have been published to analyze a few antimalarial drugs (artemisinin derivatives and chloroquine) in water or soil. For that reason, the first multi-residue method for the analysis of antimalarial drugs and their metabolites in water has been developed. The analytical process combines SPE with LC-MS/MS and can be further developed to analyze soil samples. The presented method can be used to describe environmental fate profiles of antimalarial drugs in the environment.

TU 041

Occurrence and fate of triclosan and triclocarban during wastewater treatment and biosolid treatment

M.M. Hidalgo, E.P. Sagrista, M.G. Casademont, V.M. Salvadó

Triclosan (TCS) and triclocarban (TCC) are broad spectrum antimicrobial agents extensively used in a wide variety of personal care products including antibacterial soaps and detergents, shampoos, deodorants, cosmetics, mouth rinses and toothpastes.

During wastewater treatment, the removal efficiency of triclosan and triclocarban from the aqueous phase can be considerable in activated sludge processes but is dependent on process operating conditions. Triclocarban is recalcitrant during the sewage treatment process and is detected in streams and sediments downstream of WWTPs. TCS, TCC and MTCs have lipophilic properties and hence partition to sludge during wastewater treatment and may be present in concentrations ranging from ng g⁻¹ to % of the liquid phase on the solids and accumulates present and the extent of removal during wastewater and sludge treatment. Moreover, the sludge accumulated WWTPs is often processed to produce biosolids intended for land application. Thus, the agricultural recycling of biosolids, the favored option for sludge management, may lead to adverse environmental impact. In this work, TCC, TCS and MTS were monitored in both waters and sludge at different stages within the wastewater treatment process in two WWTPs with different characteristics located in the coastal area of Girona (NE Spain). Moreover, the influence of sludge digestion process on the degradation of target compounds was evaluated by analyzing the resulting digested biosolids under both aerobic and anaerobic conditions. The effect of the temperature on the occurrence of the studied compounds in the final biosolid was also investigated.

TU 042

Dominant time scale of antibiotic concentrations in rivers through one-year field campaign study

S. Coutu, V. Wyrsch, L. Rossi

In the presented study, the occurrence of antibiotics in surface waters was studied throughout one year in the Rhône River. The variation of antibiotic concentrations is strongly correlated to the human activity level in the region. The results showed a dominant time scale of two to three days for the occurrence of antibiotics.

TU 043

Quantification of pharmaceuticals and endocrine disruptors in river sediments: development and validation of a QuEChERS based extraction technique


In this work, TCS, TCC and MTS were monitored in both waters and sludge at different stages within the wastewater treatment process in two WWTPs with different characteristics located in the coastal area of Girona (NE Spain). Moreover, the influence of sludge digestion process on the degradation of target compounds was evaluated by analyzing the resulting digested biosolids under both aerobic and anaerobic conditions. The effect of the temperature on the occurrence of the studied compounds in the final biosolid was also investigated.
The experimental concept is validated in a small flume that allows the simulation of different hydraulic conditions in the hyporheic zone. Under abiotic conditions, we applied the approach successfully to measure retention of several pharmaceuticals at residence times of up to 16 hours; longer residence times will be evaluated. Currently, we are testing the influence of biotic conditions compared to a set of pharmaceuticals and, in addition, with some reference compounds. Our contribution will summarize the experimetal concept and the major finding of this method development study, and it will highlight the potential of the method for improving our understanding of hyporheic processes and thus of the environmental fate of organic micropollutants.

TU 045
Comparative analysis of emerging concern substances from a centralized municipal treatment plant and on-site wastewater treatment systems receiving commercial wastewater input


Baylor University, Waco, tx, United States of America

Though over 25% of the United States population employs decentralized on-site technologies for wastewater treatment, a comparative understanding of treatment efficacies of these systems remains less understood than those from centralized municipal wastewater treatment plants. In fact, it is estimated that 10 to 20 percent of these systems malfunction annually, releasing untreated wastewater to groundwater and surface water, which can degrade water quality and result in impacts on surface waters in regions experiencing drought - surface water exchange. Even less understood is a comparative understanding of contaminants of emerging concern (CECs) associated with these systems and subsequent loadings to the environment. The primary objective of this study was to assess the occurrence and removal efficiencies of select CECs among different wastewater treatment systems. Our objective was to evaluate the influence of seasons and influent dosing scenarios on-site aerobic treatment systems. A study further examined the occurrence of CECs, including 25 µg of abuse metabolites, between weekend and weekday sampling events. The studied CECs covered a variety of common pharmaceutical classes, including analgesic, anti-hypertension, antibiotic, psychostimulant metabolites, antihistamine, anti-seizure, benzodiazepine, anti-coculagent, anti-inflammatory, anti-lipemic, caffeine, and the artificial sweetener sucralose, which appears to represent a robust tracer of anthropogenic activity. In a effort to reduce the number of fish required to obtain a BCF, the OECD 308 study aims to estimate BCFs using a minimum number of sampling time points and therefore a reduced number of fish. Currently, we are comparing and evaluating different strategies for obtaining a BCF using a reduced sampling method. The goal of this project is compare the BCFs of several active pharmaceuticals obtained through standard OECD 305 test methods with those BCFs determined using the reduced sampling method.

TU 046
Water-sediment biodegradation: challenges in modeling and screening for pharmaceutical transformation products

E. Ericson

Pfizer Inc, Groton, United States of America

The current OECD 308 test is a water-sediment simulation test that is typically conducted over a 100 - 200 day period. It is intended to estimate the parent half life in the water phase, sediment phase and collectively in the total water-sediment system; determine the distribution and mass balance of the residues in the test system; as well as characterize the transformation products. Given the length of the test exposure period, the expense and costs associated with conducting the test, it is often desired that a more rapid screen for assessing the potential transformation of pharmaceuticals would be available. Such information would be helpful in developing the ERA testing strategy especially when the identification of a key transformation product would be helpful early on in the risk assessment process. Screening for transformation products in the environmental samples is currently being performed using liquid chromatography tandem mass spectrometry (LC-MS/MS) method that employs independent isotopically-labeled standards for quantification of each compound was applied to quantify target compounds for all samples. ANOVA was performed to test differences of treatment type, and season on CEC concentrations and other routine water quality parameters. Results showed that concentrations of CECs are typically in the range of <1-100 ng/L in the effluent discharges, which are generally consistent with peer-reviewed literature reports for these CECs. CEC concentrations from advanced on-site systems were reduced relative to septic systems. The present study, which included CECs with varied physicochemical properties, provides an initial understanding of the range of environmental loadings from common on-site wastewater treatment systems.

TU 047
A comparison of fish bioconcentration factors for several pharmaceutical compounds obtained following the standard OECD 305 Protocol and the estimated BCFs obtained using the reduced sampling method

L.A. Constantine

Pfizer Inc, Groton, United States of America

Understanding whether an active pharmaceutical ingredient is likely to be taken up by the aquatic environment by fish and bioaccumulate has triggered the need to conduct bioconcentration studies in fish. Such studies are typically considered appropriate for pharmaceuticals having a logD value > 3 and required, as per the EMA Guideline, for pharmaceuticals having logD values > 4.5. The standard OECD Guideline 305 includes an exposure (uptake) phase followed by a post-exposure (depuration) phase typically equal to 60% of the uptake phase. During the uptake phase, between range of 14 and 60 days, water and fish samples are analyzed periodically until steady state has been established and the depuration phase may be initiated. During the depuration phase, analysis of water and fish samples continues until a plateau has been reached. Based on the sampling schedule outlined in the guideline, >100 fish per study may be required to determine a kinetic bioconcentration factor (BCF). In a effort to reduce the number of fish required to obtain a BCF, an approach to estimating the aquatic bioconcentration factor using reduced sampling has been developed (Springer, et al.,2008). This reduced sampling approach aims to estimate BCFs using a minimum number of sampling time points and therefore a reduced number of fish. The goal of this project is compare the BCFs of several active pharmaceuticals obtained through standard OECD 305 test methods with those BCFs determined using the approach of estimating aquatic bioconcentration factors using the reduced sampling method.

TU 048
Waterborne beclomethasone dipropionate affects fish while beclomethasone is not taken up

M. Carney Armbrs1, J. Fick2, E. Cukley1, L. Forlini1, D.G. Larsson1

1University of Gothenburg, Goteborg, Sweden
2Umeå University, Umeå, Sweden

Glucocorticoids are steroid hormones, playing important roles in several aspects of vertebrate physiology. The synthetic corticosteroid beclomethasone has anti-inflammatory activity, as well as a role in regulating immune responses. It is administered as the more lipophilic prodrug beclomethasone dipropionate (BDP) which is metabolized to the monopropionate (BMP) and free beclomethasone in humans. A recent publication demonstrated effects of waterborne BDP (1 µg/L nominal concentration) on plasma glucose levels in fish. Although levels of in beclomethasone and its lipid esters in effluents or surface waters are not known, it can be assumed that most of the consumed product BDP is metabolized into the lipophilic forms before reaching the environment. We have therefore compared the potential of beclomethasone and BDP to bioconcentrate and to affect the physiology of exposed fish. Controlled flow-through studies with rainbow trout over two weeks to up to 0.65 µg of beclomethasone/L did not result in measurable plasma levels. Exposure to 0.65 µL BDP, on the other hand, led to accumulation of both beclomethasone, BMP and BDP in plasma, indicating a considerably more efficient uptake of the more lipophilic prodruk as well as metabolism within the fish. Accordingly, exposure to 0.65 µg of BDP significantly increased blood glucose levels, in agreement with previously published data. Furthermore, we could demonstrate a parallel increase in catalase activity in liver tissue, while exposure to beclomethasone had no effect on these endpoints. We are currently screening for beclomethasone, BDP and BMP in sewage effluents and surface water.

TU 049
The degradation of antidepressant pharmaceuticals in aerobic sludge

M. C. Melin1, S. SerranO1, D. W. J. Arzberger1, L. T. Craybrooks1

1The College of Wooster, Wooster, United States of America

The antidepressant pharmaceuticals sertraline and venlafaxine are common contaminants in both aquatic and terrestrial environments and are reported to produce adverse effects on a range of aquatic organisms. A key point of entry of these contaminants into the environment is through wastewater treatment. To learn whether microbial communities in wastewater sludge have the ability to degrade sertraline and venlafaxine and, thus, consequently reduce their environmental loads, microcosms containing aerobic sewage were spiked with deuterated sertraline and venlafaxine. Samples collected over 36 days were analyzed for the depletion of the added pharmaceuticals by liquid chromatography tandem mass spectrometry (LC-MS/MS). Municipal aerobic wastewater sludge was found to degrade sertraline and venlafaxine by over 90% over the course of 36 days, whereas no change in the added sertraline and venlafaxine concentrations were observed in abiotic control microcosms.

TU 050
Time trend of cyclic volatile methyl siloxanes in Baltic herring

A. Kirkegaard1, A. Bignert1, M.S. Mclachlan2, L. Förlin1, D.G. Larsson1

1Swedish Museum of Natural History, Stockholm, Sweden
2Umeå University, Umeå, Sweden

Cyclic volatile methyl siloxanes (cVMS) were studied in herring from the Swedish environmental sample bank. Fish from a site from the Baltic Proper southeast of Stockholm (Landsort) and from the northern part of the Bothnian Bay (Harturjden) were analysed. Skinless dorsal muscle samples from six individuals were pooled. Two pooled samples were analysed from each site for every second year from the period 1989 - 2009. Octamethylcyclotetrasiloxane (D4), decamethylcyclopentasiloxane (D5) and dodecamethylcyclohexasiloxane (D6) were analysed. The D5 concentrations were of the 50 ng/g lipid weight, while the concentrations of D4 and D6 were lower and frequently below detection levels. The concentrations were generally lower at the beginning of the period and highest around 2005-2007. There were no marked differences in the concentration in the two locations.

TU 051
Degradation studies of the ionophores lasalocid, monensin, narasin, and salinomycin

M. Schulz1, J. Murphy1, A. Stencel1, S. Strand1, J. Snider1

1The University of Missouri, Columbia, United States of America

The degradation of ionophores lasalocid, monensin, narasin, and salinomycin in aerobic sludge were spiked with deuterated sertraline and venlafaxine . Samples collected over 36 days were analyzed for the depletion of the added pharmaceuticals by liquid chromatography tandem mass spectrometry (LC-MS/MS). Municipal aerobic wastewater sludge was found to degrade sertraline and venlafaxine by over 90% over the course of 36 days, whereas no change in the added sertraline and venlafaxine concentrations were observed in abiotic control microcosms.
Like: change of pH, ionic strength of solution and temperature were also tested. Various of sorption and kinetics models were used to describe obtained results.

Other external factors were studied to describe the environmental fate of ionophores and to identify new and ecotoxicological relevant transformation products. Abiotic and biotic transformation studies were conducted on four ionophoric anti-coccidials; lasalocid, monensin, narasin, and salinomycin. Abiotic studies focusing on hydrolysis and photolysis were conducted following international OECD guidelines. Hydrolysis was observed under acidic conditions for narasin, monensin and salinomycin, while photodegradation was observed under all conditions. In addition, photodegradation of both lasalocid and monensin was observed for both wavelengths, so that photodegradation of monensin and narasin and salinomycin can be discarded. Biotic degradation studies were conducted in lab-scale bio-reactors inoculated with Nocedex extracted soil bacterial communities. In addition, during the work with these very lipophlic anti-coccidial agents, it was observed that adsorption to analytical equipment was highly relevant to assess under acidic conditions.

After abiotic transformation of the ionophores, the soil bacterium Nitrosonomas europaea was used as a screening tool for transformation product toxicity. This effect-directed study was conducted by exposing bacteria to the mixture of ionophore degrates.

TU 052
Formation and structure elucidation of stable transformation products of pharmaceuticals in the water cycle
M.H. Lamoree, H. Weiss, T. Vasconcelos, P. Roche, V. Boiteau, A. Hebert, B. Roig, S. Monpelet, K. Kümmerer
Institute for Environmental Studies, Amsterdam, Nederland
L’Université de Lorraine, Nancy, France
Vesalius Research Centre and Innovation SNC, Rueil-malmaison, France
Ecole des Hautes Études en Santé Publique, Nimes, France

Pharmaceutically active substances undergo transformations starting from human metabolism to degradation and transformation in environmental processes and finally during drinking water treatment. Often degradation during sewage and water treatment and the environment is incomplete, resulting in the formation of stable transformation products. The formation and presence of such stable transformation products in the effluent of sewage works, surface water, and drinking water treatment is reported in the scientific literature with increasing frequency. In only a few cases, full mineralization of the parent compounds is achieved. This is even more of importance as advances in analytical methods allowing using e.g. oxygen, hydrogen peroxide, light or electro-coagulation are increasingly under discussion for the removal of pharmaceuticals and other micro pollutants in effluent and drinking water treatment. Transformations using these methods may even lead to the formation of transformation products that are more toxic than the parent compound.

In the past, comprehensive information on the degree of contamination of our environment with pharmaceuticals has been collected, but there are still some important knowledge gaps regarding the human impact of two groups of pharmaceuticals, which will be addressed in the Pharmas project (EU grant agreement no. 263546). On the one hand, for anti-cancer drugs only little information is available on environmental concentrations, while for the antibiotics, concerns is raised regarding their occurrence and the potential role of these compounds in spreading resistance against these valuable pharmaceuticals.

For a selection of pharmaceuticals of both classes, the formation of stable transformation products in various stages of the water cycle (both drinking and sewage) will be investigated in laboratory and pilot scale studies. Treatment processes include mainly chlorination, ozonation and UV disinfection for drinking water treatment and advanced oxidation processes for wastewater treatment. For structure elucidation of the transformation products formed, different LC/MS/MS approaches as well as high resolution MS techniques will be implemented. Characterization of the stable transformation products in terms of (eco)toxicological behavior will be done using a battery of in vitro bioassays.

TU 053
Predicting environmental concentrations of carbamazepine and oxcarbazepine and their main metabolites in a coastal system
H. Fenno1, L. Arpin-Point2, A. Vanhoube Brunier2, D. Munaron2, A. Fandirier1, S. Chiron1, H. Budzinski1, D. Hillaire-Buys3, O. Mathieu1, C. Boillot4, E. Gomez1
UMR Hydrosciences, Montpellier, France
IFREMER, Site, France
UMR EPOC LTCE, Talence, France
CHU Laboratoire de toxicologie et pharmacologie médicale, Montpellier, France

Predicting environmental concentrations of carbamazepine and oxcarbazepine and their main metabolites in a coastal system

In this project, we aim at developing a model to predict the behavior of carbamazepine (CBZ), oxcarbazepine (OxCz) and their main metabolites in a regional environmental system: a coastal zone with a WWTP submarine outfall. The model takes into account the initial CBZ and OxCz prescriptions, metabolisms and partial losses in the coastal waters. A proportion of CBZ and OxCz flow to the coastal zone through the submarine outfall. Regional data on CBZ and OxCz prescription were obtained from the medical care system. CBZ and OxCz prescribed amounts have been studied over 6 months in view to calculate concentrations in wastewater treatment plant effluent and so allow for Predicted Environmental Concentrations (PECs) estimation. The human metabolic pathways of CBZ and OxCz required to include in the model the contribution of the major urinary metabolites: carbamazepine-10,11-epoxide, 10,11-dihydro-10,11-trans-dihydroxy-carbamazepine, 10-hydroxy-carbamazepine and other hydroxylated derivatives. PECs are in the ng/l level in the wastewater effluents and were compared to the measured concentrations (MECs). The diffusion in the coastal zone was estimated with a hydrodynamic numeric model (MARS 3D). The behavior in the coastal zone was qualitatively compared to measured concentrations obtained with POCIS passive samplers. Data on pharmaceuticals in the coastal zone are scarce and PECs and diffusion model might therefore be useful for studying pharmaceutical transfer and fate in the coastal environment.

TU 054
Fate of anti-diabetic drugs: gliclazide, glibeclamide and glimepiride in soil environment
W. Mrózık, J. Stefanská
Medical University of Gdańsk, Gdańsk, Poland

It is estimated that around 3–5% of human population suffers from diabetes mellitus type 2. Since large quantities of anti-diabetic drugs are used for treatment, it is possible that huge amounts of these pharmaceuticals and their metabolites are deposited in the environment due to excretion from humans and because of the improper utilization of off-date drugs. The most common way to enter the natural environment by these drugs is by sewage. Therefore, the most endangered are natural waters, soils and sediments.

Concluding the composition of these matrices it is obvious that the most dominant interaction are sorption and biodegradation processes. Transport of the compound in porous media, such as soils, sediments and aquifers, is strongly influenced by its tendency to sorb on to the various compounds of the solid matrix. Moreover, since molecular transfer is a prerequisite for the uptake of organic pollutants by organisms, the bioavailability of a given compound and thus its rate of biotransformation, is affected accordingly.

Sorption process of the three sulfonylurea based of anti-diabetic drugs were tested on three various soil. Selected soils differed in their physical and chemical properties and thus, it was possible to assess the influence on sorption of: organic matter content; pH; moisture; fine fraction content and cation/ anion exchange capacities. Other external factors like: change of pH, ionic strength of solution and temperature were also tested. Various of sorption and kinetics models were used to describe obtained results.

TU 055
Evaluation of pharmaceuticals and personal care products focused on anthelmintics in human-waste, sewage, hospital wastewater, livestock wastewater and receiving water
1Pusan National University, Busan, South-Korea (Rep)
2UNIST, Ulsan, South-Korea (Rep)
3Institute for Environmental Studies, Amsterdam, Nederland
4CHU Laboratoire de toxicologie et pharmacologie médicale, Montpellier, France
5University of Copenhagen, Copenhagen, Denmark

We investigated 33 PPECs focused on anthelmintics in the human-waste treatment plants (HTPs), sewage treatment plants (STPs), hospital wastewater treatment plants (HWWTPs), and livestock wastewater treatment plants (LWTPs). Additionally, the concentrations of anthelmintics, The HWWTPs and HTPs had relatively high levels, indicating that livestock wastewater and human waste are principal sources of anthelmintics. In the sources except for the LWTPs, human anthelmintics, albendazole and flubendazole, were the most dominant. In some receiving water samples, veterinary anthelmintics showed higher proportion than human drugs, suggesting some other sources flowing into the water environment. Overall, anthelmintics showed insignificant removal efficiencies in wastewater treatment plants. Compared with NSAIDs, antibiotics and β-Blockers, anthelmintics showed relatively lower levels. In the future, additional studies need to be performed to understand the pathway of anthelmintics and their metabolites in the water system.

TU 056
Degradation of antibiotics by photocatalysis on immobilized titania dioxide
A.G. Sanz1, R. Llobet2, L. Arpin-Point2, P. Arnoux, O. Zahraoui1
CNRS, Nancy cedex, France

Pharmaceuticals are micropollutants which release in the aquatic environment has been a subject of concern for several years as they can give rise to two problems: i) they can have a direct effect on bacteria, either those involved in wastewater treatment (activated sludge, biofilms) or those present in natural aquatic environment where they contribute to river self-cleaning, ii) they can promote the development of resistance to antibiotics in aquatic environment, including those that pathogenic to man and animal. Most antibiotic are non biodegradable and an advanced physicochemical process should be applied for their elimination. There are several such processes but photocatalysis is often proposed as it can use part of the solar spectrum as an energy source and is reagent free. However most of the works described in literature are based on titanium dioxide slurries. After treatment these nanoparticles should be recover which is not easy. One solution to this problem is photocatalyst immobilization. However immobilized photocatalysts are generally less efficient than suspended photocatalysts as less surface can be activated. Within this framework tests...
of photodegradation of two antibiotics often observed in the environment: a veterinary drug, tylosin (916 g/mole, pKa = 7.1) and a human drug sulfamethoxazole (253 g/mole, pKa = 5.7). Two photocatalysts (titanium dioxide) have been used: PC500 (Millenium) and P25 (Degussa). Two modes of immobilization have been tested: on a glass plate in the lab for both photocatalysts or on cellulose fibers for PC500 only (Ahlstrom, Pont-Evêque, France). Antibiotics degradation was monitored by UV-visible spectrometry and HPLC. End products (organic carbon and nitrogen species) were also quantified. Degradation was observed, P25 being more efficient than PC500. Besides the mode of immobilization, other parameters have been investigated such as pH, position of the lamp, flowrate and antibiotic initial concentration.

TU 057 Direct and indirect photolysis of human metabolites of antibiotic sulfamethoxazole

F. Bonvini1, J. Omlir2, R. Rutler1, T. Kohl1
1Enviromental Chemistry Laboratory, Lausanne, Switzerland
2Environmental Chemistry Laboratory, EPFL, Lausanne, Switzerland

Both direct and indirect photodegradation processes have been reported to be important removal mechanisms of sulfamethoxazole (SMX) in the environment. However, most of SMX is adsorbed to human and animal waste matter, yet as their environmental fate is not known. In this study, we assessed the direct and indirect photodegradation kinetics at 3 different pHs of 5 human metabolites of SMX, namely, nitro-SMX, nitrosuo-SMX, acetyl-SMX, hydroxyl-SMX and SMX-glucuronide. Similar to SMX, all metabolites were photolabile, however, with the exception of SMX-glucuronide, half-lives were all greater than that of the parent compound. The protonation state affects absorbance of the parent compound and degradation rate. Slowest direct photolysis rates were observed at environmentally relevant pH 8.4, where the anionic form of the compounds predominates, except for SMX-glucuronide. The faster degradation of indirect photolysis to the overall photolysis was found to be fastest for nitro-SMX (70% in presence of 10 mg/L of humic acid). Experiments conducted in lake water (1.19 mg/L NO2, 2.43 mg/L TOC) showed degradation rates comparable to humic acid experiments. Furthermore, we examined the occurrence of SMX and metabolites in the proximity of wastewater discharge in Lake Geneva, Switzerland. Two human metabolites of SMX, acetyl-SMX and SMX-glucuronide were regularly detected in wastewater effluent and lake water samples, in concentrations lower than that of the parent compound.

TU 058 Ubiquitous distribution of sulfamethoxazole in tropical Asian and African waters

H. Takada1, A. Shimizu2, T. Koike1, A. Takehisa1, N. Nakada1, S. Suzuki1
1Tokyo University of Agric. & Technol., Tokyo, Japan
2Ehime University, Matsuyama, Japan

Human and veterinary antibiotics have been widely detected in municipal and agricultural wastewater and receiving waters. Antibiotics are biologically active and their ecological impacts have been of concern. Especially, induction of antibiotics resistance is of great concern. Very limited information is available on antibiotics in tropical waters. In this study, the distribution and environmental fate of SMX was investigated in the major rivers of tropical Asian and African countries. Seven sulfonamides, trimethoprim, five macrolides, lincomycin, and three tetracyclines were measured in sewage, livestock and aquaculture wastewater, and river and coastal waters in 7 tropical Asian countries. Sum of the concentrations of the target antibiotics were sub to low ppb levels in sewage and heavily sewage-impacted waters. Most of the antibiotics, particularly sulfamethoxazole (SMX) followed by lincomycin or sulfathiazole . SMX-glucuronide were regularly detected in wastewater effluent and lake water samples, in concentrations lower than that of the parent compound.

TU 059 Environmental fate, occurrence and toxicity of the antiparasitic pharmaceutical toltrazuril

K.A. Krogstad1, M.C. Havsland1, J. Olsen1, S.A. Bak1, A. Brandt2, B. Hallin-Sørensen1, E. Bjerklund1
1University of Copenhagen, Copenhagen, Denmark
2Danish Medicines Agency, Copenhagen, Denmark

Toltrazuril, a triazines endoparasiticide, has been marketed in the acute and prophylactic treatment of livestock such as poultry, piglets, sheep and cattle against coccidiosis. It is metabolized through stepwise sulfation resulting in pharmacologically active metabolites. Hence toltrazuril is excreted as the parent compound and as two active metabolites; toltrazuril sulfoxide and toltrazuril sulfone, mainly via feces. The massive use of other anticoccidial drugs has resulted in increasing resistance of the parasites [1] as a result the use of toltrazuril is expected to be escalating.

Already in 2003, Boxall et al. [2] expressed concern about this compound and considered it as a high-priority drug with respect to especially environmental and toxicological concerns. However, today still little is known about its environmental occurrence, fate and toxicity in the open environment. In 2008, concerns were raised by Germany during the Marketing Authorization approval of a tolerantriumin (3) Toltrazuril and its metabolites may present a risk to the environment due to toxic effects on terrestrial plants and due to a risk for ground water contamination caused by misuse application on agricultural fields.

Analytical methods utilizing LC-MS/MS have been developed to quantify toltrazuril and metabolites in aqueous matrices using solid-phase extraction (SPE) and in solids matrices using pressurized liquid extraction (PLE). These methods are applied in this work to determine the occurrence of toltrazuril and its metabolites in drainage water, upper and lower ground water and soil from agricultural fields amended with manure containing toltrazuril. Furthermore, the developed methods have been applied to determine the fate of toltrazuril and metabolites in different abiotic processes such as hydrolysis and photolysis. Toxicity was assessed by performing acute growth inhibition tests on Selenastrum Capricornutum (freshwater algae, ISO guideline 14442), cyanobacteria (OECD guideline 201 and acute immobilisation tests Daphnia Magna (freshwater water fleas), Chironomus tentans (invertebrates) and Rana temporaria (frogs). Two active metabolites; toltrazuril sulfoxide and toltrazuril sulfone, mainly via feces.
A comprehensive evaluation of the effects of the antimicrobial personal care product triclosan (TCS) in the terrestrial environment was performed. This evaluation included the toxicity of TCS on soil microorganisms and its impact on terrestrial arthropods. Acute respiratory and survival studies were performed with 12-14 day old wheat seedlings, and effects on emergence and growth of terrestrial plant species. Microbial respiration and nitrification were evaluated in soil treated with 0.1-2.0 mg/kg TCS for 28 days. The acute and chronic toxicity of TCS to worms were tested in an artificial soil in accordance with OECD guidelines 207 and 222. Test concentrations for acute and chronic toxicity studies were based on historical studies, respectively. The effects of TCS on the predatory mite Hypoaspis aculeifer exposed to 0.3-320 mg/kg (dw) TCS for 14 days were evaluated in accordance with OECD guideline 226. Phytotoxicity studies evaluating survival, emergence, shoot biomass and length, and normalcy of development in 10 species of terrestrial plants were performed in accordance with OECD guideline 208 using 0.1-1,000 mg/kg (dw) TCS for 14 days. No Observed Effects Concentrations (NOEC) and Lowest Observed Effects Concentrations (LOEC) for soil respiration and soil nitrification were 2 and 2 mg/kg (dw), respectively. NOEC and LOEC values for acute and chronic toxicity to earthworms were 1,026 and >1,026 mg/kg (dw) [survival], and 100 and >100 mg/kg (dw) [survival and reproduction], respectively. NOEC and Lowest Observed Effects Concentrations (LOEC) values for survival and reproduction were 10 mg/kg (dw) and 32 mg/kg (dw), respectively. LOEC values in terrestrial plants ranged from 75 and 100 mg/kg (bw) [ biomass in lettuce] to 1,000 and >1,000 mg/kg (dw) [emergence and phytotoxicity in tobacco].

This disturbingly high figure can however not be extrapolated to the entire Swedish market since we preselected 9 APIs known to be present in the effluent of the Indian plant. Also, actual sales figures were not accounted for. The aims of the present study are therefore to describe where the APIs in pharmaceutical products, sold in Sweden, are used and to what extent the price pressures are correlated to the country of origin of the API. We will also investigate if price pressures to corrumption and environmental performance indexes in the manufacturing plant. Such surrogate measures are used as conclusive information on pollution level is lacking for most of the APIs.

UO 067

The ScnAT exposure model: a novel spatial method to inform environmental risk assessments of personal care products in China

L.E. Holm, O.P. Price, C. Holmes, R. Yamada

Univeristy, Bedfordshire, United Kingdom

Waterborne Environmental Inc, Leesburg, United States of America

Pharmaceutical industries outsource more and more of their manufacturing of active pharmaceutical ingredients (API) to low income countries. We have previously shown that price pressures on medicines result in more pollution. Does price pressure on medicines result in more pollution?

Gothenburg University, Gothenburg, Sweden

L. Gunnarsson, D.G.J. Larsson

The Environmental Risk Assessment (ERA) of pharmaceuticals mainly considers the aquatic compartment, since the majority of active pharmaceutical chemicals (APIs) are hydrophilic and thus expected to concentrate in sewage sludge during municipal sewage treatment, and following application of sludge to land as fertilizer. There is a potential for chemical residues in soils. With the rapid growth of the human population, water use-re practices are diverse and increasingly global. The irrigation of crops with raw or treated wastewater could act as a potential source of APIs to the food chain. Exposure via this route and its significance is not currently considered within ERA guidelines. The disposal of unused medicines is also of interest, and recent monitoring studies have shown that drugs disposed to landfill can potentially leach out and contaminate local groundwater and surface waters.

This poster presentation describes a risk assessment for pharmaceuticals associated with emission potential routes to the terrestrial environment: application of biocides to agricultural land; wastewater irrigation of agricultural land; unused medicines to landfill. The potential risks have been evaluated with modelling techniques contained within the European Commission's technical guidelines, and where input parameters are not available, estimation methods have been adopted. The assessment highlights the relative risk between each of these emission routes and how uncertainty in key parameters can affect the outcome. This indicates the potential need for additional pharmaceutical fate study data in order to carry out robust risk assessments associated with the terrestrial environment.

UO 068

A comparative assessment of Predicted-No-Effect-Concentration (PNEC) aquatic toxicity data for pharmaceuticals

T. Verschyle, F. Mastrocco, J.C. Lema

Gradient, Cambridge, United States of America

Pharmaceutical industries outsource more and more of their manufacturing of active pharmaceutical ingredients (API) to low income countries. Therefore a qualitative assessment was performed to determine if spatial patterns of water quality were consistent with data published by the Ministry of Environmental Protection. The results show the PECs are qualitatively consistent with other spatial assessments of water quality. The model fits neatly with a unit world approach (e.g. EUSES, RAIDAR and USEtox), which is quick and easy to run and catchment models (e.g. GREFER and PhAte) which give a better approximation of real world but are complex and data heavy.

UO 069

Environmental risk assessment for the polycyclic musk AHTN and HHCB in the Molgora river (Lombardia Region, Italy)

V.S. Villa

University of Milano Bicocca, Milan, Italy

Polycyclic synthetic musk (PCMs) compounds are used in fragrances in a wide array of personal care products. The two most important PCM compounds are galaxolide (HHCB) and Toluene-2,3-dicarboxylic anhydride (AHTN). In Europe such substances are classified as persistent organic pollutants (POPs) due to their persistence, mobility and bioaccumulation potential in the environment. The use of such chemicals in personal care products, in particular in cosmetics, is increasing worldwide, as is the use of such products.

The removal of both substances during municipal sewage treatment process has been estimated as being approximately 40-60% of the initial amount. For these reasons, it is not surprising to find AHTN and HHCB as contaminants of the aquatic environments. Indeed, the concentrations detected in environmental samples range from ng/l to µg/l in surface waters and effluents. The fact that both compounds show high values of log Kow and potential for bioaccumulation raised serious concerns on their potential adverse effects on the aquatic ecosystems. Furthermore, it has been suggested that both chemicals can act as chemosensitizers and could therefore have indirect effects by allowing normally excluded toxicants to permeate cells. Literature data, reporting the presence of PCMs in the Italian aquatic systems, are scarce and limited. Very recently, monitoring surveys performed for HHCB and AHTN carried out in 2010 along the Molgora river, located in a very densely populated area of Lombardy (northeastern Italy), revealed that HHCB and AHTN were present in samples collected along the river course at 19 sampling sites. The observed concentrations of both chemicals dissolved in water are far below the risk threshold, while HHCB adsorbed to particulate organic matter can pose a risk for aquatic species. Various concentrations of AHTN and HHCB were tested in the daycare treating plant at a concentration of 1 mg/L.

The observed concentrations of both chemicals dissolved in water are far below the risk threshold, while HHCB adsorbed to particulate organic matter can pose a risk for aquatic species. Various concentrations of AHTN and HHCB were tested in the daycare treating plant at a concentration of 1 mg/L.

The observed concentrations of both chemicals dissolved in water are far below the risk threshold, while HHCB adsorbed to particulate organic matter can pose a risk for aquatic species. Various concentrations of AHTN and HHCB were tested in the daycare treating plant at a concentration of 1 mg/L.

The observed concentrations of both chemicals dissolved in water are far below the risk threshold, while HHCB adsorbed to particulate organic matter can pose a risk for aquatic species. Various concentrations of AHTN and HHCB were tested in the daycare treating plant at a concentration of 1 mg/L.
TU 071 Do pharmaceuticals with evolutionary preserved drug-targets pose a greater environmental risk?

S.M. Furuhagen, A. Fuchs, E. Lundström, E. Gorokhova, M. Breitholtz
Stockholm University, Stockholm, Sweden

Human pharmaceuticals are designed to target specific molecules involved in a particular metabolic or signaling pathway in humans to obtain desirable effects at low doses. Although not all of these drug-targets are present within the diversity of biological life found in nature, some are evolutionary well-preserved. It has therefore been hypothesized that non-organisms with highly conserved human drug-targets may be at a greater risk to be affected by pharmaceutical residues in the environment. In this study, the hypothesis that pharmaceuticals will be more likely to cause adverse effects in the cladoceran Daphnia magna have greater effects on gene expression and RNA content. Three different pharmaceuticals were tested: the anti-fungal drug miconazole, the anti-histamine promethazine (both with highly conserved drug-targets in D. magna), and the progestogen levonorgestrel (with a low drug-target homology). For each pharmaceutical, juvenile daphniids were exposed to sublethal concentrations and raised over a complete life cycle. Gene expression data was assessed at the level of (1) gene expression (vitellogenin and cuticle protein mRNA using β-actin as a housekeeping gene), (2) relationship between total RNA and DNA (as a proxy for protein synthesis rate), and (3) body size. The exposure to miconazole resulted in a two- and three-fold decreased gene expression of vitellogenin and cuticle protein genes, respectively, as well as a significant increase in RNA content in relation to DNA. The down-regulated expressions of vitellogenin and cuticle protein genes are indicative of endocrine disruption in RNA can be a result of enhanced protein synthesis as a way to combat stress. By contrast, promethazine and levonorgestrel did not alter RNA-DNA relationship. No effects on the body size were observed for either test substances. Thus, our preliminary results indicate that for miconazole, the drug with well-conserved drug-targets, the endocrine and protein synthesis disrupting effects were indeed observed at sublethal concentrations. To fully test the hypothesis, complementary analyses on the other two pharmaceuticals are also being conducted.

TU 072 Androgenic activity of levonorgestrel in three-spined stickleback (Gasterosteus aculeatus)

U.J. Svensson, I. Brands, B. Brunstrom
Uppsala University, Uppsala, Sweden

Synthesis of androgens in reproduction and have emerged as widespread contaminants in the aquatic environments. They have been shown to impair reproduction in fish at concentrations in the low ng L−1 range. The mechanisms behind the reproductive toxicity of synthetic progestins are largely unknown. Some synthetic progestins, such as levonorgestrel (LNG), exert androgenic effects in humans and other mammals by binding to the androgen receptor (AR). Studies in fish indicate that AR activation by progestins may partly mediate their reprotoxic effects, and cause female fish to develop male secondary sex characteristics. In order to acquire a quantitative determination of the androgenic potency of progestins in fish, we exposed three-spined stickleback (Gasterosteus aculeatus) to LNG. Male sticklebacks synthesise a unique glue-like glycoprotein called spiggin, which is used in nest building. Spiggin is produced in the kidney under the influence of androgen binding to the AR. Spiggin production is absent in females but can be induced by exogenous AR agonists, and serves as the best known biomarker for androgens in fish. Adult stickleback females in duplicate groups were exposed to semi-static LNG at 3, 30, 300 and 3000 ng L−1 for 24 days. The effects of LNG on the mRNA expression of the spiggin and vitellogenin, kidney epithelium height and organosomatic indices were studied. Spiggin and vitellogenin transcripts were measured using real-time quantitative PCR. Kidney epithelium height was determined in histological sections. The results show a clear androgenic effect of LNG at concentrations ≥ 30 ng L−1. Spiggin expression, nephroscopic index and organosomatic index, were all significantly increased and vitellogenin and cuticle protein gene expressions were significantly reduced at 338 ng L−1. Our in vivo quantitative data show that LNG acts as a potent androgen in fish, giving support to the contention that androgenic effects of certain progestins may contribute to their reproductive toxicity.

TU 073 Investigating the genotoxicity effects of pharmaceutical photo-transformation products

University of South Bohemia in Ceske Budejovice, Vodnany, Czech Republic

Photo-stability is an important aspect of pharmaceuticals in order to ensure the quality of products, and may be affected by environmental conditions. However, the potential effects of photo-transformation on the genotoxicity of pharmaceuticals are not well understood. In this study, we investigated the genotoxicity effects of pharmaceuticals exposed to UV light, and in particular, the effects of photo-transformation on the genotoxicity of three pharmaceuticals: the antifungal drug miconazole, the antihistamine promethazine, and the progestogen levonorgestrel. We measured DNA adduction, chromosomal aberrations, and micronucleus formation in human hepatocellular carcinoma cells (HepG2). Our results indicate that the effects of photo-transformation on the genotoxicity of these pharmaceuticals are still at its early stage.

TU 074 Transcriptome analysis of the brain of the gilthead sea bream (Sparus aurata) after exposure to environmental concentrations of human pharmaceuticals

M. Hamperl1, M. Milan2, J. Blasco3, S. Ferraress4, L. Bargelli5
1Institute for Marine Sciences of Andalusia, Puerto real, Spain
2University of Padova, Legnaro, italy
3Institute for Marine Sciences of Andalusia, Puerto real, Spain
4School of Pharmacy, University of Gothenburg, Sweden
5Institute of Marine Sciences of Andalusia, Puerto real, Spain

Pharmaceuticals are being released into the environment in extremely large quantities on a regular basis. Ingested drugs are eventually excreted from individuals, as well as they are released from manufacturing and disposal of unused or expired drugs ultimately winding up in the effluent of wastewater treatment plants and aquatic environments. In order to determine long-term effects of exposure to environmental relevant concentrations, we exposed the gilthead sea bream (Sparus aurata) to representative drugs found at ng-μg/L levels in surface-/groundwater and coastal waters. Acetaminophen (APAP), Carbamazepine (CBZ) and Atenolol (AT) were used as model compounds to assess the transcriptomic effects of low, long term exposure on the expression of the brain transcriptome.

The treatment with the greatest number of differentially expressed genes was CBZ with 467 features, followed by APAP and 44 for AT. The selected vehicle, DMSO, didn't show any significant expression changes in comparison with the SW control. Out of all these features, only one was common between all the three treatments. This feature was identified by homology search as Sparus aurata cytochrome c oxidase subunit I mRNA. No other feature was common between APAP and AT or CBZ and AT. However, there were 130 common features between the APAP and CBZ treatment.

Functional annotation clustering and enrichment analysis of APAP and CBZ candidate genes in DAVID revealed treatment specific activation of different pathways and processes, with energy-related features present in all the applied treatments.

TU 075 Chronic effect of atenolol on physiological indices in rainbow trout (Oncorhynchus mykiss)

V. Zlábek, V. Burinka, H. Kroupova, G. Steinbach, R. Grabic, G. Fedorova, J. Vesik, T. Randak
University of South Bohemia in Ceske Budejovice, Vodnany, Czech Republic

Atenolol is a representative of second generation of the beta-blockers, which is often detected in the surface water, due to its extensive use and relatively high stability. In the study presented, the negative effects of atenolol were studied on juvenile rainbow trout, Oncorhynchus mykiss, by chronic semi-static bioassay. Fish were exposed to sublethal concentrations of atenolol (1, 10 and 1000 ng mL−1) for 42 days. Multiple biomarkers were measured, including morphological indices, haematological parameters, antioxidant responses and CP450 activities. Parameters measured in this study displayed various dependent parameters to atenolol concentrations and exposure time. In short, the multiple responses in fish indicated that atenolol induced physiological stress and could be used as potential biomarkers for monitoring residual atenolol in aquatic environment.

TU 076 Investigating the genotoxicity effects of pharmaceutical photo-transformation products

M.I. Garcia-Käufer1, M. Kümmerer1, D. Fatta-Kassinos2
1University of Cyprus, Nicosia, Cyprus
2Institute of Sustainable Chemistry and Material Resources, Ljubljana, Germany

All types of urban wastewater discharge and reuse practices, including irrigation of landscape and agricultural areas, groundwater replenishment, discharge into inland surface-waters and sea, cause the release of organic xenobiotic substances into the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar chemical compounds, specifically designed to interact with living organisms, represent an important concern for humans and the ecosystems. It has already been proved that conventional treatment placement in urban wastewater treatment plants is incapable of eliminating these substances and as a result pharmaceuticals, their metabolites and/or transformation products are released in the environment. Research has been concentrated mainly on the effects the parent compounds may have; whereas investigation of possible effects caused by metabolites and transformation products is still at its early stage.

This study has been focused on investigating effects of photo-transformation products of oxloccin, a photolabile second generation fluoroquinolone, widely used and frequently found in the environment. Photo-transformation of oxloccin was achieved by phenolic and photocatalytic treatment at various times. Nine photo-transformation products and degradation intermediates based on piperazinyl dealkylation and decarboxylation are proposed. Furthermore, their genotoxicity using the cytokinesis-block micronucleus assay with the hepatocellular liver carcinoma cell line (HepG2) was studied and demonstrated that a long irradiation time (greater than 30 min) is required to eliminate possible genotoxic effects.

TU 077 Ecotoxicity of 14 serotoninergic pharmaceuticals in the cladoceran Daphnia magna, the microalgae Pseudokirchneriella subcapitata and the marine gastropod Haliotis tuberculata

E. Farcy1, R. Bureau1, A. Serpentini1, J.M. Lebel2, M.P. Halm2
1CENAKVA, CZ-1,0521, 1,0001.0024, Grant agency of the Chinese Academy of Sciences, 1,0001.0024, Grant agency of the Czech Republic
2Universität Rostock, Germany

Chemical and ecological descriptors of pharmaceuticals are based on their chemical structure and molecular properties, which can be divided into two main groups: the toxicokinetic properties and physicochemical properties, both of which are important for understanding the effects of pharmaceuticals on aquatic ecosystems. In this study, we investigated the ecotoxicity of 14 serotoninergic pharmaceuticals, which have serotoninergic properties, i.e. enhancing the effects mediated by serotonin in the central nervous system. The tested pharmaceuticals included serotonin, doxepin, citalopram, paroxetine, fluoxetine, fluvoxamine, sertraline, venlafaxine, desvenlafaxine, mirtazapine, nefazodone, aripiprazole, olanzapine, and risperidone. The ecotoxicity of these pharmaceuticals was assessed using the microalgal Pseudokirchneriella subcapitata, the cladoceran Daphnia magna, and the marine gastropod Haliotis tuberculata. The results showed that all 14 pharmaceuticals exhibited significant acute toxicity to at least one of the three test organisms. The effects varied depending on the concentration and the time of exposure, with some compounds showing delayed effects. The study highlights the need for further research to understand the ecotoxicological implications of these pharmaceuticals in aquatic environments.
molecules are mainly antidepressants (fluoxetine, sertraline, paroxetine, fluvoxamine, citalopram, clomipramine, amitriptyline, mianserin, milnacipran, duloxetine, venlafaxine) but also antipsychotic drug (clozapine), cough suppressant/hallucinogenic drug (dextromethorphan) or beta-blocker (propranolol). These molecules have the common property to play directly or indirectly a role on the serotonin transporter and/or serotonin receptors. The 14 molecules were tested for their ecotoxicological effects using chronic and sub-chronic bioassays with the marine crustacean Daphnia magna. Additionally to these conventional bioassays, a novel bioassay was developed using primary cell culture of hemocytes from the marine gastropod abalone (*Haliotis tuberculata*). This assay was used in order to address the question of pharmaceutical effects in a marine species. The acquired data were used to build quantitative structure activity relationship (QSAR) modeling in order to (1) determine if the chemical properties of the molecules can explain their toxicity, (2) identify the mode of action of the selected pharmaceuticals.

**TU 079**

**Environmental effects of anticholinesteratic therapeutic drugs on a crustacean species, Daphnia magna**

R.J. Rocha 1, C.P. Marques 1, F.J. Gonçalves 2, B.A. Nunes 1

1University of Aveiro, Aveiro, Portugal
2University of Porto, Porto, Portugal

The environmental presence of pharmaceutical drugs is nowadays an important field of toxicology, since the presence of such residues can cause a series of deleterious effects on exposed biota. This study assessed the ecotoxicological effects of two anticholinesteratic therapeutic drugs, neostigmine and pyridostigmine in *Daphnia magna*. This evaluation was performed using single and combined effects (response surface) and sub-lethal concentrations of the two compounds. The pharmacological effects of neostigmine and pyridostigmine derive from their capacity to induce a reversible inhibition of cholinesterase activity, and have thus been used to test the human disease myasthenia gravis. We observed alterations at a sub-individual parameter directly related to the anticholinesteratic activity. Our study calculated 48 h LC 50 values in the immobilization assay of 167.7 μg L -1 for neostigmine, and 8.1 μg L -1 for pyridostigmine, respectively. In the reproduction assay, the most affected parameter was the somatic growth rate (LOECs of 21.0 μg L -1 and 2.9 μg L -1 for neostigmine and pyridostigmine, respectively), followed by the fecundity (LOECs of 41.9 μg L -1 and 11.4 μg L -1 for neostigmine and pyridostigmine, respectively). We also determined a 48 h EC50 for cholinesterase activity of 1.7 and 4.5 μg L -1 for neostigmine and pyridostigmine, respectively. These results demonstrate that both compounds are extremely toxic for *D. magna* at concentrations in the order of μg L -1. By comparing the here-obtained results with the actual concentrations of pyridostigmine previously reported in the aquatic environment (0.22 μg L -1), it is possible that this compound can significantly alter the feeding behavior of *D. magna*. Hence, the ecological implications of these data are of great importance and must be considered under the risk assessment framework of both pharmaceutical drugs.

**TU 079**

**Acute and chronic tests of Tamoxifen and its metabolites on Daphnia pulex**

M.B. Borgatta 1, T.B. Bucelin 1, P.W. Wardel 1, N.C. Chièvre 1

1Université de Lausanne, Lausanne, Switzerland

The environmental presence of pharmaceutical drugs is nowadays an important field of toxicology, since the presence of such residues can cause a series of deleterious effects on exposed biota. This study assessed the ecotoxicological effects of two anticholinesteratic therapeutic drugs, neostigmine and pyridostigmine in *Daphnia magna*. This evaluation was performed using single and combined effects (response surface) and sub-lethal concentrations of the two compounds. The pharmacological effects of neostigmine and pyridostigmine derive from their capacity to induce a reversible inhibition of cholinesterase activity, and have thus been used to test the human disease myasthenia gravis. We observed alterations at a sub-individual parameter directly related to the anticholinesteratic activity. Our study calculated 48 h LC 50 values in the immobilization assay of 167.7 μg L -1 for neostigmine, and 8.1 μg L -1 for pyridostigmine, respectively. In the reproduction assay, the most affected parameter was the somatic growth rate (LOECs of 21.0 μg L -1 and 2.9 μg L -1 for neostigmine and pyridostigmine, respectively), followed by the fecundity (LOECs of 41.9 μg L -1 and 11.4 μg L -1 for neostigmine and pyridostigmine, respectively). We also determined a 48 h EC50 for cholinesterase activity of 1.7 and 4.5 μg L -1 for neostigmine and pyridostigmine, respectively. These results demonstrate that both compounds are extremely toxic for *D. magna* at concentrations in the order of μg L -1. By comparing the here-obtained results with the actual concentrations of pyridostigmine previously reported in the aquatic environment (0.22 μg L -1), it is possible that this compound can significantly alter the feeding behavior of *D. magna*. Hence, the ecological implications of these data are of great importance and must be considered under the risk assessment framework of both pharmaceutical drugs.

**TU 080**

**Calcium binding as mediator of action of antifungal imidazole pharmaceuticals in non-target organisms: implications for mixture toxicity assessment**

M.C. Breitholtz, S. Furuhagen, K. Eik, P. Ivanov, E. Gorokhova

Stockholm University, Stockholm, Sweden

Calcium ions (Ca2+) are not addressed in current regulation of pharmaceutical chemicals, several theoretical models have been developed and applied to predict mixture toxicity in environmental research. The Concentration addition (CA) model describes the mixture toxicity of components with similar mode of action (MOA). Imidazoles are primarily known as antifungal substances interfering with synthesis of ergosterol in fungi. However, imidazoles are also competitive antagonists of calmodulin (CaM). CaM is a calcium binding protein expressed in all eukaryotic cells, where it participates in many signaling pathways (e.g. nitric oxide signaling), thereby affecting many different cellular functions, particularly neurosecretory activity. Since arthropods are unable to synthesize sterols relying on dietary sources, the sterol synthesis inhibition is not likely a primary mode of action. Here, we hypothesized that exposure to imidazoles disrupt CaM-dependent nitric oxide synthesis in microcrustaceans. Further, assuming CA-Mim to be the primary MOA for these substances, we evaluated CA models as a tool for assessing mixture toxicity of imidazoles.

**TU 081**

**Behavioural and physiological responses to pharmaceutical exposure in Gammarus spp. and Fucus vesiculosus**

A.K.E. Wicklund, H. Oksanen, G. Thorsen, L. Kumbold

Stockholm University, Stockholm, Sweden

Gammarus spp. and Fucus vesiculosus are two foundation species of the Baltic Sea. These species inhabit the littoral community and are thereby exposed to substances released in coastal areas. In this study both species were exposed to three concentrations of two pharmaceuticals, ibuprofen and propranolol. Both physiological and behavioural parameters were estimated to examine potential effects in the organisms. Respiration, feeding rate, activity with and without predator cues by a Multispecies Freshwater Biomonitor (MFB[TM]), were estimated for Gammarus spp. and gross production to respiration ratio (GP/R) and chlorophyll fluorescence for F. vesiculosus. Additionnally to these conventional bioassays, a novel bioassay was developed using fixed ratios of each individual substance' LC50 value. This exposure resulted in a calculated median lethal concentration (based on Toxic Units) of 0.86 (95% CI: lower 0.74; upper 1.01), which shows that the mixture displays concentration additive toxicological effects. We then compared our results with the CA model. In contrast to the CA model, no concentration or any interaction in the experimental mortality data was found. The results indicate that the pharmaceutical concentrations may not be mixture additive and it is important to examine their potential synergistic effects on non-target organisms and to justify the application of CA models for assessment of imidazole mixture toxicity.

**TU 082**

**Acute effects of psychiatric drugs on *D. magna* under insecticide exposure**

L.T. Pestana 1, M.F.L. Lemos 1, V. Calisto 1, C. Barata 1, V. Esteves 4, A.M.V.M. Soares 4

1University of Aveiro, Aveiro, Portugal
2ESTM&GIRM, Polytechnic Institute of Leiria, Peniche, Portugal
3IDAEA-CSIC, Barcelona, Spain
4International Laboratory for Aquatic Environmental Safety (ILAES), Aveiro, Portugal

The environmental presence of pharmaceutical drugs is nowadays an important field of toxicology, since the presence of such residues can cause a series of deleterious effects on exposed biota. This study assessed the ecotoxicological effects of two anticholinesteratic therapeutic drugs, neostigmine and pyridostigmine in *Daphnia magna*. This evaluation was performed using single and combined effects (response surface) and sub-lethal concentrations of the two compounds. The pharmacological effects of neostigmine and pyridostigmine derive from their capacity to induce a reversible inhibition of cholinesterase activity, and have thus been used to test the human disease myasthenia gravis. We observed alterations at a sub-individual parameter directly related to the anticholinesteratic activity. Our study calculated 48 h LC 50 values in the immobilization assay of 167.7 μg L -1 for neostigmine, and 8.1 μg L -1 for pyridostigmine, respectively. In the reproduction assay, the most affected parameter was the somatic growth rate (LOECs of 21.0 μg L -1 and 2.9 μg L -1 for neostigmine and pyridostigmine, respectively), followed by the fecundity (LOECs of 41.9 μg L -1 and 11.4 μg L -1 for neostigmine and pyridostigmine, respectively). We also determined a 48 h EC50 for cholinesterase activity of 1.7 and 4.5 μg L -1 for neostigmine and pyridostigmine, respectively. These results demonstrate that both compounds are extremely toxic for *D. magna* at concentrations in the order of μg L -1. By comparing the here-obtained results with the actual concentrations of pyridostigmine previously reported in the aquatic environment (0.22 μg L -1), it is possible that this compound can significantly alter the feeding behavior of *D. magna*. Hence, the ecological implications of these data are of great importance and must be considered under the risk assessment framework of both pharmaceutical drugs.
Pharmaceutical and personal care products (PPCPs) are considered new environmental pollutants, since hundreds of these molecules are commonly revealed in the aquatic environment in the high ng/L to low µg/L range worldwide. Among them, the occurrence of the antibiotic triclosan (TCS), the antibiotic trimethoprim (TMP) and the non-steroidal anti-inflammatory drugs (NSAIDs) ibuprofen (IBU), diclofenac (DCF) and paracetamol (PCM) is well documented in both surface and sewage waters. NSAIDs have been widely used as model compounds because of their high solubility and low sorption potential, making them suitable for toxicological studies. Also, triclosan was chosen as a model compound. Acute toxicity of the Oswego Lake strain of the green algae Desmodesmus subspicatus (Chlorophyta) and the blue-green algae Anabaena flos-aquae (Cyanobacteria) were investigated in compliance with the TGD. As Desmodesmus subspicatus is an established marine alga, it is commonly used to assess the ecotoxicological effects of various pollutants. We investigated the effects of these pharmaceuticals on two strains of the green alga D. subspicatus: one from Lake Oswego, New York, and the other from the coastal waters of the North Sea. Both strains were tested in a semi-static 48 h renewal assay with four replicates per concentration. The results showed that the Oswego Lake strain was more sensitive to the tested pharmaceuticals than the North Sea strain. We conclude that these pharmaceuticals can have significant adverse effects on algae at environmentally relevant concentrations. Further studies are needed to investigate the effects of these pharmaceuticals on other organisms and ecosystems.
action and physical-chemical properties. Next to this, endocrine-disruptive activities have been observed for a few of the tested PPCPs. The obtained data indicate which of

TU 090

Effects of chronic exposure to pharmaceuticals on aquatic biota: an experimental study

I. Roessink1, J.C.L. Jessica2, S. Mclondoogh3, A.M.V.M. Soares4, A.J.A. Nogueira1, I. Domingues1

1University of Aveiro & CESAM, Aveiro, Portugal

2Laboratory of Aquatic Toxicology (OTX) and amoxicillin (AMX) are antibiotics that are extensively used worldwide. Both compounds are applied in fish and shrimp farming practices, and are often present in wastewater treatment plants. Their effluent application has a threat to both human and environmental health. Considering this scenario, our study aims at assessing sub lethal effects of AMX and OTX in embryos and adults of zebrafish. To achieve these objectives a battery of biomarkers were analysed in adults (liver, head, muscle, gill tissues) and embryos (whole body homogenates) exposed to these chemicals. Representative biomarkers still managed to pass the plants usually still active compounds into the environment has led to concerns previously because although they are designed to work for humans these compounds can also provoke unexpected effects on aquatic organisms. Although acute effect studies indeed prove that effects on aquatic non-target organisms is already found at much higher concentrations than actually monitored in the environment. However, less information on chronic effects is available. From a previous monitoring it became apparent that STP effluents contained relatively high concentrations of metformin, metoprolol, salol, valsartan, atenolol, diclofenac, carbamazepine, anfetol, and guanurea. Consequently, it was decided to test these compounds in realistic levels (MIX) next to a control and raw effluent. This poster will present the results of an indoor microcosm study testing the potential impact of pharmaceuticals on on the bacterial and ciliate setup. Indoor microcosms comprising a simple water-sediment systems were seeded with the worm Lumbriculus variegatus, the isopod Asellus aquaticus, the snail Physella sp., and the cladoceran Daphnia magna. Test medium was refreshed every two weeks and test organism abundances were monitored for approximately 8 weeks in all treatments.

TU 091

Toxicity of Ciprofloxacin and Sulfamethoxazole on marine biofilm communities

G.H. Johnson1, T. Backhaus2

1Department of Plant and Environmental Sciences, Gothenburg, Sweden

2University of Gothenburg, Gothenburg, Sweden

Pharmaceuticals are widely used compounds and many of them will eventually end up in the aquatic environment where they might affect various organisms. Two commonly used antibiotics that have been shown to be present in the aquatic environment are Sulfamethoxazole and Ciprofloxacin. As they are used to efficiently treat bacterial infections there is a great risk that they affect environmental microorganisms similar to their target organisms if they end up in the environment. The concentration-response relationship of these two substances was investigated on natural marine biofilm communities (periphyton) mainly composed by diatoms and bacteria.

Glass discs were submerged in the sea outside Fiskebackskil on the Swedish west coast and the biofilms colonized the substrate during a week. Thereafter the biofilms were exposed to the two antibiotics (5nmol/L - 9nmol/L) in the lab using the semi static SWIFT periphyton test during 72 hours.

We describe our experience with the operation of this sensitive equipment and the results that we have obtained with the reference substance 3-5 dichlorophenol and other pharmaceuticals. The obtained data indicate which of the different targets are likely to cause resistance.

TU 092

An automated respirometer for measuring activated sludge respiration rates in OECD Method 209

W.R. Jenkins, C.A. Jenkins, R.A. Dickinson, G.L. Podd

Huntingdon Life Sciences, Eye, United Kingdom

The activated sludge respiration inhibition test (OECD Procedure 209) is used to assess the inhibitory effects of a substance on the respiration of the heterotrophic population of aerobic microorganisms grown in the activated sludge wastewater treatment process. The original OECD guideline for the test was first issued in 1984 and remained unchanged until 1995. In 2003 the guideline followed the test design update to improve the statistical basis of the test design. Changes introduced in the new guideline included an increase in the level of replication of test and control mixtures to allow the determination of the NOE (Non Observed Effect Concentration) of a substance, a requirement of Guideline EMEA/CHMP/INS/4447/00 for the risk assessment of pharmaceuticals, together with methods for assessing inhibition of nitrification.

We have introduced and validated a computer-controlled respirometer system comprising 30 incubation chambers each containing an oxygen probe, aerator and headspace nitrogen purge system and a stirrer to provide mixing and flow of media across the probe membrane. Each chamber is connected to an automated, computer controlled data capture system, which records the oxygen consumption by samples of activated sludge in each incubation chamber after aeration has been terminated and the headspace purged with nitrogen.

TU 093

Evaluation of the potential risk due to exposure of children to allergens during bath

M. Herva1, P. Diaz, M. Llompart, E. Roca

University of Girona, Girona, Spain

The use of personal care products is a common practice in developed countries. This brings as consequence a frequent exposure to chemicals likely to be damaging for human health, particularly in the case of babies and children. Fragrances are a group of chemicals incorporated in most cosmetic and other personal care products including baby care ones. The Scientific Committee on Consumer Products (SCCP), has identified 26 of these ingredients as likely to cause contact allergies. Among products for baby care and other children care, those intended for the bath such as shampoos, bubble baths, shower gels, and soaps, contain detergents that can break down the natural barrier of the skin, allowing exposure to other irritants and allergens to penetrate. Based on analytical data previously published providing concentrations of 26 fragrance suspected allergens in bathwater samples, the aim of this work was to estimate the potential risk to children under 3 in daily exposure to bathwater.

TU 094

Comparative responses of zebrafish life stages exposed to oxytetracycline and amoxicillin

R. Oliveira1, J.C.L. Jessica2, S. Mclondoogh3, A.M.V.M. Soares4, A.J.A. Nogueira1, I. Domingues1

1University de Aveiro, Aveiro, Portugal

2Laboratory of Aquatic Toxicology (OTX) and amoxicillin (AMX) are antibiotics that are extensively used worldwide. Both compounds are applied in fish and shrimp farming practices, and are often present in wastewater treatment plants. Their effluent application has a threat to both human and environmental health. Considering this scenario, our study aims at assessing sub lethal effects of AMX and OTX in embryos and adults of zebrafish. To achieve these objectives a battery of biomarkers were analysed in adults (liver, head, muscle, gill tissues) and embryos (whole body homogenates) exposed to these chemicals. Representative biomarkers still managed to pass the plants usually still active compounds into the environment has led to concerns previously because although they are designed to work for humans these compounds can also provoke unexpected effects on aquatic organisms. Although acute effect studies indeed prove that effects on aquatic non-target organisms is already found at much higher concentrations than actually monitored in the environment. However, less information on chronic effects is available. From a previous monitoring it became apparent that STP effluents contained relatively high concentrations of metformin, metoprolol, salol, valsartan, atenolol, diclofenac, carbamazepine, anfetol, and guanurea. Consequently, it was decided to test these compounds in realistic levels (MIX) next to a control and raw effluent. This poster will present the results of an indoor microcosm study testing the potential impact of pharmaceuticals on on the bacterial and ciliate setup. Indoor microcosms comprising a simple water-sediment systems were seeded with the worm Lumbriculus variegatus, the isopod Asellus aquaticus, the snail Physella sp., and the cladoceran Daphnia magna. Test medium was refreshed every two weeks and test organism abundances were monitored for approximately 8 weeks in all treatments.

TU 095

Gemfibrozil and naproxen biodegradation in a river water ecosystem

A. Barra Caracciolo, P. Grenni, M. di Lenola, L. Patrolecco

National Research Council, Monterotondo, Rome, Italy

Incompleter removal during wastewater biological treatments is the main source of surface water contamination by pharmaceuticals. Degradation of a chemical in the aquatic
ecosystem depends on a variety of factors, including compound properties and environmental factors and above all the presence of a natural microbial community able to degrade it via metabolic and/or co-metabolic pathways. Although pharmaceutical and therapeutic products are widely found in the natural environment, the ecological effects on receiving ecosystems remain largely unknown.

Naproxen, a nonsteroidal anti-inflammatory drug and gemfibrozil, a fibrate drug used as lipid regulator, have been found in several natural waters. They were also found in water samples collected from aquatic environments and were exposed to ibuprofen concentrations close to nominal (105 ± 2.6 and 502 ± 49 µg L⁻¹). Analysis was performed by solid-phase extraction (SPE) followed by a developed reversed phase high performance liquid chromatography (RP HPLC) method. The chromatography was using a Zorbax Eclipse XDB-C8 column (4.6 mm x 150 mm, 5 µm particle size) at 25°C, with a mobile phase of 0.1% THF in water (pH 8) - acetonitrile (85:15, v/v). The flow rate was 1 mL/min, and detection by DAD at 233 nm. Samples were collected in July 2011 on seven different locations of the Danube River on a territory of Novi Sad, Serbia. Caffeine content ranged 0.8-4 ng/L on the 1st day and 0.5-2 ng/L on the 30th day after sample collection. On the 60th day after sampling caffeine was under the limit of detection in all water samples. Presence of caffeine confirmed the existence of human waste in the Danube River. Highest values were obtained in sample collected from location near the water supply source “Ratno orostvo”, Novi Sad. Obtained results due to caffeine amounts significantly decreased during two months storage of samples on 4°C most likely due to its degradation.

The work was supported by Ministry of Education and Science, Republic of Serbia (II46009) and NATO Science for Peace Project ‘Drinking Water Quality Risk Assessment and Prevention in Novi Sad municipality, Serbia’ (JEPASEPISF 984087).

EM022 - Fate and exposure modelling

TU 096

determination of emerging substance as human waste indicator in the Danube River samples

N.N. Gruje1, N.B. Milc2, M.M. Turk Sekulic3, M.B. Vojvonic Miloradovic4, M.L.J. Milanovic1, J.R. Radonic1

1Faculty of Medicine, Novi sad, Serbia
2Faculty of Sciences, Novi Sad, Serbia

Caffeine, methylxanthine derivative, is a pharmacologically active substance which stimulates the central nervous system, increases heart rate, dilates blood vessels and works as a weak diuretic. It is present in human sewage and found in aquatic environments. The objectives of this study were to determine caffeine presence in the Danube River samples and to evaluate its stability during two months storage of samples on 4°C. Analysis was performed by solid-phase extraction (SPE) followed by a developed reversed phase high performance liquid chromatography (RP HPLC) method. The chromatography was using a Zorbax Eclipse XDB-C8 column (4.6 mm x 150 mm, 5 µm particle size) at 25°C, with a mobile phase of 0.1% THF in water (pH 8) - acetonitrile (85:15, v/v). The flow rate was 1 mL/min, and detection by DAD at 233 nm. Samples were collected in July 2011 on seven different locations of the Danube River on a territory of Novi Sad, Serbia. Caffeine content ranged 0.8-4 ng/L on the 1st day and 0.5-2 ng/L on the 30th day after sample collection. On the 60th day after sampling caffeine was under the limit of detection in all water samples. Presence of caffeine confirmed the existence of human waste in the Danube River. Highest values were obtained in sample collected from location near the water supply source “Ratno ostrov”, Novi Sad. Obtained results due to caffeine amounts significantly decreased during two months storage of samples on 4°C most likely due to its degradation.

The work was supported by Ministry of Education and Science, Republic of Serbia (II46009) and NATO Science for Peace Project ‘Drinking Water Quality Risk Assessment and Prevention in Novi Sad municipality, Serbia’ (JEPASEPISF 984087).

TU 097

The effects of ibuprofen exposure on fathead minnows (Pimephales promelas)

A. Patel1, H.T. Trollope2, Y.C. Glennon3, G.H. Pantner2, J.P. Sumpter1, M. Rand-Waev4

1Brunel University, Middlesex, United Kingdom
2University of North Carolina, Environmental Laboratory, Brixham, Devon, United Kingdom
3Institute for the Environment, Brunel University, Uxbridge, Middlesex, United Kingdom

Bioassays were conducted to quantify spatial and temporal mass loadings of pesticides into tributaries to the Sacramento River, San Joaquin River, and Bay-Delta estuary California. The aim was to guide future risk assessments for sensitive and endangered species. As part of this project, ten years of daily mass loadings were simulated for 40 chemicals in a 164,000 km² area of California’s Central Valley. Environmental fate and transport models were run for each of the 40 chemicals to simulate pesticide losses in irrigation tail water, and the rice water quality model (RICEWQ). Model inputs included historical pesticide use data from the California Department of Pesticide Regulation’s Pesticide Use and Registration (PUR) database, daily weather data from 19 stations in the California Irrigation Management Information System, detailed soils information (SSURGO) from the NRCS, and high resolution land use data from the California Department of Water Resources. Results are represented in the simulations included fruit, vegetable, grain, nuts, rice, landscape maintenance, and structural applications. Approximately 9,115,000 pesticide applications were represented in the simulations, accounting for a total mass applied of 50,000 million kg of active ingredient for the 40 chemicals. Approximately 14.2% of the applied amount was predicted to reach surface waters via runoff, erosion, drift, and discharge. Runoff from agriculture accounted for over 86% of the mass losses, Erosion and drift from agricultural applications accounted for approximately 3.0% and 4.4% respectively of mass loadings. Another 4.3% was predicted to discharge and run off from rice paddies. Urban runoff accounted for less than 1 percent.

TU 100

Modelling the seasonal cycle of POPs in soil, vegetation, and cow milk from a high altitude pasture in the Italian Alps

N. Guazzoni, M. Parolini, P. Tremolada

1University of Milan, Milan, Italy

Pollution in soil, vegetation, fodder, milk and feeds from dairy cows that graze on a high altitude plateau in the Italian Alps has been measured during the pasture season. We followed the seasonal cycle of some obsolete pesticides (DDT and its isomers and metabolites, HCH and its isomers, HCR) of some congeners of polychlorinated biphenyls (PCB) and some congeners of brominated flame retardants (PBDE) during several pasture seasons that, at those altitude, last typically from June to September. Soil act as the main repository compartment with a high dynamic role because consistent concentration changes were observed over relatively short periods (few months). Typically POPs re-volatilization process from soils occurs just after the snow melting in May/June; the PCBs emission was quantified in terms of several tens of μg/m² depending from the topographical features. During this period, soil acts as a secondary source of contamination to the pasture, which shows a concentration peak in July. Vegetation confirms its role as an efficient sink of POPs fluxes from the air and from the soil during emission periods, and its role was quantitatively evaluated. We also found some evidences that air should be considered as a two layer compartment, dividing the part that is under the vegetation cover and the upper part that is interested by turbulent air fluxes made by winds. The lower layer, when soil is covered by herbaceous vegetation, could be very thin, but nevertheless seems to be extremely important in determining the exchange fluxes between terrestrial system and vegetation. Vegetation is an efficient pathways for transferring POPs into terrestrial food chains. By monitoring intake and output of pollutants we were able to develop a multicompartamental ‘cow model’ describing the main fluxes of POPs between the pasture environment. We observed a transfer of pollutants between soils and herbaceous vegetation (that act as a temporary filter) and from vegetation to milk and feeds, with fast transit rates. We also observed differences in PBDE fingerprint between inputs and outputs, pointing out differential absorption and/or metabolism of these compounds in cows.

TU 101

Fate and behavior of pesticide in US soil: use of kinetic modeling to assess environmental relevance of metabolites

E. Beltran1, P. Adran2, L. Pontal3, D. Darriet4

1CEHTRA SAS, Ste eulalie, France
2Biosciences, Brunel University, Uxbridge, Middlesex, United Kingdom
3U.S. Environmental Protection Agency, Region 9, Sacramento, United States of America

With increasingly more detailed data and faster computers, it becomes easier to model pesticide mass loadings into aquatic systems at a high-resolution with temporal and spatial detail. A large body of work has been conducted to quantify spatial and temporal mass loadings of pesticides into tributaries to the Sacramento River, San Joaquin River, and Bay-Delta estuary California. The aim was to guide future risk assessments for sensitive and endangered species. As part of this project, ten years of daily mass loadings were simulated for 40 chemicals in a 164,000 km² area of California’s Central Valley. Environmental fate and transport models were run for each of the 40 chemicals to simulate pesticide losses in irrigation tail water, and the rice water quality model (RICEWQ). Model inputs included historical pesticide use data from the California Department of Pesticide Regulation’s Pesticide Use and Registration (PUR) database, daily weather data from 19 stations in the California Irrigation Management Information System, detailed soils information (SSURGO) from the NRCS, and high resolution land use data from the California Department of Water Resources. Results are represented in the simulations included fruit, vegetable, grain, nuts, rice, landscape maintenance, and structural applications. Approximately 9,115,000 pesticide applications were represented in the simulations, accounting for a total mass applied of 50,000 million kg of active ingredient for the 40 chemicals. Approximately 14.2% of the applied amount was predicted to reach surface waters via runoff, erosion, drift, and discharge. Runoff from agriculture accounted for over 86% of the mass losses loadings. Erosion and drift from agricultural applications accounted for approximately 3.0% and 4.4% respectively of mass loadings. Another 4.3% was predicted to discharge and run off from rice paddies. Urban runoff accounted for less than 1 percent.
The data on PUF show that the use of the FOCUS default of 0.5 is a very conservative approach in terms of leaching assessment. For the test compounds exhibiting ionic to hydrophobic character, the PUF values have been experimentally derived for four substances covering a wide range of polarity (ionic, polar, medium polar, lipophilic) in three different crops (Tomato, Wheat and Maize).

(iii) The locations of pesticide input and the sites where ecotoxicological effects may occur are apart from each other.

The plant uptake factor (PUF) is defined as the concentration of a compound in the solution taken up by the roots divided by its concentration in the soil porewater. The plant uptake factor (PUF) is used to calculate the amount of a compound taken up by a plant together with the plant biomass. The PUF is therefore an important parameter for a realistic leaching assessment.

The pesticide concentration in flowing waters observed at a point of a river stretch fluctuates irregular, depending on the temporal and spatial pattern of the pesticide input upstream. For the registration procedure these concentration oscillations has to be transformed into an operational exposure indicator, comparable to a regulatory acceptable level (RACL). The poster presents results of the PEC-dynamic approach to a real brook in Germany.

(i) In flowing waters, the hydrodynamic dispersion lowers the peak concentration but spreads the longitudinal extension of an initial substance pulse. (ii) Pesticide applications on fields along a river stretch alochostatically or as a water package moving downstream the water course may be affected by depositions via spray drift, runoff and tile drainage, respectively, more than one time.

The objective of this work is to present a case study where apparent conflicting results were obtained between US-type soil metabolism and EU-type soil metabolism studies: In the US study, additionally to one major metabolite M, two metabolites (m1 and m2) were considered to be formed directly from the parent in the metabolic pathway proposed by the laboratory in amounts continuously increasing up to around 7% of the applied radioactivity until the end of the one year incubation. These results were consistent to the studies where only M was identified. Kinetics optimization with ModelMaker software and statistical analysis of the data according to the recommendations of the FOCUS Kinetics Workgroup (2006) were performed.

The kinetic evaluation demonstrated that, using a new metabolic pathway, this optimization of kinetic data leads to an acceptable error. Therefore, these soil metabolites were found not to be environmentally relevant according to EU guidance. This justifies the need to perform additional kinetic investigation of the metabolism of pesticides so as to set up properly the degradation pathway.
The general outline of the project and results of Work Package 1 (Evaluation of the FOCS surface water modelling concept with respect to representativity and protection of the included scenarios for German conditions in comparison to the current assessment methods in the German national authorization procedure) will be presented.

**TU 107**

Impact of recent EFA guidance on soil degradation rates and environmental exposure modelling

L.P. Pontalé, E. Beltran*, M. Darriett*, P. Adrian*

CEHER, Paris, France

**CEHTRA Europe SPRL, Waterloo, Belgium**

Registration of agrochemicals under the EU Regulation 1107/2009 requires a lot of challenges and numerous guidance documents have been recently issued, thanks to EFA for a rapid guidance. In case of pesticides, the methodology for the derivation of kinetic parameters linked to the leachate/soil/groundwater interaction is probably the most advanced in the Regulatory arena world-wide. This poster is showing the deal with the estimation of DegT50 which has to be used not only for the soil exposure assessment but also for the assessment of potential leaching to groundwaters and surface waters. The issue is to calculate degradation values that are well known for the same compounds during this process can appreciably affect the results. Usually a minimum of four laboratory studies are required to estimate the dissipation pattern in soils. If the degradation half-life (DegT50) in top soil at 20°C and pH = 2 - 2.5 exceeds 60 days additional field dissipation studies need to be conducted.

In the presented paper, the influence of the rainfall criterion is discussed, i.e. soil moisture and temperature having an significant effect on the bioactivity of the microflora. Normalisation of field degradation data may need to be performed to obtain reliable degradation parameters and to be used for modelling purposes. FOCS (2005 & 2006 & further to, FOCS,1997) developed guidance on estimating degradation rate parameters from laboratory and field studies.

In the past years, the time-step normalisation procedure as described by FOCS (2006) has become popular in the EU registration. This procedure assumes that the decline in the field can be described well by numerical models that assume first-order degradation kinetics. The procedure implies that the decline curve after normalisation can be used directly to estimate the DegT50 of the top soil at 20°C and pH = 2.

However, according to EFA panel, this decline is expected to show a rapid initial phase in the period when surface process plays an important role followed by a slower phase that is dominated by the degradation rate within the soil matrix.

In the proposed paper, we will show for an existing substance how the methodology is being used (according to the new EFA (2010) guidance) to derive degT50 and we will discuss the impact of this new guidance on the results and on exposure estimation.

**TU 108**

How reliable is the predicted leaching of pesticides into Groundwater? - Validation of the FOCS groundwater model PELMO 4 for use in the German national registration process

W. König1, G. Holld1, P. Klaas1, M. Klein1

1Federal Environment Agency (UBA), Dessau, Germany

2Fraunhofer IME, Schmallenberg, Germany

In the registration procedure in Germany the risk assessment for the leaching potential of plant protection products into groundwater is based on modelling results using simulated leaching concentrations of the FOCS Hamburg scenario from the latest version of the FOCS PELMO model (tier 1, 2). Dependencies of pesticide sorption and degradation data from different soil properties as well as the parameter variability are considered in endpoint selection for modelling, which is in line with the FOCUS recommendations. The measured leachate concentrations for active substances and/or metabolites from outdoor lysimeter studies are accepted as higher tier endpoints in the risk assessment and overwrite predicted concentrations from simulation runs (tier 3). This is generally justified by comparable soil and climate conditions in the Hamburg scenario and for the respective substances and/or metabolites. Preliminary results are presented and lead to discussions about the reliability of the predicted potential leaching behaviour of pesticides into groundwater in Germany.

Further investigation is planned on the critical points, how the short duration of lysimeter studies in combination with a single application finally affects the prediction of the leaching behaviour of respective substances, compared for instance with PFOCS PELMO was chosen to derive degradation and sorption values for selected substances and allow a model based extrapolation of the lysimeter results to different conditions, e.g. longer investigation period, multiple application, different application rates and crops. The outcome of the analysis shall indicate under which conditions lysimeter studies can be evaluated as endpoint or as process studies. A proposal, how inverse modelling of lysimeter results can be adequately considered for future regulatory decision making, is thought to be useful with respect to further harmonisation between member states in the EU.

**TU 110**

The impact of the rainfall criterion in the new EFA soil persistence guideline on the results of field degradation trials

N. Setteri-Winn, G. Wiedermann, M. Wang

Rifcon GmbH, Heidelberg, Germany

In the new EFA guideline on soil persistence (EFA, 2010) it is intended to exclude loss processes on the soil surface (photolysis, volatilisation) for the derivation of field half-lives of pesticides. As a pragmatic approach, it is suggested that only sampling points after 10 mm cumulative rainfall should be used to derive DT50. While this rainfall criterion is meant to ensure that processes on the surface are not taken into account for kinetic evaluation of field studies, there is no clear scientific basis for the selected 10 mm rainfall criterion. Therefore we evaluated which impact the selection of this criterion has on the kinetic analysis based on field studies from different locations across Europe and for different substances. Of those studies which could be evaluated according to the new guideline, a substantial fraction showed different results (DT50) depending on the selected rainfall criterion (e.g. 5 mm, 10 mm, 15 mm, etc). While in some cases only the resulting DT50 varied according to the applied rainfall criterion, in other cases, different conclusions could be evaluated alternatively. We also show that the impact of the rainfall criterion can be influenced by the study location within Europe and the time of application. These results show that the selection of the rainfall criterion can have a pronounced effect on the results of field studies. Hence, this criterion needs to be chosen with care. Studies on the speed of movement of pesticides in the soil, depending on substance and soil specific properties and rainfall, may help to show how the currently proposed value of 10 mm is reasonable.

**TU 111**

InversePELMO a specific software to perform inverse modelling simulations with FOCUSPELMO 4

P. Gallon1, R. Herr1, M. Klein1

1Federal Environment Agency (UBA), Dessau, Germany

Fraunhofer-Institute for Molecular Biology and Applied Ecology, 57392 schmallenberg, Germany

In the assessment for authorisation of plant protection product its leaching beha- viour is an important factor to protect the groundwater. In this context the sorption to soil (Parameter: Koc) and the degradation (Parameter: DT50) are processes that must be taken into account. Recently, the new FOCS groundwater group suggested a third methodology for the parameter setting of FOCUS 2006. The idea is to analyse outdoor studies, especially lysimeters, using the inverse modelling method that allows the estimation of Koc and DT50 parameters within a single step. For this procedure an optimisation tool, the program PEST (Model Independent Parameter Estimation), has to be combined with a leaching model (here: FOCUSPELMO 4). The aim of inverse modelling simulations is to find those Koc and DT50 values that could describe the outdoor studies, while the recorded data in experiments (e.g. rainfall, temperatures, percolation, and substance fluxes). Therefore all data of a lysimeter study are used to vary the input parameters Koc and DT50 until the leaching model shows the same results as the experiment. Generally, 2 steps have to be conducted when performing inverse modelling simulations.

Firstly, the hydrology in soil is optimised, followed by the optimisation of pesticide fate. The software InversePELMO is able to provide both procedures as a built-in module and the simulation model with the necessary input files in the correct format. InversePELMO has also a built-in module to perform standard statistical tests to check the quality of the optimisation such as the determination of the ‘FOCUS error’ at which the chi² error passes as described in FOCUS (2006). It was also tested that PEST works under all relevant windows operating systems (XP, Vista and 7) in a 32 bit as well as 64 bit version. The results of InversePELMO can be used to make predictions for field likely behavior if the rain in the study area has been evaluated over a longer time period. Translations of the lysimeter results to a different situation with respect to the environmental conditions (e.g. different climate), translations of the lysimeter result to a different situation with respect to the application pattern of the substance (e.g. change of the rate), translations of the lysimeter result to a refined reduced tier 1 simulation.
full-field environmental programme is barely affordable for a new active ingredient let alone for a single formulation. Simulation models are the primary basis for regulating pesticides against EU ground- and surface-water protection standards, but the current models cannot explicitly represent plants or their roots, or the effects of formulations and formulation placement strategies (e.g. slow-release microcapsules and seed treatments). Other models exist that represent individual components of the system in a more satisfactory way.

Current models used for pesticide registration within the EU are 1-dimensional and have a simplified representation of root development and uptake of pesticides. Conversely, plant growth and uptake models can have sophisticated representation of plant processes, but often do not consider pesticide dynamics. An ongoing project has created a conceptual framework for representing local pesticide concentrations in the whole soil-plant system, and will next produce a spatially-explicit simulation model. By relating local concentrations of pesticides to product efficacy, it will be possible to use the model to design better active ingredients, formulations and placement strategies.

The new model will also enable the environmental benefit of advanced formulations and placement strategies to be quantified in a cost-effective way for the first time. This presentation will introduce the project to the scientific community, overview results from the first year of work, and discuss anticipated outcomes and the potential benefits to the scientific and regulatory communities.

The project co-funded by the Technology Strategy Board, the Department for Environment, Food and Rural Affairs (DEFRA), and the Biotechnology and Biological Sciences Research Council (BBSRC).

TU 112
Law advances and perspective for a better risk assessment of the tropical use of Protection Plant Products in France
A.D. Duboisset, A.B. Bosvin, P.C. Carpenteret, M.V. Volte, P.C. Cannet, A.C. Conrad1, D.A. Abehinemour1, V. Poulsen1

1ANSES, Maisonneauze, France
2INRA, Montpellier, France
3CIRAD, Montpellier, France

Risk assessment of water contamination required prior the pesticides registration for French overseas territories is currently conducted using tools and guidance documents established for EU context although the agro-pecudicinial conditions and transport of pesticide in these territories underlines that (1) a minimum of four scenarios (2 soils: arable and nitosol and 2 crops: banana and sugar cane) would be necessary for the risk assessment of the main uses of the French overseas territories and (2) the models to be used for predicting transport of pesticide have to account for preferential flow and specific redistribution of rainfall by crops canopy for banana. For water surface contamination, the module for surface water fate would likely to be initially simplified to a static receiving water body of dimensions defined consistently with French overseas territories and protection goals. Finally, the main features of two models currently used under test-representing surface and subsurface flow of water and pesticides in banana crops on tropical volcanic soils are summarized and the schedule of a 2 year research project (2012-2014) to adapt them for regulatory purposes introduced.

TU 113
Simulation of the herbicides flufenacet and metazachlor in a lowland catchment with the model SWAT - A sensitivity analysis
A. Eitsch1, U. Ulrich1, K. Kolyvakulos2, N. Fohrer1

1 University of Kiel / Institute for Natural Resource Conservation, Kiel, Germany
2 University of Kiel, Inst. for Natural Resource Conservation, Kiel, Germany

Spatial differentiated impact assessment of chemicals in freshwater ecosystem at multiple scales
S. Ala, D. Marinov, M. Trombetti, D.W. Pennington

European Commission- Joint Research Centre, Ispra, Italy

Spatial differentiation is a topic of increasing interest within ecological risk assessment (ERA) and Life Cycle Impact Assessment (LCIA). A key issue to be addressed in the impact assessment methods and corresponding impact factors is the level of spatial detail required and uncertainties related to the use of generic impact factors when the exact location of the activities is unknown. For freshwater ecotoxicity evaluations were performed in order to assess the relative influence of scale in calculation of LCIA characterisation factors, comparing them with the result of site specific risk assessment. In this work, we applied the spatial differentiated multimedia model MAPPE in order to highlight the influence of processes such as USEtox ERA tools are calculated following a site-specific ecological risk assessment procedure that integrates in the assessment the spatial distribution of aquatic ecosystem. ERA results at different scale present higher variability: key drivers of variability and relevant differences in addressing spatial differentiation will be presented and discussed. Key driving forces for spatial differences were identified and discussed.

TU 114
Combination of SFA and multi-media fate modeling to assess the consequences of global trade and informal recycling of WEEE in China
H. Tien, S. Heise1, N. Sacui2, E. Caprì, M. Trevisan1, M. Schuhmacher1, M. Nadal2, J. Rovira2, X. Seguí1, J. Casal2, R.M. Darbra2

1 Universitat de Barcelona, School of Chemical Engineering, Universitat Rovira i Virgili, Tarragona, Spain
2 Superior Technical School of Chemical Engineering, Universitat Politecnica de Catalunya, Barcelona, Spain
3 University of Kiel / Institute for Natural Resource Conservation, Kiel, Germany

The flow of obsolete electric and electronic devices is constantly growing, according to a prediction of Zoeteman et al. (2010) by 3 to 5 % each year. It is suspected to add up to a volume of 20 to 50 million tons every year (Brigden et al. 2005). A large amount of waste electric and electronic equipment (WEEE) containing a variety of hazardous substances such as PBDE and Pb is shipped overseas to China, India and Western Africa for recycling. In these countries, WEEE is often processed by “informal recycling” without proper equipment for metal extraction, and labor safety. Thus it heavily affects the health of workers and people living in the vicinity, as well as the environment.

In order to quantify mass flows of WEEE from the developed to developing states, and assess the impact of these transports on local scale, substance flow analysis (SFA) followed by multi-media fate modeling were applied. In the frame of the SFA the following information was gained:

a) Global transportation routes and mass flows of WEEE
b) Data on the composition of typical e-wastes exports with regard to the European WEEE-Directive categories
c) Chemical composition of the single categories with a special focus on lead and bromiumated flame retardants (PBDEs and TBBPA)
d) Estimated emissions of Pb and BFR to the environment as a consequence of different informal recycling techniques.

In a second step, results from the SFA were used to a feed multi-media fate model that was applied to assess the environmental distribution of the selected hazardous substances and to perform an estimation of human and environmental risk. For this, Guyu region in China was chosen as a local case site as it is one of the largest informal recycling areas.

References:

TU 115
Modelling the environmental fate and effect of organic bulk emissions from industrial effluents in LCA
C.E. Rapisarti1, A. Koehler2, R. Juraske1, S. Hellweg2

1 ETH Zurich, Zurich, Switzerland
2 E3L, International. Switzerland, Winterthur, Switzerland

Several fate and effect models have been developed to assess the ecotoxic impact of individual chemical contaminants on aquatic freshwater organisms in Life Cycle Assessment (LCA). These methods suffer when it comes to the impact assessment of complex chemical mixtures, such as industrial effluents, as the list of constituent compounds is rarely known in its entirety, leading to under- or overestimation of ecotoxicological effects. A more holistic and meaningful method of evaluating the environmental impact of industrial effluents in LCA would be to model the fate and effect of comprehensive and commonly measured sum-parameters, such as total organic carbon (TOC), total nitrogen (TN) and 

References:
Health risk assessment of chlorpyrifos with rice farmers in Vietnam

T. Phung, B. Connell, M. Chu, G.M. Miller

Griffith University, Brisbane, Australia

Vietnam is an agricultural developing country with over 80 per cent of workers employed in agriculture, mainly rice farming cultivation. Farmers use back-pack reservoirs with hand pumps to apply pesticides, but their knowledge of safety in pesticide application is low. Chlorpyrifos is the most common organophosphate insecticide registered for agricultural use in Vietnam, but health risk assessment of chlorpyrifos use has not been carried out and limited investigation in Vietnam and other developing countries.

The objective of this study is to evaluate the health risk of chlorpyrifos exposure to a typical group of rice farmers after application in Vietnam, using a probabilistic approach. Biological monitoring of rice farmers was used to estimate chlorpyrifos exposure from all pathways during application. Urine samples (24 h) were collected from farmers (18) over 1 day prior to application and over 5 days post-application, and then analysed for TCP, the main metabolite of chlorpyrifos, using HPLC-MS/MS. Urinary TCP levels were converted into an absorbed daily dose (ADD) of chlorpyrifos for each farmer. The health risk of chlorpyrifos exposure for the rice farmers was characterised by comparing exposure doses (ADD) with acute guideline doses for chlorpyrifos used by USA and Australian agencies.

The study provides an evaluation of the health risk of chlorpyrifos exposure for rice farmers, which is essential for improving the safety of pesticide use in Vietnam.

RA02P - Approaches for comparative hazard and risk assessment of chemicals

TU 121

Health risk assessment of chlorpyrifos with rice farmers in Vietnam

T. Phung, B. Connell, M. Chu, G.M. Miller

Griffith University, Brisbane, Australia

Vietnam is an agricultural developing country with over 80 per cent of workers employed in agriculture, mainly rice farming cultivation. Farmers use back-pack reservoirs with hand pumps to apply pesticides, but their knowledge of safety in pesticide application is low. Chlorpyrifos is the most common organophosphate insecticide registered for agricultural use in Vietnam, but health risk assessment of chlorpyrifos use has not been carried out and limited investigation in Vietnam and other developing countries.

The objective of this study is to evaluate the health risk of chlorpyrifos exposure to a typical group of rice farmers after application in Vietnam, using a probabilistic approach. Biological monitoring of rice farmers was used to estimate chlorpyrifos exposure from all pathways during application. Urine samples (24 h) were collected from farmers (18) over 1 day prior to application and over 5 days post-application, and then analysed for TCP, the main metabolite of chlorpyrifos, using HPLC-MS/MS. Urinary TCP levels were converted into an absorbed daily dose (ADD) of chlorpyrifos for each farmer. The health risk of chlorpyrifos exposure for the rice farmers was characterised by comparing exposure doses (ADD) with acute guideline doses for chlorpyrifos used by USA and Australian agencies.

The study provides an evaluation of the health risk of chlorpyrifos exposure for rice farmers, which is essential for improving the safety of pesticide use in Vietnam.
A health assessment in Perm, an industrial city in European Russia, has been performed using the WHO methodology. The findings indicate spatially differentiated environmental exposure of 95% of the Perm citizens to various chemicals (formaldehyde, ethyl benzene, benzene, nitrogen dioxide, etc) at concentrations exceeding maximum permissible concentrations (MPC) (acute exposure) and maximum permissible average daily concentrations, by 16.7 and 13.5 fold, respectively. More than 65% of the exposed population experienced water which does not meet the drinking water standards, i.e. trichloromethane, residual chlorine, iron, manganese, and other impurities levels exceed MPC by 2.3 fold. We have observed an increase in acute and chronic hazard indices up to 30 fold for 14 out of the 17 analysed critical body systems and organs. Almost all of the city population is at an unacceptable environmental risk for respiratory, eyesight, hematological and immune disorders as well as central nervous system impairments. More than 99% (99.8%) of Perm’s adult population exposure, and all the children’s exposure, is considered unacceptable at the current risk level of the chemical compounds in blood, i.e. acetaldehyde -0.049 mg/dm³, formaldehyde -0.059, benzene -0.0013, manganese -0.039, chromium -0.021, nickel -0.075 and chloroform -0.0021 mg/dm³. We have identified NOEL values in the air: Ni = 0.00009 mg/m³, Cr = 0.0011, Mn = 0.00003, formaldehyde -0.003, acetaldehyde -0.002, benzene -0.03 mg/m³; chloroform reference dose in drinking water: 0.07 mg/L. We argue that priority environmental factors (Ni, Cr, Mn, formaldehyde and acetaldehyde) cause 3,246 additional new cases of respiratory diseases. The total economic damage for respiratory diseases is € 1.3 million per year. Acceptable risk levels can be reached by reducing industrial emissions of 19 industrial companies, using traffic optimisation and clean fuel and improving the water supply system quality and water treatment.

We recommend to amend the Klimisch system by adding a scoring system for the criteria for reliability, relevance and plausibility, we propose that critical information distributed across different studies should be evaluated with a priori scoring for each study. The prioritisation methodology is not suitable for metals and other inorganic chemicals because of biases in the way that fate and behaviour are dealt with, e.g., measures of transfer and bioaccumulation. A separate approach for metals might be needed to deal with different risks.

Like more sophisticated schemes, this method does not require a draft EQS in order to prioritise chemicals. Rather, it categorises chemicals in terms of their likely (or actual) environmental occurrence based on use and monitoring data, and the hazard they pose to aquatic life, based on persistence, bioaccumulation and toxicity criteria. Classifications based on exposure and hazard are then combined and chemicals assigned to risk categories. Those assigned to the highest risk category are taken forward as potential candidates for EQS development. Almost a third of the chemicals considered could not be assigned a risk ranking due to a lack of data. This is of particular concern for emerging contaminants where both hazard and exposure data are often limited. Lack of exposure or hazard data contributed equally to the assignment of ‘Insufficient information’. Predictive tools such as QSARs or ‘read across’ techniques may have a useful role in filling some gaps in hazard data. Gaps in exposure data may be filled by gathering monitoring data; in this respect the risk assessment has helped identify monitoring needs that may lead to identifying future EQS candidates.

We therefore recommend to amend the Klimisch system by adding a scoring system for the criteria for reliability, relevance and plausibility, of the data, to ensure a more consistent evaluation of the data. The methods developed by Kusterer et al. (2009, 2010) and Agerstrand et al. (2010) provide a useful basis for refining the quality assessment criteria and could be adapted for all substance groups. Additionally, the assessment should also consider if a critical study is plausible in the context to the whole dataset. To test plausibility, we propose that critical information distributed across different studies should be evaluated with a weight of evidence assessment, e.g., Gross et al. (2011).

In conclusion, we propose a more structured reliability and relevance evaluation of critical ecotoxicological studies together with a plausibility assessment based on a weight of evidence approach for the whole dataset. This should increase the scientific quality of environmental risk assessments of substances, e.g., in Environmental Quality Standard (EQS) derivation according to the Technical Guidance Document for EQS (European Commission 2011). The guideline is to provide guidance for different interests from science, hazard assessment and regulation. However, we recognize that the weighting assigned to criteria might vary between different chemical assessment regulations.

TU 127

EQS derivation for metals in EU and USA: a comparison using copper

318 SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
TU 128

Efficient toxicity testing when test information is uncertain: a stochastic cost-effectiveness analysis
S.G.M. Gabbert, G. Cottelleer
 Wageningen University, Wageningen, Netherlands

Changing policy settings for chemicals risk management, for example in Europe and in the U.S., have led to increasing awareness of the urgent need for more effective testing of chemicals. The economic concept of efficiency calls for allocating scarce resources (e.g. money, time, human skills) such that output is maximised. Hence, if for a toxicological endpoint different testing options exist, a decision maker must identify the testing strategy that provides the highest information gain per unit of cost. This clearly, requires to weigh the costs associated with a testing strategy, usually measured in monetary terms, against the information gains from testing. The latter are commonly expressed in terms of the a test's predictive performance. Cost-effectiveness analysis (CEA) provides a powerful tool for solving this problem. CEA allows for a comparative evaluation of the cost-benefits of different testing methods and strategies. While CEA has been widely used in healthcare domains, for example in medical decision-making, there are only few attempts to apply CEA to testing in toxicology. These studies share the assumption that information gains from testing, measured in terms of a test's predictive performance, are known. The predictive performance of testing methods is, however, uncertain, irrespective of what type of testing method (e.g. a “gold standard” in vivo test, an in vitro test, or a “non-testing” method) is used. Our study, therefore, moves beyond existing deterministic CEA modelled in toxicology by developing a stochastic approach to CEA that accounts for the uncertainty about the quality of test information. The aim is to allow for a more robust and transparent evaluation of testing methods and strategies both within and across endpoints. This guides decision-makers in coherently selecting the testing method or strategy that provides the highest information gain per unit of cost. Another contribution of the study is to offer a critical synopsis of data and research needs in order to apply our approach to various endpoints and to make it operational in the regulatory context of REACH.

TU 129

IFRA Environmental Standards: risk and hazard assessment update for 2012
A. Lapczynski
Research Institute For Fragrance Materials, Woodcliff Lake, nJ, United States of America

The International Fragrance Association expects the fragrance industries’ hazardous safety program with the development of IFRA IFRA Environmental Standards for both risk and hazard in 2008. Fragrance material risk assessment for these Standards are incorporated in the Research Institute for Fragrance Materials’ (RIFM) testing program in coordination with its Expert Panel. To identify material for risk assessment refinement, fragrance materials were screened using the RIFM Environmental framework and also compared against actual ‘unified framework was published in Environmental Toxicology and Chemistry (Salvito et al., 2002, 1301-1308). In addition, hazard assessment on these materials was also performed and reviewed. As a result nearly 3,000 materials were screened with preliminary risk quotients estimated to rank priority materials for risk assessment refinement. In an effort to provide greater transparency to the developing IFRA Environmental Standards, we reported here the prioritization of these materials, the testing history (for both risk and hazard assessments). 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. IFRA and RIFM have decided to present an annual update of this test program and the IFRA Environmental Standards. This work represents the latest effort for 2011-2012.

TU 130

The HEROIC project: coordinated efforts towards the harmonization and cross-fertilization of human and environmental risk assessment of chemical substances
A. Capri,1 L. Aicher,1 D. Barceló,2 P. Cifroy3, Ma Faust4, R.Glass,5, K. Macher6, A. Pery6, G. Schüürmann7, M. Wilks8
1Università Cattolica del Sacro Cuore, Piacenza, Italy 2UT, Basel, Switzerland 3IDAE-CSIC, Barcelona, Spain 4EDF Research&Development, Paris, France 5Fao and Backhouse Consulting GmbH, Bremen, Germany 6Food and Environment Research Agency, York, United Kingdom 7Benaki Phytopathological Institute, Kifissia, Greece 8Institut National de l’Environnement Industriel et des Risques, Paris, France

UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany
9MACHT, University of Basel, Basel, Switzerland

Today, human risk assessment (HRA) and environmental risk assessment (ERA) are typically separated. There is a lack of mutual understanding between experts and data from toxicological and ecotoxicological studies are not readily accessible by risk assessors of the two disciplines. The need for RA will continue to increase (e.g. REACH or toxicity of mixtures) along with budget restrictions and political and public pressure to reduce the number of animal tests. Therefore more cost effective, predictive and rapid testing methods with high quality sustainable RA are needed, including a better exploitation of existing data sources. The HEROIC coordination activity on TRP - will provide a platform for networking among all the relevant stakeholders in the RA value chain and will provide them with the most relevant background information to contribute to the development of harmonised approaches which meet the challenges of RA. The project will enable the improvement and harmonisation of tools and methods in RA, by exploring how data generated in ecotoxicology and human toxicology can be applied across disciplines, and will develop a framework for integrated methodologies and approaches for RA. This will increase transparency in RA and allow better risk communication to maintain public trust and provide uncontaminated guidance for improved risk management.

HEROIC starts with a comprehensive landscape exercise to identify common methodological and data needs in current human and environmental risk assessment practices and identifies areas of existing in-vitro methods and exposure assessment (for instance in-site) and data. The selection process ranks and weights data based on their reliability and relevance and uses a Weight-of-Evidence Approach to integrate such information to develop an Integrated Testing Strategy (ITS) for decision making. A dedicated web portal called ‘Tox-Hub’ that presents information from diverse sources and that functions as a central point of access to the most relevant toxicological and ecotoxicological information will be created. A diverse range of dedicated activities is planned for information, dissemination, capacity building and communication. These coordinating activities will result in enhanced sharing of knowledge, building consensus and development of clear, easily understood, transparent and unambiguous integrated RA procedures.
An environmental specimen bank (ESB) is an archive for biological samples that can be used to perform (traditionally chemical) analyses to obtain information about long-term variability and temporal trends in the chemistry of the biota and the ecosystem quality. Aware that chemical endpoints alone are not enough for ecosystem health assessment, the Biscay Bay Environmental Biospecimen Bank (BEBB) was designed including specimens for biological endpoints, say biotoxins for histopathology/immunochemistry, cryo-specimens for molecular/cellular analysis, and dried mineralized tissues (shell/otoliths) for biometric determinations. Banking methods and specimen sampling and processing are being adapted for these needs. In a first practical application, a retrospective study was performed using the ‘Mussel Shell Section’ of the BBE (2001-2010) localities covering the area of geographical distribution of Mytilus galloprovincialis in the North Berin coast). Changes in shell size (L; width; height, H), allometry and shell weight (SW) were analyzed, and the shell thickness was estimated after regression of the log SW against SSF (Shell Size Factor, LxWxH in mm). Overall, shell growth exhibited a decreasing trend during the study period with a seemingly more marked arrest growth in 2003-2006. These results are discussed in terms of interactions between global warming and the global consequences of the Prestige oil spill. However, since only specimens of L>3.5-4.5 cm were analyzed in most cases and mussels of the same shell length can belong to different age classes depending on the geographical variability and the influence of environmental conditions for a given locality, the incidence of the age in the interpretation of the obtained results is also discussed. In summary, the development of Mussel Shell Sections in environmental biospecimen banks is highly recommended as they may offer an excellent opportunity for retrospective monitoring after low cost processing and storage. In addition, our results also suggest that mussel watch monitoring programs and ESB archives should be supported on the basis of samples of same-age rather than same-length mussels. This study was supported by the Government of the Basque Country through the E-GORKITZEN project.

TU 135
Using banked seabird eggs for determining geographic patterns of trace elements in marine regions

R.S. Pugh1, W.C. Davis1, D.G. Lawton2,3

1National Institute of Standards and Technology, Charles Town, United States of America
2Ocean Research Institute, University of Texas at Austin, Austin, United States of America

The present study was performed in order to study the presence of As and Se in eggs of seabirds from different locations in the world. To this purpose, the eggs were collected in the last few years and stored in a deep-frozen state. The analysis of these eggs was performed by using the atomic absorption spectrometry technique. The results show that the concentrations of As and Se are lower in eggs from the North Atlantic Ocean than in eggs from the South Pacific Ocean. The highest concentrations of As and Se were found in eggs from the North Pacific Ocean.

TU 136
Specimen security in long term specimen banking - zebra mussel example in the German ESB

M. Paulus*, T. Teubner*, T. Bartel-Steinbach, T. Weimann*, R. Klein1, K. Weinfurtner1, G. Wagner1, S. Kottwitz, P. Hsu1

1Freie Universität Berlin, Dep. of Earth Sciences, Hydrogeology, Berlin, Germany
2National Institute of Standards and Technology, Charleston, United States of America

The zebra mussel (Dreissena polymorpha) has become an invasive species in the North American Great Lakes and the Baltic Sea. In the Baltic Sea, the zebra mussel has been studied since the 1980s. The present study is focused on the analysis of the Long-term specimen bank of the zebra mussel in the German Environmental Specimen Bank. The specimens were collected from 1999 to 2005.

The results show that the concentrations of As and Se are lower in eggs from the North Atlantic Ocean than in eggs from the South Pacific Ocean. The highest concentrations of As and Se were found in eggs from the North Pacific Ocean.
Toxicity of suspended matter and sediments in relation to contaminant load and expected effects of climate change on European rivers

A.G.M. van Hattum1, T. Hammers1, J. van Gool1

1Instituto for Environmental Studies, Amsterdam, Nederland

Climate change may not only affect river water discharges in terms of water quality, but also in terms of water quality. During flooding periods, for instance, higher water discharges may dilute a pollution loading over a shorter period of time. The other hand, higher discharges may also result in an increased mobilization of polluted sediments and therefore the potential for long-range atmospheric transport of contaminants is influenced by climate change. Elevated discharges did not lead to any significant increase of contamination fluxes may be recorded. Long-term projections of regional climate models are variable and tend to predict more extreme rainfall and dry episodes but with a limited overall increase in river discharges and suspended particulate matter (SPM) loads to the North Sea. In this study, the possible impact of climate change on the quality of urban and coastal waters, a battery of in vitro bioassays was applied to determine the toxicity profiles of environmental samples collected during climate change related events. SPM and sediment samples were collected in rivers from Norway, Sweden, Denmark, Germany, and The Netherlands during periods of dryness, flooding and extreme run-off. In addition, passive sampling was performed using silicone rubber sheets to evaluate the effects of dissolved contaminants. Extracts from SPM and passive samples were tested for respiratory toxicity (Microtox), dioxin-like activities, (anti)androgenic, (anti)estrogenic, and thyroid hormone-like activities, and for mutagenicity. Variable patterns of both increased or decreased toxicity in relation to soil and sediment in the catchment areas were noted between rivers. For some compounds, the trend in toxicity was consistent for episodic elution (of which the flow is known). The work described was performed within the context of the DiP project (Impact of Climate Change on the quality of urban and coastal waters - Diffuse Pollution), which is funded by the Interreg IVB North Sea Region Programme.

Toxicity of suspended matter and sediments in relation to contaminant load and expected effects of climate change on European rivers

TU 141

The Elbe estuary is characterized by the Hamburg Port, the second largest port in Hamburg, about 100 km upstream of the mouth of the river. Even though the river was observed only in marine, and, to a minor extension, estuarine sediments. No SPC were detected in sediments from freshwater systems. The presence of sulfate-reducing bacteria has been described in sediments from the North Sea, the Wadden Sea, and the Wadden Sea. Some of the locally very fast growing freshwater wadden areas are close to Hamburg, and at the mouth of the Elbe the river widens to a large marine wadden area which is feeding and nesting site of many bird and fish species.

In order to assess the impact of a high water discharge situation on the sediment quality of ecologically important wadden areas, freshly deposited sediment (FDS) was sampled during normal and high water discharges at two freshwater mudflats close to Hamburg and at two places near the mouth of the Elbe close to the North Sea. Chemical analyses were performed on the samples collected and compared to the background levels measured in either sampling site. An extreme high water event in January 2011, however, led to an increase in contamination in freshwater as well as coastal mud flats. Especially high was the increase in the uppermost “Heuckenlock” which is of particular ecological importance. Ecotoxicologically, little effect could be measured and it needs to be clarified how biodegradable the historical contaminants still are after their transport through the Elbe River.
Influence of feeding type and behaviour on whole sediment toxicity tests with the oligochaete Lumbriculus variegatus

T. H. Nguyen1, M.B. Vandegechute2, B. Muyssen3, J. Garrevoet1, B. de Samber1, K. Appel1, V. Laszlo1, C.R. Janssen1
1Ghent University, Ghent, Belgium
2DSY, Hasylab, Hamburg, Germany
3IWW Rhenish-Westfalian Institute for Water Research, Mülheim, Germany

Lumbriculus variegatus were exposed for 28 days to 0, 180, 560 and 1800 µg Zn g-1 sediment and received 2 feeding regimes. The partitioning of Zn between sediment, pore water and overlying water was enhanced by a 2-year equilibration period. Feeding regimes used in the toxicity tests were (i) food (Urtica-cellulose) spiked into the sediment with a daily renewal of the overlying water and (ii) daily feeding with TetraMin. Thus 4×2 design of the experiment was set up to test the hypothesis that feeding characteristics can affect the performance, response to toxicants and internal toxicant distribution of L. variegatus.

No adverse effects were noted in the TetraMin treatment, while in the SED+ treatment the total number of worms and biomass was significantly reduced at 560 µg g-1 and 1800 µg g-1 of both feeding regimes, indicating the presence of unknown contaminants. The internal Zn distributions were analysed using synchrotron radiation based on micro-X-ray fluorescence (XRF). The results show that in worms fed via the sediment, Zn is mainly associated with epidermis and less with the gut walls. It is, however, equally present in gut wall and epidermis in worms fed TetraMin. This supports the assumption of feeding inhibition due to avoidance behaviour toward contaminated sediment/food. The XRF data also show that at 1800 µg g-1, Zn was mainly distributed in the epidermis and sub-epidermis of L. variegatus, confirming the role of dissolved Zn as the predominant exposure route when SEMZn-AvS-50.

Influence of feeding type and behaviour on whole sediment toxicity tests with the oligochaete Lumbriculus variegatus

T. H. Nguyen1, M.B. Vandegechute2, B. Muyssen3, J. Garrevoet1, B. de Samber1, K. Appel1, V. Laszlo1, C.R. Janssen1
1Ghent University, Ghent, Belgium
2DSY, Hasylab, Hamburg, Germany
3IWW Rhenish-Westfalian Institute for Water Research, Mülheim, Germany

Lumbriculus variegatus were exposed for 28 days to 0, 180, 560 and 1800 µg Zn g-1 sediment and received 2 feeding regimes. The partitioning of Zn between sediment, pore water and overlying water was enhanced by a 2-year equilibration period. Feeding regimes used in the toxicity tests were (i) food (Urtica-cellulose) spiked into the sediment with a daily renewal of the overlying water and (ii) daily feeding with TetraMin. Thus 4×2 design of the experiment was set up to test the hypothesis that feeding characteristics can affect the performance, response to toxicants and internal toxicant distribution of L. variegatus.

No adverse effects were noted in the TetraMin treatment, while in the SED+ treatment the total number of worms and biomass was significantly reduced at 560 µg g-1 and 1800 µg g-1 of both feeding regimes, indicating the presence of unknown contaminants. The internal Zn distributions were analysed using synchrotron radiation based on micro-X-ray fluorescence (XRF). The results show that in worms fed via the sediment, Zn is mainly associated with epidermis and less with the gut walls. It is, however, equally present in gut wall and epidermis in worms fed TetraMin. This supports the assumption of feeding inhibition due to avoidance behaviour toward contaminated sediment/food. The XRF data also show that at 1800 µg g-1, Zn was mainly distributed in the epidermis and sub-epidermis of L. variegatus, confirming the role of dissolved Zn as the predominant exposure route when SEMZn-AvS-50.

T. H. Nguyen1, M.B. Vandegechute2, B. Muyssen3, J. Garrevoet1, B. de Samber1, K. Appel1, V. Laszlo1, C.R. Janssen1
1Ghent University, Ghent, Belgium
2DSY, Hasylab, Hamburg, Germany
3IWW Rhenish-Westfalian Institute for Water Research, Mülheim, Germany

Lumbriculus variegatus were exposed for 28 days to 0, 180, 560 and 1800 µg Zn g-1 sediment and received 2 feeding regimes. The partitioning of Zn between sediment, pore water and overlying water was enhanced by a 2-year equilibration period. Feeding regimes used in the toxicity tests were (i) food (Urtica-cellulose) spiked into the sediment with a daily renewal of the overlying water and (ii) daily feeding with TetraMin. Thus 4×2 design of the experiment was set up to test the hypothesis that feeding characteristics can affect the performance, response to toxicants and internal toxicant distribution of L. variegatus.

No adverse effects were noted in the TetraMin treatment, while in the SED+ treatment the total number of worms and biomass was significantly reduced at 560 µg g-1 and 1800 µg g-1 of both feeding regimes, indicating the presence of unknown contaminants. The internal Zn distributions were analysed using synchrotron radiation based on micro-X-ray fluorescence (XRF). The results show that in worms fed via the sediment, Zn is mainly associated with epidermis and less with the gut walls. It is, however, equally present in gut wall and epidermis in worms fed TetraMin. This supports the assumption of feeding inhibition due to avoidance behaviour toward contaminated sediment/food. The XRF data also show that at 1800 µg g-1, Zn was mainly distributed in the epidermis and sub-epidermis of L. variegatus, confirming the role of dissolved Zn as the predominant exposure route when SEMZn-AvS-50.

T. H. Nguyen1, M.B. Vandegechute2, B. Muyssen3, J. Garrevoet1, B. de Samber1, K. Appel1, V. Laszlo1, C.R. Janssen1
1Ghent University, Ghent, Belgium
2DSY, Hasylab, Hamburg, Germany
3IWW Rhenish-Westfalian Institute for Water Research, Mülheim, Germany

Lumbriculus variegatus were exposed for 28 days to 0, 180, 560 and 1800 µg Zn g-1 sediment and received 2 feeding regimes. The partitioning of Zn between sediment, pore water and overlying water was enhanced by a 2-year equilibration period. Feeding regimes used in the toxicity tests were (i) food (Urtica-cellulose) spiked into the sediment with a daily renewal of the overlying water and (ii) daily feeding with TetraMin. Thus 4×2 design of the experiment was set up to test the hypothesis that feeding characteristics can affect the performance, response to toxicants and internal toxicant distribution of L. variegatus.

No adverse effects were noted in the TetraMin treatment, while in the SED+ treatment the total number of worms and biomass was significantly reduced at 560 µg g-1 and 1800 µg g-1 of both feeding regimes, indicating the presence of unknown contaminants. The internal Zn distributions were analysed using synchrotron radiation based on micro-X-ray fluorescence (XRF). The results show that in worms fed via the sediment, Zn is mainly associated with epidermis and less with the gut walls. It is, however, equally present in gut wall and epidermis in worms fed TetraMin. This supports the assumption of feeding inhibition due to avoidance behaviour toward contaminated sediment/food. The XRF data also show that at 1800 µg g-1, Zn was mainly distributed in the epidermis and sub-epidermis of L. variegatus, confirming the role of dissolved Zn as the predominant exposure route when SEMZn-AvS-50.

T. H. Nguyen1, M.B. Vandegechute2, B. Muyssen3, J. Garrevoet1, B. de Samber1, K. Appel1, V. Laszlo1, C.R. Janssen1
1Ghent University, Ghent, Belgium
2DSY, Hasylab, Hamburg, Germany
3IWW Rhenish-Westfalian Institute for Water Research, Mülheim, Germany

Lumbriculus variegatus were exposed for 28 days to 0, 180, 560 and 1800 µg Zn g-1 sediment and received 2 feeding regimes. The partitioning of Zn between sediment, pore water and overlying water was enhanced by a 2-year equilibration period. Feeding regimes used in the toxicity tests were (i) food (Urtica-cellulose) spiked into the sediment with a daily renewal of the overlying water and (ii) daily feeding with TetraMin. Thus 4×2 design of the experiment was set up to test the hypothesis that feeding characteristics can affect the performance, response to toxicants and internal toxicant distribution of L. variegatus.

No adverse effects were noted in the TetraMin treatment, while in the SED+ treatment the total number of worms and biomass was significantly reduced at 560 µg g-1 and 1800 µg g-1 of both feeding regimes, indicating the presence of unknown contaminants. The internal Zn distributions were analysed using synchrotron radiation based on micro-X-ray fluorescence (XRF). The results show that in worms fed via the sediment, Zn is mainly associated with epidermis and less with the gut walls. It is, however, equally present in gut wall and epidermis in worms fed TetraMin. This supports the assumption of feeding inhibition due to avoidance behaviour toward contaminated sediment/food. The XRF data also show that at 1800 µg g-1, Zn was mainly distributed in the epidermis and sub-epidermis of L. variegatus, confirming the role of dissolved Zn as the predominant exposure route when SEMZn-AvS-50.
by means of chemical and ecotoxicological approach the toxicity of the sediments of this river, and their elutriates, in a region downstream Três Marias reservoir, in a site near a processing industrial plant. For this, a battery of three laboratory bioassays, using two cladoceran (Daphnia similis and Ceriodaphnia dubia) and one amphipod (Hyallela azteca) species, was used to assess the toxicity. 12 different metals (Al, As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn) and the different geochemical sediment fractionation was conducted to estimate the potential impact of the industrial plant. The effect of sediment metal contamination was assessed applying multivariate techniques. The results showed concentrations of Zn, Cd and Pb that involve an important potential risk on the aquatic environment. The sediments affected by the industrial plant presented high levels of toxicity, although the hydrodynamic of the river plays an important role in the metal distribution and consequently in the toxicity of the sediments.

**TU 152**

Ecotoxicological assessment of sediments from rivers impacted by a petroleum refinery
P. Sauras Rocha, D.F. Angelus, T. Brauneck, M.M. Marin-Morales
UNESP, Ribeirão Preto, Brazil

Ecotoxicological studies are important for evaluating the effects of toxic agents on different environments. Aquatic sediments have a high potential for accumulating contaminants. As pollutants become available in certain environmental conditions, the sediments can also become a potential source of contamination to the environment. The objective of this study was to evaluate the ecotoxicological potential of sediment samples from three rivers impacted by a petroleum refinery, by means of Neutral Red assay (cytotoxicity), EROD assay (CYP1A induction potential), the sediment contact with fish embryos bioassay (Salmo salar) and classical analyses. Among these rivers, the data collected in the Tiete river have been used to investigate the potential impact of toxic contaminants at sites near Punta Prieta and La Paz city to the Bay of La Paz. This type of analysis is essential to identify areas of risk in studies of environmental analysis.

**TU 153**

Seasonal variation of toxicity and genotoxicity of sediments samples of the Ensenada de la Paz, B.C.S., Mexico
S. Sobrino-Figueroa, C. Cáceres-Martínez
Universidad Autónoma Metropolitana, México, d.f., México

In this paper was carried out a qualitative assessment of toxic and genotoxic effects of sediment collected at 8 locations in the Ensenada de la Paz, B.C.S., in 2 contrasting seasons summer and winter of 2010, using a battery of biological tests with organisms of different trophic levels and the SOS-Chromotest microbioassay. Compounds with toxic and genotoxic effects were detected in 5 locations, located in the Canal de la Paz, near the termoelectric power station and the Pichilingue navy. LC50 and genotoxicity values were obtained, indicating the presence of toxic compounds at sites near Punta Prieta and Cincimal, sediment toxicity decreases with increasing distance from these points. This fact possibly indicates a contribution of harmful compounds probably from Punta Prieta and La Paz city to the Bay of La Paz. This type of analysis is essential to identify areas of risk in studies of environmental analysis.

**TU 154**

Toxic effects of sediments from a semi-arid coastal system, influenced by a gold ore mine
S. Sobrino-Figueroa, A.J. Marroje-Lojdriguez, V.R. Magallanes-Ordóñez
*Universidad Autónoma Metropolitana, México, d.f., México*

An intense industrial activity has been taking place in Wallonia (Belgium) since the Middle Ages. The proximity to major waterways has enhanced the industrial development and, consequently, an aquatic ecotoxicological environment. Sediments are known for their ability to trap pollutants and release these substances years or even decades after the pollution has ended. In order to assess the current status of sediment pollution, bioassays can be used as suitable monitoring tools to answer the Water Framework Directive (WFD) requests and ascertain the causes of a water body failure to achieve the environmental objectives. They integrate all contaminants effects including additive and synergistic effects of unknown substances and breakdown products. A sediment quality recurrent monitoring throughout the Walloon Region has been set up, taking into consideration physico-chemical parameters (including Priority List substances from the WFD) and ecotoxicological effects of collected environmental samples in a triad-type approach. Different species (Chironomus riparius, Heterocorpius incongruens for whole samples, Vibrio fischeri, Pseudokirchneriella subcapitata and Brachionus calyciflorus for pore waters) are used in this approach because they provide different information due to a wider range of exposure (ingestion, regeneration contact) and because they represent different trophic levels (decomposer, producer or consumer).

Among of the sediments analyzed at 10 stations studied in 2010, four showed a relatively low toxicity toward several organisms of the bioassays battery (the Wilm, the Scare, the Guelle and the Rhones), 3 showed low toxicity toward one of the organisms (the Ose, the Molineux and the Eau d’Heure) and 3 showed no signs of toxicity (the Biesnies the Marennes and Salomons) even if 2 non-toxic samples exceed the maximum acceptable levels as defined by decree of the Walloon Region.

Results of the 2011 monitoring program will also be presented.

**TU 155**

Bioassays in sediment assessment for investigative monitoring in the context of the WFD
M.H. Hémart, Y. Marneffe, R. Pirotte, V. Wrona, C. Chalon, P. Naport, V. Rollin, C. Corin, A. Classens
ISSEP, Liege, Belgium

Adverse and genotoxic effects of sediment and water samples collected from a depleted aquiferic environment. Sediments are known for their ability to trap pollutants and release these substances years or even decades after the pollution has ended. In order to assess the current status of sediment pollution, bioassays can be used as suitable monitoring tools to answer the Water Framework Directive (WFD) requests and ascertain the causes of a water body failure to achieve the environmental objectives. They integrate all contaminants effects including additive and synergistic effects of unknown substances and breakdown products. A sediment quality recurrent monitoring throughout the Walloon Region has been set up, taking into consideration physico-chemical parameters (including Priority List substances from the WFD) and ecotoxicological effects of collected environmental samples in a triad-type approach. Different species (Chironomus riparius, Heterocorpius incongruens for whole samples, Vibrio fischeri, Pseudokirchneriella subcapitata and Brachionus calyciflorus for pore waters) are used in this approach because they provide different information due to a wider range of exposure (ingestion, regeneration contact) and because they represent different trophic levels (decomposer, producer or consumer).

Among of the sediments analyzed at 10 stations studied in 2010, four showed a relatively low toxicity toward several organisms of the bioassays battery (the Wilm, the Scare, the Guelle and the Rhones), 3 showed low toxicity toward one of the organisms (the Ose, the Molineux and the Eau d’Heure) and 3 showed no signs of toxicity (the Biesnies the Marennes and Salomons) even if 2 non-toxic samples exceed the maximum acceptable levels as defined by decree of the Walloon Region.

Results of the 2011 monitoring program will also be presented.

**TU 156**

Ecotoxicological assessment of contaminated rivers as a proxy for the water framework directive: an injured mine drainage analysis
D.S. Vidal, J.L. Perera, N. Abrantes, A.M.V.M. Soares, F. Gonçalves
University of Aveiro, Aveiro, Portugal

*University of Aveiro & CESAM, Aveiro, Portugal*

metal contamination of freshwater water bodies resulting from mining activities or deactivated mines is a common environmental problem in Portugal. Despite authorities recognized as an environmental concern, the establishment of monitoring networks in highly polluted areas is still failing or being too delayed. Bracal and Palhal, located in Central-North of Portugal in a riverside position, are both examples of deactivated mining areas lacking for remediation plans. The results showed that Bracal mining area was the most polluted of the two cases, evidenced through the establishment of toxicological hotspots, which showed the potential of toxic effects elicited by the Bracal mining area. This method allowed the identification of the main sources of metallic pollution from the Bracal mining area. The results show that the degree of pollution varied from moderate to highly polluted. The analyses for the SQT indicate that the stations nearest to the alteration zone were severely polluted. These results suggest that there are health risks to human populations and activities such as vegetable and cattle farming or rural touristic recreation in the area. In order to restore the alteration zone to healthy conditions a remediation program would be necessary.

**TU 157**

Assessment of effects of agro-chemicals use in ecological status of Kilombero Flood Plain, Ramsar site
M. S. Fischer, H. Zwi,
Hamburg University of Applied Sciences, Hamburg, Germany

Tanzania is rich in water resources with an estimated 10% of the land surface covered by significant freshwater wetlands providing essential ecosystem and livelihood support. The Kilombero River (KRNT, UNESCO Biosphere Reserve) is one of the most important resources, thus destroying the ecological functions of wetlands. Tanzania ratified to the Ramsar Convention on 2002, as a commitment to maintain the ecological character of its wetlands for international importance and to plan for the sustainable use of all other wetlands in the country. The Kilombero Valley, designated in the same year, is among four (since 2000) Ramsar sites in Tanzania and covers 7,576 km² with a total catchment area of about 40,000 km². Kilombero Valley is rich in endemic species of flora and fauna and characterised by high concentrations of large mammals especially Puku, Buffalo, Elephant, Hippopotamus and Limpopo.

Over the last two decades an human settlement in the valley has increased, parallel with the socio-economic activities such as livestock keeping, fishing, cultivation, and bee keeping. The agro-pastoralism, large and small scale cultivation of rice and sugar cane with an intensive application of diverse arrays of pesticides, is a major threat to this valley’s ecological integrity. However, little is known about sediment chemical contamination and pesticide load of Kilombero wetlands. This is the first study to investigate the potential impact of toxic chemicals, especially agrochemicals, on the sediment-water quality of this flood plain. During a first survey, screening of the region for hot spots will be done by applying selected bioassays that are sensitive to pesticides contaminated sediment and water samples. In a second tier, chemical analysis of those samples identified as toxic will be collected out in order to identify hotspots. Water and sediment samples will be collected out in order to identify causality and reasons, the first survey being conducted between February and April 2012. Based on data from this first survey, a conceptual site model will be set up and presented.
The project's further objectives comprise the assessment of human and environmental risk due to pesticide exposure, the communication of these risks to farmers and inhabitants living in the area and development of management recommendations for a more efficient and less environmentally adverse use of this Ramsar site.

TU 158

Heavy metal pollution assessment in sediments of the Nemrut Bay, Turkey
F. Koçbaş1, R. Oral2
1Gelal Bayar University, Manisa, Turkey
2Ege University, Izmir, Turkey

Surface sediments in the fraction <63 μm collected from eight stations in Nemrut Bay, Aegean Sea were analyzed for trace metals (Cd, Pb, Cu, Zn, Zn) by using inductively coupled plasma spectrometry. The concentration of heavy metals varied between 0.1-0.95 mg/kg for Cd, 15-190 mg/kg for Pb, 13-38.65 mg/kg for Cu, 20.2-71.9 mg/kg for Zn and 8.09-18.3 mg/kg for Zn. The results show that some elements such as Cd, Pb and Cu are at risk level in the sediments near the harbour, harbour activity and petrochemical industry may be the sources of these elements.

TU 159

Determination of ecotoxicological effects of persistent organic pollutants from sediment cores of the Baltic Sea: a combination of chemical measurements and aquatic toxicity testing
S.C. Lang1, D. Schulz-Bull2, K. Schmidt3, G. Witt4
1University of Applied Sciences Hamburg, Hamburg, Germany
2Baltic Sea Research Institute, 18119 rostock, Germany
3TU 162

The first sight into contamination of Polychlorinated biphenyls and Polybrominated diphenyl ethers in sediments of Tam Giang-Cau Hai Lagoon, Central Vietnam
3, S. Takahashi3, S. Tanabe2, 1, T. Pohlert2, R.A. Düring1
1, G. Witt4
1, I. Foster5, E.V.A. Valsami-Jones6

Rapid economic development and urbanization growth in Vietnam have made this country become an important subject for extensive studied dealing with environmental pollution recently. So far, there has been no information on PBDEs contamination in Central Vietnam and the information about PCBs sources and levels is limited. Tam Giang-Cau Hai Lagoon is a Ramsar site and one of the major wetlands in northern Vietnam, which is protected under the convention of the Wetlands of International Importance. The project's further objectives comprise the assessment of human and environmental risk due to pesticide exposure, the communication of these risks to farmers and inhabitants living in the area and development of management recommendations for a more efficient and less environmentally adverse use of this Ramsar site.

TU 160

Triad approach for risk assessment of sediment and floodplain soil of a metal-polluted stream
H.J. de Lange1, J. Bovenschen2, L. van Loon1, J. Beyerens, f. Lab. 1 and J. Martinson coefficients (Kaw and Kd) were determined in batch equilibrium studies by solid-phase microextraction (SPME) coupled to gas chromatography (GC). In addition, adsorbs were investigated by imaging mass spectrometry and scanning electron microscope coupled to energy-dispersive X-ray spectroscopy (SEM-EDS). Results indicate mechanisms of sorption similar to those observed in marine systems. The next steps are to further investigate re-mobilization processes as well as bioavailability of HCB in aqueous ecosystems. Results yield important physicochemical properties of sorbents for better understanding the environmental behavior and pathways of chemicals and beyond that to model environmental fate under changing climate conditions.

Acknowledgement
Research has been carried out within the departmental research program KLJWAS - Impacts of climate change on waterways and navigation of the German Federal Ministry for Transport, Building and Urban Development. It was financed by the Federal Institute of Hydrology in the project ‘cohesive sediments’.

TU 161

Hexachlorobenzene-contamination of sediments of the Upper Rhine River - identification of sorbents to assess bioavailability
L. Boekh1, T. Pohlert2, R.A. Düring1
1, I. Foster5, E.V.A. Valsami-Jones6

Hexachlorobenzene (HCB) is a toxic and persistent organic pollutant (POP). By reason of its strong sorptive characteristics, HCB is mainly bound to organic substances. However, geogenic clay minerals are also capable sorbents. Regarding the contaminated sediments, the spatial distribution of HCB is considerably more heterogeneous, then e. g. the distribution of polychlorinated biphenyls (PCBs). Further, maximum loads of HCB occur rather in larger particle fractions (6.3 - 2000 μm), than in smaller fractions (< 20 μm). Knowledge of the specific HCB-sorbents in the different fractions is of importance, because their characteristics control sorption strength, which is an important factor for re-mobilization as well as bioavailability of organic contaminants.

The mineral composition of sediments (measured by X-ray Diffraction, XRD) and its influence on the amount of sorption is presented, as well as composition and sorption capacity classified by particle size and content of organic matter.

The results indicate mechanisms of sorption similar to those observed in marine systems. The next steps are to further investigate re-mobilization processes as well as bioavailability of HCB in aqueous ecosystems.

Results yield important physicochemical properties of sorbents for better understanding the environmental behavior and pathways of chemicals and beyond that to model environmental fate under changing climate conditions.

ACKNOWLEDGEMENT
Research has been carried out within the departmental research program KLJWAS - Impacts of climate change on waterways and navigation of the German Federal Ministry for Transport, Building and Urban Development. It was financed by the Federal Institute of Hydrology in the project ‘cohesive sediments’.

TU 162

River sediment sampling and environmental quality standards
U. Mokwe Ozoezode1, S.H.A.R.R. Mcdowen1, I. Foster5, E.V.A. Valsami-Jones6

1University of the West of Scotland, London, United Kingdom
2Natural History Museum, London, United Kingdom

Sediment forms an important part of the aquatic environment and provide habitat to benthic organism. However, poor water quality has been linked to contaminated sediments. One of the worst is PCBs which consist of complex materials transported within river or deposited on river bed. Sediment has been identified as major transporter and sequesterer of fluvial contaminants such as heavy metals, most especially the fine sediment. At present, there are no environmental quality standards (EQSs) for bed sediments or fluvial suspended sediments, and one of the major problems in establishing sediment EQSs is the identification of the suitable sediment fraction to measure - the actively transported or non-labile deposited sediment. The variability in sediment characteristics is mainly attributed to their active properties and the characteristics of the rivers such as pH, redox, and high water discharge, which is investigated during sediment sampling.

The study aims to investigate the effect of particle size on heavy metal concentration, study seasonal variation in the concentration of Cu, Ni, Pb and Zn in Ravensbourne River. The influence of selection of specific metal concentrations between different compartments such as suspended sediment, bed sediment, bank sediment and the water column of Ravensbourne River. Sediment (bed and bank) and water samples were collected from Ravensbourne River over a period of 12months. Sediment samples were tested for heavy metal concentration using the aqua regia, sequential extraction using a 6hour extraction technique proposed by Maiz et al. (1997).

TU 163

The first sight into contamination of Polychlorinated biphenyls and Polybrominated diphenylethers in sediments of Tam Giang-Cau Hai Lagoon, Central Vietnam
T.H. Pham1, N.M. Tieu2, G. Suzuki3, S. Takahashi3, S. Tanabe2

1Faculty of Biology, Hanoi University of Science, Hanoi, Vietnam
2Center for Marine Environmental Studies (CMES), Ehime University, Ehime, Japan
3National Institute for Environmental Studies, Tsukuba, Japan

Rapid economic development and urbanization growth in Vietnam have made this country become an important subject for extensive studied dealing with environmental pollution recently. So far, there has been no information on PBDEs contamination in Central Vietnam and the information about PCBs sources and levels is limited. Tam Giang-Cau Hai Lagoon lies along the coastal line of Thua Thien-Hue Province, Vietnam. Due to recent industrial and economical growth in this region, large amount of untreated industrial and wastewater are discharged to the river system, which may cause adverse environmental consequences and increased health risk for local communities. In this study, the contamination status, distribution and congener profiles of PCBs and PBDEs in surficial sediment of Tam Giang-Cau Hai Lagoon were investigated. PCBs and PBDEs were detected in all sediment samples with mean concentrations of 0.19 and 0.56 ng/g dw, respectively. The highest concentrations of both contaminants were observed downstream at the river mouths, indicating the river flow as a main source of pollutants into the lagoon system. The similarity of PCB congener distributions in sediments suggest the presence of a unique source over the entire study area, probably connected to local use of old electrical equipments containing
low chlorinated PCB formulations. Atmospheric transport & post depositional processes might modify to some degree the fingerprint of PCB inputs to the environment favouring the predominance of 3, 4 & 5 chlorinated congeners. The PBDEs profile in sediments was relatively uniform, with decaBDE as the dominant congener, followed by nona- and octaBDEs, indicating DecaBDE as the major technical mixture in consumer products in this region. In general, the levels of PCBs and PBDEs in lagoon sediments were low, and have been decreasing at least since 2005. However, mercury levels exceed Mexican advisory levels in the muscle of fish in about 20% of the fish. For sustainability and biodiversity reasons, this constitutes a threat to environment. Nevertheless, the first time detection of PBDEs in the lagoon-river system might be an indicator of enhanced recent contamination of the lagoon-river system. The results have been presented to management authorities.

As one of the components of the Sustainable Management of the Gulf of Mexico Large Marine Ecosystem, the pilot project on monitoring and environmental assessment selected Terminos as the site to study. The project consists of five modules: water quality, sediment quality, contaminants and biomarkers in fish, benthic community, and seasonality. Periods of study were chosen for Period 1, highest flow seasonality may play a relevant role in environmental metal levels, bioaccumulation and the biological responses of oysters against environmental insult. Fluxes (in kg d-1) were provided as well. Period 2 having the highest flow gave the highest fluxes per site. Results show that PCDD/Fs and DL-PCBs concentrations are variable not only between estuaries but also within each estuary. In general, the highest values were found at sites near large populations and industrial complexes (e.g. Tagus, Ria de Aveiro and Sado). The lowest PCDD/Fs and DL-PCBs values were measured in Ria Formosa, a protected area with strong tidal regime (OCDD is the most abundant PCB congener in the samples but PeCDD or PeCDF were the major contributors to WHO-PCDF/TEQ2005. For DL-PCBs, PCB 118 was the dominant congener while PCB 126 was the major contributor to WHO-PCB-TEQ2005 in all the assessed periods.

TU 169 Environmental monitoring and assessment of Terminos Lagoon, Mexico
V.Y. Garcia-Rios1, O. Zapata-Perez2, J. Herrera-Silveira3, S.M. Morales-Ojeda4, L.S. Alpuche-Gual4, D. Pech5, G.J. Villabobos-Zapata1, G. Gold-Bouchot2
1, Gibeau Center for Functional Ecology, Coimbra, Portugal
2, Centre for Pharmaceutical Studies, Coimbra, Portugal
3, University of the Philippines, Los banos, Philippines
4, Ateneo de Manila University, Quezon city, Philippines
5, Orleans Université, Orleans, France

University of the Basque Country, Leioa, Spain

Oysters have been widely used as sentinel organisms in order to determine the presence of pollutants and their effects in coastal and estuarine environments. In the present work, the Urdaibai Reserve of the Biosphere (UNESCO) was selected as the site to study. The project consists of five modules: water quality, sediment quality, contaminants and biomarkers in fish, benthic community, and seasonality. Periods of study were chosen for Period 1, highest flow. Correlations among the parameters had been achieved as well. Fluxes (in kg d-1) were provided as well. Period 2 having the highest flow gave the highest fluxes per site. Results show that PCDD/Fs and DL-PCBs concentrations are variable not only between estuaries but also within each estuary. In general, the highest values were found at sites near large populations and industrial complexes (e.g. Tagus, Ria de Aveiro and Sado). The lowest PCDD/Fs and DL-PCBs values were measured in Ria Formosa, a protected area with strong tidal regime (OCDD is the most abundant PCB congener in the samples but PeCDD or PeCDF were the major contributors to WHO-PCDF/TEQ2005. For DL-PCBs, PCB 118 was the dominant congener while PCB 126 was the major contributor to WHO-PCB-TEQ2005 in all the assessed periods.

An increase in the BSD volume density was observed in parallel with an increased metallothionein content. In conclusion, the results confirmed that the Urdaibai Reserve of the Biosphere presents low-to-moderate levels of metal both in oysters and waters, with only minor biological effects in oysters. It is worth noting that, seasonality may play a relevant role in environmental metal levels, bioaccumulation and the biological responses of oysters against environmental insult.
Monitoring of sediments genotoxicity of the Yucatcno, lagoon Tab, Mexico

K.A. Dafforn1, S.L. Simpson2, B.P. Kelaher3, G.F. Clark4, K.A. Dafforn5

1US Navy Environmental Support Office-NW, Bremerton, WA, United States of America
2US Army Engineering Research and Development Center, Portland, OR, United States of America
3US Army Engineering Research and Development Center, Menlo Park, CA, United States of America
4RSK, Manchester, United Kingdom
5University of Technology, Sydney, Australia

Bang for buck: the challenge of choosing environmental indicators of anthropogenic impacts in estuaries

S.L. Simpson1, B.P. Kelaher2, G.F. Clark3, K.A. Dafforn4, G. F. Clark5

1US Navy Environmental Support Office-NW, Bremerton, WA, United States of America
2US Army Engineering Research and Development Center, Portland, OR, United States of America
3Advocate Development Group, Limited Liability Company, Wilmington, Delaware, United States of America
4Procter & Gamble, Cincinnati, Ohio, United States of America
5DuPont Corporate Remediation Group, Wilmington, Delaware, United States of America

Integrated estuarine Modelling to support watershed management for Sinclair and dyes inlets, Puget Sound, WA, USA

R.K. Johnston1, P.F. Wang2, B.E. Skahill1

1US Navy Marine Environmental Support Office-NW, Bremerton, WA, United States of America
2US Space and Naval Warfare Systems Center, San Diego, United States of America

Ecological risk management at a site adjacent to an area of special scientific interest

M.J.G. Archer1, S. Stevens2, D. Thomas3, C. Bozmir4, L. Thomas5, R. Stahl6, D. Fletcher7

1University of Southampton, Highfield, UK
2University of New South Wales, Sydney, Australia
3University of Technology, Sydney, Australia
4University of Hong Kong, Hong Kong
5Natural Resources Wales, Swansea, Wales, UK
6RSK, Manchester, United Kingdom
7DuPont Corporate Remediation Group, Wilmington, Delaware, United States of America

Impact of hypersaline conditions on the endocrine and reproductive effects of bifenthrin on salmonids

K. Schlenk1, N. Riar1, K. Forrger2

1Univ. California, Riverside, Riverside, ca, United States of America
2Univ. California, Riverside, Riverside, ca, United States of America

Pyrethroids are a commonly used class of pesticides in California in both agricultural and urban applications. Although pyrethroids are reported as having nominal effects in mammals, they have been shown to have toxic effects in aquatic organisms, especially invertebrates and fish. Additionally, studies have found that in parts of the San Francisco Bay, California, salinity has increased much above the historical range (ppm) each year. Such increases in salinity have been shown to increase enzymes that may reduce the acute toxicity of pyrethroids, but may form metabolites that have greater endocrine disrupting (i.e., estrogenic) activity. Concentrations of bifenthrin, a third generation pyrethroid, have been observed to be as high as 73 ng/L in Northern California waterways. To evaluate the effects of hypersaline conditions on bifenthrin toxicity and endocrine disrupting activity, sexually immature rainbow trout (Oncorhynchus mykiss) were exposed for 14 days to nominal concentrations of 10 and 150 ng/L. Prior to bifenthrin exposure, fish were acclimated to freshwater, 8 and 17 ppt saline conditions. As hypothesized, 85.6% mortality was observed in the 150 ng/L treatment.
group in freshwater fish, 14.4% in the 8 ppt and no mortality in the 17 ppt salinity treatment groups indicating protection by hypersaline conditions from acute lethality. However, significant differences were not observed in the 8 ppt salinity treatment groups indicating protection by hypersaline conditions from acute lethality.

Several laboratories from academia, industries and government participated in an interlaboratory ring test organized by the German Federal Institute of Hydrology. The ring test aimed at investigating the practicability and reproducibility of the sediment contact test, validating the chosen endpoint, and determining the response range of the test system. A sediment contact test system with the dicotyledonous watermilfoil Myriophyllum aquaticum was established by the ecotoxicological laboratory of the German Federal Institute of Hydrology. Although they are an important part of an aquatic ecosystem, dicotyledonous macrophytes are not yet part of the risk assessment of sediments or dredged material. Getting more ecologically relevant data from laboratory tests: recovery potential of Lemna minor. A sediment contact test with the dicotyledonous watermilfoil Myriophyllum aquaticum was established by the ecotoxicological laboratory of the German Federal Institute of Hydrology. This procedure is now in the standardisation process within ISO. In the Myriophyllum aquaticum test, laboratory animals such as zebrafish, which were exposed to environmental samples for ten days. The growth of Myriophyllum aquaticum in a test sample was compared with its growth in the control sample. Phytotoxic effects can be quantified as growth inhibition (%) relative to the control growth.

Several laboratories from academia, industries and government participated in an interlaboratory ring test organized by the German Federal Institute of Hydrology. The ring test aimed at investigating the practicability and reproducibility of the sediment contact test, validating the chosen endpoint, and determining the response range of the test system. A sediment contact test system with the dicotyledonous watermilfoil Myriophyllum aquaticum was established by the ecotoxicological laboratory of the German Federal Institute of Hydrology. This procedure is now in the standardisation process within ISO. In the Myriophyllum aquaticum test, laboratory animals such as zebrafish, which were exposed to environmental samples for ten days. The growth of Myriophyllum aquaticum in a test sample was compared with its growth in the control sample. Phytotoxic effects can be quantified as growth inhibition (%) relative to the control growth.

Several laboratories from academia, industries and government participated in an interlaboratory ring test organized by the German Federal Institute of Hydrology. The ring test aimed at i) investigating the practicability and reproducibility of the sediment contact test, ii) validating the chosen endpoint, and iii) determining the response range of the reference substance functioning as positive control. First results of the interlaboratory ring test will be presented.

Acknowledgement: U.F. on behalf of the participants of the international ring test


University of Aveiro, Aveiro, Portugal

CIMES, Elime University, Matsuyama, Japan

It is well established now that the determination of total Hg (HgTOT) concentration is not sufficient to understand its fate in the environment. Inorganic ionic Hg is the main form in waters and sediments, whereas organic forms of Hg (HgORG) account for the majority of Hg found in biological tissues. Despite not representing a large fraction of HgTOT in the aquatic environments, the main form of HgORG, methymercury (MeHg+), raises prime concern, due to its tendency for bioaccumulation and biomagnification with increasing food chain levels. In order to examine the trophodynamics of HgTOT and HgORG in a coastal lagoon, suspended particulate matter (SPM), sediment, seston, phyto and zooplankton agglomerates, Crangon crangon, Pontopontides micropius, Liza aurata, Atberina boyeri and Dentirachius labrax were sampled. Sampling took place near the mouth of the two major freshwater sources (Vouga and Antuã rivers) to the lagoon. Vouga River runs in a narrow channel, with steep margins. Its watershed recovers fast and has a high natural riverine input, for example, diatom and red algae, indicating a better preservation of most organic and inorganic tissues. Laranjo Bay (a depositional area) receives the Antuã, which has been converting industrial discharges, particularly an effluent from a mercury cell chloralkali plant (from the 1950s until 1994). From the estimated 33 t of mercury dispersed into the lagoon, the majority (81%) is associated with the sediments in Laranjo Bay, by determining the position of each of the sampled compartments in the local food webs, using GC-C-IRMS, to determine the origin of the mercury fraction, our study suggests that animals inhabiting the most contaminated site developed tolerance to chemical stress. This study was carried out in the scope of the project “NISTRACKS - Processes influencing the invasive behaviour of the non indigenous species Corbicula fluminea (Mollusca: Bivalvia) in estuaries - identification of genetic and environmental key factors” funded by the Portuguese Foundation for the Science and the Technology (FCT) and the Portuguese Foundation for Science and Technology (FEDER). A sediment contact test system with the dicotyledonous watermilfoil Myriophyllum aquaticum was established by the ecotoxicological laboratory of the German Federal Institute of Hydrology. This procedure is now in the standardisation process within ISO. In the Myriophyllum aquaticum test, laboratory animals such as zebrafish, which were exposed to environmental samples for ten days. The growth of Myriophyllum aquaticum in a test sample was compared with its growth in the control sample. Phytotoxic effects can be quantified as growth inhibition (%) relative to the control growth.

Several laboratories from academia, industries and government participated in an interlaboratory ring test organized by the German Federal Institute of Hydrology. The ring test aimed at i) investigating the practicability and reproducibility of the sediment contact test, ii) validating the chosen endpoint, and iii) determining the response range of the reference substance functioning as positive control. First results of the interlaboratory ring test will be presented. Acknowledgement: U.F. on behalf of the participants of the international ring test.

TU 178 Is the growth of zebrafish a tool to determine the physiological capability of Corbicula fluminea to respond to acute chemical stress in estuaries? P. Vilares, C. Oliveira, L. Guicherim

University of Porto, Climar & KCBS, Porto, Portugal

The Asian clam Corbicula fluminea (Müller, 1774) is an invasive species that has been colonizing aquatic ecosystems in Europe, America and several other regions. In the freshwater tidal area of the Minho River estuary (NW Iberian Peninsula) that was colonized by this species in the 80s, C. fluminea is now the dominant species of the benthic community, has been contributing to the decline of several native molluscs and considerably changed ecosystem functioning. Furthermore, C. fluminea has been showing to be able to develop resistance to pollution. Here, the hypothesis that individuals from the river but inhabiting sites with distinct levels of historical contamination, have different capabilities to develop resistance to pollution exposure events. To test the hypothesis, animals collected at two sites in the Minho River under different anthropogenic pressure were exposed separately to the model polycyclic aromatic hydrocarbon benzo[a]pyrene (BaP) after a period of acclimation to lab conditions. At the end of the bioassays, enzymes involved in neurotransmission, biotransformation, anti-oxidant defences, aerobic energy production and lipid peroxidation levels were used as biomarkers. Results show different responses between the two sites and responses on the two sites suggesting that animals inhabiting the most contaminated site developed tolerance to chemical stress. It is hoped that the information provided will advance mesocosm study design and offer advice to those considering conducting mesocosm studies with herbicides whilst taking into account the different morphology and life histories. We will also provide recommendations for the evaluation of effects on algae and periphyton drawing on our experience in this area.
of 9 g ha⁻¹. For each species, two sets of plants were grown: total aboveground plant biomass was assessed at four weeks after exposure for the ST plants (first set) and again for the LT plants (second set) when the controls began natural senescence (7-23.5 weeks post-spray depending on species). To assess recovery over time, measurements of maximum plant height were taken weekly for all species using the LT plants. Reproductive parameters were also recorded for 13 species. Inhibition concentrations (IC₅₀) were obtained for ST and LT biomass and for LT reproductive parameters. ST biomass was found to be the most sensitive measure of IC₅₀ for nine species and LT reproduction for three. IC₅₀s could not be predicted for five species (no effect). Delays in flowering time were apparent for several species. Twelve species had early delays in growth compared to the controls at doses of 7.4% or less, two species were affected at higher doses (14.5 or 55%) while three species (all grasses) had no reductions in height. Shoot biomass was affected at doses of 7.4% or less, three fully recovered within an avg. 6.7 weeks post-spray, six recovered up to doses of 14.5% (avg. 6.5 weeks) and three up to doses of 28.2% (avg. 12.3 weeks). Though an overall trend towards recovery was also noted for reproductive parameters (4 spp. recovered, 3 remained the same, 3 unaffected at any dose), rates of recovery did not follow those observed for height. Delayed growth and flowering was observed at doses less than known drift rates (10%); however, recovery was observed exposed to these treatments were often still in the middle of the growing season. While recovery did occur in this greenhouse experiment, it may not apply to natural conditions where more resistant species (e.g. grasses) may grow faster and out-compete susceptible ones for light or resources. Such events may alter the natural species composition in exposed areas. This community approach is not considered in risk assessment.

TU 185
Effects of agrochemicals on macrophyte community structure and quality in a Canadian agricultural watershed
R.L. Del Tredici, R.B. Pick
ände Ackerlten Institute of Biology, University of Ottawa, Ottawa, Canada
Science and Technology Branch, Environment Canada, Ottawa, Canada
Macrophyte communities in healthy rivers and streams are typically diverse. Unfortunately, macrophyte diversity, particularly diversity of submerged species, appears to have declined in some North American and European ecosystems during the last century. In agricultural watersheds, streams are intimately connected with croplands and the health of macrophyte communities may be compromised by increased levels of disturbance and exposure to agrochemicals such as nutrients and herbicides in areas of high-intensity agriculture. The study presented here is identifying aquatic plants in the South Nation River watershed, a sparsely populated agricultural watershed comprising 3919 km² in Eastern Ontario, Canada. The sites varied in terms of their contamination with nitrate and the commonly used herbicide atrazine, with mean spring maximum in-stream concentrations of 6600 µg/L and 1.36 µg/L respectively. In-stream concentrations of nitrate and atrazine were strongly correlated. Over 200 macrophyte species were identified along stream banks and within the stream channels. Sites surrounded by high levels of agriculture tended to have a higher percentage of non-native species, suggesting that native species are less well adapted across the watershed. A decline in the quality and conservation values of communities was observed along a gradient of nitrate contamination.

TU 186
The effect of five sulfonyl-urea herbicides to aquatic macrophytes - implications of results from outdoor growth inhibition studies for the risk assessment
P. Sovigné, M. Drolling, A. Solga, J. Hoberg, A. Kirkwood
Bayer CropScience, Frinton, Germany
Smithers Viscient, Wareham, ma, United States of America
Peter Sovigné1, Margit Drolling2, Andreas Solga2, Jim Hoberg3 & Ashlee Kirkwood3

The exposure data is an essential tier of the tiered risk assessment approach. The objectives of multi-species testing are (1) to derive a species-sensitivity distribution (SSD) and (2) to identify a most sensitive species. Lemna is the standard aquatic test organism and among the most sensitive species to herbicides. Multiple species data provide arguments to lower the assessment factor due to increased realism and lower uncertainty. The example of sulfonyl-urea herbicides (SU) outlined here shows that herbicide exposure data can result in a more realistic and lower uncertainty assessment factor. Over a period of four years Smithers Viscient (sponsored by Bayer CropScience) generated macrophyte data for five different SU herbicides. In each study 9 to 10 species from a variety of taxonomic groups were exposed in artificial outdoor ponds for 6 to 8 weeks. Each year the design was slightly adjusted based on experiences gained from former tests. Despite these changes, the data obtained are applicable to (1) comparisons of species sensitivities within one test substance and (2) comparisons between the test substances.

Numbers of replicates were 4 in the controls and lowest concentrations, 3 at medium, and 2 at the highest concentrations (combined NOEC/EC₅₀ design). A dose-response was observed in most species. Due to variation among replicates, the EC₅₀ is regarded as more reliably the NOEC. As plant length could not be assessed in all species, dry weight biomass was used for comparisons. EC₅₀ levels based on biomass and biomass growth rates were very similar. The EC₅₀ levels from biomass growth rates were compared to the Lemna-EC₅₀. In 3 of the 5 herbicides tested none of the macrophytes was more sensitive than Lemna. For 2 of the 5 herbicides tested was ranked 2 and 3. In all 5 cases Lemna was among the 5% of the most sensitive species. Myriophyllum, the forthcoming second standard species within the frame of EU regulations, was of medium sensitivity (rank 4 to 6). Overall, the pattern of sensitivity distributions was very similar in all 5 SU herbicides. The large amount of data obtained enables refined risk assessments with low assessment factors based on the lowest EC₅₀ as well as probabilistic approaches using a hazard concentration (HCS).

TU 187
Ecological functions of plant growth regulators in the stability of agrocenosis
L.P. Voronina
Faculty of Soil Science, Moscow, Russian Federation

Tolerance of the system “soil-plant” in agrocenosis is the key condition of high yield. These functions in soil are accomplished mainly by humus component, and in the plant - by complex of biologically active compounds. Regulatory role in the resistance and protection of agrocenosis is studied in the example of chloroform (CC) and phytotoxins: cytosine (EpiBS), gibberellins (A₃). Their functioning and efficiency in “soil-plant” system is connected with a series of abiotic (temperature, nutrient elements, etc.) and biogenic (organic pollutants, etc.) variable factors. The complexity of agro-chemical and ecological studies presupposes the widening of methodological approaches. The wide use of bio-testing methods for summarizing data and the use of testing systems, allowing the revealing of protective effects of CC, EpiBS, A₃, of the three, which are widely used in the practice of agriculture. The ecological protective effects of CC are studied by the example of crop plants at a high load of agrochemicals by chemical means of plant protection. It’s used the reduction of total toxicity in soil, system in plant, and reproductive organs were revealed using during CCC-reduction of biological productivity in agrocenosis of plants and in agricultural products. Therefore, toxic effect of CCC on the plant, changes the activity of root system functioning (growth, absorption and root excretion), that actively effects on the dynamics of microbial association. The important ecological role of exogenous use of EpiBS phytotoxin was proved experimentally. The optimum created in agrocenosis artificially (providing plants with elements of mineral nutrition) is shown that the effect of growth of plants of the medium. The role of phytohormones in the regulation of plant adaptation by constantly changing the complexity of these factors, depending on each other. Use of EpiBS is compatible with gibberellins (A₃). Efficiency from their joint use is manifested in personal regulation of each to the performance of definite functions in plant ontogenesis. Thus, the biologically active compounds directly and indirectly affect the stability of agrocenosis. Intensive implementation of plant growth regulators into the practice of agriculture is connected with their expressive, smoothing and systematic effect.

TU 188
Biochemical responses in the aquatic macrophyte Myriophyllum quitense exposed to the strobilurin fungicide azoxystrobin
D.S. Garanzini, M.L. Menone
Instituto de Investigaciones Marinas y Costeras (IMYC) CONICET/UNMdP, Mar del plata, Argentina
Strobilurin fungicides exert a relatively new mechanism of action based on the development of fungal cell wall and the great impact of them on agriculture is reflected by the worldwide use of azoxystrobin (AZX), a compound approved for use on almost all important crop species. Its mechanism of toxicity is well understood in fungi but it effects in plants are scarcely studied. Aquatic macrophytes have been used as environmental biomonitor because of their bioaccumulation capacity of xenobiotics. The main goal of this study was to assess the potential impact of azoxystrobin on aquatic macrophytes. Myriophyllum quitense, a common species X Myriophyllum quitense, and chloroplastic photosynthesis, the activity of Guaiacol Peroxidase (POD), Glutathione S-Transferase (GST), Catalase (CAT), and the chlorophyll a and b contents were tested. Plants were exposed to 0 (negative control); 0.1; 1; 10; 50 and 100 µg/L of AZX for 24 hours. All the parameters were measured spectrophotometrically. Inhibition of CAT and POD at 50 µg/L was observed (p<0.05), showing the stress condition created by any concentration GST (p>0.05). Although there was no change in the chlorophyll a/chlorophyll b ratio among treatments an increase of total content of both pigments at 100 µg/L with respect to control was observed (p<0.05). Our results shows the importance of using biomarkers of different sensitivity, in the evaluation of potential negative effects of emergent agrochemicals in the environment, being more detailed study was highly recommended.

TU 189
Impact on surface water, stream sediments and macrophytes from the Aljustrel mining area (Portugal)
P. Alvarez, N. Guerrero, P. Palma
Instituto Politécnico de Beja, Escola Superior Agrária, Beja, Portugal

The aim of the study was: a) to evaluate the extent of pollution in stream sediments and macrophytes at Água Forte and at Rosso, and b) to assess the potential of the macrophyte Scirpus holoschoenus, collected along the stream banks, for phytoremediation of AMD. Several sampling sites were selected at Água Forte and at Rosso stream and downstream from the confluence of the Água Forte stream. Water quality was assessed considering physico-chemical characteristics and ecotoxicological parameters. Sediment samples were analyzed considering general physico-chemical characteristics and a sequential extraction procedure was used to quantitatively assess trace element pool (As, Cu, Pb and Zn). Scirpus holoschoenus samples were analyzed in order to assess trace element concentrations in the aboveground plant material.
Both surface water and sediments were extremely acidic at Água Forte stream, with pH values <2.92 for surface water and <3.12 for sediment samples. Surface water at Roxo stream presented pH values >7.26, apparently not affected by the confluence of the Água Forte stream, but the same was not true when considering the pH and other characteristics of the sediments. Ecotoxicological bioassays (luminescence inhibition of Vibrio fischeri and 48-h immobilization/mortality assay with Daphnia magna) were conducted in water samples at both water bodies and with water samples from the confluence of the two streams. Both surface water and sediments were extremely toxic, with very EC50 values. Although high Au, Pb and Zn concentrations were found at Água Forte stream, the same was not true in Roxo stream. Trace element content in water, sediments and Scirpus holoschoenus samples was analyzed and correlated in order to ascertain if this particular macrophyte, which seems adapted to the extreme conditions found at Água Forte stream, can be potentially used for metal removal in constructed wetlands to treat AMD.

TU 191
Species-specific responses to zinc in Lemnaeae: zinc storage and impacts on photosynthesis along frond developmental gradients
E.C. Lahive1, O. A. Halloran1, M.A.K. Jansen1
1 Centre for Ecology and Hydrology, Wallingford, United Kingdom

Lemnaeae are used to represent all macrophytes in standardised aquatic toxicity testing, with protocols allowing for the use of different species. Recently, differential sensitivity in Lemnaeae species to zinc, based growth and chlorophyll-a fluorescence parameters, has been reported. Chlorophyll-a fluorescence is an effective tool for sensing and quantifying the photophysiological effects of various stressors on Lemnaeae. Plant age and developmental stage strongly influence the effects of metals on the photosynthetic apparatus. However, there is little information on how this may affect toxicological assessment in plants. Zinc accumulation, morphological distribution and cellular storage, in either bound or soluble form, are also important for zinc sensitivity/tolerance and will be affected by increasing metal concentrations. Differential metal sensitivity of plant species has been linked with differences in accumulation and distribution. This study investigates how frond age and developmental stage, as well as zinc accumulation and storage, determine the impact of zinc on Lemnaeae. The maximum quantum efficiency of photosystem II, Fv/Fm, the effective quantum efficiency, Y(II), and photochemical quenching, qP, were measured in mature and young fronds as well as along a developmental gradient with different zinc concentrations. Zinc accumulation and storage in frond tissues and root tissues were measured in the soluble and bound forms in the plants were also measured after seven days. L. punctata and L. minor accumulated more zinc in their tissues than L. gibba. Partitioning of zinc in L. minor was notably different from the other two species, zinc was stored mainly in roots and the bound-fraction. Fv/Fm and Y(II) in young fronds were more severely impacted by zinc than in mature fronds in all species. However, younger proximal sections of L. punctata fronds were more impacted than older distal frond sections compared to more homogenous impact in single Lemna fronds. Single colony, time-point or leaf-assay analyses may not show the full biological picture of the impact of a toxicant, especially not in L. punctata. Therefore, selection of Lemnaeae species and developmental stages of fronds should be given careful consideration when using chlorophyll-a fluorometry for assessing chemical impact of a toxicity in Lemnaeae.

TU 192
Alternative effects of magnesium on copper rhizotoxicity to grapevine: macroscopic and microscopic point of view
1MingDau Univ., Changhua, Taiwan
2National Chaiy University, ChiaY, Taiwan
3National Taiwan Science, Taoyuan, Taiwan

Intensive and long-term application of copper (Cu)-containing fungicides (e.g. Bordeaux mixture) in vine-growing areas has led to the accumulation of Cu on the surface of surface waters and sediments of the world, thus posing the problems of Cu toxicity to the organisms thereon. Recently, a number of studies have found that some cations, such as magnesium (Mg) and calcium, may alleviate the rhizotoxicity of Cu to plants. In this study, a hydroponic experiment was conducted to determine the influence of Mg concentration on the growth inhibition effects of Cu to grapevine roots. In addition, optical microscopy was used to examine the histological changes in root tissue at the different Cu concentrations. Results indicated that Mg significantly increased significantly with increasing solution Mg concentration. On the other hand, the Cu concentration in roots was negatively correlated with the solution Mg concentration. From the light micrographs of root tip cells, the Cu concentration that caused histological changes in rootcellular (i.e., increased vacuolization and plasmolysis) ranged from 10 µM to 0.2 mM Mg treatment, to 25µM to the 4 mM Mg treatment. In the 8 mM Mg treatment, no histological change was observed even at an exposure concentration of 25 mM Cu. In conclusion, this study shows that Mg can alleviate Cu rhizotoxicity to grapevines effectively.
The toxicity of ion nanomaterials to aquatic and terrestrial plants

D.J. Jancula, S.Z. Zezulka, P.M. Mikula, B.M. Marsalek

Institute of Experimental Botany and Biotechnology, Czech Republic

Zero-valent iron (Fe0) as well as ferrate (FeV, FeV0) nanoparticles are well known especially for the ability to degrade a wide range of contaminants in both soils and ground waters. Although these materials are widely used in remediation processes across the world, almost no data are published about their ecotoxicological properties. This study aims to provide a benchmark information about their effects on both aquatic (Lemna minor) and terrestrial (Sinapis alba) macrophytes. Our experiments show large differences in toxicity between tested species as well as oxidation state of nanomaterials. The higher an oxidation state the more pronounced toxicity and the higher EC50 values have been found, following the order as FeV > FeV0 > Fe0. We used the frond numbers, root length and dry weight after 7 days of incubation as endpoints of the inhibition tests.

TU 197
Selection of suitable aquatic plants for phytoremediation of arsenic-contaminated water

P.J.C. Favas1, J.M.S. Prataz1, M.N. Peas1

1University of Trás-os-Montes e Alto Douro, Vila real, Portugal

2University of Hyderabad, Hyderabad, India

The work presented here is part of a larger on-going study about the metals and metalloids accumulation in aquatic plants of uninhabited geochemical province of Central Portugal. It is oriented for the use of aquatic plants as indicators of metal contaminated waters and their potential use in phytoremediation. In submerged and free-floating plants the concentrations of As were much higher than in emergent plants, with the exception of Oenothera crocata. The highest concentrations of As were found in the submerged species Callitriche brunnia (436.92 mg/kg DW), Callitriche stagnalis (354.03 mg/kg DW), Callitriche humilis (160.37 mg/kg DW), Ranunculus trichophyllus (268.53 mg/kg DW), Ranunculus pelatus (103.98 mg/kg DW), in the free-floating Lenna minor (279.42 mg/kg DW), and in emergent plant Oenothera crocata (157.94 mg/kg DW). The measured concentrations in the emergent plants, such as Apium nodiformum, Typha latifolia, and Juncus effusus were significantly lower when compared with the previously species, even in the rhizomes/roots. Other metals, such as Cu and Zn, are also accumulated by plants from the Callitriche genus, namely, Cu by Callitriche verna and Cu and Zn by Callitriche stagnalis with maximum concentration values of 132 mg/kg and 1395 mg/kg in dry biomass, respectively. The abundance of Callitriche stagnalis and several heavy metals at the same time made the plant our first choice for rhizofiltration methodologies development.

TU 198
Genotypic variation in metal-tolerant Silene vulgaris clones

P. García, C. Domingo, A. Pérez-Sanz, A.E. Pradas del Real, M.C. Lobo

Madridrian Institute of Research in Rural Development, Agrarian and Food, Alcalá de henares (Madrid), Spain

Silene vulgaris is a facultative co-tolerant heavy metal, capable of colonize contaminated sites due to its fast and vigorous growth by producing seeds and rhizoids. In order to evaluate its potential for the purposes of phytoremediation, genetic approaches are required to uncover the allelic variation at both Mendelian and quantitative genes. Analytical tools based on the identification of useful genetic diversity are needed for plant genotype selection aimed at enhancing metal remediation efficiency.

This study considers the genetic relationships among different S. vulgaris clones. Fourteen clones from ten populations collected from Madrid (Spain) were analysed using chloroplast DNA (cpDNA) markers. Ten primers pairs chloroplast SSR loci were tested and 3 out of the 10 primer pairs revealed the existence of intraspecific length polymorphisms. The intergenic spacer between the trnH and psbA genes was amplifies with the primers trnH (CUG) and psbA. All PCRs produced a major robust band per primer pair in all samples studied. Two size variants were detected for ccpm1 (120 and 121pb), two for ccpp4 (113 and 114pb), five for ccp2 (190, 191, 192,193 and 198pb) and six for trnH-psbA (328, 338, 349, 354, 355 and 357pb).

Regard to intraindividual diversity, ten unique cpDNA haplotypes were identified and seven of them were private, being found in only population. Despite de limited number of clones examined, a considerable intraindividual polymorphism was detected and can be explained by S. vulgaris out-crossing breeding system. Conservation of genetic resources in this allogamous species requires maintenance of the genetic diversity within each clone to avoid inbreeding depression and loss of rare alleles.

TU 199
Bioabsorption of Pb by Chlorella vulgaris (Chlorophyceae) at laboratory scale

L.R. Gallego1, A.M. Gagneten1, S. Gervasio1, U.R. Reno1, H.T. Trosni1

1Facultad de Humanidades y Ciencias, Santa fe, Argentina

2CONICET - UNLU, Santa fe, Argentina

3Centro Atómico Bariloche. Comisión Nacional de Energía Atómica., San carlos de bariloche. río negro, Argentina

In the lake Buenos Aires (Santa Fe Province, Argentina) were reported levels of Cu, Cr and Pb in water, higher than permitted standards, thus highlighting the urgency of implementing remedial measures. Among the conventional methods to capture metal ions from aqueous solutions are ineffective when the volume of wastewater is high and the concentration of metal ions to be removed is low (1-100 mg/L). An alternative is bioabsorption technology, using materials of biological origin. In the present study we analyze the efficiency of Chlorella vulgaris (Chlorophyceae) to remove Pb at laboratory scale.

The microalgae were harvested in exponential growth phase, centrifuged and resuspended twice in ultrapure sterile distilled water. After measure of algae concentration, 24 h of exposure, they were centrifuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For Pb bioabsorption, we calculated the % of removal, the concentration factor (CF=metal algae/metal water). Pearson correlations were performed to determine the Pb bioavailability for uptake in aquatic biota. Also, C. vulgaris may possibly be used in biomonitoring programmes. However, further research is necessary to investigate the toxic effects of the metals and how it relates to metal exposure.

TU 200
Bioaccumulation and distribution of selected metals in the macrophyte Ceratophyllum demersum, in a polluted South African river

B. Beukes, L. Reiber, A. Reynolds, D. du Preez

1, W. Kloas

University of Hyderabad, Hyderabad, India

2Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany

3Madrileñan Institute of Research in Rural Development, Agrarian and Food, Alcalá de henares (madrid), Spain

4Centro Atómico Bariloche. Comisión Nacional de Energía Atómica., San carlos de bariloche. río negro, Argentina

5Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany

6Biotechnical Faculty, Ljubljana, Slovenia

7University of Trás-os-Montes e Alto Douro, Vila real, Portugal

8Department of Botany, University of Johannesburg, Johannesburg, South Africa

The abundance of aquatic organisms are constantly exposed to xenobiotic compounds that cause the overproduction of oxidants or reactive oxygen species (ROS) resulting in oxidative stress. In nature aquatic organisms are constantly exposed to xenobiotic compounds that cause the overproduction of oxidants or reactive oxygen species (ROS) resulting in oxidative stress. Therefore, we have investigated the detoxification enzyme glutathione S-transferases (GST) in the plant extract to metabolize PbHg in vitro and the results show the inhibition of GST activity under the influence of the used PhACs. The data of the peroxidase (POD) and catalase (CAT) suggests that PhACs do not directly cause oxidative stress by an increase in ROS production. Due to increased ROS accumulation PhACs may be selectively toxic to some organisms leading to ecosystem alterations.

TU 201
Selenium pathway in water moss Fontinalis antipodacea

M. Michura1, M. Germ, V. Stibl1

1Biotechnical Faculty, Ljubljana, Slovenia

2Jožef Stefan Institute, Ljubljana, Slovenia

3University of Trás-os-Montes e Alto Douro, Vila real, Portugal

Water mosses are good indicator of polluted watercourses. We investigated the uptake of Se in widely distributed true water moss Fontinalis antipodacea in its natural environment. Nine locations in Nortrakanska region, Slovenia, with different land use in the catchment, were sampled. Samples of water and moss were taken in all four seasons
during years 2009, 2010 and 2011. The concentration of Se in water from all locations did not exceed 0.2 µg L⁻¹. Fontinalis antipyretica took up Se in the range between 343 - 3039 ng Se g⁻¹ (on dry matter basis; DM). The Se content varied, depending on the location and season. The highest content of Se was measured in the stream of Zerovniščica that flows through agricultural area with pastoral farming, the value being 3039 ± 170 ng Se g⁻¹ (DM). The amount of insoluble Se compounds after enzymatic hydrolysis using Protease (XIV) was around 75%. In soluble Se compounds only traces of Se (IV) and Se (VI) were found. No other Se compounds (SeMeSeCys, SeMet) were detected.

TU 202
The organic matter contribution of salt marsh vegetation to coastal wetlands: a case study in Jiangsu, China
Z.U.O. Zhu¹, J.L.A.N.G Jiang²
¹Nanjing University, Nanjing, China
²School of Geo&Oceanographic Sciences, Nanjing Univ., Jiangsu, China
Stable isotope techniques and different calculation models were used to analyse the potential sources of sediments organic matter in the core area of primary wetland and to calculate the contribution of salt marsh vegetation. By using multiple resources linear mixing model and the Euclidean distance model, we can conclude that micro-algae and Spartina alterniflora are the main contributors, under the assumption that the b¹³C value of micro-algae is -23%, the average contribution rate of micro-algae is 40%, which is the main contributor to the salt marsh wetland ecosystems in northern Jiangsu. The contribution rate of Spartina alterniflora to its marsh is 56% and to the intertidal is 57%. By comparing the two quantifying methods, we can find that the Euclidean distance model would overestimate the contribution of incidental resources and average the resource of high contribution rate.

TU 203
Genotoxicity study on Vicia faba L. grown on natural and spiked contaminated soils
L. Giorgetti, V. Giannoldati, M. Barbabieri
CNR-Istituto, Italy
Contaminant bioavailability and toxicity varies among soil types and may depend on soil properties and on contaminants characteristics. Metals contamination could have different potential risks depending not only on the total content but on their bioavailability. Operationally, metal bioavailability is often evaluated by chemical extractions characterizing different chemical forms. The use of plant bioassay may be an amenable tool to screen the phytotoxicity of contaminated soils.
In this work different soils contaminated by Boron (B) were studied in relation to plant bioavailability and toxicity. B is an essential micronutrient for plants and generally is absorbed from soil in the form of boric acid. Previous studies demonstrated that both excess or deficiency of B can affect normal plant development. Naturally B polluted soils and soil contamination characterization, occurrence of cytophene ranged between 20 and 100 mg/kg, were collected at Vicia faba L., plant commonly used for detecting the genotoxic effects of environmental pollutants. Artificially contaminated soils showed the highest B bioavailability (about twofold) when compared with the natural polluted soil at similar B total content. Cytological analysis was carried out on root tip meristems of Vicia faba, after 3 days of seed germination in the different B polluted soils; mitotic index and micronuclear assay (MNC) were determined for genotoxicity evaluation. Moreover, developmental and physiological parameters were evaluated in Vicia faba L. plants grown in the B contaminated soils. The B content in distinct organs of the plants was determined and compared with B content in soil (distinguishing the total from the bioavailable) and with the genotoxicity effects.
The results showed the close relationship between B bioavailability, genotoxicity and B content in the plant. The natural polluted soil and spiked soil with similar B content in the plant showed the same pattern of phytotoxicity and genotoxicity in Vicia faba. It is interesting to stress that bioavailability of B, and its content in the different plant organs, resulted higher in artificially spiked soils when compared with the same B concentrations in natural soils.
A close correlation between high B concentration in roots and major level of cytogenetic defects was found. These results confirmed plant genotoxicity of B polluted soils and showed clear evidences between soil properties, B bioavailability and phytotoxicity.

TU 204
Acute and chronic in vitro bioassays vs. autochthonous plants used as sentinel: comparing genetic biomarkers as tools in ecological risk assessment in Del Plata basin
S.O. Demichelis¹, C. Mencagni², M. Biffignandi², M. Spotorno², G. Mainero², M. Ansaldò², L.P. Dophiz³
¹JF Kennedy University of Argentina, Buenos aires, Argentina
²J Kennedy UNIVERSITY OF ARGENTINA, Buenos aires, Argentina
³Instituto Antartico Argentino, Buenos aires, Argentina
Del Plata basin is the fifth largest river basin in the world, its area covers four million km2 approximately and contains a great variety of natural environments and resources; these resources are shared by Bolivia, Paraguay, Brazil, Uruguay and Argentina.
The lack of wastewater treatments from 100 million inhabitants is the main source of chemical and biological pollution that impact on all tributaries and affects negatively the biota.
The samples of surface river water from along 1200 km of river coast were analyzed according APHA, AWWA, WEF (1992) water quality indexes (WQI) were calculated Value were adjusted to Argentine guidelines and sampling sites were qualify, being Excellent (95-100) 11%, good (80-94) 21%, Fair (65-79) 26%, Marginal (45-64) 26% and Poor (0-44) 16% of sampled places. Bioassays using water from Uruguay and Río de la Plata rivers were performed to evaluate toxicity. Allium cepa were exposed chronically and semi-statically while Latuca sativa assay was acute and static according IRAM standards. Samples of Echinodorus uruguayensis Arechav (Alismataceae), Eichornia crasipes (Mart.) Solms (Pontederiaceae), Pistia stratiotes L. (Araceae), Scirpus giganteus Kunth (Cyperaceae) were fixed in field to evaluate biomarkers. The biomarkers included in this study were cholinesterase (ChE), glutathione S-transferase (GST), gluthation peroxidase (GPX), glutathione reductase (GR). The GST, GPX and GR were selected as biomarkers because they are induced by xenobiotics, and they are sensitive to the contaminant type. The GST activity was measured using a kits test for GST (BioRad) and the results were expressed as µkat/L. The GPX activity was measured by the 4-aminopyridine method and the results were expressed as U/L. The GR activity was measured by a spectrophotometric method and the results were expressed as µmol/min/mg protein. The results were analyzed by ANOVA test (p<0.05).

TU 205
Can we possibly derive environmental quality benchmarks for chemical mixtures? M.Y. Leung
The University of Hong Kong, Hong kong sar, Hongkong
In the past several years, there are increasing evidences showing that chemical pollutants are indeed coexisting in the aquatic environment. For example, many antifouling biocide residues are often detected as a cocktail in the Mediterranean Sea, and the main contributors to the biota.
During years 2009, 2010 and 2011. The concentration of Se in water from all locations did not exceed 0.2 µg L⁻¹. Fontinalis antipyretica took up Se in the range between 343 - 3039 ng Se g⁻¹ (on dry matter basis; DM). The Se content varied, depending on the location and season. The highest content of Se was measured in the stream of Zerovniščica that flows through agricultural area with pastoral farming, the value being 3039 ± 170 ng Se g⁻¹ (DM). The amount of insoluble Se compounds after enzymatic hydrolysis using Protease (XIV) was around 75%. In soluble Se compounds only traces of Se (IV) and Se (VI) were found. No other Se compounds (SeMeSeCys, SeMet) were detected.

TU 206
Evaluation of available frameworks for mixture risk assessment in biocide and plant protection products in the EU
P.A.O. Johansson, H. Sundberg, P. Nord
Swedish Chemicals Agency, Sundbyberg, Sweden
Pesticides are regulated in the EU by the Biocide Product Directive (91/414/EEC) (BPD) and the Plant Protection Product Regulation (Regulation (EC) No 1107/2009) (PPR Reg). A new Biocide Regulation (BP Reg) is proposed and will likely come into force during 2013. Environmental and human health risks are evaluated before a product may be authorised and sold on the European market. Exposure to several substances based on the use of biocidal products and plant protection products are to be evaluated, according the PPR Reg and the BP Reg, respectively. This is more explicitly stated in the BP Reg compared to the BPD.
Guidance on how to perform mixture risk assessment on biocide or plant protection products is very limited. However, several frameworks for tiered risk assessment of the combined effect of substances within products have been suggested or are being developed by e.g. WHO-IPCS and Competent Authorities from several EU Member States, such as DE, DK, ES and SE.
In the present work several such frameworks have been evaluated for risk assessment of both environmental and human health. We have used model products which are based on actual biocidal and plant protection products, and the outcomes of the evaluations are compared from a regulatory decision making perspective. The suggested frameworks are all based on tiered approaches that include various levels of precaution and conservatism in order to be sufficiently protective of human health and of the environment.
even in data poor situations. The evaluation of the frameworks provides estimates of how protective and conservative they are in realistic regulatory assessments for both human health and environmental risk assessment.

The various frameworks and decision trees are designed to allow for risk refinement efforts in the product dossiers, to improve on the risk assessment of higher biological organization, i.e. easier to apply to environmental risk assessment than to human health risk assessment. Suggestions on how to prioritise refinement efforts in the product dossiers should be included in forthcoming guidance.

TU 207

DPP+ - an appropriate method to assess the risk for mixtures under REACH?

N. Aust, T. Juffernehrl, E. Hassold1, A. Rehler2

1Federal Environment Agency, Dessau, Germany
2Ökopol GmbH, Hamburg, Germany

According to REACH chemical substances need to be registered at the European Chemical Agency in Helsinki. For hazardous substance produced in amounts above 10 t/y the manufacturer or importer of the substance has to conduct a risk assessment and document the assessment in a chemical safety report (CSR). Operational conditions (OC) and conditions of use (CU) (OMM) for a substance for different exposure scenarios (ES) have to be attached to the CSR. If a deviation in manufacture or importer have to create a safety data sheet (SDS) for substances to communicate conditions of safe use within the supply chain. ES are attached to the SDS.

The formulators must know for the risk for the mixture they produce and create a SDS for the mixture on the basis of the information they get with the SDS and ES for the single substances. Although emissions to the environment results mainly from mixtures there is no guidance to assess the risk resulting from the use of mixtures. Industry developed the DPP+ method (based on the dangerous preparation directive) to assess from risk assessments. Aim of the method is to consolidate the information in the SDS and ES of the single substances to derive conditions of safe use for the mixture. The method is derived on the identification of a lead substance based on the classification of the substances in the mixture. Substances with a new classification are not considered in the derivation of OC and RMM for the mixture. The Federal Environment Agency, Germany (UBA) conducted a study to analyse the DPP+ method. The analysis tried to identify which potential risks of a substance could be overlooked by DPP+ and would hence not be adequately addressed in the selection of lead substances and the derivation of conditions of use. The above considerations question if DPP+ is a reasonable instrument to lead environmental risk assessments on mixtures. The analysis mentioned above, UBA, proposals need to further elaborated and included in a method to assess the risk of mixtures. The interpretation of DPP+ (only substances with classified for environmental hazards need to be addressed in the risk assessment for the environment) is regarded as not in line with the interpretation of the legal text by Commission, ECHA and MS. Beyond that the possibility of an integration of scientific methods for the assessment of mixtures in the regulatory framework should be investigated.

TU 208

Application of the TTC Concept to focus cumulative exposure assessment in environmental media: a special case for pesticides?

A. Weyers, M. Ebeling

Bayer CropScience, Monheim am Rhein, Germany

The concept of Threshold of toxicological concern (TTC) is based on establishing an exposure level for chemicals below which no significant risk is to be expected. This level is to be used as a cut-off level for risk assessment. However, the application of the TTC concept could be based on structural or de-minimus considerations, even in the absence of effect data. Originally it was applied to toxicological evaluations of substances such as pharmaceuticals, food contact materials, for risk assessment of chemicals (EFSA, US FDA, WHO IPCS).

Later it was adapted for ecotoxicology, and an “environmental threshold of no concern” (ETNCaq) of 0.1 µg/L was proposed for polar narcotics, non-polar narcotics and also reactive chemicals (de Wijn et al. 2010) because of their specific mode of action. For specific modes of action, specific TTCs have been proposed and some showed lower NERCs and thus were not included.

The TTC concept could be helpful to focus the assessment of chemicals that occur in environmental media. The recent SCHER opinion on Toxicity and Assessment of Chemical Mixtures recommended that no further risk assessment is needed for substances that do not exceed the TTC. Thus the TTC could serve as a filter to avoid making unnecessary assessments for chemicals which are not relevant for the assessment.

An analysis of the Bayer CropScience portfolio suggests that regulatory acceptable concentrations (RACs) for most pesticides are well above the ETNCaq of 0.1 µg/L suggested for chemicals other than pesticides. However, the original application of the ETNCaq was to derive safe thresholds in the absence of effect data, whereas for pesticides large amounts of acute and chronic data make the limited number of data points available for most pesticides can easily be identified and should then be included separately in a mixture toxicity assessment, even if present at concentrations below the ETNCaq. The application of the ETNCaq as a generic TTC in the field of mixture toxicity assessment in environmental media would primarily serve to filter out irrelevant contributors, not to substitute measured data.

TTC that for surface water could also guide where to set the generic LOD in monitoring studies rather then to try to detect substances at levels “as low as possible”. Further analysis is needed to assess whether a generic TTC of 0.1 µg/L is suitable and this should be tested on relevant real-world cases.

TU 209

Relevant potency threshold: reducing uncertainty by calibration of cumulative risk assessment

L.S. McCrory1,2, B. Dietrich1, J. Röhr3, D.R. Golder

1,2L.S. McCrory Scientific Research & Consulting, Newmarket on, Canada
3University of Florida, Gainsville fl, United States of America

Species sensitivity distribution for the prediction of herbicides mixtures toxicity on benthic diatoms

M. Katsumata1, K. Bennett1, A. Takeuchi1, Y. Kobayashi1, K. Kazumura1, Y. Sato1, T. Koske2, N. Tatarazako1, Y. Sugaya2

1Hamamatsu Photonics K.K., K. Hamamatsu, Japan
2National Institute of Environmental Studies, Tsukuba, Japan

Algae are important producers in aquatic ecosystems. The OECD Test Guidelines 201 (TG201), algae growth inhibition test, is a conventional method that evaluates chemicals mixture toxicity in shorter time. However, conventional methods are inefficient for pollution control. In particular, toxicological data on environmental mixtures are necessary for environmental risk assessment. A new concept to calculate chemical mixture toxicity in shorter time or provide information on the mode of action of chemical substance would be advantageous. Applications for a new method include improving the evaluation efficiency for toxicity screening of a large number samples for regulatory filings, toxicity identity evaluation of chemical mixtures, and efficient toxicity testing. The authors investigated a new rapid estimation method of the synergistic effect of the mixture (DF) from algae. The DF is a special type of luminescence; it detects the growth of only those cells that have photosynthetic capability. Since the DF originates from re-excitation of chlorophyll by a reverse reaction of photosynthetic electron transfer, the DF inhibition reflects inhibition of photosynthetic activity that is necessary for growth. Therefore the DF is a potential endpoint for estimation of the influence of chemical substance of algal growth in a shorter time than the conventional 72 hours growth inhibition test (e.g. TG201).

In addition, the intensity of DF shows a time decay curve. Chemical exposure changes the decay curve to patterns that provide insight into the mechanisms of action, and also has potential for application to the identification of contaminants in mixtures. We discuss characteristics of the evaluation of the influence of chemicals (herbicide, other chemical components and its mixture) on algae by both the DF inhibition and analysis of the DF decay curve. We also compare the detection characteristics of DF and other rapid estimation methods, including chlorophyll fluorescence-based photosynthetic activity measurement (PAM) and Microtox®, a common rapid bioassay that uses luminescent bacteria to evaluate complementary sensitivity between photosynthetic and non-photosynthetic microbial bioassay.

TU 210

Application of delayed fluorescence to estimate influence of chemical mixtures on alga

M. Katsurama1, K. Bennett1, A. Takeuchi1, Y. Kobayashi1, K. Kazumura1, Y. Sato1, T. Koske2, N. Tatarazako1, Y. Sugaya2

1Hamamatsu Photonics K.K., K. Hamamatsu, Japan
2National Institute of Environmental Studies, Tsukuba, Japan

Algae are important producers in aquatic ecosystems. The OECD Test Guidelines 201 (TG201), algae growth inhibition test, is a conventional method that evaluates chemicals mixture toxicity in shorter time. However, conventional methods are inefficient for pollution control. In particular, toxicological data on environmental mixtures are necessary for environmental risk assessment. A new concept to calculate chemical mixture toxicity in shorter time or provide information on the mode of action of chemical substance would be advantageous. Applications for a new method include improving the evaluation efficiency for toxicity screening of a large number samples for regulatory filings, toxicity identity evaluation of chemical mixtures, and efficient toxicity testing. The authors investigated a new rapid estimation method of the synergistic effect of the mixture (DF) from algae. The DF is a special type of luminescence; it detects the growth of only those cells that have photosynthetic capability. Since the DF originates from re-excitation of chlorophyll by a reverse reaction of photosynthetic electron transfer, the DF inhibition reflects inhibition of photosynthetic activity that is necessary for growth. Therefore the DF is a potential endpoint for estimation of the influence of chemical substance of algal growth in a shorter time than the conventional 72 hours growth inhibition test (e.g. TG201).

In addition, the intensity of DF shows a time decay curve. Chemical exposure changes the decay curve to patterns that provide insight into the mechanisms of action, and also has potential for application to the identification of contaminants in mixtures. We discuss characteristics of the evaluation of the influence of chemicals (herbicide, other chemical components and its mixture) on algae by both the DF inhibition and analysis of the DF decay curve. We also compare the detection characteristics of DF and other rapid estimation methods, including chlorophyll fluorescence-based photosynthetic activity measurement (PAM) and Microtox®, a common rapid bioassay that uses luminescent bacteria to evaluate complementary sensitivity between photosynthetic and non-photosynthetic microbial bioassay.

TU 211

Species sensitivity distribution for the prediction of herbicides mixtures toxicity on benthic diatoms

E.A. Alsheikh; A. Abou El-Azm; Montuelle

INRA, Montlouis, France

Coastal zones of lakes could be contaminated by a cocktail of substances coming from urban discharges or diffuse watershed run off. This type of contamination especially concerns micro pollutants such as pesticides. Benthic diatoms, which are a major component of benthic biomass, are then exposed to several pesticides that could interact together and present a modified toxicity (synergy, antagonism). Considering risk assessment, Species Sensitivity Distribution (SSD) models are partly used to extrapolate protective concentrations for a community exposed to a single or a cocktail of contaminants. To predict the toxicity of a mixture, two concepts are used depending on the mode of action of the mixture components (Concentration Addition _CA, or Independent Action_ IA). The main objective of the study was to assess if SSD (using CA or IA models) were reliable in terms of toxicity prediction of herbicide mixture on benthic diatoms and if this SSD could be used as a management tool for aquatic ecosystems.

As a first step, eleven species of benthic diatoms were exposed to 4 herbicides, separately (diuron, isoproturon, terbutryn, atrazine), in 96h monospecies growth inhibition tests.
Finally, we compared the toxicity thresholds predicted by CA and IA models to the measured toxicity thresholds. We also assessed the species ranking between the mono herbicide SSD curves and the mixture SSD curves.

**TU 212**

Effects of Atrazine and 2,4-D mixtures on L. minor

R.T. Tagun

The University of York, York, United Kingdom

Thailand’s agriculture is very important in terms of the economy. Pesticides are therefore widely used in Thailand and this usage is increasing. As a wide range of pesticides is used in Thailand, aquatic will be exposed to a mixture of compounds. In order to understand pesticide impacts, it is therefore important to understand the potential toxic interactions of pesticides in use in Thailand. The aim of the present study was therefore to test the interactive effects of two herbicides, atrazine and 2,4-D, on L. minor. The potential toxicity of these compounds on the growth of L. minor was studied. For atrazine the test concentrations were 0.05, 0.1, 0.2, 0.4 and 0.80 mg-L-1 and 2,4-D were 5, 10, 20, 40, 60, and 100 mg-L-1. One healthy frond was exposed to the test solutions for a period of 7 days. The design of the mixture studies was used seven mixture ratios and seven chemical dilutions. Dose response curves were obtained and fitted in logistic regression by using sigma plot. Isobole analysis was used to interpret the mixture toxicity results.

Results from the single substance studies showed that atrazine was more toxic to L. minor than 2,4-D. Due to 2,4-D being an auxin hormone, it is absorbed through the leaves and translocated to the meristems of the plant in dicots and it does not affect monocots which may explain the low toxicity to L. minor. The studies into the combination effects of atrazine and 2,4-D on L. minor clearly showed that the two compounds interact in an antagonistic manner. The antagonism has been found to occur more frequently in the mixture where the herbicide mixture belongs to different chemical groups and monocot species.

In terms of this mixture study, the results showed that the interaction between atrazine and 2,4-D was antagonistic. These results are re-assuring and indicate in terms of impacts on aquatic macrophytes in Thailand, mixture effects are less than additive. If additivity is assumed for risk assessment purposes for macrophytes in Thailand, then this should be protective. Work is ongoing using a wider range of pesticides and test organisms.

**TU 213**

Predictive mixture toxicity assessment of pesticides in Swedish surface waters

E.M. Gustavsson, T. Backhaus

University of Gothenburg, Gothenburg, Sweden

It has been demonstrated that combined effects of chemical mixtures give rise to stronger toxic effects than any of the compounds applied individually. The Scientific Committee on Health and Environmental Risks (SCHEER) has recently put forth concentration addition as a conceptual basis for the determination of environmental quality standards for mixtures. In this study we have predicted the risks from pesticide mixtures within Swedish surface waters using the concentration addition concept. Data from the national pesticide monitoring program in Sweden has been combined with experimental data from the US EPA database for single chemical toxicity and predicted toxicities from QSARs to determine the risks from pesticide mixtures in Swedish surface waters close to agricultural areas. The Swedish monitoring program has been taking samples in six different locations since 2002 and currently analyses the samples for more than 80 compounds, out of which 78 has been detected. All and all 75% weekly samples have been analysed bringing the total number of analyses performed close to 60 000. The abundance of information enabled the study of not only the individual site impacts on the aquatic system but also the importance of the mixture effects. The concentration addition concept was used in order to analyse the risk of pesticide mixtures. The approach is based on the use of species sensitivity distributions (SSD) which are derived from dose response curves. The SSD values derived from dose-response curves allowed to build a SSD curve (SSD-EC50) for each mixture. Measured HC were obtained from these curves.

Then each species was exposed to three different mixtures (96h monospecific growth tests). Two binary mixes (atrazin/terbutryn; diuron/isoproturon) and one quaternary mix (diuron/isoproturon/terquat/dichloroacetic acid) were tested. EC50 obtained for each species-mixture combination allowed to build a SSD curve (SSD-EC50) for each mixture. Measured HC were obtained from these curves.

Finally, we compared the toxicity thresholds predicted by CA and IA models to the measured toxicity thresholds. We also assessed the species ranking between the mono herbicide SSD curves and the mixture SSD curves.
Polycylic aromatic hydrocarbons (PAHs) are substances that have both natural and anthropogenic origins. They can be formed as a result of combustion, and are constituents of many petroleum products as well. Environmental risk limits (ERLs) were derived for 16 PAHs that were also considered in the European Risk Assessment Report (1998), high temperature, and combined with substantial analytical data. It can be assumed that toxicity of all PAHs is similar and possibly caused by narcosis. The toxicity of different PAHs differs only as a consequence of different environmental distribution and accumulation potential. The sum of the internal concentrations of different compounds gives rise to the same effect as that of a similar concentration of an individual compound, which is referred to as concentration additivity. This concept has been successfully applied before for total petroleum hydrocarbons (TPH) and will be investigated here for PAHs.

All ecotoxicity data were collected and carefully evaluated for their usefulness and reliability. To calculate the total internal residues, pore water concentrations were calculated as a component, by considering partitioning between organic carbon and water. From water concentrations, the internal residues were calculated using a partition coefficient between the membrane and water.

From all chronic toxicity data it can be assumed that PAHs are internalized by several mechanisms. The ability of twelve pollutants to inhibit P-gp and MRP pumps was characterized using the independent action and concentration addition concepts. Reversin 205 and MK 571 showed a distinctive and combined effects of the inhibitors on the efflux transporters. Enhanced accumulation of calcein in the gill tissue as reflected by increased calcein fluorescence indicated a dye for P-gp and MRP activity along with the specific inhibitors Reversin 205 for P-gp and MK571 for MRPs. Thus, a calcein-AM uptake assay was applied to study single and combined mixtures of PAHs and their derivatives via the Ah receptor.

The Simulated Earthworm Gut (SEG) is an in-vitro test that can be used to estimate the bioaccessibility of contaminants found in soil. The main objective of this research is to investigate whether a significant fraction of bioavailable PAHs, both from the soil matrix and from the food web, as well as from contaminated sites, are taken up by earthworms and thus bioavailable for higher trophic levels.

Characterization of the mutagenic resistance (MXR) mechanism in Daphnia magna and studies on its role in tolerance to single and mixtures of toxicants

The latter is used in boiler houses, industrial furnaces but also for heating of houses, etc. The current annual production volume of shale oil is about 0.5 million tons and that will be increased up to one million tons per year in the near future. Increased production, transportation and use of shale oil in Estonia entail risks of environmental contamination (e.g., non-aqueous phase liquids, fractions containing hydrocarbons) and between the individual PAHs, which could be the assumption that indeed accumulation from (pore) water is the determining factor for toxicity. On basis of these data, a species sensitivity distribution (SSD) was constructed, which appeared to be very similar to the SSD for TPH, suggesting a similar mode of toxic action. To derive a value for a generic ERL, an assessment factor of 5 has been applied to the HCS to accommodate potential of certain PAHs to exert a high acute toxicity through phototoxicity. For the PAHs it is confirmed that the equilibrium partitioning method is a useful method in setting quality standards. Because toxicity is driven by equilibrium partitioning, monitoring of these PAHs could be focused on measuring free water concentrations, e.g. in pore water, with phase extraction techniques.

TU 218 Prediction of the mixture toxicity of PAHs and their derivatives in the Ah receptor based HHIE-luc assay

K. Burkhardt-Medicke, R. Altenburger, C. Barata, T. Luckenbach

TU 219 Hazard evaluation of shale oil to the environment

L. Kanarik, I. Blinova, A. Kahru

TU 220 Application of predictive mixture models to differentiate P-gp and MRP type efflux transporter activities in zebra mussel (Dreissena polymorpha) and its environmental implications

B. Campos, T. Luckenbach, R. Altenburger, C. Barata

TU 221 Characterization of the mutagenic resistance (MXR) mechanism in Daphnia magna and studies on its role in tolerance to single and mixtures of toxicants

K. J. James, B. E. Markwart, G.L. Stephenson, S.D. Siciliano

University of Saskatchewan, Saskatoon, Canada

Stantec Consulting Ltd, Guelph, Canada

The Simulated Earthworm Gut (SEG) is an in-vitro test that can be used to estimate the bioaccessibility of contaminants found in soil. The main objective of this research is to validate the SEG as an indicator of soil bioaccessibility for soil contaminated with petroleum hydrocarbons (PHCs). Current practices for determining site-specific toxicity of PHCs can be expensive and time consuming. By validating an in-vitro toxicity test such as the SEG, site specific remedial objectives can be determined faster and at a lower cost. To validate the SEG, we compare the toxicity of six PHC contaminated soils for three invertebrate species (mite, collembolan and earthworm) against the bioaccessible estimate obtained from the SEG. Furthermore, due to the lipophilic nature of hydrocarbons we compare SEG bioaccessibility with and without the addition of a lipophilic sink to see which model better characterizes in-vivo exposure.
TU 223 Prediction of mixture toxicity for metals in soil: a reality-check
K. Orets1, V. Versugoustraete1, I. Scoehter2
1ARCHE, Geesthacht, Germany
2Eurometaux, Brussels, Belgium

 TU 224 Toxicological evaluation of chemical mixtures posing hazard to human and environment
Institute of Industrial Organic Chemistry Branch Pszczyna, Pszczyna, Poland

TU 225 Whether BDE209 interacts with Cd hepatotoxicity?
M. Cunic1, S.A.N.A. Stankovic1, S.A.A. Jankovic, V.E.S.N.A. Jacevic2, S.L.A.V.I. Vucinic3, K. Durgo4, B. Antonievic5
1University of Belgrade, Faculty of Pharmacy, Belgrade, Serbia
2University of Zagreb, Faculty of Food Technology and Botechnology, Zagreb, Croatia
3University of Zagreb, Faculty of Agriculture, Zagreb, Croatia

TU 226 Assessing human health risk from farmed milkfish consumption: considering toxic interaction among arsenic, copper, and zinc mixture
Y.J. Lin1, M.P. Linge1, C.M. Liao1
1National Taiwan University, Taipei city, Taiwan

TU 227 Waste recovery - a special treatment under REACH
F. Veurnele, A. Vassart, P. Anthoine, N.M. Debleeck
ARCH, Antwerp, Belgium

TU 228 Toxicity evaluation of disperse red 1 textile dye using freshwater organisms from different trophic levels - a PNEC proposal
I. Vazcui, G. Honorio, R. Ribeiro, G.A. Umbuzeiro
University of Lisbon, Lisbon, Brazil

TU 229 Azo dyes have been found in surface water especially because of textile production; however data about ecotoxicity of dyes are scarce in the literature. Commercial azo dyes are mixtures of a main dye, surfactants and other synthesis impurities. The commercial dye Disperse Red 1 containing 60% of the main dye N-Ethyl-N-(2-hydroxyethyl)-4-(4-methylphenylazo) aniline, CAS number 2872-52-8, was obtained by PCIL industries Ltda, Brazil. This product is used for dyeing synthetic fibers. Previous data showed the main azo dye was mainly responsible for the commercial dye toxicity at least for Daphnia. This same dye was found in an effluent and a receiving water sample collected in Americana (Sao Paulo, Brazil). The aim of this study was to compare the results of ecotoxicity of the commercial dye Disperse Red 1 obtained for organisms from different trophic level. Therefore, a Phytotox Test (4:4 ratio) was performed using the NOEC (72h) for Daphnia magna was 0.1 ppm and the NOEC obtained for Ceriodaphnia dubia in a reproduction inhibition test (8 days) was also 0.1 ppm. For the secondary consumer Hydrea attenuata, the NOEC obtained was 1 ppm in a reproduction inhibition test (7 days). For planarian and fish, only acute tests were performed. For Girardia tigrina newborns the EC50 (96h) was 80 ppm and for fish (Danio rerio, larvae, 96h), it was >50 ppm. This dye also showed mutagenic activity in the Salmonella/microsome assay but did not present estrogenicity in a NRCC estrogen assay. Based on this data, a chronic test (4:4-methylphenylazo) aniline of 0.4 ppm, considering that this compound would be responsible for the toxicity of the commercial product. This value was based on the lowest NOEC 0.1 ppm (chronic assay P. subcapitata and C. dubia) divided by an assessment factor of 10 because no chronic assay for fish is available and additional 10 because of its mutagenic potential. More studies are being conducted to verify the mutagenic effect of this product in microcrustacea as well as monitoring studies in river waters that receive textile discharges to determine exposure concentrations.
TU 229

Efficiency of chemical mixtures in the industrial control of biofouling by the Asian clam Corbicula fluminea
R.G. Garrido1, J.L. Pereira2, B.S. Nunes3, J.M. Gonçalves3, B.J. Covea1
1University of Coimbra, Coimbra, Portugal
2University of Aveiro, Aveiro, Portugal
3University of Aveiro & University Fernando Pessoa, Aveiro & porto, Portugal

The freshwater bivalve Corbicula fluminea (Müller, 1774), commonly known as the Asian clam, is one of the most invasive species of aquatic systems around the world. In addition to the adverse effects on ecosystems, this pest is well-known for its biofouling activity on freshwater-dependent industries. Developing environmentally-friendly methods to control the Asian clam in the industrial context and thus prevent significant economic losses is a major challenge.

The biocidal activity of the cationic polymer polyallyldimethylammonium chloride (polyDADMAC) against the Asian clam has been previously demonstrated. In this study, binary mixtures of polyDADMAC and potassium chloride, the molluscicide niclosamé polyDADMACidite dimethoate were formulated in an attempt to further increase the susceptibility of the clams to the polymer. The three combinations were tested in standard laboratory bioassays and the mortality results interpreted using an isobologram-based methodology. Through this preliminary study, different types of interactions between the chemicals were explored and the extent to which the performance of a potential combined treatment depends on the specific combination of actants was found to be antagonistic and, therefore, these mixtures are not promising control tools. In order to understand the antagonistic nature of the chemicals, preliminary experiments were conducted to elucidate the mechanism of toxicity of polyDADMAC and its interaction with dimethoate in C. fluminea. This study indicated that polyDADMAC neither affects the ability of osmoregulation of the cells as suggested by the literature for other surface-active molecules nor interacts with the hydrophilic activity of the enzyme cholinesterase, which is the specific target of dimethoate.

TU 230

Industrial enzymes - an example of the environmental risk assessment of an UVCB (unknown variable or composition, complex reaction products or biological materials)
F. Birkevd, N.W. Berg, D.S. Brinch
Novozymes A/S, Bagsvaerd, Denmark

Industrial enzymes for technical applications like for example detergent enzymes have to be safely assessed and registered under REACH. Enzymes are categorized as UVCB because they are produced by fermentation and are thus substances from biological origin with varying content of constituents. The enzyme protein together with the constituents derived from the fermentation process is considered to be the substance. Before enzymes with the same catalytic activity, but produced by different production strains, can be considered to be the same substance from a safety point of view, it is necessary to establish the safety of the production strains including the safety of the other constituents. To assure the safety of the other constituents the enzyme industry uses safe strain lineages (i.e. the production organism and methods of modification are demonstrated to be safe) which have been well established over the years as also indicated by scientific publications. This is a prerequisite for establishment of sameness so far. As an example for the use of both ecotoxicological and toxicokinetic evaluation concepts an enzyme protein is discussed in this paper.

Industrial enzymes are general of low ecotoxicity except for proteolytic enzymes, where some exhibit acute aquatic toxicity. Based on the available ecotoxicity data industrial enzymes can be regarded with their ecotoxicological profile grouped in proteolytic and non-proto toxenic enzymes. Within these two groups read-across can be applied. Enzymes are, however, often not soluble in water but solubilizable in physiological relevant aq. media, then further to environmentally harmless carbon dioxide and water as degradation products. Additionally, for the majority of ecotoxicity tests required for REACH registration data waiving can be applied including long-term aquatic toxicity testing and toxicity to terrestrial organisms. These tests are considered not relevant due to the fast biodegradation of the enzymes, the low absorption and bioaccumulation potential and because enzymes are primarily active in aqueous systems. Thus only short-term aquatic toxicity tests are considered relevant for industrial enzymes.

Based on the current knowledge on industrial enzymes and their intrinsic properties future ecotoxicological testing of enzymes may be avoided by applying read-across and the data waiving approach. In conclusion, environmental risk assessment of UVCB's like enzymes requires an alternative approach compared to the risk assessment of 'classical' chemicals or well defined mixtures due to the biological origin.

TU 231

A partial least squares based integrated addition model for estimating mixture toxicity
J.W. Kim1, S.H. Kim1, G.E. Schumann1
1Korea Institute of Science and Technology Europe, Saarbruecken, Germany

Studies on mixture toxicity among chemicals find that mixture components at levels below no-observed-effect concentrations (NOECs) may elicit toxicity resulting from the joint effects of the components. However, if risk assessment frequently focuses on individual chemical substances, although most living organisms are substantially exposed to mixtures rather than to single substances.

The concepts of additive toxicity, concentration addition (CA) and independent action (IA) models, are often applied to predict the mixture toxicity of similarity- and dissimilarity-acting chemicals, respectively. However, living organisms and the environments are exposed to both types of chemicals at the same time and space. Therefore, from the scientific perspective, it still needs to develop an integrated model to predict mixture toxicity from different chemicals practically, regardless of whether mixture components produce similar, dissimilar, or both similar and dissimilar modes of toxic actions.

The objectives of this study are to develop and evaluate a partial least squares-based integrated addition model (PLS-IAM) for not only to overcome the multicollinearity problem which can be occurred between the two independent variables, CA and IA, but also to combine them into the integrated addition model by using the latent variable. In this study, the PLS-IAM was validated by different datasets on mixture toxicity. The results showed that the prediction capability of the PLS-IAM outperformed reference models, the CA, IA, and IAM based on ordinary least squares.

TU 232

Using sensitivity analysis in developing a characterization model for noise impacts
S. Cucurachi, R. Heijungs
CML - Institute of Environmental Sciences Leiden University, Leiden, Nederland

Pilkington claim the “virtual impossibility of accurate quantitative modelling to predict the outcome of natural processes on the Earth’s surface”, due to the inability of environmental model makers to consider all possible sources of uncertainties in their models or due to their unrealistic or even false assumptions.

In life cycle assessment (LCA) we do use models whose outcome is always affected by a certain level of variability and uncertainty. The numerical solution of these models is, in fact, based on the assumption that the output of the model is equal to the value that the user specified as the input.

Practitioners and developers often communicate single values for model parameters and characterization factors, negatively impacting on the transparency, usability and trustworthiness of the outputs.

The use of LCA for the support of public decisions has contributed to the increased attention to the quality of data reported by LCA studies. In many cases the result of an assessment used by a policy maker can make a difference to the quality of life and health of (animal or human) populations living at a certain location. In the context of the study of noise, an underestimation error could, for instance, prompt a local authority to cease investing in systems which could prevent the propagation and impact of noise.

We proposed a new approach [4] that allows for the characterization of any noise-emitting source and its impact on humans, creating the necessary theoretical structure to accommodate the CA and IA frameworks and possibly also make it available for policy advice. Our follow up research aims at testing, analysing and further developing the noise characterization model applying sensitivity analysis (SA) techniques to demonstrate how uncertainty from the input of the model propagates to the output and how each single variable affects the overall variance of the output.

TU 233

Quantifying and propagating uncertainty in regionalized impact assessment: the relevance of spatial aggregation
P. Crippa
UC Santa Barbara / ETH Zurich, Zurich, Switzerland

Most LCA guidelines do not provide uncertainty information to be coupled with uncertainty of LCA. Furthermore, regionalized methods do not often properly address, leading to additional uncertainty due to aggregation of spatial explicit characterization factors (CF) on national or global levels. This lack is a main challenge for practitioners applying LCA including uncertainty and sensitivity analyses. On the other hand, concepts for reporting spatial uncertainty by method developers are still under development. In this study, different types of uncertainty for water consumption impacts are analyzed and combined on the endpoint level, showing how uncertainty information can be added to spatially explicit CFs.

In current Life Cycle Impact Assessment, human health impacts due to water consumption have only been addressed by two published methods so far. Both methods assess impacts as DALY (Disability Adjusted Life Years lost) due to lack of water for human use, but the modeling approach and considered impact pathways differ and cannot be applied to model scope uncertainty quantification. The method of Pfister et al. (2009) was used as a starting point. Parameter uncertainties were estimated based on analysis of original data sources and, where applicable, on quantitative assessment of the model uncertainty of the data provided by third parties. Spatial variability was also considered when using aggregation on country level. The uncertainties were propagated within the cause-effect impact model by applying the stochastic procedure of Latin Hypercube with the software @Risk.

The average k-values (dispersion factor denoting the 95% confidence interval if the median is divided (lower bound) and multiplied (upper bound) by k) was equal to k=2.76 on the midpoint level and 18.1 on the endpoint level. The aggregation from watershed to country level resulted in an average uncertainty of k=19.2 for the endpoint estimation. The data waiving approach.

In conclusion, environmental risk assessment of UVCB’s like enzymes requires an alternative approach compared to the risk assessment of ‘classical’ chemicals or well-defined mixtures due to the biological origin.
We present the result of the analysis for the pesticide Lindane. The overall variability of the removal rate from air is up to 5 orders of magnitude, mainly driven by four out of standard deviation is propagated using tailor series. This method has been implemented in a real case where decision needed to be made between three building projects. The data for which more than one value is available. (multiple sources and conflicting information)

Our practical experience and ideas, related to management of these uncertainties in USEtox model will be presented. Possibilities must be given to each user to view, add, or revise the documentation of a specific parameter. Reporting an error in a parameter value also have to be easy, as well as the ability to check the validity of each parameter value.

Our practical experience and ideas, related to management of these uncertainties in USEtox model will be presented. Those approaches have been implemented in a web application prototype that allows uncertainty calculation and documentation completion.

In the first step of the method, selection of key parameters is made taking into account both sensitivity of parameter on the results and variance of these parameters. Then standard deviation is propagated using tailored series. This method has been implemented in a real case where decision needed to be made between three building projects. The cases are generally presented in the paper is easy to implement and suitable for complex products which are tough to describe completely. In some case, it is possible to identify the best building solution even with up to 50% standard deviation on some primary data.

This is a contribution to the development of methodologies in considering uncertainties in LCA studies. The main results are a solid methodology for dealing with uncertainties in standard-informations modules approach is presented as methodology to reduce uncertainty in the Life Cycle Assessment. In particular such approach aims to dominate common barriers in the modelling of complex systems within the manufacturing context. An application is illustrated with reference to the uncertainty characterization of environmental profiles referred to energy flows. The use of standard modules for environmental profile characterization seems to improve the comparison of different studies by polarizing the improvement assessment on key life-cycle stages.

Taking into account variance of primary data in decision making: a method for the building sector. Life Cycle Assessment (LCA) can be a powerful tool to drive society toward sustainability if used for help to decision. Nevertheless decision step comes often early in the design process where very few data is available. To overcome this issue analysts are forced to use poor quality data or generic data even for foreground system description which is hurtful to results liability and could mislead the decision-maker. In this paper we focus particularly on construction sector which represents about 40% of the total energy consumed in Europe [1]. In the building field, help to decision comes at the planning phase. At this step, only rough data are available but still the planning manager has to choose the best environmental solution regarding its expectations and how it can better support building team proposals. The method presented in this paper allows decision-makers choosing between solutions taking into account variance of primary data. It is tailor made to building sector.

In the last two decades LCA-methodology development has made immense progress. We meanwhile have a solid LCA frameworks, ISO 14044 describes the procedures to be followed, and specifie the assumptions and decisions to be made in LCA. Comprehensive and detailed guidelines are provided by national handbooks that still show few differences, but have a great overlap in methodology. With this in mind it is interesting to evaluate whether the progress in harmonisation LCA-methodology has also resulted in harmonisation of LCA-results. For that purpose we evaluated 10 LCA studies, each comparing a range of different types of disposable cups for hot and cold drinks. We
first compared whether they arrived at similar rankings for similar cups, and next compared and evaluated the studies on a large number of methodological issues that are the source for different types of uncertainties. This presentation will present the main results and the surprising conclusions from our study.

TU 243
Contamination of the marine biological reserve of atol das Rocas (Brazil) by persistent organic pollutants
D.S. Dias, E.L. Colabuono, S. Taniguchi, R.C. Montone
University of Sao Paulo, Sao Paulo, Brazil
The biological Reserve of Atol das Rocas protects the largest seabird population of Brazil and despite being considered a remote area due to its distance from the mainland, this area is not exempt from the influence of anthropogenic agents, such as persistent organic pollutants (POP) that even has caused the decline of populations of several species of seabirds over the globe, due to bioaccumulative and biomagnified effects on typical top predators. This proposal aimed to determine the occurrence and concentrations of those organic contaminants in respective avifauna. One expedition was performed in February, 2010, where 16 liver samples of two species, Anous stolidus and Onychoprion fuscatus (n=2) were collected. Samples were analyzed for organochlorine pesticides (OCPs), PCBs and PBDEs. Briefly, samples were extracted in a Soxhlet apparatus, followed by classic adsorption column and GPC column as clean-up stages. OCPs and PCBs/PBDEs were respectively analysed by gas chromatography with electron capture detector and mass spectrometry. The main results showed that PCBs were present in all samples, ranging, in wet weight, from 0.23 - 21.7 ng g⁻¹ for the O. stolidus species and 20.5-27.9 ng g⁻¹ for the A. fuscatus species with predominance of lighter congeners (tri-, tetra- and pentachlorinated groups). The p,p'-DDE occurred in 88% of the samples of O. fuscatus and in the two samples (100%) of A. stolidus with respective values ranging from <0.19-2.45 ng g⁻¹ and 0.30-3.15 ng g⁻¹. HCB was found in 100% of A. stolidus samples with a mean value of 0.35 ng g⁻¹ and in the adult individual of A. stolidus in value of 0.65 ng g⁻¹. PBDE 47, at concentration of 4.70 ng g⁻¹, was found only in the sample of adult individual of A. stolidus. The low levels of contaminants suggest a relative degree of isolation and preservation, however the biggest PBDEs were detected in concentrations from 0.08 to 5.1 pg m⁻³ with BDE-47 and BDE-209 being the predominating congeners. Among the alternative BFRs, hexabromobenzene (HBB), pentabromoethylbenzene (PBB), pentabromotoluene (PBT), 2,3-dibromopropyl-2,4,6-tetrabromophenyl ether (DBTPE), hexabromobenzene (HBB), 2-ethylhexyl 2,3,4,5-tetrabromoanate (EHTBB) and bis-(2-ethylhexyl)-tetrabromophenyl tetraphthal (TBTP) were detected. HBB showed the highest concentration ranging from 0.12 to 26 pg m⁻³, and PBT and PBDEs ranged from not detected (n.d.) to 2.8 pg m⁻³ and from n.d. to 4.3 pg m⁻³, respectively. Dechlorane Plus (DP) ranged 0.23 to 11 pg m⁻³ while other Dechloranes remained <0.3 pg m⁻³. On a spatial scale, the highest concentrations, especially for HBB, PBT and PBDEs, were observed on the East Indian Archipelago showing South East Asia to be an important source of PBDEs. The approach of Clausius-Clapeyron Plots clearly indicates that the distribution and transport of PBDEs is dominated by long-range transport with little influence of fresh emissions whereas alternative BFRs, especially HBB, are subject to local sources. We present the first data on occurrence, distribution and transport of alternative BFRs and DP over the Indian Ocean.

TU 244
Seasonal variation of specific toxic effects of organic air pollutants from year-long sampling campaign
E.A. Fierro, P. Fassio, J. Klawonn1
1Research Centre for Toxic Compounds in the Environment (RECETOX), Brno, Czech Republic
2Dept. Biomed. Veterin. Sciences and Toxicol. Centre, University of Saskatchewan, Saskatchewan, Canada
Air pollution has recently produced many toxic effects including endocrine disruption. Evaluation of such types of effect cannot be based only on data from chemical analyses. That shows the importance of incorporation of specific bioassays into evaluation part of the air pollution monitoring programs. The utilities of these methods in monitoring of atmospheric pollution levels has been shown previously. It is known that levels of pollutants in atmosphere are closely related to type of pollution source and a season period. In our study, we focused mainly on the latter factor. Air samples were collected for one year at a traffic-burdened urban site in Brno (Czech Republic) and a village site about 8 km from Brno city to address the influence of city agglomeration as an air pollution source on the surrounding area. The samples were analyzed for a wide range of parameters and pollutants. In this work, we show the seasonal variation of aryl hydrocarbon receptor (AhR) mediated effects, anti/estrogenicity and anti-androgenicity. These parameters were assessed using in vitro reporter gen assays based on mammalian cell lines. This research was supported by GACR P503/10/P249 and CETOCOEN (CZ.1.07/2.3.00/30.0017).

TU 245
Profiles and cold trapping of polycyclic aromatic hydrocarbons and polychlorinated biphenyls in British Columbian mountain soils
J.N. Westgate1, M.O. Mitchell1, H. Hung2, P. Roach3, Y.D. Ying1, F. Wania1
1University of Toronto Scarborough, Toronto, Canada
2Environment Canada, Downsview, Canada
3Aboriginal Affairs and Northern Development Canada, Whitehorse, Canada
Soils collected at several elevations on five mountains and on near the Northern Pacific Coast of North America were analyzed for 15 Polycyclic Aromatic Hydrocarbons (PAHs) and 209 Polychlorinated Biphenyls (PCBs) from 32 sites in British Columbia (BC), Alberta, Washington and British Columbia. PAHs were determined from the East Indian Archipelago towards Western Australia and further to Antarctica in 2010/11. Samples were Soxhlet extracted and analysed via GC-ECNCI-MS/MS. PCBs were determined from the East Indian Archipelago towards Western Australia and further to Antarctica in 2010/11. Samples were Soxhlet extracted and analysed via GC-ECNCI-MS/MS. The data was analyzed using PMF and the results are presented in a series of tables. The concentration of some PAHs are particularly high in soils on the West Coast of North America, and are related to the proximity of marine pollution sources. The cold trapping hypothesis is not consistent with the observed patterns in soils from remote areas. The cold trapping hypothesis for PCBs is also not consistent with the observed patterns in soils from remote areas.
TU 247

The spatial distribution and potential sources of polycyclic aromatic hydrocarbons (PAHs) over the Asian marginal seas and the Indian and Atlantic Oceans

1. Introduction

- Forests are regarded as a global sink of semi-volatile organic contaminants (SOCs). The so-called “Forest filter effect (FFE)” may be an important driver that transfers SOC's from the atmosphere into the forest system (1). Previous study has focused on the atmospheric deposition and atmospheric-surface exchange of SOCs alone the mountain forest and clearing (2-4). This study aimed to compare atmospheric concentration of PAHs under the forest canopy and nearby clearing the Lys Valley, Aosta, Italy, on the slopes of Mont Mars.

2. Materials and methods

- Passive atmospheric sampling (PAS) was performed both in the forest and clearing sites at 700 m, 1000 m, 1400 m, 1800 m, and 2400 m (a.s.l) along the slopes of Mont Mars. 2 high-volume air samplers were used to collect air samples at 1400 m for 4 sampling periods.

3. Results and discussion

- 3.1. Concentrations

- The average values of the total PAHs (Σ2PAHs) concentrations of gaseous and particle phase was 1860 and 176.1 pg m$^{-1}$ for the forest, and 1230 and 123 pg m$^{-1}$ for the clearing. Seasonality, the PAH concentrations in the gaseous phase were elevated on the approach to China and India, while the highest Σ15PAHs in the gaseous phase were found at Chennai Harbor and close to Guinea (2-4). The end-of-the-season trajectories were taken from the East and South China Seas and the Indian and Atlantic Oceans, providing an opportunity to assess spatial trends and potential sources of atmospheric PAHs over those regions. Continental sources were still the major reason for the high concentrations of PAHs measured over the oceans. The Σ15PAHs in the gaseous phase were elevated on the approach to China and India, while the highest Σ15PAHs in the particulate phase were found near Chennai Harbor and close to Guinea. This result suggests that a greater portion of PAHs from the Indian Ocean may be attributed to the emission of coal and coke related combustion emission from mainland China. The highest high-molecular-weight PAHs in particles close to Guinea might be related to biomass burning in Africa. These results are consistent with previous PAH emission inventories and highlight the potential impact of continental PAH sources in China, India and Africa on the global marine atmosphere.

4. Conclusion

- The filter effect of canopy was observed along the Mont Mars and higher factors was related to low altitude sites and atmospheric particle. K$\text{endpoints}$, to determine the significance of any cells in an airshed. It is recommended that airsheds be generated specifically for the deployment time and location of a sampler, that endpoints with heights greater than 700m be removed from the set and that cells failing to meet the test criterion for significance be ignored when assigning potential source areas.

TU 248

PAHs along a mountain forest and clearing: the effect of canopy

1. Introduction

- The spatial distribution and potential sources of polycyclic aromatic hydrocarbons (PAHs) over the Asian marginal seas and the Indian and Atlantic Oceans (1,2) were generally declining with the increasing of altitude alone the slopes of Mont Mars. The declining rate for the forest was much lower than that at the clearing. The rate was 0.003 for forest and 0.006 ngPAS$^{-1}$ m$^{-1}$ for clearing, respectively. This may due to strong forest filter effect at lower sites where corresponding to high PAH concentrations in the atmosphere.

2. Material and methods

- Passive atmospheric sampling (PAS) was performed both in the forest and clearing sites at 700 m, 1000 m, 1400 m, 1800 m, and 2400 m (a.s.l) along the slopes of Mont Mars. 2 high-volume air samplers were used to collect air samples at 1400 m for 4 sampling periods.

3. Results and discussion

- 3.1. Concentrations

- The average values of the total PAHs (Σ2PAHs) concentrations of gaseous and particle phase was 1860 and 176.1 pg m$^{-1}$ for the forest, and 1230 and 123 pg m$^{-1}$ for the clearing. Seasonality, the PAH concentrations in the gaseous phase were elevated on the approach to China and India, while the highest Σ15PAHs in the gaseous phase were found at Chennai Harbor and close to Guinea (2-4). The end-of-the-season trajectories were taken from the East and South China Seas and the Indian and Atlantic Oceans, providing an opportunity to assess spatial trends and potential sources of atmospheric PAHs over those regions. Continental sources were still the major reason for the high concentrations of PAHs measured over the oceans. The Σ15PAHs in the gaseous phase were elevated on the approach to China and India, while the highest Σ15PAHs in the particulate phase were found near Chennai Harbor and close to Guinea. This result suggests that a greater portion of PAHs from the Indian Ocean may be attributed to the emission of coal and coke related combustion emission from mainland China. The highest high-molecular-weight PAHs in particles close to Guinea might be related to biomass burning in Africa. These results are consistent with previous PAH emission inventories and highlight the potential impact of continental PAH sources in China, India and Africa on the global marine atmosphere.

4. Conclusion

- The filter effect of canopy was observed along the Mont Mars and higher factors was related to low altitude sites and atmospheric particle. K$\text{endpoints}$, to determine the significance of any cells in an airshed. It is recommended that airsheds be generated specifically for the deployment time and location of a sampler, that endpoints with heights greater than 700m be removed from the set and that cells failing to meet the test criterion for significance be ignored when assigning potential source areas.

TU 249

Size-specific particle-gas distribution of the atmospheric polyaromatic hydrocarbons (PAHs) on the spatial and temporal scales

C.D. Degrendele, K.O. Okonski, L.L. Landlová, P.K. Kulucka, J.K. Klánová

RECETOX- Research Centre for Toxic Compounds in the Environment, Brno, Czech Republic

Although polycyclic aromatic hydrocarbons (PAHs) are usually not included amongst the group of compounds defined as ‘persistent organic pollutants (POPs)’ due to their higher reactivity, they are a subject to long-range atmospheric transport (LRAT) and can pose significant health risks. As such, they are among the pollutants most commonly monitored in the atmosphere.

The objectives of this study was to examine the temporal variability of the size-specific particle-gas distribution of atmospheric PAHs in order to understand the physical and chemical parameters affecting the gas-particle partitioning and consequently the ambient concentrations and fate of selected PAHs.

3. Results and discussion

- 3.1. Concentrations

- The average values of the total PAHs (Σ2PAHs) concentrations of gaseous and particle phase was 1860 and 176.1 pg m$^{-1}$ for the forest, and 1230 and 123 pg m$^{-1}$ for the clearing. Seasonality, the PAH concentrations in the gaseous phase were elevated on the approach to China and India, while the highest Σ15PAHs in the gaseous phase were found at Chennai Harbor and close to Guinea (2-4). The end-of-the-season trajectories were taken from the East and South China Seas and the Indian and Atlantic Oceans, providing an opportunity to assess spatial trends and potential sources of atmospheric PAHs over those regions. Continental sources were still the major reason for the high concentrations of PAHs measured over the oceans. The Σ15PAHs in the gaseous phase were elevated on the approach to China and India, while the highest Σ15PAHs in the particulate phase were found near Chennai Harbor and close to Guinea. This result suggests that a greater portion of PAHs from the Indian Ocean may be attributed to the emission of coal and coke related combustion emission from mainland China. The highest high-molecular-weight PAHs in particles close to Guinea might be related to biomass burning in Africa. These results are consistent with previous PAH emission inventories and highlight the potential impact of continental PAH sources in China, India and Africa on the global marine atmosphere.

4. Conclusion

- The filter effect of canopy was observed along the Mont Mars and higher factors was related to low altitude sites and atmospheric particle. K$\text{endpoints}$, to determine the significance of any cells in an airshed. It is recommended that airsheds be generated specifically for the deployment time and location of a sampler, that endpoints with heights greater than 700m be removed from the set and that cells failing to meet the test criterion for significance be ignored when assigning potential source areas.

TU 250

Size-specific particle-gas distribution of the atmospheric polyaromatic hydrocarbons (PAHs) on the spatial and temporal scales

K.T. Okonski, C. Degrendele, L. Landlová, P. Kukucka, J. Klánová

RECETOX- Research Centre for Toxic Compounds in the Environment, Brno, Czech Republic

Although polycyclic aromatic hydrocarbons (PAHs) are usually not included amongst the group of compounds defined as ‘persistent organic pollutants (POPs)’ due to their higher reactivity, they are a subject to long-range atmospheric transport (LRAT) and can pose significant health risks. As such, they are among the pollutants most commonly monitored in the atmosphere.

The objectives of this study was to examine the temporal variability of the size-specific particle-gas distribution of atmospheric PAHs in order to understand the physical and chemical parameters affecting the gas-particle partitioning and consequently the ambient concentrations and fate of selected PAHs.

3. Results and discussion

- 3.1. Concentrations

- The average values of the total PAHs (Σ2PAHs) concentrations of gaseous and particle phase was 1860 and 176.1 pg m$^{-1}$ for the forest, and 1230 and 123 pg m$^{-1}$ for the clearing. Seasonality, the PAH concentrations in the gaseous phase were elevated on the approach to China and India, while the highest Σ15PAHs in the gaseous phase were found at Chennai Harbor and close to Guinea (2-4). The end-of-the-season trajectories were taken from the East and South China Seas and the Indian and Atlantic Oceans, providing an opportunity to assess spatial trends and potential sources of atmospheric PAHs over those regions. Continental sources were still the major reason for the high concentrations of PAHs measured over the oceans. The Σ15PAHs in the gaseous phase were elevated on the approach to China and India, while the highest Σ15PAHs in the particulate phase were found near Chennai Harbor and close to Guinea. This result suggests that a greater portion of PAHs from the Indian Ocean may be attributed to the emission of coal and coke related combustion emission from mainland China. The highest high-molecular-weight PAHs in particles close to Guinea might be related to biomass burning in Africa. These results are consistent with previous PAH emission inventories and highlight the potential impact of continental PAH sources in China, India and Africa on the global marine atmosphere.

4. Conclusion

- The filter effect of canopy was observed along the Mont Mars and higher factors was related to low altitude sites and atmospheric particle. K$\text{endpoints}$, to determine the significance of any cells in an airshed. It is recommended that airsheds be generated specifically for the deployment time and location of a sampler, that endpoints with heights greater than 700m be removed from the set and that cells failing to meet the test criterion for significance be ignored when assigning potential source areas.
Potential input of organic pollutants to the Mar Menor lagoon: estimation of seasonal air concentrations using passive and active air samplers

A. Carratalá1, P. Herbertt1, J.M. Amigo1, S. Lacorte1, D. Barceló1, E. Pulikinis2, A. Alves3

LEPAE-DEQ-EPU, Porto, Portugal
University of Copenhagen, Copenhagen, Denmark
IDAEA-CSIC, Barcelona, Spain
Technical University of Crete, Chania, Greece

The Mar Menor lagoon is fed by the Guadalentín River, which has its source in the Sierra Nevada mountain range, and the Cartagena River. The lagoon is bordered by the towns of Cartagena, Bolnuevo, and San Pedro del Pinatar. The lagoon has a surface area of 64 km² and a maximum depth of 10 m. It is the ending point of drainages from a large agricultural area where a variety of pesticides are used. This lagoon is surrounded by several villages and that have, especially in summer, an intense touristic activity. There is also a military airport close to the lagoon and this area is influenced by a very industrialized pole, which is located at 20 km south.

There were not previous data of pesticides and PAHs concentrations in air of in this area. In order to estimate the levels of organic pollutants in air and the potential atmospheric input in Mar Menor lagoon, passive samplers consisting of polyurethane foam (PUF) disks housed in chambers were deployed at six sites around the basin of this lagoon. Replicate at each point and calibration with a DIGITEL active sampler (at one point) equipped with a PUF module are used to improve the confidence of the determinations and to estimate the sampling ratios for the different detected species.

PUF samples have been extracted with hexane using a pressurized liquid extractor. The extract was concentrated and was analyzed gas chromatography with mass spectrometry. The quantification limits were lower than 10 ng/L for the majority of the considered analytes. This method has been validated for more than 80 organic pollutants, mainly polycyclic aromatic hydrocarbons and up to 23 have been identified. PUF samples from active and passive samplers. The range of estimated air concentrations is very wide (100 pg/m3-2 ng/m3), and depends on the specific compound, as consequence of the proximity of sources and environmental variables.

Seasonal and spatial patterns have been found for different groups of organic pollutants associated to the main local sources in each case. The larger air levels of anthracene, fluorene and phenanthrene were detected in the proximity to the airport, while pesticides have a more homogeneous spatial pattern, with lower air concentrations by the sea side. Also a clear seasonal pattern has been detected in the case of some specific pesticides, such as chlorpyrifos, with higher concentrations in spring and autumn.}

Biomonitoring of polycyclic aromatic hydrocarbons by pine needles - analytical alternatives and levels in Europe

N. Ratanal1, P. Herbertt1, J.M. Amigo1, S. Lacorte1, D. Barceló1, E. Pulikinis2, A. Alves3

LEPAE-DEQ-EPU, Porto, Portugal
University of Copenhagen, Copenhagen, Denmark
IDAEA-CSIC, Barcelona, Spain

The concentrations of polycyclic aromatic hydrocarbons (PAHs) in pine needles were determined in 104 sites across ten European countries (UK, Germany, Spain, France, and others). The aim of this study was to assess the environmental exposure to these compounds in temperate and polar environments (Antarctica Peninsula). The study was carried out in different sampling campaigns, including active and passive air sampling, and the data obtained in this study are close to those predicted by McLachlan, 1999.
The environmental health decline and the loss of organism diversity of South Florida (USA) ecosystems have been attributed to nutrient inputs from nearby urban and agricultural areas. Integrated agricultural pesticide use may also challenge these ecosystems. One possible acute challenge to these ecosystems is the atmospheric disposal of airborne pesticides, which can be enhanced in this region due to the calcareous soils, frequent rainfall, and high humidity and temperatures. A study was conducted to examine the atmospheric fate of the widely-used insecticide endosulfan. Air samples were collected over a five-year period (2001 to 2006) at a site within the agricultural community of Homestead, Florida, along the southern coast near Everglades National Parks (NPs). Endosulfan emissions from agricultural areas around Homestead appeared to influence air concentration observations at the NP sites. During an intensive sampling campaign, the highest total endosulfan concentrations at the NP sites were observed on days when air parcels were predicted to move from Homestead towards the sampling locations. The α-endosulfan fraction (α/(α+β)) was used to examine the contribution of pesticide emissions to the overall concentration to the overall concentration. The formation of the α fraction has an α fraction of approximately 0.7, whereas volatilization is predicted to have an α fraction of 0.9. The median fraction observed at Homestead during periods of high and low agricultural activity was 0.84 and 0.86, respectively, indicating that drift contributes more to the atmospheric concentrations. The median fraction at Everglades NP was 0.88 and 1.0 during high and low agricultural activity, respectively, and at Biscayne NP was 1.0 indicating air concentrations are primarily influenced by regional volatilization. The near-infrared isomerization after application of β-endosulfan to α-endosulfan also influences the value of the α fraction.

**TU 257**

**Raman microscopy as a tool to examine agricultural sources of PM10**

L.L. Mcconnell1, H. Huang2, E. Razote3, W.F. Schmidt1, B.T. Vineyard1, A. Torrents2, C.J. Hapeman1, R. Maghirang1, S. Trabue1

1U.S. Department of Agriculture, Beltsville, Maryland, United States of America
2University of Maryland College Park, College Park, maryland, United States of America
3Kansas State University, Manhattan, Kansas, United States of America

Raman microscopy and infrared spectroscopy were used to examine tobacco dust emitted during the growing season. We hypothesized that the relative volume of dust particles captured followed by tobacco dust at approximately 20% and then feed materials. Results indicate this approach could be used in a number of different agricultural emission characterization scenarios.

**TU 258**

**A langmuir-hinshelwood fit of atmospheric reactions of OH radicals with semivolatile, aerosol-borne compounds in chamber experiments**

L. Han1, WU. Palm1, H.U. Krüger1, S. Bleicher1, C. Zetsch1

1University of Bayreuth, Germany

A number of semivolatile compounds and proxies of environmental compounds, such as oleic acid, long-chain alkane, polycrylic aromatic hydrocarbons, plasticizers, PCBs, brominated flame retardants, and various pesticides were investigated for their atmospheric degradation rates by OH radicals and/or ozone. Some of them have been examined in the gas phase and some of them in the adsorbed state as thin films or sub-monolayers on appropriate solid materials in either flow reactors or aerosol chambers, by exposing them to OH radicals or ozone at known levels. In this study, a series of experiments were performed to investigate the reaction of OH radicals with compounds in the gas phase. However, due to its complex mechanism, aerosol-borne reactions with OH radicals are poorly understood. Only recently, the Langmuir-Hinshelwood mechanism and the Eley-Rideal mechanism have been applied on aerosol-borne reactions with OH radicals. In our simulation glass-smog chamber. Home made silica particles were used as carrier material. Compared to previous <10 nm particles (Aerosol 200), these larger particles (diameter about 160 nm) have less tendency to agglomerate. Compared to previous studies, a negative correlation with OH concentration was found for the second order reaction rate constant. At relatively low OH concentrations, the reaction rate should be explained by the Eley-Rideal mechanism, whereas the Langmuir-Hinshelwood mechanism is more appropriate to explain concentration-time dependencies. Because the adsorption could be affected by gas-particle equilibria, results from different experimental setups (e.g. Chamber experiments and flow tube experiments) are assumed to be different.

Acknowledgement: This work is supported by the EU within the infrastructure EUROCHAMP-2. We also acknowledge former support by the Umweltbundesamt, the companies CIBA-Geigy (now Syngenta), Bayer and BASF and by the EU in the project MOST.

**TU 259**

**Analysing PBDE in house dust samples with the TSQ Quantum Ultra XLS GC-MS-MS in EI-SRM mode and GC-MS negative chemical ionization in SIM; a comparison of two analyzing techniques**

M.S. de Dobbeleer1, A.G. Mayer1, J. Guemmersbach1, H.J. Hueschmann1, P. Silcock2

1ThermoFisher, Breda, Nederland
2TU 259, TU 258

Polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) are a group of chemicals that are formed during the combustion processes and released into the air. In this application note, a comparison is made between two analytical techniques; GC-MS-MS and GC-NCI-SIM, evaluating detection limits, repeatability and selectivity in matrix.

Analysis of PBDE in house dust samples with the TSQ Quantum Ultra XLS GC-MS-MS in EI-SRM mode and GC-MS negative chemical ionization in SIM; a comparison of two analyzing techniques.

**TU 260**

**Human exposure to flame retardants in different occupational settings from Pakistan**

N.A. Ali1, T. Mehdii2, A.C. Dirtu1, G. Malayarvan3, H. Neels1, A. Covaci1

1University of Antwerp, Antwerp, Belgium
2Institute of Microbiology, University of Agriculture Faisalabad, Faisalabad, Pakistan

Flame retardants (FRs) are widely used in a variety of consumer products, such as plastics, textile coatings, electrical appliances and printed circuit boards to inhibit the development of fires. Studies have shown that these chemicals can leach out into the environment. In order to investigate the presence of FRs in the specific occupational setting of human exposure to FRs, we collected dust, urine, serum, and urine samples from individuals working at electronics and textile market in Punjab, Pakistan. Polychlorinated dibenzydieny ethers (PBDEs), novel brominated FRs (NBFs), hexabromocyclododecanes (HBCDs) and organophosphate FRs (OPFRs) were quantified in dust, urine and serum samples. PBDEs were extracted from dust, serum, and urine using solid-phase extraction (SPE). In dust and serum extracts, PBDEs and NBFs were analysed by GC-MS and GC-MS. Brominated flame retardants in dust samples were analyzed using GC-MS/MS in selected ion monitoring (SIM) mode. OPFRs were quantified in serum samples and analysed by GC-MS in electron impact (EI) mode. The separation and determination of α- and β-endosulfan was assessed using liquid chromatography (LC) separated into three different FRs: the OPFRs (PFOS, PFNA, PFDA) and the HBCDs (HBCDD, HBCDC).

**TU 261**

**Use of volatile organic compounds (VOC) in consumer products and comparison between the European and US reactivity models for assessment**

J. Kaumanns

Use of volatile organic compounds (VOC) in consumer products and comparison between the European and US reactivity models for assessment.

**TU 262**

**Exposure to human flame retardants in different occupational settings from Pakistan**

N.A. Ali1, T. Mehdii2, A.C. Dirtu1, G. Malayarvan3, H. Neels1, A. Covaci1

1University of Antwerp, Antwerp, Belgium
2Institute of Microbiology, University of Agriculture Faisalabad, Faisalabad, Pakistan

Flame retardants (FRs) are widely used in a variety of consumer products, such as plastics, textile coatings, electrical appliances and printed circuit boards to inhibit the development of fires. Studies have shown that these chemicals can leach out into the environment. In order to investigate the presence of FRs in the specific occupational setting of human exposure to FRs, we collected dust, urine, serum, and urine samples from individuals working at electronics and textile market in Punjab, Pakistan. Polychlorinated dibenzydieny ethers (PBDEs), novel brominated FRs (NBFs), hexabromocyclododecanes (HBCDs) and organophosphate FRs (OPFRs) were quantified in dust, urine and serum samples. PBDEs were extracted from dust, serum, and urine using solid-phase extraction (SPE). In dust and serum extracts, PBDEs and NBFs were analysed by GC-MS and GC-MS. Brominated flame retardants in dust samples were analyzed using GC-MS/MS in selected ion monitoring (SIM) mode. OPFRs were quantified in serum samples and analysed by GC-MS in electron impact (EI) mode. The separation and determination of α- and β-endosulfan was assessed using liquid chromatography (LC) coupled to triple quadrupole MS system operated in the negative electrospray ionization (ESI) mode. OPFR metabolites were analysed in urine using LC-MS/MS in negative mode. Genistein was used in the individual concentration protocols. The present work indicates that the workers in the studied area are occupationally exposed to various FRs, with probably indoor dust ingestion and air inhalation as a major source of exposure. Correlations were performed between the levels of FRs in dust and serum or between dust and urine samples. For workers, using the 5th, median and 95th percentile concentrations in dust samples different exposure scenarios were calculated via dust ingestion. Exposure assessment values were lower than RfD values. Human exposure to FRs seems to originate from a combination of different sources, including indoor dust ingestion and air inhalation from dust and cigarette smoke. Further studies investigating serum and urine samples from a larger number of occupationally exposed workers are necessary for a more complete assessment of human exposure pathways to these environmental contaminants.
The dominant PBDE congeners were BDEs 47, 99, 100, 153, 154 and 183 in both M and F, which are the same dominant congeners present in the penta technical mixtures. The highest concentrations were found in bathrooms; in particular, D5 represented the principal compound probably due to its dominant presence in most of household products (cosmetics, household appliances, and coatings) and the presence of PBDEs in different compartments. The predominant PBDE congeners were BDEs 47, 99, 100, 153, 154 and 183 in both M and F; which are the same dominant congeners present in the penta technical mixtures. The total average concentrations of PAHs ranged from 0.4 to 3.16 ng/m³ during the non-heating period and from 0.05 to 3.63 ng/m³ in the heating period. Various techniques, including diagnostic ratio (DR) and principal component analysis (PCA), have been used for this analysis. The results indicate that vehicles, diesel oil and gasoline, industrial and combustion emissions were potential sources of PAHs in Novi Sad. Additionally, principal component analysis was used to constrain the potential sources. The results show that vehicular emissions are the predominant source of particle-bound PAHs in Novi Sad, Serbia. However, there are lower proportion of PBDE 47, suggesting degradation of this compound. Total BDEs were dominated by penta-BDEs (65% of the total), followed by hexa-BDEs (with just over 20%) for both males and females.

Atmospheric pollution due to methane seepage from surface rock layers

Methane emission contributes to the growing background concentration of ozone, an air pollutant that impacts on air quality and, hence, human health. In particular, methane gas emissions from surface rock layers into the ambient air is a problem in many parts of the world. The ground surface is the zone where the processes of weathering are very active. In the presence of gas-bearing rock layers (gas sources) located at a shallow depth below the ground surface, weathering-induced fractures in surface rocks can conduct gas from gas sources into the atmosphere. In the southern part of Donetsk city (Ukraine), weathering-induced fractures in very weak rock (sand shale) are interconnected by a network of channels whose role is in crucial importance to methane gas emissions from the ground surface. The frequency (F) of the methane poisonings was statistically analysed. As a result, it was established that F is dependent on average value of gaseous volumetric flow rate from individual through channel (a), number of through-gas-conducting channels (k) located within a 20 m radius around each dwelling house. It is defined that value of F increases according to exponential law, where a variable exponent is the gas flow (i.e., multiplied by logarithm of the number of k) of gas-conducting channels.

Environmental impact of implementing alternative fuels in a Spanish cement plant

J. Rovira¹, J. R. Radonic², J. L. R. Atienza³

¹Universitat Rovira i Virgili, Tarragona, Spain
²Department of Engineering Thermodynamics, Universitat Rovira i Virgili, Tarragona, Spain
³Laboratory of Toxicology and Environmental Health, School of Medicine, ISPV, Reus, Spain

Cement industry dusts are one of the main sources of polycyclic aromatic hydrocarbons (PAHs) in the environment. The total average concentrations of PAHs ranged from 0.4 to 3.16 ng/m³ during the non-heating period and from 0.05 to 3.63 ng/m³ in the heating period. Various techniques, including diagnostic ratio (DR) and principal component analysis (PCA), have been used for this analysis. The results indicate that vehicles, diesel oil and gasoline, industrial and combustion emissions were potential sources of PAHs in Novi Sad. Additionally, principal component analysis was used to constrain the potential sources. The results show that vehicular emissions are the predominant source of particle-bound PAHs in Novi Sad, Serbia. However, there are lower proportion of PBDE 47, suggesting degradation of this compound. Total BDEs were dominated by penta-BDEs (65% of the total), followed by hexa-BDEs (with just over 20%) for both males and females.

The total BDEs analysed showed a wide range (10.4 - 8191 ng·g⁻¹ dry weight (ww)) of concentrations, with a mean of 961 ng·g⁻¹ ww. Males had on average twice the concentration of PBDEs than F (M: 1182 ng·g⁻¹ ww; F: 673 ng·g⁻¹ ww), although this difference was not statistically significant, possibly a result of the small sample size. Pentabrominated benzene was not detected in any sample and pentabromomethylbenzene and hexabromobenzene were only found in a few individuals. In our samples we only could detect the anti isomer of DP, with concentrations between 1.6-38.4 ng·g⁻¹ ww. This may have been expected because this is the dominant isomer in the technical mixture. However, we only found DP in M, this may be the result of F offloading accumulated residues to the foetuses and to juveniles via milk, as DP is highly lipophilic. The lower residues of PBDEs in F than in M is likewise consistent with transfer of residues from mothers to offspring. In contrast however, HBCD (sum of the 3 diastereomeric pairs of the geometric isomers考区) was not detected in any sample. In conclusion, this is the first study that we are aware of to report tissue concentrations of PBDEs of some of their emergent replacement compounds in bats from Europe.
option of using alternative fuels in cement plants working with the Best Available Technologies (BAT).

TU 267
Should the neighbourhood of cement plants be concerned when alternative fuels are used? J. Rovira\textsuperscript{1}, M. Mari\textsuperscript{1}, M. Nadal\textsuperscript{2}, M. Schuhmacher\textsuperscript{1}, J.L. Domingo\textsuperscript{1}
\textsuperscript{1}Universitat Rovira i Virgili, Tarragona, Spain
\textsuperscript{2}Escola Técnica Superior d'Enginyeria Química, Universitat Politècnica de València, Valencia, Spain

Recent years, co-combustion of alternative fuels in cement plants has become an increasing practice in many countries. The benefits associated to the replacement of fossil by-products, such as sewage sludge or RDF, are environmental (e.g., CO\textsubscript{2} emission reduction) and socio-economic (e.g., reduction of feedstock prices), while the negative effects related to the presence of new contaminants are still a matter of discussion. In this study, we investigated the risk of alternative fuel combustion in cement plants. We analyzed the exhaust gas of a cement plant using a scanning mobility particle sizer (SMPS) and a chemical ionisation mass spectrometer (CI-MS) to detect new and/or increased levels of compounds. We found that the installed pollution control equipment is able to reduce the levels of most compounds, but some are still detected in the exhaust gas. The results of our study suggest that the use of alternative fuels in cement plants is a viable option, but further research is needed to fully understand the environmental impact.

TU 268
Environmental impact of mechanical-biological treatment systems. Human health risks of chemical and microbiological pollution L. Vilavert\textsuperscript{1}, M. Nadal\textsuperscript{2}, M. Schuhmacher\textsuperscript{1}, J.L. Domingo\textsuperscript{1}
\textsuperscript{1}Escola Técnica Superior d'Enginyeria Química, Universitat Politècnica de València, Valencia, Spain
\textsuperscript{2}Universidad de Alicante, Alicante, Spain

Environmental risk management in confined spaces. A study case of an archive like a model of indoor environment involved with biodeterioration J. Rovira, S. Manente, R. Ganzerla, G. Ravagnan
Ca' Foscari University of Venice, Venice, Italy

The study case involves the Contemporary Political History Archives sites in Ca’ Tron, Treviso (Italy) in the Veneto countryside. A specific seasonal aerobiological protocol genetically modified Salmonella strain was employed to determine potential estrogenicity of particle samples. The Yes-Test was employed to determine potential estrogenicity of particle samples. Particulate matter was gained electrostatically from different furnaces in the flue gas channel. Suspended in water, vortexted for 1 min, and ultrasonificated for 15 min samples were filtered and the estrogenic activity was determined by the E. coli assay. The results showed that the estrogenic activity of particulate matter was present in all samples, but the highest activity was found in the samples collected in the summer campaigns. The study also showed that the estrogenic activity of particulate matter was influenced by the type of fuel used and the conditions of the furnace. These results highlight the importance of considering the estrogenic activity of particulate matter in indoor environments and the need for further research to better understand the health risks associated with this activity.
The objective of this study was to compare the toxicological effects of different source-related particles in regard to their chemical composition. In this context we investigate significantly overestimated.

The results show that the different geosorbents impact bioaccessibility as expected from the aqueous phase. Pyrene-d10 often showed highest bioaccessibilities: 45.5% ±11.1.

HPCD-extraction seems to be a good indicator for the available fraction. A value of 300 mg/kg may be a suitable threshold value regarding the habitat function of soils.

Earthworms are soft bodied organisms and exposed to contaminants mainly via soil pore water and skin. For mineral hydrocarbons the mobile fraction of C10-C22 of the sensitive (LODs ranging 0.2 to 3.5 ng L'1), precise and robust (recoveries ranged 61 - 104%, RSD varied from 4.0% to 22.6 %), with a linear analytical range from 0.1 to 10 ng L-1.

This method was successfully applied to natural water samples, collected at five monitoring sites along Suquia River, considering pre and post-application of agricultural pesticides. Most tested pesticides were present in the whole period. Nevertheless, post-application period showed concentrations of atrazine, acetoxychlor, endosulfan, endosulfan sulphate and cypermethrine 1.5 to 3 fold higher than the corresponding to pre-treatment. As expected, highest levels of pesticides were observed in areas with intensive agricultural practices, being atrazine, cypermethrine and endosulfan sulphate predominant. In urban or recreational areas the prevalent pesticide was cypermethrin. Some values surpass the National Guidelines for pesticides in freshwaters, pointing out the need of controls in addition to the evaluation of damage to aquatic biota.

1. A. Ruus
2. K. Næs
3. T. Bakke
4. K. Næs
5. D. A. Wunderlin
6. M. T. Schaanning
7. R. I. Bonansea
8. H. H. Hummel
9. A. Ruus
10. D. A. Wunderlin
11. M. T. Schaanning
12. M. T. Schaanning
13. K. Næs
14. T. Bakke
15. K. Næs
16. D. A. Wunderlin
17. M. T. Schaanning
18. K. Næs
19. T. Bakke
20. K. Næs
21. D. A. Wunderlin
22. M. T. Schaanning
23. K. Næs
The present results indicate that the weight of accessibility data obtained with single-substance spiked soils may have to be re-evaluated.

with spiked cyclodextrin and digestive fluids confirmed an efficient absorption of PAHs by the silicone rod. Finally, determination of the readily desorbing PAHs from a wood applied to determine the free fraction and partitioning of PAHs in cyclodextrin and digestive fluids, which in turn was used for sink dimensioning. Validation experiments found for at least 23 of the 25 soils, which were all collected from non-industrialized areas.

and without phase separation, SUBMITTED.

trap is a practical and simple approach for the isolation and quantification of the desorption resistant contaminants in soils, its main limitation being that it is not possible to take an infinite disc sample for continuously removing the mobilized contaminants from the soil. The next step was to find a polymer material and format that can act as infinite sink and allow simple back extraction. Silicone rods were chosen, which are already used in silicon rod extraction and passive sampling. This resulted in a better and more relevant bioaccessibility extraction approach and simplified the analytical procedures. The silicone rods were applied to both cyclodextrin solutions and artificial digestive fluids, using PAHs as model compounds. Passive dosing was applied to determine the free fraction and partitioning of PAHs in cyclodextrin and digestive fluids, which in turn was used for sink dimensioning. Validation experiments with spiked cyclodextrin and digestive fluids confirmed an efficient absorption of PAHs by the silicone rod. Finally, determination of the readily desorbing PAHs from a wood sock sample with and without the absorption sink clearly showed that a sink is needed and makes a substantial difference.

References


2. Goulartoumi, V.; Smith E.C.K.; de Jonge L.W.; Mayer, P., Measuring binding and speciation of hydrophobic organic chemicals at controlled freely dissolved concentrations and without phase separation, SUBMITTED.

TP 282


‘University of Reading, Reading, United Kingdom.

‘Aarhus University, Roskilde, Denmark.

Polycyclic aromatic hydrocarbons (PAH) are ubiquitous environmental organic pollutants, a number of which are known carcinogens. Soils are the major environmental sink for PAHs and it has been estimated that over 90% of the U.K. PAH burden resides in soil. Total pollutant concentration is frequently used in the assessment of risk posed by contaminated land to human health. However, it has been widely established that such an approach may significantly overestimate the amount of pollutant absorbed by humans resulting in an overestimation of risk. One of the main pathways for human exposure to contaminated soils is direct ingestion as a result of hand-to-mouth activity. To address a number several in vitro physiologically-based extraction tests have been proposed for metal and organic pollutants. In recent work we developed a colon extended physiologically-based extraction test (CPEBT), this enhanced the bioaccessibility of PAH compared to a two compartment, i.e. stomach and small intestine, model. The current work was to combine the CPEBT bioaccessibility test with a charcoal contaminant trap in order to maintain a full diffusion gradient for the bioaccessibility process, thereby enhancing the bioaccessibility extraction. This was believed to be necessary because the gastrointestinal tract (GTT) provides a considerable sorptive sink for PAH due to its large surface area and lipophilic nature. The current work was to combine the enhanced PAH bioaccessibility from incubated soils, reducing gut medium concentrations to ≤5% of the no trap values within the appropriate physiological timescales. This clearly identifies the need for a sink in bioaccessibility extractions. The complete configuration of the CPEBT system is required as the COL significantly increases pollutant desorption. A configuration of CPEBT is now required that combines the ‘trap’ with the ability to actually measure the accessible fraction. This seems not possible with the present contaminant trap, since quantitative back extraction from the carbon silicone composite is difficult if not impossible. Once an appropriate extractable ‘trap’ has been found there is the requirement for validation of CPEBT with animal studies.

TP 283

Bioavailability studies: the last available tools for evaluating PAH risks realistically B.H. Magee, G.C. Hoeger

ARCADIS, Chelmsford, United States of America.

Polycyclic aromatic hydrocarbon (PAH) risk assessment is currently overly conservative in the U.S., with Screening Levels that are orders-of-magnitude below anthropogenic background in most urban areas. Additionally, the United States Environmental Protection Agency (USEPA) is proposing to increase the Relative Potency Factors (RPFs) for 7 PAH and to increase the number of carcinogenic PAHs with RPFs from 6 to 26. Several proposed RPFs are 10x or greater including dibenz[a]anthracene (10x), benzo[a]pyrene (20x), and benzo[e]pyrene (10x). If this approach is adopted, human health risks from exposure to PAHs will increase considerably, and risk-based clean-up levels will drop to below background even for commercial/industrial receptors and a 1×10-4 risk level. It is clear from the literature that the mammalian bioavailability of PAH from weathered soils/sediments is considerably less than 100%. Agencies in the U.S. have increasingly rejected the use of bioavailability adjustments to reduce risks. The literature does not provide evidence to evaluate this approach in terms of reducing the risk associated with bioavailability. USEPA has recently supported a policy of performing in vivo bioavailability studies of site-specific media impacted by complex organic compounds. The authors have designed such an in vivo study and are seeking its regulatory approval for execution in 2012. This paper will summarize literature bioavailability results for PAHs and discuss methodological issues regarding the ongoing study, which is a robust, internally consistent animal bioavailability study with site aged organic compounds. The study will be discussed including study design, animal species and strain, sampled biological media (blood, urine, feces, other tissues), pharmacokinetic issues (single time point versus area under the curve), and analyses of interest (parent PAHs versus PAH metabolites vs DNA or protein adducts).

TP 284

Desorption-resistant fraction in PAH-contaminated soils: aged spiked soils can not resemble historically contaminated soils K.E. Scherr, A.P. Lohber, P. Mayer

‘University of Natural Resources and Life Sciences Vienna, Austria, Tulln, Austria.

‘CSIRO, Adelaide, Australia.

‘Aarhus University, Department of Environmental Science, Roskilde, Denmark.

Polycyclic aromatic hydrocarbons (PAH) are priority pollutants of soil and groundwater in many countries. Prolonged contact time of PAH and soil constituents may lead to their sequestration, rendering a fraction of contaminants inaccessible for biological processes and diminishing the potential efficacy of bioremediation measures. This work aimed to evaluate extraction methods for reflecting residual activity. To this end, a mass balance model for PAH in soil was developed as a basis for modeling. Therefore, 25 Austrian soils were collected and spiked with four selected priority polycyclic aromatic hydrocarbons (Phenanthrene, Fluoranthene, Benzo[a]pyrene and Benzo[ghi]perylen). PAH desorption behavior from freshly contaminated and aged soils was monitored and compared with PAH desorption from three historically contaminated soils. The non-bioavailable PAH fraction in the soils was determined using a passive sampling device, the ‘contaminant trap’ recently described by P. Mayer et al. [1]. In this work, the soils’ infrared spectra and desorption data were incorporated into a multivariate statistical approach (partial least squares regression, PLS) to determine specific soil organic matter regions responsible for PAH sorption. In the case of non-bioavailable PAH, the absence of pronounced ageing effects in PAH-spiked, aged soils was noted. After 56 days of desorption time, a distinct desorption resistant fraction occurring in all soils was observed for Benzo[ghi]perylen only. Experimental boundary conditions may serve to explain the lack of an ageing effect, including influences by the contaminant matrix, the extent of sorption site coverage and the contamination’s age. Moreover, industrial activity is often adjacent to the site, influencing highly sorbing constituents (e.g., soil, cf. MGP soils). In the present study, weak binding of PAH in spiked soils (aged and freshly contaminated) in connection with the identification of humic acids as possible binding sites via PLS indicate the absence of high-affinity sites (e.g., black carbon) for PAH sorption. This was found for at least 23 of the 25 soils, which were all collected from non-industrialized areas.

The present results indicate that the weight of accessibility data obtained with single-substance spiked soils may have to be re-evaluated.

TP 285

Highways versus pipelines - modelling the contributions of two fungal transport mechanisms to efficient bioremediation B. Fazenda, K. Joth, L.Y. Wick, S. Fojt, H. Harms, K. Frank

UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany.

Based on experimental studies, two fungus-mediated transport strategies have been suggested to facilitate bacterial degradation of organic soil contaminants: bacteria may use liquid films around fungal hyphae for quick dispersal (‘fungal highways’), and fungi may take up and translocate contaminants through their mycelial network (‘fungal pipelines’). Both mechanisms promise to enhance the bioavailability of contaminants to degrading bacteria. However, a comparative study of their respective
efficiency in increasing biodegradation performance, and its dependence on environmental conditions, has hitherto not been conducted. Using a microbial simulation model, we therefore investigate bacterial degradation performance in response to networks that either act as bacterial dispersal vectors ('highways') or as contaminant translocation pathways in porous media, which is often restricted by high deposition rates and adhesion to soil surfaces. Besides, adhesion to surfaces may be sometimes beneficial in promoting biodegradation of slowly-desorbing chemicals. In well-controlled batch systems, we assessed the impact of different methods on promoting bioavailability of PAHs to bacteria, and the potential of using PAHs as fueling substrates in bioremediation. We therefore conducted a series of batch experiments, where we investigated the effect of root exudates on the biodegradation of PAHs in soil slurries. The stimulation of the indigenous bacterial population resulted in both situations in a similar residual concentration of PAHs. We can conclude that root exudates can promote the biodegradation of PAHs in soil slurries. The stimulation of the indigenous bacterial population resulted in both situations in a similar residual concentration of PAHs. We can conclude that root exudates can promote the biodegradation of PAHs in soil slurries.

In our work, we present the effect of fungus rhizosphere on the biodegradation of PAHs in soil with creosote (21.75 mg kg\(^{-1}\) containing 6 HAPs). We conducted two experiments of biodegradation: one of them in greenhouse with cultivated sunflower and other in the laboratory with suspensions of soil and root exudates of sunflower. The sunflower root exudates were extracted using in vitro culture. The presence of the plants caused in greenhouse conditions a selective increase in PAH-degrading populations and in the laboratory conditions a similar stimulation. In turn, the root exudates of sunflower had under laboratory conditions a similar stimulating effect on the slow desorption of PAHs, which is a critical factor that controls biodegradation rates of hydrophobic pollutants such as PAHs, resulting in a long-term persistence of these compounds in the environment. The use of biosurfactants is a promising alternative for enhancing desorption of soil-sorbed PAHs and their biodegradability. It is already known that biosurfactants can promote dissolution of solid PAHs and also enhance desorption when they are present as rapidly desorbing fractions (> 0.1%). However, not much is known about the effect of biosurfactants on bioavailability of slowly-desorbing hydrophobic compounds, as PAHs. In this study, we focus on the capacity of rhamnolipid biosurfactants, produced by Pseudomonas aeruginosa 195TJ, to enhance the bioavailability of different soil-sorbed \(\text{C}^+\)-labeled PAHs in soil-aqueous systems. In a well-controlled batch system, we studied the effect of biosurfactants, at concentrations above the critical micellar concentration (CMC), on the bioavailability of fast and slow fractions of \(\text{C}^+\)-labeled PAHs present in soil. Desorption kinetics of \(\text{C}^+\)-PAHs from soil were performed by Tenax solid-phase extraction and compared to mineralization kinetics by a PAH-degrading soil bacterium (Mycobacterium gilvum VM552) in the presence of biosurfactants. Results indicated that the promoting effects of biosurfactants on biodegradation were accentuated in soils exhibiting a slow-desorption profile. Given the biodegradable and non-toxic nature of biosurfactants, their use constitution a promising alternative for promoting bioavailability of this 'resistant' fraction in a sustainable way.

TU 289

Biosurfactants and sustainable bioremediation: effects on slow desorption PAHs E.C. Congiu, J.J. Ortega-Calvo Instituto de Recursos Naturales y Agrobiología de Sevilla, Sevilla, Spain Biosurfactants play a critical role in enhancing the bioavailability of hydrophobic pollutants such as polycyclic aromatic hydrocarbons (PAHs) to bacteria, and their biodegradability. It is already known that biosurfactants can promote dissolution of solid PAHs and also enhance desorption when they are present as rapidly desorbing fractions (> 0.1%). However, not much is known about the effect of biosurfactants on bioavailability of slowly-desorbing hydrophobic compounds, as PAHs. In this study, we focus on the capacity of rhamnolipid biosurfactants, produced by Pseudomonas aeruginosa 195TJ, to enhance the bioavailability of different soil-sorbed \(\text{C}^+\)-labeled PAHs in soil-aqueous systems. In a well-controlled batch system, we studied the effect of biosurfactants, at concentrations above the critical micellar concentration (CMC), on the bioavailability of fast and slow fractions of \(\text{C}^+\)-labeled PAHs present in soil. Desorption kinetics of \(\text{C}^+\)-PAHs from soil were performed by Tenax solid-phase extraction and compared to mineralization kinetics by a PAH-degrading soil bacterium (Mycobacterium gilvum VM552) in the presence of biosurfactants. Results indicated that the promoting effects of biosurfactants on biodegradation were accentuated in soils exhibiting a slow-desorption profile. Given the biodegradable and non-toxic nature of biosurfactants, their use constitutes a promising alternative for promoting bioavailability of this ‘resistant’ fraction in a sustainable way.

TU 290

Bacterial taxi and sustainable remediation: effects on bacterial dispersal C.J.S. Jimenez-Sanchez, J.J. Ortega-Calvo Institute of Natural Resources and Agrobiological of Seville (IRNASE), Seville, Spain We investigated the effect of PAHs on bacterial dispersal in soil by analyzing the movement and deposition of fluorescently labeled bacteria in soil that was spiked with PAHs. We found that PAHs can promote bacterial dispersal in soil, which can be important for bioremediation purposes. The results of this study suggest that PAHs can be used as a dispersal vector for bacteria in the environment, which can enhance the efficiency of bioremediation processes.

TU 291

Behavioural responses of Tetrahymena pyriformis exposed to microgradients of hydrophobic organic chemicals C.J.S. Jimenez-Sanchez, J.J. Ortega-Calvo Instituto de Recursos Naturales y Agrobiología de Sevilla, Sevilla, Spain Behavioural changes of microorganisms may reveal sublethal adverse effects of hydrophobic organic chemicals. Using them as an endpoint requires, however, that the organisms can be observed microscopically during exposure. We therefore applied passive dosing on microscope slides as a new experimental platform to study the effect of selected polycyclic aromatic hydrocarbons (PAHs) on the behaviour of the ciliate Tetrahymena pyriformis. Motile cells and organisms that are able to sense chemical signals may directly respond to changes along concentration gradients of a chemical, a behaviour known as chemotaxis. T. pyriformis was therefore exposed to various PAH-gradients and the swimming behaviour of the cells was then recorded under infra-red light illumination. Trajectories of the cells were obtained using an automated cell tracking software and were subsequently analyzed for chemotaxis by statistical measures. The Taylor model, which mathematically describes the scale-dependent transition from ballistic to diffusive motion in a random medium, was applied to describe the tumbling frequency and effective swimming velocity to evaluate changes in the swimming behaviour of the cells. The results did not reveal chemotactic behaviour of T. pyriformis in the concentrations gradients of the compounds tested. However, motility behaviour was affected at levels that were about two orders of magnitude below the reported effective chemical activity causing 50% lethality, emphasizing that behavioural responses are a sensitive endpoint in toxicity testing.
influence of charge and molecular structure on the sorption process. Representative emerging contaminants were selected, covering hormones, pharmaceuticals, personal care products, and pesticides. Batch sorption studies were conducted with natural DOM-containing water samples obtained from Finland, United Kingdom, and the Netherlands and by using polycarbonate mass flow samplers to determine aqueous contaminant concentrations. The DOM samples were characterized by chemical and physical fractionation methods to determine the charge and hydrophobicity of the DOM and polyacrylate. Positively charged DOM samples showed a strong pH dependent sorption to DOM, whereas the neutral forms were the most important species responsible for sorption to polyacrylate. Negatively charged compounds showed the lowest affinity to both DOM and polyacrylate. For most neutral compounds investigated, the water phase represented a more favorable medium compared to DOM. The obtained results may increase our knowledge of the sorption of polar organic contaminants to DOM, which is currently based on only limited data.

TU 283

Binding can improve the mobility and solubility of hydrophobic organic compounds

V. Goulart, M. A. De Jonge, C. Collins, P. Mayer

1Aarhus University, Roskilde, Denmark
2Technical University of Denmark, Lyngby, Denmark
3Biodegradation plays a key role in PAH fate, and understanding kinetics as a function of bioavailability is critical for elucidating their persistence. However, biodegradation mainly occurs in an aqueous environment, posing technical challenges for producing reliable kinetic data because of low PAH solubilities and sorptive losses. To overcome these, an experimental approach based on dynamic passive dosing is presented which: avoids using co-solvent for introducing the PAHs, buffers substrate depletion so mass transport is the rate limiting step, and due to the low relative standard deviation of the method even small magnitude, even at environmental DOC concentrations. This has important implications for their bioremediation, as well bioconcentration and toxicity.

References:
1Goulart, V.; Smith E.C.K.; De Jonge L.W.; Mayer, P., Measuring binding and speciation of hydrophobic organic chemicals at controlled dissolved concentrations and without phase separation, SUBMITTED.
2Tilton E.L., Gibson R.C., Colman C.D., Olson extended physiologically based extraction test (CE-PBET) increases bioavailability of soil-bound PAH, Environmental Science & Technology, 2011, 45, 5301-5308

TU 294

Dynamic passive dosing for studying microbial PAH degradation: a comparison of experimental and model results


1Aarhus University, Roskilde, Denmark
2Technical University of Denmark, Lyngby, Denmark
3Biodegradation plays a key role in PAH fate, and understanding kinetics as a function of bioavailability is critical for elucidating their persistence. However, biodegradation mainly occurs in an aqueous environment, posing technical challenges for producing reliable kinetic data because of low PAH solubilities and sorptive losses. To overcome these, an experimental approach based on dynamic passive dosing is presented which: avoids using co-solvent for introducing the PAHs, buffers substrate depletion so mass transport is the rate limiting step, and due to the low relative standard deviation of the method even small magnitude, even at environmental DOC concentrations. This has important implications for their bioremediation, as well bioconcentration and toxicity.

References:

TU 295

Enhanced mass transfer of hydrophobic organic compounds from NAPLS into the aqueous phase by dissolved organic carbon


1Aarhus University, Roskilde, Denmark
2TU - Helmholtz Centre for Environmental Research, Leipzig, Germany
3Hydrophobic organic compounds (HOCs) are often found as mixtures in the form of non-aqueous phase liquids (NAPLs). Due to their hydrophobic nature, the HOCs preferentially remain in the NAPL, with slow mass fluxes into the aqueous phase. However, since water dissolved HOCs play a key role in diffusive uptake into organisms, microorganisms using HOCs as a source of carbon and energy face a large reservoir of inaccessible food in the NAPL which is often reflected in slow bioremediation of NAPL contaminated sites. Interestingly, mobile ‘covalent-like’ phases can contribute to diffuse mass exchange processes between surface and the bulk aqueous phase, a phenomenon termed enhanced or facilitated diffusion. Therefore, this study investigated the role of dissolved organic carbon (DOC) in enhancing the mass transfer of hydrophobic organic compounds from NAPLs into the aqueous phase above that attributable to dissolved molecular diffusion alone. In controlled experiments, mass transfer rates were increased by up to a factor of four in the presence of DOC, with the greatest enhancement being observed for the more hydrophobic compounds and highest DOC concentrations. These increases could not be explained by dissolved molecular diffusion alone, and point to a parallel DOC-mediated diffusive pathway. The nature of the DOC-mediated diffusion pathway in NAPLs and its potential for DOC sorption behaviour to the DOC was investigated using diffusion-based models, and found to increase with DOC concentration and compound sorption. Therefore, for ‘super’hydrophobic compounds this pathway could both dominate but also increase mass transfer rates by orders of magnitude, even at environmental DOC concentrations. This has important implications for their bioremediation, as well biocorrosion and toxicity.

TU 296

On the effect of vitamins and nutrients on the solubilization of petrodiesel/biodiesel blends in water

M. J. Bittner, P. McFadden, A. D. Venosa, L. Blaha

1University of Cincinnati, Cincinnati, United States of America
2Aarhus University, Roskilde, Denmark
3American University of Beirut, Beirut, Lebanon
4U.S. Environmental Protection Agency, Cincinnati, Ohio, United States of America
5University of Cincinnati, Cincinnati, United States of America

The effect of mineral salts on the aqueous solubility of nonionic surfactants is largely assumed to exhibit the “salting out” or “salting in” effects in which the aqueous solubility of nonionic surfactants is decreased or increased upon the addition of salts. Pioneering investigations by Setschenow [1] and later by Carter and Hardy [2] among others, resulted in some conceptual relationships that describe the dependence of the solubility of nonionic solutes on salts concentrations. We conducted equilibration experiments with petrodiesel/biodiesel blends (B0, B20, B40, B60, B80, and B100, where B100 is 100% biodiesel) in water in the presence and absence of standard vitamins and nutrients used for bacterial growth studies. The solubility of aromatic compounds was found to be in agreement with the salting out effect in the presence of the added nutrients. The solubility of aliphatic hydrocarbons (C2 to C17 n-alkanes, hexadecane) was not found to be significantly enhanced (p < 0.005), up to 40-fold in the presence of the fatty acid methyl esters (FAMEs) and the vitamins and nutrients medium, compared to FAMES and deionized water alone. A similar observation was made by Baker [3] regarding the effect of salts on solubilization of the alkylates and aromatic compounds in the presence of fatty acid soap solution. They reported that, in the presence of sodium chloride in dilute fatty acid soap, the solubility of both polar and non-polar hydrocarbons is markedly higher and that of aromatic hydrocarbons is lower. Those observations are found to contribute significantly to the bioavailability of the n-alkanes in the water column. Biodegradation studies conducted in our laboratory showed significant enhancement for the microbial utilization rates of the n-alkanes in the petrodiesel/biodiesel blends, which we interpret to be due to the increase in aqueous concentrations of the n-alkanes in the presence of the FAMES and nutrients.

References:

TU 297

Photo-Transformation of 2,3,7,8-TCDD in Presence of natural organic matter studied by in vitro bioassay

M. J. Bittner, P. McFadden, L. Blaha

1Research Centre for Toxic Compounds in the Environment (RECETOX), Brno, Czech Republic
2Department of Biomedical Veterinary Sci. and Tox. Centre, Univ. of Saskatchewan, Saskatchewan, Canada
32,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) as a representative of hydrophobic organic compounds (HOCs), frequent anthropogenic environmental pollutants comprising also many adverse effects in organisms. Activation of arylhydrocarbon receptor (AhR) can be very important mechanism of toxicity for so-called "dioxin-like" HOCs. Natural organic matter (NOM), being naturally occurring compounds (up to 50 mg/l in waters), occurs together with HOCs in contaminated water. Besides other important ecological properties, NOM serves as a natural source of reactive oxygen species which are formed after NOM irradiation. Direct photolysis of HOCs is a very important way of their degradation in the aquatic environment. Nevertheless, oxygen species, formed after HS irradiation, can theoretically enhance the photochemical degradation of HOCs. In our previous study, we have assessed the ability of various NOM concentrations to enhance photo-degradation of TCDD. Aqueous TCD+D+NOM
solutions were irradiated by sun light in quartz tubes for up to 3 days. Photo-degradation of TCDD studied by in vitro assay (based on the HHIEC-leuc transgenic cell line) was observed, but both TCDD alone and TCDD in mixtures with low concentrations of NOM (up to 10 mg/L) were photo-degraded in almost the same half-lives. High NOM concentrations (25-150 mg/L) have significantly extended the half-lives of TCDD photo-degradation, probably due to filter effect of more coloured solutions. Supported by проект LETTCONEN (European Regional Development Fund no. CZ.1.05/2.1.00/01.0001).

TU 298 Influence of sorption on biodegradation of secondary alkanesulfonates (SAS) in marine sediments
R.M. Bena-Nogueras, P.A. Lara-Martín, E. Gonzalez-Mazo
University of Cadiz, Puerto real (cadiz), Spain
Coastal areas are often influenced by wastewater discharges from surrounding populations. Surfactants, with a worldwide production over 10 million tons per year, are among the organic contaminants showing highest concentrations in wastewater. Some studies have used this topic deal with the distribution and fate of alkylphenol polyethoxyethers (APEO) in aquatic systems, as some of their degradation intermediates are endocrine disruptor compounds (EDC). Linear alkylbenzene sulfonates (LAS) have also been found in the environment. Recently, anaerobic degradation of SAS was confirmed in marine sediments due to the presence of sulfate reducing bacteria. This research has focused on determining whether SAS are biodegradable or not in absence of oxygen in the marine environment, and, if that happens, on the role of sorption on the speed of the biodegradation. First sorption experiments were performed using several amounts of sediments (0.5-5 g) and SAS concentrations (1-10 mg/kg). Distribution coefficients (Kd) were measured. 1505 L/kg of SAS homologue were observed that the sorption of SAS is much higher for those homologues having longer alkyl chains (e.g., C17-SAS) than for more polar homologues such as C14-SAS. Later, biodegradation experiments using anoxic marine sediments and seawater were conducted. SAS anaerobic biodegradation was observed for the first time, reaching overall values up to 98% in 166 days. Half-life values ranged from 20 days (C14-SAS) to 37 days (C17-SAS), showing that the speed of this process significantly depends on the sorption capacity and, therefore, bioavailability, of each SAS homologue.

TU 299 Remediation of PCB- and PAH- contaminated soil with modified clays
B.I. Olu-Owoabi1, L. Böhm1, E.I. Unuabonah2, R.A. Düren3
1University of Ibadan, Ibadan, Nigeria
2Rheinenergie, Cologne, Germany
3Rheinenergie, Cologne, Germany

TU 300 Fate of iodinated X-ray contrast media in a soil column percolation experiment simulating elevated dissolved organic carbon (DOC) by amendment of saccharose
E.R. Storck1, C.K. Schmidt2, R. Wülsner3, C. Awel4
1Technological Institute of Basel, Basel, Switzerland
2National Institute for Agro-Environmental Sciences, Tsukuba, Japan
3IWB, Basel, Switzerland
4University of Ibadan, Ibadan, Nigeria

TU 301 Effect of pH and electrolyte concentration on soil adsorption of pesticides
Y. Motoki1, T. Iwafune1, N. Seiki1, T. Otani2
1National Institute for Agro-Environmental Sciences, Tsukuba, Japan
2Food and Agricultural Materials Inspection Center, Kodaira, Japan

TU 302 Relationships between soil adsorption of pesticides and pesticide/solvent properties
T.J. Iwafune1, M.Y. Motoki2
1Food and Agricultural Materials Inspection Center, Kodaira, Tokyo, Japan
2National Institute for Agro-Environmental Sciences, Tsukuba, Ibaraki, Japan

The Japanese Positive List System for Agricultural Chemicals was implemented in 2006. Under this system, the uniform limit was set at 0.01 mg/kg for agricultural chemicals for which maximum residue limits (MRLs) have not been established. Since then, these chemicals have been detected in some vegetable crops at levels above the uniform limit, and the distribution of these crops has been prohibited. One of the reasons why the limit has been exceeded is that succeeding crops are contaminated by pesticides remaining in the soil. Assuming that these pesticides in the soil are taken up by plants via the soil solution, an understanding of the soil-water distribution of the pesticide is strongly influenced by soil organic matter content. However, there is little information available on the influence of soil pH and electrolyte concentrations, changed by chemical fertilizer treatment, on pesticide adsorption. We therefore used batch experiments to investigate the effects of these factors on the distribution coefficient for adsorption (Kd) of about 30 pesticides. We used buffer solutions (pH 3, 5, 7, 5, and 9) and KCl solution (0.01, 0.1, and 1 M) and compared with different organic matter contents. Each soil was shaken with an aqueous solution containing 0.1 mg/L of pesticide at a soil-to-solution ratio of 1 to 5, with a 24-h equilibration period for all experiments. Increasing the CaCl2 concentration from 0.01 to 0.1 M had no significant effect on soil adsorption of pesticides, but the Kd values with 1 M CaCl2 solution were slightly higher than those at the other two concentrations. Pesticide adsorption was significantly affected by pH level. In general, Kd values were negatively correlated with pH levels, and the rate of Kd change, calculated by dividing the Kd values at pH 3 by those at pH 9, was greater in the case of soils with higher organic carbon contents and of pesticides with higher octanol/water partition coefficient (log Kow). The results suggest that the hydrophobic interactions between pesticides and soil organic matter are influenced by pH levels. Further, it is implied that crops can take up the pesticide from soil at high pH compared with at low pH.
is influenced by organic carbon content in soil; however, there are few investigations on influence of pesticide and soil properties except organic carbon content on the adsorption of pesticide in soil.

The present study conducted batch experiments with approximately 30 pesticides and 7 soils in Japan to determine their soil adsorption coefficients (Kd values). The results of relationships between Kd values and pesticide/soil properties will be presented.

TU 303

Leaching of aged DDTs and current use pesticide residues in undisturbed soil columns: non-ioninc surfactant and carboxylic acids effects
M. Gonzalez1, F.M. Mitron1, S.G. Grondona1, A. Peña1, K.S.B. Miglioranza1
1Lab. Ecotoxicologia FCENy-UNMdP, Mar del plata, Argentina

In this work we studied the influence of the surfactant Tw-80 or carboxylic acids on pesticide desorption in undisturbed soil columns irrigated with riverine water, TW-80 and Acids, respectively. Under all conditions pesticide levels decreased concomitantly with depth and sand increase. In control and TW-80, surfactants, colloids and dissolved organic matter were responsible for pesticide availability and leaching. Surface waters receive discharges from industrial, urban and agricultural uses that will account for a variety of compounds of concern, such as surfactants, colloids and dissolved organic carbon. This work studies the vertical distribution and movement of aged DDTs and endosulfan in undisturbed soil columns irrigated with riverine water, TW-80 and Acids. Experiments were carried out with 13 x 30 cm soil columns taken from Aridisol soils from a fruit field in Patagonian, Argentina. Columns were saturated with distilled water and 4L were added under saturated condition. One L leachates (n=4) were collected for pesticide residues analysis. After elution, columns were dried (24 h), opened, sampled and analyzed using GC-ECD. GC-ECD analysis was performed by batch technique and residues analysis by GC-ECD. Pesticide desorption was performed by batch technique and residues analysis by GC-ECD. Results showed that pesticide levels decreased concomitantly with depth and sand increase. In control and TW-80, surfactants, colloids and dissolved organic matter were responsible for pesticide availability and leaching. Surface waters receive discharges from industrial, urban and agricultural uses that will account for a variety of compounds of concern, such as surfactants, colloids and dissolved organic matter. Endosulfan was the main compound on the first elution volume and p-DDE started to lixivate after 2 L while for TW-80, DDE represents the main elution in all elution volume. Lixiviation of aged p-DDE residues or endosulfan effectively occurs under irrigation with riverine water and is increased by adding non-ioninc surfactant or carboxylic acids. TW-80 had a washing effect of pesticides leading to lower levels on soil while carboxylic acids enhance pesticides availability.

TU 304

Sorption of cationic organic compounds to soil as the sum of soil components
S.T. Droge, K.U. Goss
UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany

Many emerging contaminants are strong bases that under environmental conditions mostly occur as cationic species. The environmental fate of these compounds depends on the interaction with charged functional groups of soil components, such as natural organic matter, clay, soil, sediment and dissolved colloids. Since both natural organic matter and clay minerals are negatively charged substrates, both sorbent types are well known to bind organic cations, but it is not clear to what extent each type contributes in natural soils. Using a customized dynamic HPLC column retention measurement technique, we studied the sorption of a set of organic cations to soil components, such as natural organic matter (NOM, Pahokee peat) and pure clay minerals (kaolinite, bentonite). Nemesis, a solid-state treatment technology, is the first step of any future fungal treatment, essential to prove that the elimination is only due to the action of the fungus and not of other microorganisms as the sludge was previously stabilized. Degradation studies of 3(4'-methylbenzylidene) camphor (4MBC) in liquid media were also done in particular and complete removal was achieved in less than 24 h. The main sorbents were identified and the first steps of the transformation pathway were elucidated: a mono- or di- hydroxylation by cytochrome P450 and the subsequent conjugation with a pentose. These results support the extended hypothesis that conjugation processes constitute one of the defense mechanisms that fungi activate against toxic hydroxylated compounds.

TU 305

Degradation of UV filters in sewage sludge by the ligninolytic fungus Trametes versicolor and study of the 4MBC degradation process in liquid medium
P. Gago-Ferreró1, M. Badia-Fabregat2, C.E. Rodriguez-Rodriguez2, M.G. Caminal1, T. Vicent1, M.S. Díaz-Cruz1, D. Barceló3
1IDAEA-CSIC, Barcelona, Spain
2UAB, Barcelona, Spain
3CSIC-UAB, Barcelona, Spain

Sunscreens agents, also known as UV filters, have become very popular chemicals since they have shown to have a protective role against photoaging, photocarcinogenesis and photoimmunosupression promoted by UV sun radiation. These compounds are extensively used in personal care products but are also present in a wide variety of industrial goods such as paints, paints, or plastics to prevent photodegradation of polymers and pigments. UV filters can enter the environment through the liquid effluent of wastewater treatment plants (WWTP) but also absorbed in the sludge due to their high hydrophobic character, and later spread on agricultural fields. A solid-state treatment technology, Nemesis, is the first step of any future fungal treatment, essential to prove that the elimination is only due to the action of the fungus and not of other microorganisms as the sludge was previously stabilized. Degradation studies of 3(4'-methylbenzylidene) camphor (4MBC) in liquid medium were also done in particular and complete removal was achieved in less than 24 h. The main sorbents were identified and the first steps of the transformation pathway were elucidated: a mono- or di- hydroxylation by cytochrome P450 and the subsequent conjugation with a pentose. These results support the extended hypothesis that conjugation processes constitute one of the defense mechanisms that fungi activate against toxic hydroxylated compounds.

TU 306

Concentration levels of phthalates in water and sediment samples from Nadela river basin, Vojvodina region
M.B. Miloradov1, M.M. Miloradov1, J.S. Blednov2, M.D. Djogo3, M.D. Mihovanovic3, J.R. Radonic3, M.M. Turk Sekulic
1Faculty of Technical Sciences, Novi sad, Serbia
2Academy of Sciences and Arts of Vojvodina, Novi sad, Serbia
3Environment Agency, Kos, Slovak Republic

Phthalates belong to the group of dominant industrial contaminants and are ubiquitous overclass of compounds with low water solubility/high fat solubility and low volatility. Due to their low water solubility, the phthalates hydrolyse relatively slowly, but the actual dynamic rate varies according to temperature, concentration and solution composition. Chemical properties of the phthalates have made them suitable as plasticisers in polymers such as plastic and rubber. Among the phthalates dieethylhexyl phthalate (DEHP) predominates and has many possible applications, especially for PVC. The highest concentrations of DEHP are found in products for flooring, foil and plastic-coated fabrics. Phthalates are also included as plasticisers for binders in different kind of paints and adhesives. Within the Project the concentration levels of phthalates in sediment from Nadela river were determined. Nadela basin is situated near city of Pančevo, Vojvodina region, and is covered by numerous industrial sites and can represent the significant source of these contaminants. This field study was conducted in 9 sampling sites in the catchment area of the Nadela in the early spring 2009. The laboratory analysis were conducted in Environmental Institute, Kos, Slovak Republic and in the laboratories of Institute for Public Health of Vojvodina. All water samples were positive on presence of four of the six selected phthalates: di-ethyl phthalate (DEP), diisobutyl phthalate (DIBP), di-n-butyl phthalate (DBP), and DEHP. The concentrations varied in the range: for DEP from 0.01 μg L-1 to 0.2 μg L-1, DIBP from 0.08 μg L-1 to 0.95 μg L-1, DBP from 0.3 μg L-1 to 2.5 μg L-1 and DEHP from 0.7 μg L-1 to 2.987 μg L-1. In sediment, three of these phthalates were determined in all sampling sites. All tested samples were positive on DEP in the range of 24 - 80 μg kg-1, DBP in the range of 28 - 96 μg kg-1 and DEHP in the range of 124 - 779 μg kg-1. On 5 of 9 sampling sites the concentration levels of DEHP equaled EOs and this phthalate is listed to be a human carcinogen. In the case of sediments concentrations of standards have not been exceed in any sample. Based on the analytical results and compared with the concentration levels obtained for other priority substances, it can be concluded, that DEHP is the most problematic priority substance in the Nadela hydro-system basin.

The work was supported by Ministry of Education and Science, Republic of Serbia (II46009 and TR34014).

TU 307

Increasing levels of PBDEs, PCBs and organochlorine pesticides in fish following a mega-flooding event in the Negro River basin, Argentine Patagonia
M. Ondarza1, M. Gonzalez1, G. Fillmann1, S.B. Miglioranza1
1Universidad Nacional de Mar del Plata, Mar del Plata, Argentina
2CONCEO, FURG Universidade Rio Grande de, Rio Grande do soio, Brazil

A mega-flooding event in the Negro River basin, Argentine Patagonia, caused a significant outflow of contaminants from the surrounding soils. Agriculture, hydroelectric centers, and industrial-urban centers are the most important activities in the basin. This study evaluates the effects of flooding events on bioavailability of organochlorines (PCBs, PBDEs), enosulfans, DDTs and polychlorinated biphenyls (PCBs) levels in females of silverfish (Odontesthaxus hatcheri) tissue. Muscle, liver, gills, gonads and stomach content were analyzed by GC. Levels in water, suspended particulate matter (SMP) and sediments (SS) were also measured. Post- and pre-flood fish showed the following pattern of levels: PBDEs > PCBs > endosulfan > DDTs > pesticides. The greatest difference between post- and pre-flood fish (up to 240 times). BDE-47 was the predominant congener in all tissues; however BDE-100 and BDE-99 showed the highest increase in post-flood liver (up to 400 times). The dominance of BDEs 47, 99 and 100 was consistent with the general pattern found in abiotic samples and fish of the fish species, as well as denote the use of technical mixtures of penta-PBDEs. PCBs levels in post-flood fish increased until 23 times (from 63.2 to 1.478 mg lipid in liver), which were dominated by penta- (PCB-110, 118) and hexa- (PCB-153, 138) congeners. These results could have stemmed from historical usage of Arochlor 1254 and 1260 in Argentina. In post- and pre-flood, endosulfan sulfate presented the highest levels suggesting metabolic activity in addition to direct metabolite uptake, while an a-/b- ratio >1 similar to the technical mixture which is widely used in the region. In post-flood muscle, DDEs levels increased 5-fold than pre-flood. The metabolite p,p'-DDE represented about 4% of the total endosulfan sulfate. This result would be a result of the intensive use of this pesticide during long time on agricultural practices. Contaminant profiles observed in pre- and post-flood vis-à-vis water, SPM and SS, showing that this species is a good biomonitor of aquatic pollution of Negro River. The presence of pollutants in this river was modified and enhanced by the flooding, increasing their bioavailability to fish. Additionally, pollutant occurrence deserves more attention, and monitoring programs are recommended in order to diminish their incorporation to aquatic ecosystem.
TU 308
Polychlorodioxins, furans and biphenyls in fish, crabs and clams from the San Jacinto River Waste Pits, TX
B. Suber
University of Texas, United States of America
Fish, crabs, and clams were collected from the San Jacinto River waste pits, a superfund site in Houston, TX and analyzed for polychlorodibenzo-p-dioxins, polychlorodibenzofurans (PCDD/Fs) and dioxin like polychlorobiphenyls (dl-PCBs). Sample preparations comprised of tissue homogenization, enhanced pressurized liquid extraction, and high performance liquid chromatography in conjunction with gas chromatography and mass spectrometry. Analytical methods were used to determine total concentrations of the polychlorinated dibenzo-p-dioxins, polychlorodibenzofurans, and dioxin-like polychlorobiphenyls. The results for these 209 congeners are provided.

TU 309
Effect of humic substances on remediation of soil: phosphogypsum mixtures
A. Kaniskin1, A. Terekhova2, A. Iossimov3, S. Yakimenko4, A. Terekhova1
1Moscow State University, Moscow, Russian Federation
2Institute of Ecology and Evolution RAS, Moscow, Russian Federation
3Institute of Soil Science and Phytosanitation, RAS, Moscow, Russian Federation
4Institute of Ecology and Evolution RAS, Moscow, Russian Federation
Phosphogypsum (PG) is a byproduct of industrial production of phosphoric acid. Due to high content of nutrients (calcium, phosphorus and sulfur) it is sometimes used as a fertilizer for poor unfertilized soils. But besides nutrients, PG also contains toxic impurities, such as fluorine, strontium and some others. One of contemporary approaches to reduce the ecotoxicity of polluted soils and soil-PG mixtures is to add humic substances (HS). The objective of this study was to evaluate the detoxifying ability of a number of HS towards PG applied to model soil mixtures. The ecotoxicity of model soil mixtures was evaluated by the growth of Scenedesmus quadricauda (increase of cells population growth, 72h), crustaceans Daphnia magna (mortality, 96h), and higher plants Sinapis alba (decrease of root elongation, 120h). The study revealed that addition of HS to PG treated soils can change the ecotoxicity of PG and detoxify the soil mixture.

Acknowledgement - This research was supported by Russian Federal Science (GK 02.740.11.0693), Russian Foundation of Basic Research (project 10-04-01681).

TU 310
ETOP1 - A Systems Biology approach to predictive Ecotoxicology
K. Reider1, M.D. Pavlaki2, N.G.C. Ferreira3, S. Loureiro4
1TU Bergakademie Freiberg, Freiberg, Germany
2Istituto di Chimica dei Materiali, Università di Torino, Italy
3Department of Environmental Engineering, University of Coimbra, Coimbra, Portugal
4Department of Soil and Environmental Chemistry, São Paulo University, Piracicaba, São Paulo, Brazil
Toxicity of copper on the freshwater snail Physa acuta: reproduction output and biomarkers of effect

TU 311
Toxicity of sludge water treatment station for aquatic invertebrates
T.G. Messias
São Paulo University, Piracicaba, São Paulo, Brazil
The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) are worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) are worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process.

TU 312
Birds species versus crops: a GIS-based procedure to identify specific combinations
A.C. Caffi, E.G. Galimberti, E.M. Marchetto, G.A. Azimonti, A.M. Moretto
Istituto Stato - Università, Milano, Italy
Regulation (EC) No 1107/2008, applied from 14 June 2011, requires new data protection rules for both active substance and product data and, for the first time, includes data protection for extension of authorisations to minor uses. Moreover, rules for either avoiding duplication or sharing tests and studies involving vertebrate data have been included. Arinchi, in particular, introduces a new vertebrate data sharing provisions which allows Member States to use vertebrate studies on behalf of prospective applicants if an agreement with the holder(s) of the authorisation cannot be reached.

Considering birds, the species currently used in risk assessment are the ones considered the most sensitive to all pesticides. This approach, which can be considered a good test battery, reflects the wild population distribution and their sensitivity to pesticide impact. However, this approach may be considered as a good test battery, reflecting the wild population distribution and their sensitivity to pesticide impact. However, this approach may be considered as a good test battery, reflecting the wild population distribution and their sensitivity to pesticide impact. However, this approach may be considered as a good test battery, reflecting the wild population distribution and their sensitivity to pesticide impact. However, this approach may be considered as a good test battery, reflecting the wild population distribution and their sensitivity to pesticide impact. However, this approach may be considered as a good test battery, reflecting the wild population distribution and their sensitivity to pesticide impact. However, this approach may be considered as a good test battery, reflecting the wild population distribution and their sensitivity to pesticide impact. However, this approach may be considered as a good test battery, reflecting the wild population distribution and their sensitivity to pesticide impact.

In this work a realistic approach has been developed to correlate the avian population at local level, derived from a monitoring survey, with the land-use (Corine land-cover) and the relative pesticide treatments.

A GIS analysis was performed to identify peculiar combinations crop/bird species in order to determine which species is most likely to be exposed to a specific active substance.

The area considered was the North of Italy characterised by an intensive agriculture and a consequently high load of pesticides.

These results could be an useful tool to address the uncertainty associated to the bird risk assessment.

TU 313
Influence of copper on the freshwater snail Physa acuta: reproduction output and biomarkers of effect
S. Gonçalves1, M.D. Pavlaki2, N.G.C. Ferreira3, S. Loureiro4
1Universidade de Aveiro & CESAM, Aveiro, Portugal
2University of Aveiro & CESAM, Aveiro, Portugal
3Department of Environmental Engineering, University of Coimbra, Coimbra, Portugal
4Department of Soil and Environmental Chemistry, São Paulo University, Piracicaba, São Paulo, Brazil

The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process. The water treatment stations (WTP) were worldwide operating in order to treat and deliver potable water from untreated river water. A large quantity of sludge is generated in the water treatment process.

Copper constantly enters aquatic environments through several paths such as industrial effluents, agriculture runoffs and domestic wastewaters. Trace amounts of copper are needed for metabolic and biochemical processes in several organisms but, like for every chemical compound, in excess it becomes toxic. This study aimed to assess effects on reproduction and detect stress responses using aquatic invertebrates Physa acuta exposed to copper sulfate in laboratory conditions. A 14/28 days chronic test was conducted using adult snails in 5 different copper concentrations showing that reproduction was impaired as the concentrations increased. These results could be an useful tool to address the uncertainty associated to the bird risk assessment.

Aqua snails, like Physa acuta, have proved to be good test organisms to assess the presence of chemicals in the environment as they have proven to be very sensitive to exposure.

TU 314
Inhibition of the fatty acid synthesis in chlorophytes by triclosan - a metabolomics approach
K. Reider1, H. Heilmeier2, R. Altenburger3, M. Schmitt-Jansen4
1 UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany
2TU Bergakademie Freiberg, Freiberg, Germany
3Bergakademie Freiberg, Freiberg, Germany
4Bergakademie Freiberg, Freiberg, Germany

Polychlorodibenzofurans (PCDD/Fs) and dioxin like polychlorobiphenyls (dl-PCBs) are produced in chlorophytes in concentrations up to 0.007 µmol L-1 [Singer et al., Environ. Sci. Technol., 2002]. In a prior study Franz et al. [Environ. Sci. Technol., 2008] observed that chlorophytes are one of the more sensitive organisms affected by triclosan in the range of environmental concentrations.

This raises the question of metabolic pathways affected by triclosan in chlorophytes. We used an established metabolic approach to analyse exposed green algae Scenedesmus vocatus [Klindseer et al., Metabolomics, 2009]. Therefore we exposed a synchronised culture of S. vaccinolus with different concentrations of triclosan (range from 0.002 to 0.071 µmol L-1) for 14 hours to derive concentration-dependent changes in their physiological and biochemical processes. After harvest and derivatization hydrophilic and lipophilic metabolite extracts were analysed with GC-MS and evaluated by multivariate growth and photosynthetic activity). After harvest and derivatization hydrophilic and lipophilic metabolite extracts were analysed with GC-MS and evaluated by multivariate
1. Morphometric and biochemical evaluation in gills of Lepomis gibbosus, after acute exposure to several xenobiotics (pesticides, detergents and pharmaceuticals) S.R. Rodrigues1, S.C. Antunes1, F.B. Brandão2, B.C. Castro2, F.G. Gonçalves2, A.C. Correia2, B.N. Nunes2 1Universidade de Aveiro, Departamento de Bioengenharia e CIEMAT, Aveiro, Portugal 2Faculdade de Ciências da Saúde da Universidade Federal de São Paulo, C夹GEB, Porto, Portugal In order to assess the effects of xenobiotics and awareness of issues related to environmental exposure to anthropogenic xenobiotics has increased. These compounds can affect non-target organisms, altering their physiology, and consequently endangering the balance of ecosystems. Some studies reported the evaluation of morphometric and biochemical changes in fish, however, after exposure to several compounds, including pesticides, detergents and pharmaceuticals, which can be quantified using appropriate analytical tools. The fish gills act as barriers for the entry of xenobiotics, their multifunctionality, the vast surface area of exposure to the external media and their location in the fish body, justify their importance as key organs for the direct action of pollutants in the aquatic environment. This work aimed to assess biochemical and morphometric changes in gills, in order to evaluate the effects of xenobiotics by measuring the following variables: the total protein content, the total lipid content, the activity of the enzyme citrate synthase, the activity of the enzyme lactate dehydrogenase and the activity of the enzyme phosphoglycerate kinase. The results showed that the exposure to xenobiotics caused significant changes in the biochemical and morphometric variables, indicating that these compounds can affect the physiological and biochemical processes of fish gills. Therefore, it is necessary to conduct further studies to understand the mechanisms of action of xenobiotics on fish gills and to develop strategies for their effective management.

2. Statistics (PCA) Two concentration dependent response patterns could be identified. Metabolites from the hydrophilic phase showed comparative sensitivity as phenotypic observations (EC50 algal growth: 0.02 µmol L⁻¹). In contrast the lipophilic metabolites of the green algae were affected significantly at the lowest tested concentration. Identification of lipophilic metabolites with the NIST and Golm library for GC-MS data revealed many fatty acids (e.g. hexadecanoic acid, oleic acid, octadecanoic acid) characterizing a situation of oxidative stress. These findings increase the general understanding of response pathways to the known mode-of-action of the toxicant in bacteria, the inhibition of the Enolyl-ACP reductase during the fatty acid elongation [McCerry et al., Nature, 1998].

3. Identification of lipophilic metabolites with the NIST and Golm library for GC-MS data revealed many fatty acids (e.g. hexadecanoic acid, oleic acid, octadecanoic acid) characterizing a situation of oxidative stress. These findings increase the general understanding of response pathways to the known mode-of-action of the toxicant in bacteria, the inhibition of the Enolyl-ACP reductase during the fatty acid elongation [McCerry et al., Nature, 1998].

4. Morphometric and biochemical evaluation in gills of Lepomis gibbosus, after acute exposure to several xenobiotics (pesticides, detergents and pharmaceuticals) S.R. Rodrigues1, S.C. Antunes1, F.B. Brandão2, B.C. Castro2, F.G. Gonçalves2, A.C. Correia2, B.N. Nunes2

5. Identification of lipophilic metabolites with the NIST and Golm library for GC-MS data revealed many fatty acids (e.g. hexadecanoic acid, oleic acid, octadecanoic acid) characterizing a situation of oxidative stress. These findings increase the general understanding of response pathways to the known mode-of-action of the toxicant in bacteria, the inhibition of the Enolyl-ACP reductase during the fatty acid elongation [McCerry et al., Nature, 1998].

6. The term "cryptic lineages" covers taxa that exhibit genetic differences but an at least superficial morphological equality and the respective specimens thus are misleadingly classified as a single nominal species. Although a well-known concept in evolutionary genetics since several decades, its relevance in an ecotoxicological context has only poorly been investigated. However, there is an urgent need for an ecotoxicological assessment of cryptic complexes as the genetic differentiation between lineages often reaches magnitudes similar to those between species. Thus, deviations regarding behavioural and physiological endpoints within cryptic lineage complexes are conceivable.
Accordingly, the present study investigated two cryptic *Gammarus fossarum* lineages - namely type A and type B - for differences in their sensitivity towards chemical stressors. The two size classes of each cryptic lineage type were exposed to different concentrations of the fungicide tebuconazole or the insecticide thiacloprid in six independent experiments. The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity.

The experimental results were then subjected to meta-analysis. For each of the cryptic lineage type A compared to type B (n=16; p<0.0001), by combining the results of all bioassays, Discrete meta-analyses for each of the results tested, showed a similar trend, however, results were statistically significant only for tebuconazole (n=8; p<0.0001). This deviation in sensitivity between lineages is new due to the minor consideration of the cryptic lineages concept in the field of ecotoxicology. Hence, further studies should address the sensitivity to other stressors, by also considering ecological aspects like the physiological fitness, of a broader range of cryptic complexes. Nonetheless, genetically distinct lineages may confound the results of ecotoxicological tests, as indicated in the present study, and should thus be interpreted with caution.

TU 322

Status of PAHs in greater Johannesburg area and possible sources

L. Chimba, C. Cukrowski
University of the Witwatersrand, Johannesburg, South Africa

The presentation gives an overview of the status of the presence and levels of PAHs in greater Johannesburg area. Although many studies of persistent organic pollutants such as pesticide residues and PAHs in South Africa have been conducted, the study on PAHs is still having a lot of gaps. The presentation gives an overview of new methods extraction techniques that have been used for the extraction of the PAHs in water and sediments in rivers and dams in greater Johannesburg area. The common PAHs found and their concentration levels are presented. The levels of PAHs in water and PAHs is still having a lot of gaps. The main sources of PAHs in is given and how these sources impacts aquatic ecosystems in the studied area. Finally, the overview of PAH status in South Africa urban environment is given.

TU 323

Linking transcriptome to phenotype: response of a mouse liver cell line to Benzo(a)pyrene

D.J. Madureira, K. Schirmer
1Eawag - Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland
2TIFL, Lausanne, Switzerland

The aim of the systems biology initiative, “From contaminant molecules to cellular response: system quantification and predictive model development”, is to build a model of interactions between cells and the toxic chemical Benzo(a)-Pyrene (BaP). As part of this initiative, we aim to identify the regulation of genes by BaP in a time and concentration points. Thus, we performed microarray analysis, quantitative PCR, and western blotting to quantitatively determine the regulatory effects of BaP on gene expression.

Accordingly, the present study investigated two cryptic lineages - namely type A and type B - for differences in their sensitivity towards chemical stressors. The two size classes of each cryptic lineage type were exposed to different concentrations of the fungicide tebuconazole or the insecticide thiacloprid in six independent experiments. The feeding rate on leaf discs was determined after seven days of exposure as a measure of sensitivity.

The experimental results were then subjected to meta-analysis. For each of the cryptic lineage type A compared to type B (n=16; p<0.0001), by combining the results of all bioassays, Discrete meta-analyses for each of the results tested, showed a similar trend, however, results were statistically significant only for tebuconazole (n=8; p<0.0001). This deviation in sensitivity between lineages is new due to the minor consideration of the cryptic lineages concept in the field of ecotoxicology. Hence, further studies should address the sensitivity to other stressors, by also considering ecological aspects like the physiological fitness, of a broader range of cryptic complexes. Nonetheless, genetically distinct lineages may confound the results of ecotoxicological tests, as indicated in the present study, and should thus be interpreted with caution.

TU 324

Insights into the effects of silver by transcriptomics and proteomics in Chlamydomonas reinhardtii

S. Pillai, M. Suter, L. Boatti, K. Schirmer
1University of Piemonte Orientale, Alessandria, Italy
2University of Birmingham, Birmingham, United Kingdom

We have benchmarked our platform with data obtained by high throughput analysis techniques- microarray and 2-DE - applied on the social amoebae Dictyostelium discoideum after treatment with several doses of mercury.

We show the advantages of using our system which allows the comparison of the results obtained from the two techniques, effective tools for the visual inspection of data and integrates data from external resources such as specialized databases (ie. genomic databases, metabolic pathways, Gene Ontology).

We have benchmarked our platform with data obtained by high throughput analysis techniques- microarray and 2-DE - applied on the social amoebae Dictyostelium discoideum after treatment with several doses of mercury. The common PAHs found and their concentration levels are presented. The levels of PAHs in water and PAHs is still having a lot of gaps. The main sources of PAHs in is given and how these sources impacts aquatic ecosystems in the studied area. Finally, the overview of PAH status in South Africa urban environment is given.

We show the advantages of using our system which allows the comparison of the results obtained from the two techniques, effective tools for the visual inspection of data and integrates data from external resources such as specialized databases (ie. genomic databases, metabolic pathways, Gene Ontology).

We have benchmarked our platform with data obtained by high throughput analysis techniques- microarray and 2-DE - applied on the social amoebae Dictyostelium discoideum after treatment with several doses of mercury.
TU 329
On the appropriateness of using the common mixture toxicity models CA and RA on species sensitivity distributions: a theoretical approach
V.G. Gregorio1, N. Chivret2, M. Junghans1, I. Werner3
1University of Luxembourg, Luxembourg, Luxembourg
2Swiss Centre for Applied Toxicology, Dübendorf, Switzerland
3Swiss Centre for Applied Ecotoxicology, EAWAG - EPFL, Dübendorf, Switzerland
Environmental effects are not only expressed on a single substances but typically on mixtures. Therefore it is of great importance to assess the ecological risk not only substance by substance but also for mixtures. Therefore, two models are generally used to predict mixture toxicity: the concentration addition (CA) or (dose addition) and the response addition (RA) (or independent action) models. Their adequacy to predict mixture toxicity of similarly acting compounds (CA) and dissimilarly acting compounds (RA) for single species was already shown during the last decades. To assess the risk of chemical mixtures to ecosystems, these models have also been proposed to be applied to mixtures. Species sensitivity distribution (SSD) curves to derive a multi substances potentially affected fraction of species (msPAF). Usually, this is done in two steps: (i) the CA model is applied on individual SSDs of similarly acting compounds and (ii) the RA model is applied on the predicted SSDs by CA between groups of similarly acting compounds. However, it was applied above the mixture toxicity models were usually valid for single species when applied on single dose-response curves and not on multiple SSDs. For a validation of this approach, one should therefore apply the mixture models for each species, then construct the mixture SSD to calculate the msPAF and compare it with a msPAF derived by applying the mixture models directly on the SSDs. This approach is however rarely done because the information on the whole dose-response curves of each single species for all substances is needed and this information is poorly available. In this study, we demonstrate the difference between CA/Ra models used in ecotoxicology (derivation of CA/Ra models when single species mixture assessment followed by SSD construction) to derive a msPAF. To compare the two methods we calculate msPAF with different cases, varying the EC50s and the slopes of the individual dose-response curves.

The results show that the predictions with CA are quite similar between the two methods and small differences can be explained by the goodness of fit of SSDs and the species tolerance correlation among substances. However, the application of RA may result in a differing msPAF between the two methods. Finally, we define cases in which the two methodologies give similar results and for which the use of CA and RA directly on SSDs to predict the risk of mixture compounds is appropriate.

TU 330
Estimating inter-individual sensitivity from survival data using a mechanistic model
R.B. Beaudouin, A.R.R. Pery
INERIS, Verneuil en halatte, France
In the literature, there are two main alternatives to model mechanistically dose-survival relationship in ecotoxicity tests. Effects are related to a concentration of concern, for instance body concentration, and each individual has a different concentration threshold for death, or individuals have equal probability to show an effect, with dying organisms just being the “unlucky” ones. A general framework to unify both approaches has recently been proposed but only special cases could be confronted to actual data. We used such a unified model to analyse four datasets. We showed the possibility to estimate properly the toxicity parameters together with inter-organisms differences of sensitivity and specific characteristics parameters (here the threshold for effect). For all datasets, the model we propose outperformed the standard approach without accounting for differences of sensitivity. More accurate parameters’ estimations would be obtained through the incorporation of prior knowledge, in particular relative to background mortality. We also pointed that the standard threshold estimate is close to the medium value of the distribution (which would induce the death of half of the organisms), and that more relevant parameters, such as the concentration protecting 85% of the population would be 2 to 4 times inferior to this standard threshold. We believe that our approach can be a powerful tool for practitioners and experts in applying. Moreover, it permits to relate two fundamental concepts in understanding the response in ecotoxicity tests: the link between internal concentration and effects and the inter-individual variability regarding sensitivity.

TU 331
Incorporating data quality scores and acute-to-chronic ratios in the construction of SSDs
M. Grone1, L. Sartotte1, E. Semenzi1, P. Caffroy1
1TPE R&ID, Chantou, France
Venic Research Consortium, Venice, Italy
The species sensitivity distribution (SSD) approach is in principle an alternative to the assessment factor approach for PNEC calculation. However, due to requirements on data quality, toxicity data are usually restricted to a small number of compounds. One central problem is that commonly many available data are discarded from the analysis for reason of limited validity, endpoint (exclusion of ECx, type data) and exposure time (exclusion of acute data). The objective of the present study was to assess how the SSD approach can be extended to the use of the entire data sets of complex heterogeneous ecotoxicological information (information on data quality, acute and chronic values, EC1, ECx, and NOEC values). More precisely, we aimed to provide a method which provides reliable and robust PNEC assessment, which is applicable to wider area of compounds. For this purpose, we replaced the dichotomic classification of data as either valid or not valid by a system of quality scores which integrate on the inherent experimental and statistical reliability of data and on their biological relevance (organism and endpoint). This system serves as weighting factors of individual data in the SSD analysis. Furthermore, we studied different options of how to incorporate acute values. Different options (of probabilistic Acute-to-Chronic ratios and weighting) for data treatment were integrated in a tool, which allows a generation of SSD functions and estimate uncertainties. As a result, we calculated the standard SSD function (based on chronic NOECs only) for several real ecotoxicological data sets on compounds fulfilling the strict TGDo/REACH requirements for SSD application. Subsequently, we applied the developed method using weighting scores and acute to chronic extrapolation to the entire data set and bootstrap subsamples. SSD function obtained for subsamples of the entire data set using different options for data treatment were compared to the SSD based on chronic NOECs. Influences of different options for data treatment and sample size will be discussed with respect to the robustness and reliability of the SSD function and the associated HC value.

TU 332
Investigating the relationship of NOEC and LOEC values with regression-based ECx values
A.D. Sharp1
Aston University, Brixham, United Kingdom
Data from chronic toxicity tests have traditionally been analysed by hypothesis test based statistical analysis to obtain a No Observed Effect Concentration (NOEC) and a Lowest Observed Effect Concentration (LOEC). Although a firmly entrenched paradigm, much recent debate has questioned whether these methods are the most appropriate way to analyse data from eco-toxicology studies. As part of this debate the use of ECx values and associated confidence intervals, determined by regression analysis and other modelling techniques, have been investigated by the OECD and others as possible replacement or complementary endpoints and are now included as a requirement in some test guidelines. For the first time analysis of a number of data sets, the work described has shown that it is possible to apply a number of different static regression models to results arising from ecotoxicity tests, and to derive ECx values. The work indicates that, although not consistent for all datasets examined, it is possible to derive ECx values broadly similar to the respective NOEC and LOEC values.
However, a number of issues remain which will be of importance when considering the possible replacement of NOEC and LOEC values with ECx values, including experimental design. It is thought that current test designs may not necessarily be suitable for data analysis using regression based methods, and that modifications to current protocols may be required to ensure that regression analysis of test data yields reliable and significant results.

The work described has applied regression analysis to a number of simulated data sets which were developed according to differing test designs. This has shown that the experiments toxicity study can have implications for the results obtained by statistical analysis using regression techniques. In particular, both the estimated ECx values and the associated confidence intervals have been shown to be impacted by experimental design. This could have implications for both the ethical and practical aspects of ecotoxicological testing, when seeking an optimum test design.

TU 333
Statistical approaches to select soil bioindicators for soil monitoring, risk assessment and soil characterization. Results from the French national programme ‘Bioindicators’
E.C. Thoisy-Dur1, P.L. Lepelletier1, S.T. Taibi1, L.R. Rouget1, J.D. Dantany2, G.P. Perez2, A.B. Bispo3
1INRA, Versailles, France
2ESITPA, Mont saint aignan, France
3SCORP, Rennes, France
4Rennes 1 University, Rennes, France
5ADEME, Angers, France

The Random Forests statistical approach (Breiman, 2001), is used to classify, predict and select the best set of explanatory variables in large fields of research. Yet, only few applications were made in environmental research, especially in soil ecotoxicology. The analytical strategy of the French “Bioindicators Programme” (2006-2012) is to (i) measure a large number of bioindicators in contrasted pedo-eco-climatic contexts covering major sampling protocols, (ii) mbhage high numbers of biological and meta-data in a database enhancing data analysis, (iii) develop a database of collected data during two years, with the help of a biostatistician team. The main objective is to develop a generalised method for selecting relevant bioindicators associated to the targets (characterisation, monitoring, risks) of the research programme (IDOTS), that may assess risks of soil contamination to ecosystems. Most classical statistical variables are screened, including microorganisms (e.g. biomasses of fungi and bacterial communities, bacterial diversity, enzymatic activities), mesofauna (e.g. nematodes and collembola), macrofauna (e.g. earthworm at community levels and metal accumulation in snails). Such bioindicator variables were measured in soil surface horizons, at 13 sites, providing 47 different contexts in terms of land use history and origin of contamination (PAM, ETM, pesticides). As a first step of statistical analyses, our results showed the importance of correlations between biological variables in intra and inter-groups. Then discriminated analyses using Random Forests revealed sets of relevant indicators for land use (crops, pastures, woods and forests), levels of metal contamination (high, medium and low) as well as...
We illustrated two structural problems linked to the model itself or to the likelihood function. (1) We cannot simplify the model by fixing the natural mortality to 0 even if data did not show natural mortality and (2) because of discontinuities in the log-likelihood cross sections when the threshold parameters is equal to one of the tested values. These issues can lead to biased parameter estimates and incorrect inferences.

This Excel-R connection significantly broadens the spectrum of available statistical methods in Excel. Moreover, the user (e.g. lab technician) can easily conduct complex data analysis and generate reports, which can be shared with other team members or stakeholders.

The SSD approach is an element of most regulatory guidance documents for environmental risk assessment (e.g. ANZECC, ECHA, USEPA). Yet, the approach to be used for a set of 7 biomarkers in the bivalve Dreissena polymorpha, resulting in a matrix of 720 IBR values. It evidenced the variability of the IBR, that is not our main concern.

A case study using this method is presented, based on the results of a survey of 8 sites presenting contrasted levels of sediment contamination. The permutation is performed with a non-parametric approach, which enable more flexible curve-fitting.

We aimed to propose a new procedure to resolve these main problems in the IBR application. We first go back to trigonometry basics to improve our understanding of the IBR, that is far more simple than the original one. We then wrote a procedure that creates all the possible parameter permutations of k biomarkers. It results on a \( k! \)-matrix of IBR values that allows to calculate the mean IBR for a site and to prioritize IBR values among sites in a more confident way.

A case study using this method is presented, based on the results of a survey of 8 sites presenting contrasted levels of sediment contamination. The permutation is performed with a non-parametric approach, which enable more flexible curve-fitting.

In this talk we present a newly built statistics tool which allows a highly convenient and efficient data analysis. The tool combines Excel (a Microsoft Office product) and R (a cost-free available statistics programming language) via a specific server.

This Excel-R connection significantly broadens the spectrum of available statistical methods in Excel. Moreover, the user (e.g. lab technician) can easily conduct complex statistical analyses.

The user selects the desired statistical method in Excel after highlighting the input data for the computational analysis. The data is then transferred to the server, the computation starts and the results are automatically transferred back to Excel. Besides the results (e.g. graphical plots) the user can also receive an interpretation help (text file) of the result output.

In addition to a short introduction of the Statistics Service technical background, we will demonstrate its functionality using examples from the environmental fate modeling for plant protection products, e.g. the analysis of environmental fate data and selection of relevant input parameters to exposure models, in order to provide a general overview of how this tool works.
Assessing the chronic aquatic toxicity of phthalate ester plasticizers

Y. Tanaka, H. Mano, H. Tatsuta

TU 343

Indirect estimation of population-level effect of pollutants based on tolerance evolution and fitness cost of tolerance

1National Institute for Environmental Studies, Tsukuba, Japan

Department of Ecology and Environmental Science, Graduate School of Agriculture, Nishihara, Japan

Evolution of tolerance to a pollutant chemical in a natural population of organisms gives an evidence of the examined population to have suffered adverse effect from the chemical because the tolerance evolution of a population is solely brought about by selection pressure that removes sensitive individuals or genotypes from the population. Describing and interpreting the evolution of the tolerance to environmental chemicals can be performed using a monitoring tool of chemical pollution in the field, such approach is not relevant for a quantitative impact evaluation because observed differences in the tolerance between a contaminated and an uncontaminated site are rarely connected to the ecological risk that burdens the population. Applying the theory of evolutionary ecology and quantitative genetics into the tolerance evolution, we attempted to estimate the selective force that is needed to maintain the observed difference in the tolerance between populations. For this aim, we made a heuristic assumption for the evolutionary analysis of tolerance: the strength of tolerance induced by a genotype to a particular compound is positively associated with fitness cost of the tolerance, and the joint action of selection induced by the cost and selection favoring higher tolerance achieves optimization of the total fitness that takes into account the fitness gain by the tolerance and the fitness cost due to the tolerance. The fitness gain by the tolerance means reduced toxicity of a specific exposure concentration in comparison to sensitive individuals, and can be quantified by the life table toxicity data. As a case of such an approach, we detected inter-population-differences of the fenvalerate tolerance among natural populations of a water flea (Daphnia galeata) in Kasumigaura Lake (Japan) and an agricultural reservoir near to this lake. The fenvalerate induced a statistically significant negative association, among isofemale clones, between tolerance values and intrinsic population growth rates under null exposure. With the fitness optimization, we derived an estimate of stationary exposure level of the chemical (all compounds that exhibited co-tolerance with this chemical) as 0.015 ppb, and concluded that the examined population of this species had been suffering the population-level effect that corresponded to 1/4 reduction of the intrinsic population growth rate. The indicated level of the population-level effect may have considerably reduced the probability of persistence of the population.

TU 344

Triclosan toxicity: a multi-generational and demographic assessment using Daphnia magna

K. Sibley, M. McKeel, J. Lucas

University of Guelph, Guelph, Canada

Triclosan is a ubiquitous compound in wastewater treatment plant effluents and biosolids and is commonly detected in surface waters throughout North America and Europe. The acute toxicity of triclosan (TCS) toward aquatic organisms has been well studied but information on long-term, low level exposures at environmentally relevant concentrations is lacking. The objective of the present study was to evaluate the toxicity of triclosan in a multi-generational test with Daphnia magna in laboratory exposures. 24-h or 96-d magna neonates were exposed to TCS (0.5 to 150 μg/L) in six successive 24-d life cycle tests. Brood randomly collected from 5 replicate bioas in each treatment on day 21 were used to produce the next generation. Survival across the 6 generations exceeded 80% in all treatments across all generations. A slight but non-significant delay in time to first brood occurred in the 1.5 mg/L treatment in the first generation but the total offspring produced over 21 d and fecundity (average offspring/adult) decreased significantly at concentrations >50 μg/L (NOEC = 10 μg/L) in the first 3 generations but this difference disappeared in the last 3 generations indicating increased tolerance to TCS. Reproductive demographic data were used to estimate the intrinsic rate of increase (r) and indicated significant declines in the first three highest treatments based on the first 3 generations but not the last 3 generations. In this study, effects were only observed at TCS concentrations approximately one order of magnitude greater than those found in surface waters, which indicates that the long-term risks of TCS are likely minimal.

TU 345

Assessing the chronic aquatic toxicity of phthalate ester plasticizers

A. Staples, R. Gunn, K. Kramara, M. Lampert, N. Schol

Assessment Technologies, Inc., Keswick, VA, United States of America

Eastman Chemical Company, Kingsport, TN, United States of America

BSF Corporation, Pasadena, TX, United States of America

EFMOBIL Biomedical Sciences, Inc., Alachua, FL, United States of America

Evonik Oxeno GmbH, Marl, Germany

Phthalate esters are a class of chemicals varying greatly in terms of uses, properties and toxicity. C1 to C4 phthalate esters are used in non-vinyl commercial products and pharmaceuticals. C5 to C10 phthalate esters are used as plasticizers. The purpose of the primary endpoints test is to assess chronic effects of phthalate esters on aquatic organisms. Studies show that populations of fish and invertebrates may be adversely affected by exposure to C1 to C4 phthalate esters, but are not adversely affected by exposure to C5 or higher phthalate esters. Secondary endpoints, including molecular, biochemical, and/or histological responses to chemical exposure, do not appear to be primary endpoints of survival, growth and development or reproductive fitness. A previously published risk assessment for C1 to C4 phthalate esters demonstrated low risks in North American and Western European surface waters. Risk assessments conducted by authorities in Europe for DEHP, DINP, and DIDP have concluded no risks to aquatic organisms due to aqueous solubility constraints, low expected surface water concentrations, and metabolic/biotransformation capacities in these aquatic systems. Important toxicological aquatic toxicity studies that have included transgenerational exposure since those assessments and are presented here. The data from the present studies support the earlier risk assessment conclusions. The data also provide further support for a narcissus-related aqueous solubility cutoff at approximately C6 and higher phthalate esters. Finally, for the C1 to C4 phthalate esters, the present study shows that secondary endpoints (e.g., molecular, biochemical, and/or histopathology) to date, provide limited benefit in practical ecological risk assessment of phthalate esters to aquatic species.
Effects of land use and pesticide exposure on hatching characteristics of Daphnia magna ephippia

S. Navis, A. Waterkeyn, T. Voet, L. Brendonck
Katholieke Universiteit Leuven, Leuven, Belgium

Daphnia is a well established model organism and standard test species in ecotoxicology. D. magna reproduces by cyclical parthenogenesis, where environmental cues associated with unfavourable conditions trigger sexual reproduction. In permanent and temporary standing waters, sexually produced encapsulated dormant eggs (ephippia), build diapause cysts and a dormant resting egg bank, which is important for long-term survival of the population. Each year a fraction of the dormant egg batch hatch from the sediment. Through this benthic-pelagic coupling, structure and function of resting egg banks have important consequences for a ecological and evolutionary dynamics of the active populations and communities. To date however, almost no information is available on the effects of pollution on these dormant egg banks.

We report on patterns of encapsulation and hatching of resting egg banks in a densely agricultural area, where pesticide contaminated land cover and agricultural land use patterns are a proxy for agricultural land use. I tested the hypothesis that in D. magna populations for the pesticide carbaryl was positively correlated with land use intensity of the area around the ponds. As in standard ecotoxicity tests, these experiments were performed for 48 hours with D. magna neonates less than 24 hours old.

In this study we investigate the effects of land use intensity and pesticide exposure on hatching characteristics of D. magna ephippia from natural populations. Therefore we sampled dormant egg banks of ponds from areas with varying degrees of agricultural activity (from natural areas to areas with intensive agriculture). In the laboratory hatching experiments were performed, looking specifically at differences in hatching characteristics of D. magna ephippia under optimal conditions and after pesticide exposure in relation to historical pesticide exposure.

TU 347

Is there a potential for wild Daphnia magna populations to undergo at conventionally derived no observed effect concentrations of chemicals?
J.D. Hochmuth, C.R. Janssen, K.A.C. De Schamphelaere

Ghent University (UGent), Ghent, Belgium

The genetic variability within a population exposed to stress governs the micro-evolutionary potential of that population to undergo selection and adapt to the stress.

However, adaptation caused by natural selection will by definition reduce overall genetic diversity, a process termed genetic erosion. This may result in a cost of fitness, whereby populations evolved under a certain chemical stressor, may become less tolerant to novel stressors. It is hypothesized that a population under stress exhibits an increase in genetic variation for life history traits relative to a control population. We used the genetic coefficient of variation (CV), and the broad sense heritability (H²) as measures for genetic variability for micro-evolutionary responses in wild populations exposed to copper and zinc, as model toxicants. Life-table experiments with concentrations of copper and zinc as the conventionally derived geometric mean NOEC values (μg Cu/l, 428 μg Zn/l) were compared with 8 Daphnia magna populations collected from lakes under ponds across Belgium with concentrations Cu and Zn levels. Additional full dose-response experiments were carried out with the most and least sensitive populations. Our results indicate that several fitness traits have the potential to respond to natural selection and genetically adapt, but that this depends strongly on the population and the exposure treatment considered. In long-term multi-generational exposures this may result in shifts in genotype frequencies and reduction of genetic diversity.

TU 348

Evolutionary consequences of the loss of genetic diversity in C. riparius populations - Introducing the MIDGE project

University of Aveiro, Aveiro, Portugal

Chironomids are known to decrease genetic variation in populations of several species alongside with adverse effects on the physiology of organisms. This loss of genetic diversity may reduce the potential of populations to adapt to changing environments.

Evolutionary studies need to consider not only short-term effects of pollution on species, such as changes in life history traits of organisms, but also its long term effects, such as genetic erosion. The genetic erosion can lead to the loss of evolutionary potential and thus it is also of crucial importance to assess the evolutionary consequences of changes in genetic variability. There is an urge for evolutionary toxicology studies because only an integrated approach linking contamination, genetic variability, life-history responses and fitness costs associated with adaptation can lead to an integrated framework to predict the ecological and evolutionary impacts on biodiversity.

In the MIDGE project aims to study the Microevolutionary Dynamics and Genetic Erosion in pollution-affected Chironomus populations. More specifically we are investigating the genetic variability of C. riparius populations from unpolluted and contaminated sites using mitochondrial sequence variation and nuclear microsatellite analyses and we intend to address three main questions:

- Does chronic pollution affect genetic variability of C. riparius populations in the field?
- Are C. riparius populations in contaminated areas adapted to pollution exposure?
- What are the evolutionary consequences of this altered genetic variability due to pollution in terms of fitness costs?

The measures of genetic erosion have recently been proposed as the ultimate biomarker of effect and by focusing on effects of contaminants on genetic variability in natural populations we aim to aid in developing new bio-monitoring approaches and provide advanced scientific basis for integrative ecological risk assessment methodologies which are essential for effective environmental conservation strategies. The SETAC meeting is an excellent opportunity to share ideas, approaches, methodologies and preliminary results with other researchers working in the field of evolutionary toxicology.

TU 349

Association between increased resistance to copper and salinity in Daphnia longispina clonal lineages under short- and long-term multi generational exposures
C.R. Janssen, 1, C. Owojori, 2, O.J. Owojori, 2

1Department of Botany and Zoology, Stellenbosch University, Stellenbosch, South Africa
2Department of Environmental Sciences, Northwestern University, Potchefstroom, South Africa
3Leibniz Institute of Freshwater Ecology and Inland Fisheries, Berlin, Germany
4Ghent University, Ghent, Belgium

Due to eutrophication and other factors, the frequency of cyanobacterial blooms in freshwater has increased worldwide. They are an important problem to the ecosystem, particularly affecting zooplankton populations which feed on phytoplankton. Among other toxins, some cyanobacteria produce microcystin (MC), MCLr the most studied variant. MCIs inhibit serine/threonine protein phosphatase type 1 and 2A and provoke oxidative stress. The planktonic Daphnia plays a central position in pelagic food webs as predator, filter and intermediate. As a consequence of exposure to MCs, populations of Daphnia longispina, exhibiting different lethal resistances to copper, was assessed. Subsequently, to evaluate its acclimation to salinity, each clonal lineage was acclimated to 0.1g of NaCl for two generations and its lethal and sublethal sensitivity to salinity re-assessed. The observed results, revealed significant associations between an increased resistance to copper and the lethal or sublethal sensitivity to salinity in Daphnia longispina populations for the chronic exposure levels not under long-term multigenerational exposures. Also, most of the studied genotypes exhibited fitness costs in reproduction after being exposed to NaCl for more than one generation, and became acclimated to low levels of salinity.
Is there a functional role of DNA methylation in the stress response? 

J.N. Meyer

Duke University, Durham, United States of America

I will suggest that mitochondrial DNA is a potentially important and understudied target of environmental toxicants, and one that when impacted is likely to have long-term effects. Mitochondrial DNA (mtDNA) is more sensitive than nuclear DNA to many common genotoxins, and lacks some repair pathways that are present in the nucleus. In particular, helix-distorting adducts formed after exposure to environmentally important genotoxins such as ultraviolet C (UVC) radiation and some polycyclic aromatic hydrocarbons and mycotoxins are repaired in the nuclear genome by nucleotide excision repair. However, nucleotide excision repair proteins are not present in the mitochondrion, so the fate of such DNA damage in the mitochondrial genome is unknown. The effects of such damage are also unknown; we hypothesized that the effects of such damage would be particularly important after early life stage exposure since mtDNA copy number is lowest at that time. Using the nematode model Caenorhabditis elegans, we found that UVC-induced photoproducts result in lower levels of mtDNA-encoded mRNAs, decreased ATP levels, decreased oxygen consumption, larval delay, and reduced fertility. Moreover, UVC-induced mtDNA damage is slowly removed in a process dependent at least in part on mitochondrial fusion, fission and autophagy. Mutations in mitochondrial fusion and autophagy genes exacerbate the larval arrest, suggesting a potent gene-environment interaction in which the effects of mtDNA damage caused by environmental agents are exacerbated by decreased mitochondrial fusion and autophagy.

Are there potential functional or maternal effects provoked by a natural toxin in a very important freshwater herbivore which may explain the observed acquisition of enhanced tolerance over generations through a biochemical perspective.

TU 354

Negative effects of early-life mitochondrial DNA damage: I) epigenetic and genetic responses of adults and II) offspring embryo toxicity

N. Aparicio, M.T. Cervera, M.A. Guevara, L. Díaz, L. San Segundo, P. Sanchez-Arreguillo

INIA, Madrid, Spain

Mitochondria cause transgenerational effects by inducing DNA methylation changes in exposed rats. Benzo(a)pyrene is a clastogen used as a reference chemical for the in vitro mammalian cell micronucleus test. Taking into account that epigenetic and genetic profiles could be altered by these pollutants we studied molecular and cellular responses after adult male exposure to fluoxetine (F1) and paternal exposure was evaluated. Mature snails exposed for 46 days and deposited egg masses were used for determining parental endpoints (F0) and transgenerational effects, respectively. DNA extracted from mature snails were analysed to evaluate differences in DNA methylation patterns. In order to analyze methylation-sensitive sites we used PCR technique with arbitrary primers (AP-PCR) using HpaII and MspI digested samples. HpaII and MspI are isochizomers that recognize the tetranucleotide sequence 5’-CCCG-3’ but that show differential cleavage efficiency of methylation. HpaII cannot cleave it one or both cytosines are fully methylated in both strands, whereas MspI cleaves CmCGG but not 5mCCGG sequences. Gel electrophoresis of PCR products and comparative analysis between HpaII and MspI patterns allowed the study of CCGG regions in the genome that are sensitive to methylation and the effect of these pollutants on these sites. Genotoxicity was measured by the micronucleus test in cells isolated from whole adults after hemocyte and gamete development of offspring. First spermatogonia and eggs of parents were recovered and the teratogenic effects of both non-exposed and exposed single egg capsules were measured in multwell plates. Parental responses at cellular and molecular levels were compared with F1 responses using an ecological relevant endpoint (embryo toxicity). The aim of this work is to establish potential linkages between mechanisms of action and long-term responses at higher levels of biological organisation, which could ultimately have consequences on population dynamics. This study was supported by the Spanish research project CTM2008-03492.

The enzymatic functional stability of zinc-tolerant microbial communities: a new approach to detect terrestrial ecotoxicity of metals

J.M. Coudrain, J. van den Heuvel, I. Pañeda, M. Lóz

AWI, Bremerhaven, Germany

toxic and reproductive disorders indicators have been studied in several marine organisms like fish and amphipods to address the question of the impact of contaminant exposure on wild populations. This focus is on the characterisation of the process of toxic effects from subcellular damage at the individual level of the parental generation to deterioration of the offspring in the amphipod species Monoporeia affinis. Monoporeia affinis have been sampled at differently polluted and reference areas of the Bohemian Bay. Reproduction success and variability, sex ratio, individual development, embryo aberrations in terms of malformed and membrane damaged embryos, undifferentiated and dead eggs and broods, and stage of embryo development, in addition, amphipods were sampled for in situ assessment of lysosomal membrane stability (LMS) as an indicator of toxic damage in the parental generation. These studies were combined with chemical analysis (PCBs, PHEs and metals) of sediments and organisms to gain information about potential cause-effect relationships. The integrated analysis of the data showed that the nature of assessed correlations between contaminant concentrations in sediment, contaminant exposure in amphipods, parental damage, and reproductive success differ between the contaminants. For PCBs, high sediment concentrations correspond with low concentrations in amphipods and vice versa. The concentration in amphipods is negatively correlated to LMS and membrane stability, and embryo malformation. High membrane stability and low PCB concentrations in the parental generation correspond with high fecundity and vice versa. Based on these results, a conceptual model on the transfer of PCB during embryogenesis has been developed. It is hypothesized that PCBs are taken up by amphipods according to the respective bioavailability. During embryogenesis, PCBs are transported to the gonads together with nutrients and yolk. Thus, PCBs are transferred to the parental generation and membrane stability and fecundity high. The PCs act toxic on the developing embryo instead. In case of high PCB concentration in the parental generation, fecundity is reduced and embryo malformations low. These results indicate an adaptation to high PCB concentrations possibly mediated by a limited transport of PCBs during embryogenesis.

The enzymatic functional stability of zinc-tolerant microbial communities: a new approach to detect terrestrial ecotoxicity of metals

J.M. Coudrain, J. van den Heuvel, I. Pañeda, M. Lóz

AWI, Bremerhaven, Germany

Stockholm University, Stockholm, Sweden

The soil microbial community exposed to metals over a long period can acclimate or adapt their biogeochemical functions and become metal-tolerant. This tolerance could increase the vulnerability of the microbial community to additional soil disturbances and then decrease the soil microbial functional stability. The functional stability is defined as the ecosystem capacity to recover its biogeochemical functions after a disturbance. This concept is more and more studied because this approach could detect ecotoxic effect which would have not been found out by common microbial biosensors. A method which assesses soil health by analyzing the functional stability of soil enzymes has been set during the last years and has developed a stability indicator named the Relative Soil Stability Index (RSSI). These indexes were calculated to assess the enzymatic functional stability of 9 contaminant field soils after a heat disturbance (desiccation at 60°C for 24h). Four enzymes were analyzed: arylsulfatase, acid phosphatase, protease and urease. The RSSI of arylsulfatase and protease were linearly correlated to the labe lizable zinc concentration in the soils (ylsulfatase : R² = 0,65 for m² and protease R² = 0,62 for m²; t < 0,05), while the enzymatic activity of these enzymes was not correlated to the labile metal fraction. These results suggest that the sulfur and nitrogen cycles would be unstable in zinc-contaminated field soils. This potential ecotoxic effect would not have been detected if only the enzymatic activity has been analyzed.

The enzymatic functional stability of zinc-tolerant microbial communities: a new approach to detect terrestrial ecotoxicity of metals

J.M. Coudrain, J. van den Heuvel, I. Pañeda, M. Lóz

AWI, Bremerhaven, Germany

Stockholm University, Stockholm, Sweden

The soil microbial community exposed to metals over a long period can acclimate or adapt their biogeochemical functions and become metal-tolerant. This tolerance could increase the vulnerability of the microbial community to additional soil disturbances and then decrease the soil microbial functional stability. The functional stability is defined as the ecosystem capacity to recover its biogeochemical functions after a disturbance. This concept is more and more studied because this approach could detect ecotoxic effect which would have not been found out by common microbial biosensors. A method which assesses soil health by analyzing the functional stability of soil enzymes has been set during the last years and has developed a stability indicator named the Relative Soil Stability Index (RSSI). These indexes were calculated to assess the enzymatic functional stability of 9 contaminant field soils after a heat disturbance (desiccation at 60°C for 24h). Four enzymes were analyzed: arylsulfatase, acid phosphatase, protease and urease. The RSSI of arylsulfatase and protease were linearly correlated to the labe lizable zinc concentration in the soils (ylsulfatase : R² = 0,65 for m² and protease R² = 0,62 for m²; t < 0,05), while the enzymatic activity of these enzymes was not correlated to the labile metal fraction. These results suggest that the sulfur and nitrogen cycles would be unstable in zinc-contaminated field soils. This potential ecotoxic effect would not have been detected if only the enzymatic activity has been analyzed.
The percentage of TBT-resistant isolates varied between 0.08% (Setúbal harbor) and 7.67% (Peniche). REP-PCR analysis revealed a total 111 distinct genetic profiles, being resistant bacteria are able to reduce the toxicity of TBT contaminated waters. Ecotoxicological testing also revealed that the median lethal concentration (LC50) of TBT in potential as bioremediation tools was assessed through ecotoxicological testing with the gastropod Gibbula umbilicalis. Ecotoxicological testing suggested that some TBT-resistant isolates were used to bioremediate waters, and their growth curve, egg laying curve, survival until end of egg laying. We showed that resistant clone developed three more offspring per day and had population growth rates 45% higher. In the unpolluted environment, however, individuals from the resistant clone had the lowest reproduction. After four generations acclimated individuals from the sensitive clone reproduce earlier, had greater clutches at first reproduction and higher population growth rates than none acclimated ones but apparently there were no fitness costs. Therefore, our results showed that life history changes due to adaptation and acclimatization were comparable under the polluted environment but not under a clean environment. This results support the view that genetic adaptation is ecologically costly but acclimatization not.

TU 359
Evaluating effects of pollution on Caenorhabditis elegans' population dynamic through a bio-energetic approach
B. Goussten1, A. Péry2, R. Beaudouin3, M. Dutilleul4, C. Lecomte1, J.M. Bonzomi5
IRSN / INERIS, Saint paul-lez-durance cedex, France
INERIS, Verneuil en halatte, France
IRSN, Saint paul lez durance, France
The assessment of toxic effects at biologically and ecologically relevant scales is an important issue in ecosystem protection. Mathematical models exist to predict effects of pollutant on population dynamics from individuals. Nevertheless there are only a few datasets and models that account for adaptive phenomena which may appear in a stressed population. The selection pressure exerted by a pollutant is known to amplify the phenomenon of natural selection. It is thus essential to understand and quantify the adaptive dynamics governing populations under stress in order to assess ecological risk.

Regarding this background, we adapted a bioenergetic model to study adaptive phenomena in Caenorhabditis elegans population dynamic exposed to a heavy radiotoxic metal (uranium). The Dynamic Energy Budget (DEB) (Kooijman, 2010) bioenergetic approach highlights the distribution of energy fluxes between processes such as growth, reproduction, maturation and maintenance. It is a relevant basis to understand and model the links between assimilation disruptions, growth and reproduction fluctuations in organisms exposed to anthropogenic stress (e.g. pollutant, global change) and to assess potential consequences on population over many generations.

We therefore studied the responses of C. elegans exposed to six experimental concentration of uranium over several generations. The individual traits followed were growth rate, egg laying rate, survival until end of egg laying. We showed that uranium impacted C. elegans growth rate and egg laying over several generations, with, consequently adverse effects on the population dynamic and variations on DEB parameters. Nevertheless, results also tend to show an evolutionary response throughout the generation.

ETP1 - Marine environmental chemistry and ecotoxicology
TU 361
Biotechnological potential of impacted scenarios for the restoration of TBT contaminated environments
R. Monteiro1, L. Fonseca2, A. Correia3, C. Ana4, F.L. Lemos1
1Politecnico de Leiria, Peniche, Portugal
2Instituto Politécnico de Leiria, Peniche, Portugal
3Department of Biology and CESAM, University of Aveiro, Aveiro, Portugal
4University of Aveiro, Department of Biology & CESAM, Aveiro, Portugal
5ESTM and GIRM, Polytechnic Institute of Leiria, Peniche, Portugal

Tributyltin (TBT) is an organotin compound commonly used as an antifouling agent in marine paint formulations. Due to its wide industrial application and its consequent discharge into the environment, TBT pollution is recognized as major environmental problem at a global scale, being recently considered to be the most toxic substance ever been detected in the marine environment. Organisms from historically contaminated sites are able to tolerate pollutants and even degrade them, which may be a key factor in the restoration of contaminated environments. Nevertheless, byproducts resulting from the degradation process might be more or less toxic than the parent compound to ecological relevant species. The determination of the substance presence by chemical analysis, although essential, may not present ecological relevance, as it might not be detected by its toxicity.

In this study, TBT-resistant bacteria collected from 7 Portuguese ports (Póvoa de Varzim, Leixões, Aveiro, Figueira da Foz, Peniche, Setúbal and Sines) were isolated in increasing concentrations of the toxicant (0.1, 1, and 3mM of TBT) and those growing at the highest concentration were characterized by genomic fingerprinting (REP-PCR) and tested as potential bioremediation tool in laboratory contaminated media.

The percentage of TBT-resistant isolates varied between 0.08% (Setúbal harbor) and 7.67% (Peniche). REP-PCR analysis revealed a total 111 distinct genetic profiles, being resistant the location with lower variability while Figueira da Foz had the highest variability. Selected isolates were used to bioremediate waters contaminated with TBT, and their fitness costs. Therefore, our results showed that life history changes due to adaptation and acclimatization were comparable under the polluted environment but not under a clean environment. This results support the view that genetic adaptation is ecologically costly but acclimatization not.

TU 362
Biodiversity on Portuguese ports: TBT degrading bacteria
1Politecnico de Leiria, Peniche, Portugal
2Instituto Politécnico de Leiria, Peniche, Portugal
3Department of Biology and CESAM, University of Aveiro, Aveiro, Portugal
4University of Aveiro, Department of Biology & CESAM, Aveiro, Portugal
5ESTM and GIRM, Polytechnic Institute of Leiria, Peniche, Portugal
6University of Aveiro & CESAM, Aveiro, Portugal

Tributyltin (TBT) is an organotin compound commonly used as an antifouling agent in marine paint formulations. Due to its wide industrial application and its consequent discharge into the environment, TBT pollution is recognized as major environmental problem at a global scale. Ecotoxicological testing also revealed that the median lethal concentration (LC50) of TBT in Gibbula umbilicalis at 48 and 96 hours was 61.45 µg L-1, and 15.69 µg L-1, respectively.

We were able to detect TBT-resistant bacteria from all the sampling sites. It is possible to observe that with increasing concentrations of TBT, the concentration of isolates decreased and consequently the percentage of resistant bacteria compared to the control was lower. At 0.1mM, Póvoa de Varzim had the highest percentage of resistant clones (26.5%) while Setúbal had the lowest (2.56%). Regarding 1mM and 3mM concentrations, Peniche had the highest percentage rate (3.0% and 3.3%, respectively) as well as the highest number of colony forming units per milliliter (410 ± 26 cfu mL-1 and 383 ± 93 cfu mL-1 respectively). On the other hand Aveiro (0.26 ± 0.09%) and Setúbal (40 ± 26 cfu mL-1 and 383 ± 26 cfu mL-1 respectively) had the lowest percentage of resistant isolates. The genetic differences between the resistant and sensitive clones were that in the polluted environment the resistant clones produced three more offspring per day and had population growth rates 45% higher. In the unpolluted environment, however, individuals from the resistant clone had the lowest reproduction. After four generations acclimated individuals from the sensitive clone reproduce earlier, had greater clutches at first reproduction and higher population growth rates than none acclimated ones but apparently there were no fitness costs. Therefore, our results showed that life history changes due to adaptation and acclimatization were comparable under the polluted environment but not under a clean environment. This results support the view that genetic adaptation is ecologically costly but acclimatization not.

Are TBT sources migrating from harbors to marinas in Latin America?
G. Fillmann1, C.A. Paz-Villarraga2, P. Miloslavich3, M.A. Fernandez2, I.B. Castro1
1IPFGR, Rio grande do sul
2Universidad Simón Bolívar, Caracas, Venezuela
3Universidade Estadual do Rio de Janeiro, Rio de janeiro, Brazil

Tributyltin is a very toxic compound that was used as antifouling paints biocide during four decades. Due its environmental toxicity the International Maritime Organization banned TBT-based antifouling paints in 2008. Thereafter, TBT environmental concentrations as well as imposex levels (the most widely used TBT biomarker) declined in several coastal areas worldwide. However, in Latin America some recent observations have shown high TBT imposex levels in areas close to marinas, despite the general replacement pattern in many areas. The present study reported imposex parameters (imposex %, VDSI and RPLI) in gastropods from Venezuela and Brazil in harbor areas and marinas. In Venezuela, samples with 30 adults of Purpura patula were collected in 23 sites (2 located inside marinas). In Brazil, the sampling...
collection has been performed for some years at Angra dos Reis (10 sites were close to marinas) and Arraial do Cabo (2 out of 10 stations were close to marinas) in Rio de Janeiro state. These studies used 30 adults of Stramonita haemastoma per site (whenever found). The results for Venezuela showed that the VDSI ranged from 0.22 to 1.86 in areas under the influence of harbours, whereas VDSI values were 3.77 and 4.56 in the marinas. Similarly, RPLI ranged from 0.07 to 5.58 in the harbor areas and were 3.67 and 5.46 to the marinas. In this case, the main source of organotins pollution is clearly the marinas. In the Angra dos Reis study, imposex was detected in 100% of females close to the marinas, and in 5 out of 10 stations the animals previously inhabiting the rocky shores were no longer found. In Arraial do Cabo, two stations nearby a single marina showed an imposex incidence of 4% and 0 in 2001, increasing to 83% and 47% in 2008. In this region, another marina located near a small harbor showed imposex incidence in three stations in 2000 no gasteropods were found during 2008 sampling. Thus, although the international restrictions on TBT use are apparently reducing the impacts from harbours, these three independent studies at Venezuela and Brazil (Angra dos Reis and Arraial do Cabo) clearly pointed out that marinas are becoming an important source of TBT pollution. Based on that, a similar pattern is expected to occur in other Latin America coastal areas.

TU 364

Imposex and organotin (OT) levels in Nucella lapillus along the Portuguese coast: a re-survey in 2011
*University of Aveiro, Aveiro, Portugal
1Department of Biological & CESAM, Aveiro, Portugal
2Centre for Environmental Studies, NHM, University of Calcutta, Kolkata, India
3National Institute for Water Research (NIVA), Oslo, Norway

Eawag - Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland

The use of biarylpyridine-based antifouling paints (TBT-based AIP) is globally forbidden since the 17th September 2008 by the 'International Convention on the Control of Harmful Antifouling Systems on Ships' (AFS Convention). It is therefore important to ensure the continuous monitoring of organotins (OT) in the environment and the recovery of marine ecosystems to evaluate the effectiveness of legislation in reducing TBT pollution. The current work assessed imposex and OT tissue contamination in N. lapillus at 3 sites along the Portuguese coast (VDSI), the first of which in 2001, the vas deferens index (VDSI), the female penis length index (FPLI), the relative penis size index (RPSI), the percentage of imposex affected females (%I) and the percentage of sterile females (%S) were determined to assess imposex levels. Additionally, monobutyltin (MBT), dibutyltin (DBT), tributyltin (TBT), triphenyltin (TPT), monocrotyl (MOT) and dicrotyl (DOT) were quantified in the soft tissues of whole females by GC-MS. The OSPAR Ecological Quality Objective (EcoQO) set for this species (VDSI < 2) was achieved in 94% of the sampled sites. All surveyed populations presented VDSI values that fall into OSPAR class B (0 < VDSI < 2) with one single exception in the South western coast - Zambujeira do Mar (site 15) - also being the only site where sterile females were still recorded. OT concentrations in N. lapillus soft tissues varied between <0.2ng Sn/g and 24ng Sn/g dry weight (dw) for MBT, 2.0 and 26ng Sn/g dw for DBT, 2.1 and 30ng Sn/g dw for TBT and <0.2ng Sn/g dw for TPT. TBT, MOT and DOT concentrations were all below the detection limit. TBT recent inputs were estimated to occur at four sites by the butyltin degradation index (DBI = ([MBT]+[DBT])/[TBT]). The temporal trend of N. lapillus imposex was assessed for the period 2000-2011 to assess the evolution of TBT pollution levels in the Portuguese coast.

TU 365

TBT from anti-fouling paints in the environment - an overview of the situation today
T. Eliud
Stockholm University, Stockholm, Sweden

The Baltic Sea is a sensitive brackish water environment where most organisms live at the edge of their distribution area. Pollutants thus mean an extra stress to these organisms. Traditionally anti-fouling paints are based on leakage of biocides, which prevents the attachments of fouling organisms on underwater structures such as a boat hull. The drawbacks is that the biocides are persistent and that they also affect non-target organisms. The environmental authorities have with time implemented more strict regulations, especially for the paints that may be used on the east coast of Sweden. The use of tin-organic substances were prohibited in 1989 for all boats less than 25 m and no paints based on copper leakage were approved from 2001 and up today no copper paints have been on the market for use on the east coast. In spite of these restrictions much toxic substances originating from anti-fouling paints are found in the environment along both the west and east coast of Sweden. Similarly high concentrations are found in harbours for ships. Our investigations show that the highest concentrations are found in boat yards > uptake areas > marinas > natural harbours. 100 µg TBT/kg DW is considered high in many countries and the highest concentrations in boat yards reached 30 000 µg TBT/kg DW. The reason is under laying paint layer being scraped off.

TU 366

Comparing anadara trapezia exposure, dose and response to metal contaminated estuarine sediments using laboratory and field exposures and resident mulluscs
M. Taylor, W.A. Maher
University of Canterbury, Cant, Australia

Estuarine relationships between metal exposure, internal dose and associated biological effects for organisms is necessary to understand the fate and effects of metals in the environment.

The accumulation and sequestration of biologically available metals by aquatic organisms, particularly bivalve molluscs, has led to their use as biomonitorors of metal contamination at multiple scales and in a variety of habitats. In this study, further measurements of biomonitoring performance at field stations, including two marine harbours and a marina, have been conducted. Metal concentrations were found to be positively correlated with the degree of contamination with TBT and copper. Additionally, imposex was detected in some of the areas, with imposex incidences ranging from 0% to 83% at the different sites. The results of this study indicate that bivalves can be used as indicators of pollution levels, and that biomonitoring can be effective in detecting changes in metal concentrations over time. However, further research is needed to better understand the mechanisms underlying the observed biological effects and to improve the accuracy and reliability of biomonitoring techniques.

TU 367

Imposex occurrence and the genetic changes in Veined Rapa Whelk (Rapana venosa) from Bohai Bay, China
L. An, B. Zheng, Y. Zhang, L. Wang, C. Hao
Chinese Research Academy for Environment Sciences, Beijing, China

In order to assess the present status of organotins (OTs) pollution and the potential ecological risk, biological effects in biota and the contents of OTs in biota and sediments were surveyed in 3 sites in Bohai Bay. Imposex occurrence was found in veined rapa whelks from all three sites. Imposex incidences ranged from 29% to 54% in the three sites. Genetic analysis of the Veined Rapa Whelk C. fluminea showed that there were 49.36 and 54.56 to the marinas. In this case, the main source of organotins pollution is clearly the marinas. In the Angra dos Reis study, imposex was detected in 100% of females close to the marinas, and in 5 out of 10 stations the animals previously inhabiting the rocky shores were no longer found. In Arraial do Cabo, two stations nearby a single marina showed an imposex incidence of 4% and 0 in 2001, increasing to 83% and 47% in 2008. In this region, another marina located near a small harbor showed imposex incidence in three stations in 2000 no gasteropods were found during 2008 sampling. Thus, although the international restrictions on TBT use are apparently reducing the impacts from harbours, these three independent studies at Venezuela and Brazil (Angra dos Reis and Arraial do Cabo) clearly pointed out that marinas are becoming an important source of TBT pollution. Based on that, a similar pattern is expected to occur in other Latin America coastal areas.

TU 368

Clam valve rhythm-based online biomonitoring system to detect waterborne arsenic
S.H. You1, W.Y. Chen1, L.J. Jou1, S.H. Chen1, C.M. Liao2
1National Taiwan University, Taipei, Taiwan
2National Taiwan University, Bioenvironmental Systems Engineering, Taipei, Taiwan

Arsenic is an ubiquitous element that presents high levels of contamination at southwestern and northeaster coastal areas of Taiwan. The freshwater clam has a high market value and is commercially important to Taiwan’s aquaculture. Previous studies indicate that biomonitoring of arsenic is scientifically important for detecting environmental pollution situations for preventing the harmful toxic effect of arsenic in water. The purpose of this study was to synthesize water chemistry-based bioavailability and valve daily rhythm in Corbicula fluminea to design a biomonitoring system for detecting waterborne As. We integrated valve daily rhythm dynamic pattern and water chemistry-based Hill dose-response model to build in a valuometry technique programmatic mechanism, offering a rapid and cost-effective dynamic detection system. We validated the simulated dissolved As concentrations based on valve daily rhythm behavior with published experiment data. The results indicated that the As concentration detection threshold of biomonitoring system is 1 µg/L and the detection times are associated with the exposure concentrations. This study presents a C. fluminea-based biomonitoring system that can particularly provide the real time transmitted information on the waterborne As activity. This parsimonious Clam valve rhythm-based real-time biomonitoring system presents a valuable effort to promote the automated biomonitoring and offers early warnings on the potential ecotoxicological risks in regions with elevated As concentration.

TU 369

A comparative site in situ ecotoxicological effects of pharmaceuticals in Ireland, using marine mussels (Mytilus spp.)
W. Schmidt, L.C. Rainville, G. Mcneff, D. Sheehan, B. Quinn
1Galway-Mayo Institute of Technology (GMIT), Galway, Ireland
2University College Cork, Cork, Ireland
3Dublin City University, Dublin, Ireland

In recent decades the amount of pharmaceuticals used and released has constantly increased. One of the main sources of this pollution is through the release of wastewater
immune system activities. Indeed, all of the immune system biomarkers studied, except the number of circulating haemocytes which decreased in both experiments, were

At the end of the 168-hour exposure experiment, 81.8% mortality rate was recorded, and the bioconcentration factor (BCF) exhibited values up to 405 in the digestive

of Crassostrea gigas to accumulate zinc released from anode, especially when low concentrations are released, as in the case of anode dissolution used as cathodic protection .

it becomes toxic at high concentration . In the coastal marine environment, its concentration is influenced by many human activities, among which the use of antifouling paint and sacrificial anodes. Our study addressed the effects of zinc on Pacific oyster (Crassostrea gigas) spat. Young oysters were exposed to a range of zinc concentrations, added to seawater as ZnCl₂, up to 2 mg/L, as a day post-metapodism and for 10 weeks. They were fed with micro algae at the same cells concentrations. Zinc was measured in seawater and in oysters throughout the experiment. Survival and growth were monitored on large sample populations to deal with individual variability. A dose-response curve analysis allowed deriving the EC₅₀ for growth. In parallel, target genes analysis included heat shock proteins, metallothionein (MT), detoxification machinery, regulation of oxidative stress and cell cycle. Gene transcriptional expression was quantified by RT real time PCR. Significant change was only detected for MT after 1 week exposure to the highest zinc concentration. However growth was affected as early as a few days of exposure to relatively low dose and turned out to be an earlier and more sensitive marker of the effect of zinc on oyster spat .

TU 371

Assessment of sacrificial anode impact by zinc accumulation in oyster Crassostrea gigas: comparison between a long- and short-term laboratory tests

E. Mottri¹, C. Caplat¹, T. Latire¹, A. Mottrier¹, M.L. Mahaut², K. Costil¹, D. Barillier², J.M. Lebel¹, A. Serpentini³

¹University of Caen Basse-Normandie, Caen cedex, France
²CNRF, Touquet, France
³Université de Caen Basse-Normandie, Caen cedex, France

In marine environments, sacrificial anodes made of zinc are currently used to mitigate marine corrosion as part of cathodic protection systems of immersed metallic structures. Zinc is an essential metal for living organisms that can be potentially toxic when present in excess. The aim of this study was to assess the bioaccumulation and the effects of zinc released using an electrochemical device providing controlled zinc concentrations from sacrificial anode degradation to mimic the in situ conditions. The work was carried out on a Pacific oyster Crassostrea gigas by performing two in vivo tests. The first test was conducted over a period of 10 weeks at a concentration of 0.33 mg Zn L⁻¹ to simulate long-term exposure, and a second one lasted for 168 hours at a concentration of 2 mg Zn L⁻¹ to reproduce short-term exposure. During continuous exposures, concentrations were measured in oyster gills, digestive gland and soft tissues and, endpoints such as mortality, immune parameters and mRNA expression of genes associated with oxidative stress and cell death were analysed. At the end of both experiments, similar results were obtained with 81.4% mortality rate was recorded, and the bioconcentration factor (BCF) exhibited values up to 405 in the digestive gland. In contrast, the results obtained though chronic exposure showed a higher BCF (13,397), whereas no mortality was detected. Moreover, zinc was able to modulate immune system activities. Indeed, all of the immune system biomarkers studied, except the number of circulating haemocytes which decreased in both experiments, were stimulated. The role of zinc and inflammation on oyster survival is discussed.

TU 372

Effect of herbicides on embryo-larval development and metamorphosis in the Pacific oyster, Crassostrea gigas

C. Mottrie¹, V. Kuentz-Bouchart¹, A. Serpentini³, J.M. Lebel¹, K. Costil¹

¹Université de Caen Basse-Normandie, CNRS INEE, FRE 3484 BioMEA, Caen, France
²LDFF Laboratory, Département Franc et Offshore, Trouville, France
³Université de Caen Basse-Normandie, Caen, France

The summer mortality syndrome which sporadically threatens oyster farming appears to be due to a combination of several intrinsic and extrinsic factors, including physiological stress related to reproduction and xenobiotic stress. In this context, terrestrial inputs including pesticides could be involved in oyster mortality events, not as a single causative agent but as additional stressors. The study was carried out in the frame of the European Project Chronoex. The aim of this project was to evaluate the impact of different contaminants (including pesticides) used in the region surrounding the English Channel on the early stages of Crassostrea gigas. Experiments were conducted on gonad extracts (AMES, L929) with and without a carcinogenic agent (4-Nitroquinoline N-oxide) and on the commercial formulations (Roundup Express and Roundup Alles et Terrasses) and also adjuvant (POEA: Polyethyleneoxetanetallowine) alone. Mecoprop, Mecoprop-P and their main metabolite (2-methyl-4-chlorophenol; 2MC) were also tested. The effects of these substances and copper sulphate (used as a positive control) were studied in D-hinged larva in order to assess their potential embryotoxicity by considering both normal larval growth (countings) and the kind of abnormalities (multi-variated analyses). The effects were also researched in pediveliger larva ready to metamorphose (calculations of metamorphosis rates). For metamorphosis test, we optimized Coon & Bonar’s protocol because of the difficulty to count moving larvae. For each endpoint (embryo-larval development and metamorphosis rates), results of 4 experiments allowed us to determine the EC₅₀ values. As regards embryotoxicity, 2 kinds of Roundup appeared about 10-fold more toxic than glyphosate and AMPA and the toxicity of 2MC reached 3-5 fold of those active substances. In the metamorphosis assay, a similar result was recorded and, glyphosate, AMPA and mecoprop appeared little toxic (EC50 >100 mgL⁻¹). Finally, the comparison between the 2 larval stages generally showed a greater sensitivity of D larvae (embryotoxicity) compared to pediveliger larvae. For most of the molecules, results showed that embryotoxicity is more sensitive than the classic standardized acute toxicity Daphnia magna test. This work is the first part of a study which will be continued by long time exposures and will allow us to provide guidance on pesticide regulation in the frame of the European Directive “Marine Strategy“ (2008/56/CE).

TU 373

Ecotoxicity of nitrarnes, important transformation products of amines used in carbon capture

S.J. Brooks¹, C. Courtrix², A.M. Bruno³, M.D. Woldelahawari¹, H. Nielsen¹, J. Einsert¹, E. Joner¹, D. Oughton¹, K.E. Tollefsen²

¹Norwegian Institute for Water Research (NIVA), Oslo, Norway
²NIVA, Oslo, Norway
³University of Life Sciences, Ås, Norway

Due to the imminent use of amines in the CO2 capturing process from gas power stations in Norway, it is anticipated that the inputs of amines and transformation products into the marine environment will increase. The two main groups of transformation products with the most potential to cause environmental harm have been identified as nitrosamines and nitramines, both of which are considered to be carcinogenic. For each of these theoretical models we have found nitrarnine compounds, 2-nitropropane (CAS: 71486-82-6) and dimethylamino (CAS: 11464-28-7) to be present. However, despite the likelyhood of these compounds increasing in the environment, no environmental toxicity data for these compounds currently exists. Therefore, the first aim of this work was to provide an environmental risk assessment for these compounds taking into account the key trophic groups within freshwater and terrestrial environments. The toxicity assessment was made using a suite of standardised bioassays for the measure of acute and chronic toxicity, which found the ECELC50 concentration of the selected nitramine compounds to be in the low to mid mg/L range for all aquatic toxicity tests. In addition, the sub-lethal effects of these compounds was also investigated, using in a 3 tiered approach to assess the potential endogenic and carcinogenic effects of these compounds. Overall, data to develop the environmental risk assessment for these future environmental pollutants will be presented.

TU 374

Effects of arsenic on physiological parameters of mussels (Mytilus edulis) from the Scheldt Estuary (Belgium)

J.C.L. Ladewig¹, V.K. Mubanji², R. Blust³

¹Aveiro University, Aveiro, Portugal
²University of Ghent, Belgium
³University of Antwerp, Antwerp, Belgium

Mussels are marine organisms widely used as environmental biomonitorers, due to the ability to concentrate pollutants in their tissues with minimal metabolic transformations.
Arsenic is widespread in the marine environment and involves several chemical forms, principally as arsenate (As V), and to a lesser extent as arsenite (As III) in a more toxic form of arsenic. Arsenic introduced into the environment often contaminates aquatic ecosystems, where the residence time has been estimated at about 50 years. This study aims to determine whether exposure to specific heavy metal arsenic has an effect on the health of mussels. The effect of arsenic in mussels was analyzed in an experiment in which exposure concentrations of As(III) and one control for 10 days, during this period several physiological parameters were analyzed (Scope for Growth, energy reserves, body condition index, Mts and arsenic accumulated by the mussels). Arsenic does not seem to affect the physiological parameters of Mytilus edulis, but the organisms can accumulate As (III) proportionally to the concentrations that is exposed, especially at high concentrations. Several experiments were not carried out in relation to arsenic, but their experiments. The present study has shown that the arsenic accumulated in the body of mussels did not have adverse effects to the mussels, at least in a short period of time and for those physiological parameters measured, but after 10 days of exposure some parameters (lips and SFG) have positive correlation with arsenic in sea water, suggesting an effect of arsenic. Long-term experiments should be performed to really understand these effects.

TU 376

Metal exposure and associated effects in mussels: an integrated approach - hyphenated analytical techniques and biomarkers

H. Helmholz1, M. Erk2, D. Profrock2, Z. Strizel2, P. Krivanovic2, P. Prager1

1Universität der Bundeswehr, Munich, Germany
2Ruder Bošković Institute, Division for Marine and Environmental Research, Zagreb, Croatia

Metal exposure and effects on mussel physiology and associated biomarkers were studied. For this purpose, mussels Mytilus galloprovincialis were exposed to different concentrations of copper (Cu) and cadmium (Cd) in the laboratory. A set of biomarkers were applied: acetylcholinesterase (AChE) and glutathione S-transferases (GST) enzymatic activity, levels of lipid peroxidation (LPO), lysosomal enlargement (lysosomal volume density, Vv), cell type replacement (volume density of basophilic cells, VvBAS) in digestive gland epithelium, and damage of the lysosomal membrane stability (Lysosomal Degrading Rate, LDR).

Aim of the study was to assess the impact of copper pollution in coastal areas under direct or indirect influence of maritime activities and nautical tourism (port and marinas) using integrated multi-biomarker analytical approach. In this study, eight replicates of the indicator species Mytilus galloprovincialis were exposed to Cu concentrations of 10, 15, 30, 60, 120 and 300 minutes. The results revealed that the GLC and GST activities can be used as potential biomarkers of toxicity for active monitoring in marine coastal ecosystems.

TU 377

Glutathione S-Transferase, glutathione peroxidase and acetylcholinesterase activities in mussels transplanted to harbour areas

L.V. Bellas1, I.B. Bellas1, E.N. Ezebeharry1, O.N. Niero1, R.B. Beiras1

1University of Vigo, Vigo, Spain

Two populations of mussels were used for this study, one of which was transplanted to a polluted area and the other remained in a reference area. The activities of glutathione S-transferase (GST), glutathione peroxidase (GPx) and acetylcholinesterase (AChE) in mussels were analysed.

Exposure to As (III) caused a significant decrease in the activities of GST and GPx, while AChE activity remained unchanged. The activities of GST and GPx were inversely related to the As (III) concentration, while AChE activity showed a positive correlation. The results suggest that GST and GPx activities can be used as potential biomarkers of toxicity for active monitoring in marine coastal ecosystems.

361

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
Impact of suspended particles on bioavailability of petrogenic PAH in cod (Gadus morhua), mussels (Mytilus edulis) and passive samplers exposed to produced water

M. Mammalian species (mammals), with the major focus on the role of gills in absorption of waterborne PAHs. These studies revealed that gill biotransformation capabilities and PAH metabolites in fish. Due to the important role of gills for absorption of waterborne PAHs, a histophatological investigation of fish gills was conducted as a support study to confirm the results of the previous transplantation studies. The gills of fish were exposed to PAHs at different concentrations, and the histological changes in the gills were examined to assess the effects of PAH exposure on gill morphology.

Correlation of environmental factors with PAH levels was also investigated. The study found a positive correlation between PAH levels and pH, redox potential, and dissolved oxygen, and a negative correlation with organic matter. These findings suggest that environmental conditions such as pH, redox potential, and dissolved oxygen can influence PAH bioavailability and accumulation in fish gills.

The study also examined the effects of PAH exposure on fish biodiversity and health status. The results showed that the exposure to PAHs caused significant changes in the composition of the fish community, with a decrease in the diversity of species and a shift towards species more tolerant to PAH exposure. Furthermore, the fish exposed to PAHs showed signs of physiological stress, such as increased cortisol levels and changes in behavior.

The study concluded that PAH exposure can have significant impacts on fish health and biodiversity, and that efforts to reduce PAH pollution in aquatic environments are necessary to protect these valuable resources.

Extinction of environmental conditions to maximize mussels shell capability in trace metal accumulations

A. Zuan, S. Manente, G. Ravagnan

centre for Environment, Fisheries and Aquaculture Science (Cefas), Weymouth, United Kingdom

Nickel is a known mammalian carcinogen and mutagen, typically found at low concentrations in the marine environment (<1 µg l-1), but enriched at coastal locations near human activities such as mining and effluent discharge. The study aimed to determine whether nickel exposure affects nickel accumulation in mussel gills and to assess the potential effects of nickel on gill metabolism (activity of enzymes from glycolysis and Kreb's cycle).

The study used a multiple biomarker approach in the selected species. Alternative exposure to contaminated and clean seawater respectively was performed in order to record the different metal concentration trends in shell and soft tissues. In fact, it is demonstrated that once the metal is incorporated in the crystalline carbonate calccrete, its loss from the shell during mussel life is considered to be of no concern; in other hand it is known that soft tissues are able to release contaminants in response to changes in environmental conditions.

The study concluded that nickel exposure can have significant impacts on mussel health and biodiversity, and that efforts to reduce nickel pollution in aquatic environments are necessary to protect these valuable resources.
Exposure to some environmental contaminants, even for short periods of time, may cause serious damage to exposed individuals. Thus, to evaluate the possible effects of mercury in the sea snail Gibbula umbilicalis, acute and chronic assays were performed by exposing the animals to increasing doses of the contaminant for 96 and 168 hours. Mortality, feeding rates (indirect measure by post-feeding exposure egestion) and avoidance behaviour were assessed. In the end of the experiments, animals were sacrificed and cholinesterases’ activity and energy reserves were measured.

Although evaluated at individual level, the effects observed here might be translated to the population and community level, since feeding impairment and change in energy allocation may have effects on the organisms’ fitness, and reproductive performance. Moreover, modification in cholinesterases’ activity and its common link to behaviour shifts might lead to severe implications in population dynamics.

Results have shown that most of the parameters evaluated tend to be impaired by this factor contaminant, showing the deleterious effects that this compound may have at the population level and on marine life.

**TU 388**

**Investigation on differential sensitivity of marine mollusk to various doses of detergent**

T. Kuznetsova1, V.V. Trusevich2, S.V. Khokhlovich3,4, M. Kirin1,4, Russian Federation

Institute of Biology of Southern Seas, Sevastopol, Ukraine

The problem of anthropogenic impact on marine aquaria is one of the most actual nowadays. Synthetic detergents have been detected in municipal wastewater effluent and surface waters at different concentrations ranging from mg/l to low mg/l. Detergents occur in the environment as complex compounds and could cause potential risk for human and aquatic organisms. Few chronic ecotoxicological data are available with respect to deterrents’ effects in mussels. The critical issue is the choice of methods to determine concentration response threshold and the level at which deterrents are essential for organism health status.

Objective of the present study was to develop improved method for assessing potential effect of detergent agent (e.g., SDS - dodecylsulfate of sodium) on marine mussels’ cardiac activity and behavior. The study was conducted on adult 3-years mussel Mytilus galloprovincialis Lam. Continuous recordings of the heart rate and valve movements in the mussels were carried out in the laboratory under nearly natural conditions with running ambient seawater and addition of detergent. Previously, there had been reported that concentration of 1,7 mg/l detergent is the threshold for mussels to change their filtration activity. Our results have indicated that concentration of 0,5mg/l is the detected threshold limit of SDS in mussels, which could affect on heart rate and behavior (valve gap). In high concentrations detergent caused acute toxic action, which lead to rapid valve closure, isolation and subsequent bradycardia. Results have proved that implementation of behavioral and physiological biomarkers simultaneously could be effective tool to early detection stress exposure effects in marine organisms.

The study was partly supported by RFBR grant N 08-04-92124-BONUS_a.

**TU 389**

**Bio-monitoring trace metals in Mytilus galloprovincialis off the west coast of the Cape Peninsula, Cape Town**

C. Sparks1, J. Odendaal2, R.G. Smyns2,3, Cape Peninsula University of Technology, Cape Town, South Africa

The concentration of trace metals (Fe, Mn, Cu, Zn, Cd and Pb) in the mussel (Mytilus galloprovincialis Lam.) were measured along the west coast of the Cape Peninsula, Cape Town, from autumn 2010 to autumn 2011. Sampling took place at Scarborough (considered an unpolluted site), Hout Bay, Green Point, Milnerton and Bloubergstrand. The samples of whole animal soft tissue were analysed using an Atomic Absorption Spectrophotometer (AAS). Metals in M. galloprovincialis were significantly lowest at Scarborough and at the other sites differed significantly between seasons, with winter having the highest significant difference. The efficiency of metal accumulation was measured using the Biosediment Accumulation Factor (BSAF). The results showed that the BSAF was highest in Cd, Pb, Zn and Cu, with the lowest BSAF reported in Fe and Mn.

**TU 390**

**PAM chlorophyll a fluorometry, field and laboratory research for corals and seagrass along the coast of Qatar**

T. Jebril1, C.R. Richard2, A.D. Adeneke3, E.H. Hörlin4, J.M. Dumont5, E.D. Dutrieux6,1,2

ExxonMobil Research Qatar, Doha, Qatar

ExxonMobil Upstream Research Company, Houston, United States of America

A two year-long field program was conducted to evaluate the effectiveness of PAM (Pulse Amplitude Modulation) chlorophyll a fluorometry in monitoring the health of coral reefs and seagrass along the coast of Qatar. The technique was calibrated and validated as a means of assessing sub-lethal stress for coral in the region. The reduced photosynthetic rates of corals indicated by the PAM, without clear visual signs of stress, was generally witnessed by necrosis of parts of the colonies; this was visually verified in subsequent campaigns. Two PAM evaluation parameters; photosynthetic efficiency and Rapid Light Curves (RLC) were well correlated with visual observations on the health of the organisms. Furthermore, this work has suggested a critical threshold value applicable to photosynthetic efficiency for corals in this region of Qatar. For seagrass, there was correlative coverage; however, PAM measurements did not appear to provide as strong an indication of sub-lethal stress before deterioration as obviously as it does for corals. This research has now been integrated with laboratory studies utilizing both the diving PAM used in field research and the imaging PAM, which can measure photosynthetic processes and obtain detailed visual images of photosynthesis. Gulf coral collection and cultivation and its detailed monitoring were the first steps of corals (and seagrass) laboratory experimentation. PAM measurements were performed on the Acropora sp. colonies prior to and after collection. “Mother” colonies were tagged and photographed to document their recovery. PAM measurements were conducted in the laboratory in order to monitor the recovery of the nubbins after collection and transfer. Protocols for future coral experiments are being tested and adapted. Laboratory experimentation is also underway on seagrasses to better understand the driving factors that influence sustained photosynthetic performance for this important ecological resource.

**TU 391**

**Toxicity tests using bioluminescent Phytoplankton**

S.A.E. Kools1, B.E. Burger2, J. Appels3, J. Van den Dries1, B. Bjordal4, Grooten5,6, Amsterdam, Netherlands

1MicroLAN BV, Waalwijk, Nederland
2Assyst Consult, Aarhus, Denmark
3Assyst Consult, Aarhus, Denmark
4CREOCEAN, La rochelle, France
5SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting

The use of phytoplankton is currently increasing as an alternative strategy to assess macroalgae chronic toxicity - a case study with Ulva lactuca

D.L. Gomes1, D. Rodrigues1, L. Fonseca3, A.S. Cabecinhas1, J.L.T. Pestana3, M.E.L. Lemos3

1Politechnic Institute of Leiria, Peniche, Portugal
2Department of Biology and CESAM, University of Aveiro, Aveiro, Portugal
3ESTM and GIRM, Polytechnic Institute of Leiria, Peniche, Portugal

In the field of research assessment of chemicals entering the marine environment, tools are needed as the pressure of several pollutants impacts marine and estuarine ecosystems. Relevant sources may be the chemicals from gas/oil production platforms and sea-side refineries. The discharge of compounds to the marine environment will be receiving additional attention in the EU Marine Strategy and rapid assessment tools are needed. In the field of risk assessment of chemicals entering the marine environment, tools are needed as the pressure of several pollutants impacts marine and estuarine ecosystems.

**TU 392**

**Development and validation of a colorimetric methodology to assess macroalgae chronic toxicity**

C.R. Richard2,1, E.B. Burger2, J. Appels3, J. Van den Dries1, B. Bjordal4, Grooten5,6, Amsterdam, Netherlands

1MicroLAN BV, Waalwijk, Nederland
2Assyst Consult, Aarhus, Denmark
3Assyst Consult, Aarhus, Denmark
4CREOCEAN, La rochelle, France
5SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting

...
contaminants. Since they represent a very large biomass, they can act as an important sink for contaminants becoming a gateway for higher trophic levels. Moreover, it is known that macroalgae, especially estuarine, are very important in the aquatic system due to several aspects: easy to find and to identify, vast biomass percentage and great bioindicators, making them potential sentinel of to monitor xenobiotics in aquatic environments.

Macroalgae presence or absence, as well as their look-like may reflect the current state of the marine ecosystem, thus it is mandatory to develop new tools and methodologies to quickly and cost-effectively assess their status. The green macroalga Ulva lactuca was used as a model species, when exposed to xenobiotics, can show signs of decay by losing their colour and their textural properties, and because of these they are assessed by visual observation. To be sure the algae are in decay and correctly assessed to quantify it, a new method was developed by measuring the colour across a colour scale. For this a colorimeter (Chroma Meter CR 400/410- Konica Minolta) was used and color variations calculated when exposed to contaminants. Also its validation by measuring photosystem electron transfer in exposed macroalgae was performed.

The methodology revealed to be sensitive and an effective measure of xenobiotic toxicity and a prospective tool for environmental risk assessment.

TU 393

Analytical and environmental distribution of organic micropollutants in urban protected salt marsh areas
M.G. Pintado-Herrera, E. González-Mazo, P.A. Lara-Martin
University of Cadiz (Spain), Puerto real (cádiz), Spain

Coastal areas are the most of the marine organisms and species compared to open ocean areas. However, they are often heavily affected by human activities that can jeopardize their populations. Therefore, contamination by organic compounds discharged by nearby industries and cities has attracted considerable attention from multiple perspectives. Our first objective in this work was to develop a fast, easy and low-cost consumption multiresidue method for the simultaneous identification and quantification of a wide variety of classic and emerging pollutants that often impact coastal marine systems. Stir bar sorptive extraction (SBSE) and liquid desorption (LD) was coupled to gas chromatography tandem mass spectrometry (GC-MS/MS) used for determining polymeric aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), organochlorine and organophosphorous pesticides, trazaines, plasticizers and some personal care products (triclosan, UV filters and fragrances). Briefly, 10 mm stir bars coated with a polypropylene membrane (PDM) was exposed for 15 min to a flask containing water samples (100 mL) and stirred for 24 hours at room temperature. Then, bars were sonicated during 30 min using a reduced amount of ethyl acetate (0.2 mL) to release the analytes. This extract was analyzed by GC-MS/MS, so sub-ppb levels could be detected. Several parameters were optimized: extraction and desorption time, ionic strength, presence of organic modifiers, pH and MSMS transitions. The second objective was applying this method to characterize the presence and distribution of micropollutants in two protected salt marsh areas from SW Spain that are adjacent to cities (Cadiz and Huelva, respectively). 20 water samples were collected at each area during summer 2011. Concentrations were often below 1 µg/L for most analytes; nevertheless some of them such as triclosan (up to 0.3 µg/L) can act as endocrine disruptors and affect marine organism populations after chronic exposure. Overall, results from this study provide an overview on the state of the two sampled marine environments with respect to chemical pollution, being useful for carrying out future toxicological assays with native species.

TU 394

Mixture toxicity of anthropogenic and natural organic pollutants in marine micro-algae
1University of Amsterdam, Amsterdam, Netherlands
2University of Eastern Piedmont "A. Avogadro", Alessandria, Italy
3University of Piemonte Orientale, Alessandria, Italy
4Thetis s.p.a., Venice, Italy

Nowadays, anthropogenic activities have resulted in accumulations of inorganic and organic pollutants in the environment as well as in the food chain, hence leading to serious ecological and human health problems. This may pose a risk to benthic and epibenthic organisms and it is crucial to discover tools that will identify adverse effects of stressors acting on benthic communities as well as to toxicity mechanisms to biological effects. Due to their nature as a eukaryotic cell organism and their position in the food web, ciliate protists have been proposed for evaluating the biological effects of chemicals in living organisms as well as in estimating pollution levels in aquatic environments. Lethal and sub-lethal effects of exposure to inorganic and organic pollutants were tested on cell mortality, replication rate, lysosomal membrane integrity and endocytic rate of the marine eukaryote E. crassus. Increasing concentrations of mercury, copper, and benzo(a)pyrene, individually and as mixtures, were investigated in our study as they might be bioavailable in naturally occurring polluted sites. Exposures to binary mixtures of all studied pollutants were performed showing both inorganic-organic and inorganic-inorganic additive and/or antagonist effects. Moreover, medium salinity was also varied to mimic estuarine-like environmental conditions, with respect to their responses to toxic pollutants. Results showed that the toxicity of E. crassus was increased by the organic pollutants and increased by the inorganic pollutants, being E. crassus increasingly more sensitive when both inorganic and organic pollutants were added. Furthermore, the additive or synergistic effect was observed for the binary mixtures of Hg, Cu, and Zn, where for instance the mixture of Hg and Cu showed a synergistic additive effect, while the mixture of Zn and Cu showed synergistic effect. The results also showed that the toxicity of Cu was more sensitive to Zn than to Cd. Photosystem II efficiency was less sensitive to the metal(mixtures) than photosystem I. The work represents a very important tool to quickly and cost-effectively assess their status.

TU 395

The use of protozoa in ecotoxicology: from biological model to environmental biomonitoring application
A. Gomiero1, S. Storzini2, A. Dagnino3, C. Nasci4, A. Viarengo5
1University of Eastern Piedmont "A. Avogadro", Alessandria, Italy
2University of Piamonte Orientale, Alessandria, Italy
3University of Amsterdam, Amsterdam, Nederland
4Cape Peninsula University of Technology, Cape town, South Africa
5University of the Western Cape, Cape town, South Africa

Toxicity experiments with theRobben Island dominant speciesThalassiosira pseudonana were determined after three days of exposure to Cu, Zn and equitoxic mixtures of Cu+Zn, composed according to the Toxic Unit concept. Our analysis of laboratory experiments underlined that, due to the short time and simplicity of the test procedures, the use of protozoa such as E. crassus is a promising and biocumulative bioindicator for evaluating the toxicity of different environmental matrices like pore water, sediments and wastewaters - polluted by heavy metals and organic pollutants. To validate the laboratory experiments a pilot biomonitoring program was performed in the Vence Lagoon, a protected coastal area characterized by high levels of heavy metals and organic pollutants. This was achieved by sampling water, using a combination of physical fractionation, metal photooxidation and elutriate chemical analyses. Overall outcomes were able to discriminate a gradient of stress in the four investigated sites. Furthermore, biological responses were linked to the specific occurrence of a certain class of pollutants in both sediments and elutriates.

TU 397

Can foraminifera be reliably used as environmental indicators?
E. R. Lourens, G. Rabu
1, 2, 3, 4

1Cape Peninsula University of Technology, Cape town, South Africa
2University of the Western Cape, Cape town, South Africa
3Stellenbosch University, Stellenbosch, South Africa
4University of Stellenbosch, Bellville, South Africa

The aim of this study was to investigate if foraminifera could be reliably used as environmental indicators. Foraminiferal assemblages were combined with sediment grain size distribution for the study of the Cape Peninsula near Cape Town, South Africa. The study was carried out in the period from January 2011 to December 2012. A total of 81 samples were collected along a transect of 11 sites. The samples were collected using a 2 L Niskin bottle. Analyses were performed at the Stellenbosch University core laboratory. The abundance, richness and diversity was calculated using the Shannon-Wiener index (H’), the Simpson diversity index (λ) and the equitability index (E). The species diversity, richness and abundance were negatively correlated with environmental factors and because it is considered an opportunist.
These results highlight that protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecotoxicology.

Investigations into the response to environmental stress in 

Carcinus maenas due to a great physiological plasticity notably. However, the compensation capacities that underlie tolerance to stress may be impacted by the life history of crabs in terms of exposure to pollutants notably. In addition to the chronic exposure to contaminants, a new insult is indeed likely to generate a too high degree of stress that would overwhelm resistance capacities of organisms.

Conversely, the protein ubiquitination profiles in the tissue of 

Carcinus maenas following a 7-day laboratory exposure. Effects of FLU on oxidative stress biomarkers were also investigated. Crabs were collected from a low impacted estuary. In the lab they were acclimated (7d) in filtered seawater (15 psu; 16ºC) and exposed individually (9 per treatment) to 5 FLU concentrations between 1.90-75 µg L-1. At the end of the bioassay, crabs were anaesthetized and samples of digestive gland were collected for biomarker determinations: glutathione-S-transferases (GST) and glutathione reductase (GR) activities, levels of total glutathione (GT) and lipid peroxidation (LPO), and FLU metabolites as measured by fixed wavelength fluorescence (FF). The remaining whole soft tissues were used for chemical analysis of FLU by GC-MS. The results show a strong concentration-dependent accumulation of FLU (measured by GC-MS, b = 5.21, P < 0.001, R2 = 0.993) in the soft tissues and FLU metabolites (measured by FF, b = 6.09, P = 0.002, R2 = 0.931) in the digestive gland. A strong positive linear relationship (b = 1.15, P = 0.003, R2 = 0.911) between accumulation of FLU (GC-MS) and FLU-type metabolites (FF) was also found. GST activity and TG levels were significantly increased in crabs exposed to concentrations ≥12 µg L-1 compared to controls. GR activity was not significantly modified by FLU exposure. GST activity and levels of LPO were decreased in crabs exposed to FLU. The results obtained show that FLU exposure induces a significant toxic effect on crabs.

The Toxocins of mercury in natural populations of the sea anemone Actinia equina

University of Le Havre, Le Havre, France

Carcinus maenas (L.) represents one of the most common crab species and a key component of littoral ecosystem in European shores. The wide geographical distribution of populations, their presence in pristine as much as heavily polluted areas and their intertidal location reflects a remarkable ability to cope with different stresses, due to their great diversity and flexibility in adaptation and compensation capacities that may be impacted by the life history of crabs in terms of exposure to pollutants notably. In addition to the concentration of pollutants to contaminants, a novel insult is indeed likely to generate a too high degree of stress that would overwhelm resistance capacities of organisms. To fully understand and assess how toxic exposure to pollutants affects the resistance capacities of 

Carcinus maenas to stress, we imposed a 4-days air exposure to crabs sampled in a polluted area, Le Havre harbour, and in a clean area, Yport rocky shore (France) and analysed stress markers as well as proteome variations in gills. For each site, antioxidant activities (catalase, superoxide dismutase, glutathione peroxidase, glutathione reductase, glutathione S-transferase), protein expression (2D-electrophoresis, SDS 12% polyacrylamide gels, pH 3-10) and polychromatiquation (immunoblotting of 2DE gels, ECL detection) profiles of air-exposed crabs were compared to those of control individuals that were chronically kept in water. Crabs from Le Havre showed a higher mortality rate (5%) than crabs from Yport (0%) in the course of the experiment, but no difference was found between air-exposed and control groups whatever the sampling site. Results indicate an altered resistance capacity in crabs living in Le Havre harbour in comparison with those from the clean site Yport. The protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecotoxicology.

Proteins whose expression and/or ubiquitination level are affected by crab location will be subjected to identification by mass spectrometry, in order to further elucidate the mechanisms involved in pollutant response.

TU 401

Does contamination impact the shore crab (Carcinus maenas L.) resistance to an additional stress? An insight through a multiparametric approach

F. Fanchon, J. Letendre, X. Denier, F. Bultelle, B. Rocher, F. Leboulenger, F. Durand

University of Le Havre, Le Havre, France

The shore crab 

Carcinus maenas (L.) represents one of the most common crab species and a key component of littoral ecosystem in European shores. The wide geographical distribution of populations, their presence in pristine as much as heavily polluted areas and their intertidal location reflects a remarkable ability to cope with different stresses, due to their great diversity and flexibility in adaptation and compensation capacities that may be impacted by the life history of crabs in terms of exposure to pollutants notably. In addition to the concentration of pollutants to contaminants, a novel insult is indeed likely to generate a too high degree of stress that would overwhelm resistance capacities of organisms. To fully understand and assess how toxic exposure to pollutants affects the resistance capacities of 

Carcinus maenas to stress, we imposed a 4-days air exposure to crabs sampled in a polluted area, Le Havre harbour, and in a clean area, Yport rocky shore (France) and analysed stress markers as well as proteome variations in gills. For each site, antioxidant activities (catalase, superoxide dismutase, glutathione peroxidase, glutathione reductase, glutathione S-transferase), protein expression (2D-electrophoresis, SDS 12% polyacrylamide gels, pH 3-10) and polychromatiquation (immunoblotting of 2DE gels, ECL detection) profiles of air-exposed crabs were compared to those of control individuals that were chronically kept in water. Crabs from Le Havre showed a higher mortality rate (5%) than crabs from Yport (0%) in the course of the experiment, but no difference was found between air-exposed and control groups whatever the sampling site. Results indicate an altered resistance capacity in crabs living in Le Havre harbour in comparison with those from the clean site Yport. The protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecotoxicology.

Proteins whose expression and/or ubiquitination level are affected by crab location will be subjected to identification by mass spectrometry, in order to further elucidate the mechanisms involved in pollutant response.

TU 402

Effects of mercury in natural populations of the sea anemone Actinia equina


-University of Aveiro, Aveiro, Portugal
-Departamento de Biologia & CESAM, University of Aveiro, Aveiro, Portugal
-CICS - UBI - Health Sciences Research Centre, University of Beira Interior, Covilhã, Portugal
-University of Aveiro & CESAM, Aveiro, Portugal

Mercury (Hg) is one of the most harmful heavy metals to biota, being capable of biomagnification and bioaccumulation in food chains. High concentrations of Hg were associated with developmental and behavioral abnormalities, impairment in growth and reproduction, and reduced survival. Though this metal has been extensively studied, several knowledge gaps still exist, mainly regarding its effects in different types of organisms. Accordingly, this study aimed at assessing the effects of a short-term exposure to Hg in four natural populations of the sea anemone Actinia equina from the northwestern coast of Portugal. From each population, forty individuals were collected in laboratory, under optimal conditions, for one month. Afterwards, organisms were weighed (7.09 ± 0.18 g mean ± SE), and using a flow-through system were exposed to 100 µg L-1 of Hg and to artificial sea water solely, during 96h. At the end of exposure, organisms were immediately deep-frozen (-80°C) until further analysis. The tissue of pedal disc was analyzed for bioaccumulation and biomarkers (biochemical: glutathione S-transferase-GST, catalase-CAT and lipid peroxidation-LPO and metabolic: lactate and alanine) to compare the uptake, oxidative damage and metabolic changes in the response patterns to Hg among the four populations were observed. With the two populations originated from sites with a higher Hg contamination showing a lower resistance capacity in crabs living in Le Havre harbour in comparison with those from the clean site Yport. The protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecotoxicology.

Proteins whose expression and/or ubiquitination level are affected by crab location will be subjected to identification by mass spectrometry, in order to further elucidate the mechanisms involved in pollutant response.

TU 398

Toxicological effects of three polybromodiphenyl Ethers (BDE-47, 99 and 154) on growth of marine algae Isochrysis galbana


CIMAR & ICBAS - University of Porto, Porto, Portugal

Polybromodiphenyl ethers (PBDEs) are highly persistent anthropogenic contaminants found in trace amounts in many environmental compartments far from their source areas, posing a risk to aquatic ecosystems. Our objective was to determine the relative toxicities of three BDE congeners such as BDE-47, 99 and 154 on marine phytoplankton alga Isochrysis galbana. For a highly sensitive endpoint: a 72h-inhibition of autotrophic growth rate was calculated according to standards methods. No observable effect concentration (NOEC) values were 2.53, 3.48 and 12.5 µg L-1 for BDE-47, 99 and 154, respectively and LOEC values were 5.06, 6.96 and 24.60 µg L-1 for BDE-47, 99 and 154, respectively. The calculated IC10 (the concentration inhibiting增长 growth rate by 10%) corresponded to 9.3, 12.78 and 54.6 µg L-1 for BDE-47, 99 and 154, respectively. The 50% inhibitions of growth rate (IC50) values were: 25.7 µg L-1 BDE-47, 30.0 µg L-1 BDE-99 and 243.7 µg L-1 BDE-154. Therefore, the acute toxicity of PBDEs on the growth of phytoplankton was BDE-154 > BDE-99 > BDE-47. Significant (p < 0.05) adverse effects were observed for all compounds at concentrations >15 µg L-1. Our results indicated that under laboratory conditions PBDEs were acutely toxic to seawater algae at concentrations near 10 µg L-1. However, further work is required to investigate long-term effects in these and other aquatic organisms.

TU 400

Tissue accumulation of fluoranthene and its metabolites in the shore crab Carcinus maenas in relation to oxidative stress

A.P. Rodrigues, K.K. Lehtonen, L. Guilhermino, L. Guimaraes

Finnish Environment Institute (SYKE), Marine Research Centre, Helsinki, Finland

CIMAR - University of Porto, Porto, Portugal

Concern around contamination of the aquatic environment by polycyclic aromatic hydrocarbons (PAHs) is high due to their toxic, carcinogenic, mutagenic and/or teratogenic effects. Fluoranthene (FLU) is a priority PAH that is frequently detected in sediments, water and biota of European estuaries. It is a persistent and an important lipophilic compound. These results highlight the usefulness of protein ubiquitination assessment as a potential approach to evaluate and gain insight into stress response in marine organisms. Protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecotoxicology.
A short-term in situ sediment assay based on the postexposure feeding of the estuarine isopod Cyathura carinata

M. Martinez-Varo, M. Moreira-Santos, R. Ribeiro
IMAR, Coimbra, Portugal

In situ assays based on feeding depression have been proposed as sublethal assays which allow to assess direct and immediate contaminant effects on key ecosystem functions (e.g., organic matter decomposition, grazing), long before direct effects on individuals (e.g., growth) are extrapolated to effects at higher levels of biological organization - the traditional feeding test method suffers from the selection bias of test organisms conducted under laboratory controlled conditions, which is particularly relevant for estuarine ecosystems where environmental conditions are highly variable. In this context, the objective of the present study was to develop and evaluate a short-term cost-effective in situ sediment assay based on the postexposure feeding of an estuarine species widely distributed and with an important ecological role in estuarine foodwebs. The selected species was the benthic isopod Cyathura carinata, a secondary producer, prey to fish and birds, occurring along the North Atlantic coast and in the Baltic and Mediterranean seas. The methodology for feeding quantification was first developed and optimized under laboratory conditions with Artemia franciscana (Crustacea) nauplii. Then, the sensitivity of the postexposure feeding response to a reference chemical - cadmium - was compared to that of lethal bioassays during a 48-h period. Finally, the postexposure feeding assay was evaluated by deploying organisms in chambers at reference and contaminated Portuguese estuaries (Mira and Sado Rivers, respectively). The influence of different exposure conditions (sediment particle grain size, temperature, salinity, and food availability) was also taken into account through a multiple regression model, with the ultimate goal of discriminating contaminant effects from those due to environmental factors. The in situ postexposure feeding assay with C. carinata was found to be a potential useful cost-effective tool for estuarine sediment toxicity assessments.

TU 404

Toxicity of the biotransformation products of four methylated PAHs and one PAH produced by Nereis diversicolor and Nereis virens

A.G. Hansen¹, R. Fernandez-Varela¹, L. Malmquist¹, J.H. Christensen¹
'Copenhagen University, Copenhagen, c. Denmark
²Roskilde University, Roskilde, Denmark

Risk assessments of spilled oil generally focus on the content of specific PAHs in a contaminated site. When the content of these compounds are below the set limit, elimination of the contamination has succeeded. However, when spilled oil is biotransformed, a wide range of water soluble products are created. These compounds can reenter the sediment by deconjugation reactions, but can also act as toxicants in the water column. If these transformation products are toxic, they do not only expose organisms in the water, they are also subjected to spreading in the environment in a much larger scale.

The objective of this study is therefore to: 1) assess the toxicity of the biotransformation products of 1-methylphenanthrene, 3,6-dimethylphenanthrene, 1-methylpyrene, 5-methylchrysen and phenanthrene produced by the two benthic invertebrates Nereis diversicolor and Nereis Virens, and 2) identify the most important water soluble transformation products.

The biotransformation products from PAH exposed N. diversicolor and N. Virens were collected by extracting the test water of laboratory mesocosms exposures at different times, the water soluble biotransformation products were extracted and concentrated by SPE, and their toxicity (EC50) were determined by exposing Daphnia magna to dilutions of these extracts. The water soluble biotransformation products were identified and quantified by UHPLC connected in series to a fluorescence detector and a Quadrupole Time of Flight Mass Spectrometer. To aid the identification enzymatic deconjugation of the phase II products was performed, and identified by use of Gas Chromatography/Mass Spectrometry (GC-MS).

This work presents a novel approach to test the toxicity of transformation products of a contaminant mixture, where organisms are exposed to the entire range of biotransformation products. Also, this work shows the changes in toxicities of the transformation products as transformation of the PAHs progresses, and gives insight to the mechanisms of biotransformation of alkylated PAHs.

TU 405

Vitellogenin and Zona Radiata gene expressions in three different species of catfish from Termíno Lagoon

O. Zapata-Pérez, A. Meléndez-Zempoalteca, J. Rubio-Piña, A. Garcia-Fuentes
CINVESTAV-IPN, Merida, Mexico

In an attempt to explain the differences in the Vitellogenin and Zona Radiata gene expressions of three different species of catfish (Ariopsis felis, Bagre marinus and Cathorops melanopus) collected in the Laguna de Termíno, 70 fish were collected at different sites of the lagoon and were dissected to obtain liver. Total RNA was extracted using the Trizol method along with purification with the DNase enzyme. Specific primers of Vitellogenin and Zona Radiata genes were custom designed to amplify and isolate two parts of the fragments from Ariopsis felis, Bagre marinus and Cathorops melanopus liver tissues. Gene expressions were analyzed using amplification with Reverse Transcripatase-Mediated Polymerase Chain Reaction (RT-PCR) and results showed statistical differences between Vitellogenin and Zona Radiata values for fish collected at Lagoon de Termíno. Data from this experiment show that Vitellogenin gene expressions were more sensitive than the ZR, under normal conditions in the environment. Future studies will be focused on understanding the reproductive cycle and the genetic variability of these fish.

TU 406

Polydominated diphenyl ethers and their methoxylated analogs in sea bass (Dicentrarchus labrax) from Bizerte Lagoon, Tunisia

M.R. Driss, W. Ben Amere
Faculty of Sciences Bizerte, Zarzouna, Tunisia

Concentrations of diphenyl ethers (PDEs) and methoxylated polidomedinated diphenyl ethers (MeO-PDEs) in sea bass (Dicentrarchus labrax) collected from the Bizerte Lagoon and the Mediterranean Sea (reference site) were investigated. To the best of our knowledge, this is the first report of these compounds in marine fish from Tunisia. Concentrations of 3PDEs ranged from 37.3 to 218 ng g⁻¹ lipid weight (lw) for sea bass in Bizerte Lagoon, whereas in the Mediterranean Sea, concentrations ranged from 20.8 to 36.6 ng g⁻¹ lw. BDE-47 was the major congener in samples from the two areas. Mean levels of MeO-PDEs ranged from 49.4 to 798 ng g⁻¹ lw in Bizerte Lagoon and in the Mediterranean Sea, the mean concentration of these naturally produced organohalogen compounds was 482 ng g⁻¹ lw. The total PDEs and total MeO-PDEs concentration in sea bass from Bizerte Lagoon was similar or slightly lower than those reported for other species from different locations around the world. No significant correlations were found between the organohalogen compounds levels and the fish characteristics.

TU 408

Seasonal pollutant monitoring in discarded fish species: is valorisation appropriate?

T.O. Ordoñez¹, T. Antelo², A.F. Franco³, A. Alonso⁴
¹INSTITUTO DE INVESTIGACIONES MARINAS - CSIC, Vigo, Spain
²IM - CSIC, Vigo, Spain

Increased by-catch utilisation interest may come from a greater demand for fish products: the development of new markets for previously discarded species, use of low-value by-catch specimens for aquaculture and animal feed or the creation of value-added products from by-catch or discarded fish for food, pharmaceutical or cosmetic industries.

However, the contribution to a sustainable management of this biomass through their optimal valorisation highly depends on the quality of the products to be obtained from them.

Many studies in the scientific literature, like surveys of fish and fish products in markets of different countries [1] or monitoring reports of Public Administrations and the EU [2] reported significant levels of this kind of pollutants (especially of dioxins, polychlorinated byphenyls-PCBs, organochlorinated pesticides-OCs and heavy metals) in several cases for commercial species of different fisheries, and also in species that are not usually considered to be commercially interesting, the presence of contaminants in other non-commercial species, although contamination levels in these non-targeted and/or discarded species are not usually assessed. However, a sustainable management of discards passes through the evaluation of their pollutant content, especially if it is considered that the products of discard valorisation are mainly concentrates (as fish oil and meal), Pollutants contained in the raw material are usually present at lower concentrations in the valorised product, especially if the product has a high fat content. In fact, some marine valorised by-products present pollutant levels of concern [3].

In this sustainable framework, FAROS project, co-funded by the LIFE+ Environmental Program of EU (LIFE08 ENV/ES00019), aims as one of its main objectives to analyse the potential of discards for fish production, in order to contribute to their sustainable management by minimizing discards by-catch through their optimal valorisation to recover and to produce valuable chemicals of interest in the food and pharmaceutical industry [4]. To properly define these adding-value processes, monitoring of metals, PCBs and dioxins are being performed, monitoring of metals, PCBs and dioxins are being performed, monitoring of metals, PCBs and dioxins are being performed.

TU 409

First evidences of suboptimal health status of red mullets from the priority polluted Mediterranean area of Portman (SE Spain)

C. Violante-Gomez¹, J. Bernal², J.J. Valderos³, J.A. Campillo¹, V.M. Lleoní, D. Verhaak²
¹IIM - CSIC, Vigo, Spain
²VU University of Amsterdam, Amsterdam Global Change Institute, Institute for Environmen, Amsterdam, Netherlands
³Universidade de Santiago de Compostela, Spain

Increased by-catch utilisation interest may come from a greater demand for fish products: the development of new markets for previously discarded species, use of low-value by-catch specimens for aquaculture and animal feed or the creation of value-added products from by-catch or discarded fish for food, pharmaceutical or cosmetic industries.

However, the contribution to a sustainable management of this biomass through their optimal valorisation highly depends on the quality of the products to be obtained from them.

Many studies in the scientific literature, like surveys of fish and fish products in markets of different countries [1] or monitoring reports of Public Administrations and the EU [2] reported significant levels of this kind of pollutants (especially of dioxins, polychlorinated byphenyls-PCBs, organochlorinated pesticides-OCs and heavy metals) in several cases for commercial species of different fisheries, and also in species that are not usually considered to be commercially interesting, the presence of contaminants in other non-commercial species, although contamination levels in these non-targeted and/or discarded species are not usually assessed. However, a sustainable management of discards passes through the evaluation of their pollutant content, especially if it is considered that the products of discard valorisation are mainly concentrates (as fish oil and meal), Pollutants contained in the raw material are usually present at lower concentrations in the valorised product, especially if the product has a high fat content. In fact, some marine valorised by-products present pollutant levels of concern [3].

In this sustainable framework, FAROS project, co-funded by the LIFE+ Environmental Program of EU (LIFE08 ENV/ES00019), aims as one of its main objectives to analyse the potential of discards for fish production, in order to contribute to their sustainable management by minimizing discards by-catch through their optimal valorisation to recover and to produce valuable chemicals of interest in the food and pharmaceutical industry [4]. To properly define these adding-value processes, monitoring of metals, PCBs and dioxins are being performed, monitoring of metals, PCBs and dioxins are being performed, monitoring of metals, PCBs and dioxins are being performed.
TU 410
Characterization of selected Metals in United Arab Emirates coastal fish and locally produced vegetables
F. Samara, Q. Shabaz, S.L. Knutson, K. Abbasi
American University of Sharjah, Sharjah, United Arab Emirates
Heavy metal pollution of the marine environment has long been recognized as a serious environmental concern. A lack of published literature on heavy metals contamination of local fish and proper fish advice in the United Arab Emirates (UAE) is in current need. Moreover, seafood and locally produced vegetables comprises a major portion of local daily consumption. An assessment of the contamination of selected metals including arsenic, cadmium, lead and mercury was made in several UAE food products such as fish, seafood (sardine, sable, trakey, trevaly), mushrooms, cucumbers, peppers, among others) using Inductively Coupled Plasma-Optical Emission Spectrometry (ICP-OES). The concentration levels were dependent on the food type and metal tested. For example, arsenic was found in sardine and shakelie at concentrations of 0.0241 mg/kg and 0.0298 mg/kg, respectively. The lowest arsenic concentration was obtained in peppers at 0.089 mg/kg. This data provides preliminary information for the further formulation of health risk assessments for the community of UAE.

TU 411
Sediment-contact exposure of medaka eggs to a PAH model: combined chemical, toxicological and proteomic approaches
L.N. Vicquelie1, J. Cachot1, J. Letendre2, K. Lemenach2, S. Olivier5, B. Rocher2, P. Chan1, D. Vaudry1, H. Budzinski1, J. Leray1
1University of Le Havre, Le havre cedex, France
2LPPT, Talence, France
3Protoxic platform of IFRPM 23, Rouen, France
4INSERM U982, Rouen, France
5European systems research institute for fish and nursery areas for many fish species. They are nevertheless submitted to a high anthropic pressure, which is manifested by pollution. Among the most important pollutants are polycyclic aromatic hydrocarbons. The toxicity of these pollutants is related to cell physiology, fatty acid or protein metabolism and transport. Macroscopic and microscopic effects and/or regulations were dose-dependent, which suggest that fluoranthene is involved in a metabolic pathway that we could not determine with our proteomic exposure. We are designing and implementing the effects of PAHs on the developmental stages of zebrafish (Danio rerio) by using differential screening of the liver and heart tissue.

TU 412
Long-term incubation of adult Nereis virens (Annelida: Polychaeta) in copper-spiked sediment: the effects on adult mortality, gametogenesis, spawning and embryo development
J. Watson, N. Leach, G. Fones, J. Pini
University of Portsmouth, Portsmouth, United Kingdom
The impacts of copper on polychaetes have received considerable attention with many sub-lethal endpoints developed including effects on reproduction. However, no reproductive experiments with large polychaetes lasting longer than a few days have been attempted. N. virens is an ideal candidate for long-term parental exposure to copper, and in this study we examined the effects of copper on spermatogenesis and steriodogenesis. Hypoxia significantly increased cell death at 24h as measured by Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5). Flow cytometry showed that hypoxia significantly reduced cell viability. Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5).

TU 413
Oxidative stress, genotoxicity and histopathology biomarker responses in sea bass (Dicentrarchus labrax) liver from Bizerte Lagoon (Tunisia)
W.B. Ben Ameur1, J.C. Khatir1, S. Chakroun2, M. Rihani2, S. Olivier1, B. Rocher1
1Faculty of Sciences, Bizerte, Zarzouna, Tunisia
2Unit of Experimental Toxicology and Ecotoxicology, Parc Scientifc Barcelona, Barcelona, Spain
The aim of this study was to evaluate the impact of environmental contaminants on oxidative stress, genotoxic and histopathologic biomarkers in liver of sea bass (Dicentrarchus labrax) collected from a polluted coastal site (Bizerte Lagoon, Bizerte, Tunisia) in comparison to a reference coastal site (the Mediterranean Sea). To our knowledge this is the first study of enzymatic, histopathological and genotoxic biomarkers using biomarkers from fish liver for assessment in Tunisia coastal waters. Antioxidative enzymes and trypan blue exclusion were higher in fish from the polluted site compared with fish from the reference site, suggesting deficiency of the antioxidant system to cope with oxidative stress. DNA damage was higher in fish from the contaminated site indicating genotoxic effects. The histopathological analysis revealed alterations in fish from Bizerte Lagoon. Hepatocytes featured lipid-type vacuolation and membrane disruption. Results suggest that the selected biomarkers in the studied species are useful for the assessment of pollution impact in coastal environments influenced by multiple pollution sources.

TU 414
Effects of hypoxia on spermatogenesis and steroidogenesis of marine medaka (Oryzias melastigma) testsis: in an vitro study
Y.T. Lau, A.C.R. Tse, R. Wu
The University of Hong Kong, Hong Kong
Aquatic hypoxia (dissolved oxygen levels less than 2.8 mg O2/L) has become a major concern and more than 200 "Dead Zones" have been identified by the United Nations Environment Program worldwide. Hypoxia has been shown to be an endocrine disruptor, and impairs developmental and reproductive functions in fish. However, the detailed mechanisms of reproductive impairment of hypoxia have not been fully explored. Using primary culture of fish as a test system, we examined the effects of acute hypoxia (pH=8.0) on spermatogenesis and steroidogenesis. Hypoxia significantly increased cell death at 24h as measured by Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5). Flow cytometry showed that hypoxia significantly reduced cell viability and Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5). Flow cytometry showed that hypoxia significantly reduced cell viability and

TU 415
Toxic effects of ZnO nanoparticles towards marine algae Dunaliella tertiolecta
S. Manzo1, M.L. Miglietta2, G. Rametta3, S. Buono2, Gi. Fracchia1
1ENEA, Rome, Italy
2CNR, Portici (na), Italy
3CIRIaco, Portici (na), Italy
Dose response curve and population growth rate alterations deriving from the exposure to ZnO nanoparticles of the marine alga D. tertiolecta were evaluated. Bulk ZnO and dissolved zinc ions were also investigated for comparison. Growth rate was monitored during the experimental testing time. The results show that nZnO is more toxic (EC50: 2.42 (0.97-5.36) mg L-1, NOEC: 0.01 mg L-1) than its bulk counterpart (EC50: 4.45 (3.45-5.98) mg L-1, NOEC: 1 mg L-1). Cross-referencing the toxicity parameters for ionic zinc (EC50: 0.65 (0.36-0.70) mg L-1, NOEC: 0.01 mg L-1) and the dissolution properties of the ZnO it can be gather that the higher toxicity of nZnO cannot be ascribed exclusively to free zinc ions. Nonetheless growth rates of D. tertiolecta were not significantly affected by nZnO exposure. Our findings suggest that the pristine size of the dispersed particles affects the bioavailability and the overall toxicity

TU 416
PBDE accumulation in muscle of Whitmore Brook Croaker (Macroponogus furnieri) exposed to BDE 99 and BDE 153
C. Pieroni1, J. Leonelli2, F. Gilberto1
1Unit of Experimental Toxicology and Ecotoxicology, Parc Scientifc Barcelona, Barcelona, Spain
2GIP Seine Aval and University of le Havre
Our study was to evaluate the effects of acute hypoxia (pH=8.0) on spermatogenesis and steroidogenesis. Hypoxia significantly increased cell death at 24h as measured by Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5). Flow cytometry showed that hypoxia significantly reduced cell viability and Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5). Flow cytometry showed that hypoxia significantly reduced cell viability and Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5). Flow cytometry showed that hypoxia significantly reduced cell viability and Trypan Blue Exclusion (p<0.001, n=6) and flow cytometric analysis using propidium iodide (PI) (p<0.05, n=5). Flow cytometry showed that hypoxia significantly reduced cell viability and

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting 367
Polaribrominated Biphenyl Ethers (PBDEs) are flame retardants compounds widely used in plastics, textiles, furniture, electronics, automobiles, and many other materials. Although persistent and resistant to biodegradation, earlier studies have established that some fish can debrimate certain PBDE congeners. Whitmounger croakers (Micropogonias furnieri) are an important species in the Brazilian fishery industry. Therefore, it is important to understand the accumulation pattern of PBDEs in its muscle. During 30 days, 60 Whitmounger croakers were exposed to BDE 99 and BDE 153 through diet (100 ng fish^{-1} day^{-1}), followed by a 30 days period of depuration. At days 0, 1, 5, 10, 15, 20 and 30 muscle sample were collected from at least 3 fishes. Overall, the Whitmounger croaker exposure to BDE 99 ended up accumulating BDE 47 in their muscle, indicating their capacity for processing BDE 99. On the other hand, BDE 153 accumulated without any transformation.

TU 416
Inhibition of GST, GPx and AChE activities in marine mussels by exposure to the dissolved polaribrominated diphenyl ethers BDE-47
L.V. Vidal-Liñán1, J.B. Bellas1, J.F. Fumega2, R.B. Beiras1
1University of Vigo, Vigo, Spain
2Instituto Español de Oceanografía, Centro Oceanográfico de Vigo, Vigo, Spain

The environmental presence of polychlorinated diphenyl ethers (PCDEs), among which BDE-47 is the most abundant, make toxicity data necessary to assess the hazard risk posed to aquatic ecosystems. In this paper, BDE-47 for 30 days exposure in the experiment phase, the mussels were allowed to depurate in clean sea water for 10 days. Samples were collected at time 2, 5, 9, 15, 20 and 30 days of exposure to toxic. In a second experiment mussels were exposed for 30 days to three BDE-47 concentrations. In both experiments samples were used to measure glutathione S-transferase (GST), glutathione peroxidase (GPx) and acetylcholinesterase (AChE) activities. GST and GPx were inhibited after 20 and 30 days exposure, while AChE was inhibited already from the second day of exposure. After the 10 days recovery period in clean sea water the three enzymes recovered the initial levels of activity.

TU 417
Differential gene transcription in Pocellia vivipara exposed to copper
E.C. Ferreira1, E. Zacchi1, G. Toledo-Silva1, J. Mattos1, A. Machado1, T.S. Dorrington2, A. Bianchini2, A.C.D. Bain3
1Universidade Federal de Rio Grande, Rio Grande, Brazil
2Universidade Federal de Santa Catarina - UFSC, Florianopolis, Brazil
3Australian Antarctic Division, Kingston, Australia

The increasing industrial activities and the use of CuSO4 as a fungicide in agricultural practices, as well as in the control of algae and pathogens in fish culture ponds have raised the copper concentration in aquatic systems. Furthermore, occasional accidents have aggravated this situation introducing substantial amounts of copper into aquatic environments. Copper is accumulated mainly in the liver and excreted via bile and kidneys. The aim of this study was to identify genes differentially expressed in liver of Pocellia vivipara (Guppy) exposed to waterborne copper (20 µg Cu/L) for 24 h, employing the subtractive suppressive hybridization (SSH) method. Results showed that 65 genes fragments were differentially expressed, 37 of them up-regulated, the others down-regulated. The up-regulated genes were bile salt export pump, Complement Component 3c, CYP450, enolase, Apolipoprotein B, C1 and E, microsomal glutathione-S-transferase, NAD dehydrogenase, ubiquitin a-2, plasminogen and novel protein. The down-regulated genes were Apolipoprotein A1, Coagulation factor II, HSP70, Liver fatty acid Binding Protein, perine–pyruvate mitochondrial-like. The identified genes are associated with specific functions such as biotransformation, proteins, lipids and energetic metabolism, indicating the susceptibility and/or molecular responses of this organism to the toxic effects elicited following the trace metal exposure.

TU 418
Spatial distribution and accumulation patterns of cyclic methyl siloxanes (cVMS) in fish from Northern Norway
A. Warner1, T. Nøst2, G. Christensen1
1Norwegian Institute for Air Research, Tromsø, Norway
2Akvaplan-niva, Tromsø, Norway

Cyclic volatile methyl siloxanes (cVMS) have come under environmental scrutiny in recent years in regards to their potential persistence and bioaccumulative nature. As polycyclic aromatic hydrocarbons (PAHs) are used as silicones, cVMS are categorized as high production chemicals where they are used heavily within the personal care products and cosmetics, as well as other facets of industry (surface treatment agents, plasticizers, construction materials, mechanical fluids). Although the majority of cVMS emissions are to the atmosphere (90%), the remaining emissions are discharged via wastewater effluent into local watersheds and can accumulate in aquatic dwelling organisms. However, little data exists on the spatial distribution of cVMS in the aquatic environment. This study will investigate the spatial distribution of cVMS within Northern Norway and if physiological factors (e.g., age, body length, weight) have an effect on cVMS accumulation within fish. Atlantic cod was collected in 2010 and 2011 near the city of Tromsø (site A) and 30 km north of the city (site B) in Northern Norway. All cVMS were detected in cod livers sampled with highest median concentrations for D5, followed by D4 and D6. Significantly higher median concentrations for octamethylcyclocelasiloxane (D4) and decamethylcyclopentasiloxane (D5) were observed in fish collected at site A (D4: 60 ng/g lw; D5: 1380 ng/g lw) compared to site B (D4: 10 ng/g lw; D5: 139 ng/g lw). However, no significant differences were observed in the spatial distribution for dodecamethylcyclohexasiloxane (D6) between sampling sites. Concentration of D5 within cod liver was found to be negatively correlated with age. No correlation was seen between D4 and D6 concentrations and age; however, no significant correlations were observed for body length and weight. Concentrations of D4 and D5 significantly decreased away from point sources indicating rapid elimination of these chemicals within fish. No significant differences in concentration for D6 between sampling sites may indicate greater persistence of this chemical to elimination processes. Decreasing cVMS concentrations with age (D5), body length and weight (D4 and D6) may be an effect of enhanced metabolic activity and/or growth dilution within older fish.