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

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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 quality, gonadal development, VTG, 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 in a tiered and novel regulatory framework for combined sewer systems, which may or may not be adverse, 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, potentially adverse impacts of the study site can 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 from 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

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Catalonia Water Agency (ACA) conducted three different campaigns in 2008, 2009 and 2010. A total of 41 micropollutants belonging to different families were assessed in the effluents discharged 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 after a storm event we showed that this storm event induces an increase of fluxes by a factor of 1.5 to 5 compared to dry conditions. Half to two thirds of pollutants fluxes were adsorbed 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 by the WWTPs 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.

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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 (IPR/ETR), and at harmonising the different national databases and forms of management of the assessment of the nature and amount of emissions from the assessed installations. The results of the preliminary campaigns were 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 from the extensive aquatic database for BPA.

TH 304 Simulated equation allows assessment of biodegradation of cationic surfactants in activated sludge reactors (OECD 303)

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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 is important for the selection of suitable treatment processes.

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 equations are used to calculate maximum concentrations in activated sludge wastewater. These concentrations are used in the determination of the sludge mass balance for the CAS unit:

\[ C_{\text{surfactant max}} = \frac{SRT}{HRT} \times \left( C_{\text{surfactant influent}} - C_{\text{CSTR out}} \right) \]

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 with varying adsorption capacities (decylamine, tetradecylamine, octadecylamine, dioctadecylmethylamine and dioctadecyldimethylammonium chloride) was assessed in CAS tests. The removal from the wastewater ranged from 98.8% (dioctadecylmethylamine) to 99.9% (decylamine). Removal by biodegradation was 69% (dioctadecylmethylammonium salt) to 99.9% (decylamine). These removal percentages were compared with modelling results obtained with SimpleTreat. SimpleTreat not only reproduces 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 appreciated by SimpleTreat. The expression should be included in an update of the test guideline.

TH 305 Predictive modelling of steroid oestrogens in sewage effluent demonstrates the potential for endocrine disruptive effects in wild fish populations in South Australia

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Endocrine disruption (ED) has been observed in wild fish populations worldwide and is particularly well characterised in the UK, where the presence of oestrogens in the male sperm of the female-spawned spawning season in wild rough sea bass (S. melops). These phenotypes have been linked to sewage effluent containing the natural oestrogens 17β-estradiol (E2) and oestrone (E1) as well as the pharmaceuticals 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 PECs 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 1 ng/L E2. Predictive modelling was shown to provide a good method for first tier assessment in the determination of the measured EEQ by an average factor of 1.4 when corroborated with the more robust UK STW data, however the effluent EEQ PECs for all STWs were 3-11 times higher than the 1 ng/L PNEC. The model demonstrated that although Australian STWs serve a lower population, their EEQs 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 dilution factor. The results predict that effluents discharged in both the UK and Australia both contain oestrogens at concentrations exceeding the Environment Agency PNEC, suggesting that without sufficient dilution in rivers there is a risk of ED effects occurring in wild fish.

TH 306 Inputs of pollutants by urban wet and dry weather pollution in combined sewer systems: pau urban catchment (CDAPP, France)

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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 are often considered the main source of PAHs, Pb, As and other toxic trace elements emitted into the aquatic environment. They are of great importance to the aquatic environment, as they are representative for today important sources of pollution to the aquatic environment. Wastewater treatment plants represent a major threat to the aquatic environment since they collect a wide variety of sources from both domestic and industrial activities and they are continuously discharging various polluted effluents. Urban or diffuse pollution which is considered a transient source may be transported either to the wastewater treatment 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 collect a wide variety of sources from both domestic and industrial activities and they are continuously discharging various polluted effluents. Urban or diffuse pollution which is considered a transient source may be transported either to the wastewater treatment plants or directly to the aquatic environment.

Urban or diffuse pollution which is considered a transient source may be transported either to the wastewater treatment plants or directly to the aquatic environment.

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

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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 B). Influents 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 62 studied compounds: acetaminophen (ACT), diclofenac (DIC), carazapamine (CBZ), sulfamethoxazole (SMZ), isomerop (IMP) and J7-estradiol (E2).

Fluxes were 3 times higher in WWTP-A for ACT, E2, SMZ and DIC, 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 DIC, SMZ and E2 were similar in both WWTPs. CBZ and IMP were respectively 10 and 183 times higher in WWTP-A. 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 (84-92%) and greatly varied in WWTP-B (8-56%).

Removal efficiencies were higher for all the rest of the compounds, with some significant differences. In WWTP-A, concentrations of CBZ, diclofenac and sulfamethoxazole were less than 5% of the influent concentrations.

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 evaluated were wastewater treatment plants (WWTP) effluents and river waters discharged to the sea. Polycyclic aromatic hydrocarbons, polychlorinated biphenyls, organonitrogenated pesticides, polychromatic diphenyl ethers, phthalates and alkylphenols were analyzed by solid phase extraction and gas chromatography coupled to tandem mass spectrometry. Eight WWTP effluents and six rivers discharge an estimated amount of around 25800 g d-1. The concentration of ΣOMP in coastal areas ranged from 17.4 to 8442 ng L-1.

Concentrations of CBZ and DIC were respectively 20 times 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 (84-92%) and greatly varied in WWTP-B (0% to 96%).

Results showed the presence of potential pharmaceutical sources: some were strongly suspected, others needed further investigation. The potential sources of emerging contaminants could be identified by removal efficiencies of classes of compounds and by removal rates of individual compounds.

This study identified a significant risk associated with the inputs of organic micropollutants (OMPs) to coastal waters from NW Mediterranean Sea. Pollution sources evaluated were wastewater treatment plants (WWTP) effluents and river waters discharged to the sea. Polycyclic aromatic hydrocarbons, polychlorinated biphenyls, organonitrogenated pesticides, polychromatic diphenyl ethers, phthalates and alkylphenols were analyzed by solid phase extraction and gas chromatography coupled to tandem mass spectrometry. Eight WWTP effluents and six rivers discharge an estimated amount of around 25800 g d-1. The concentration of ΣOMP in coastal areas ranged from 17.4 to 8442 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 their geographical distribution was obtained by Principal Component Analysis of the complete data set after its adequate pretreatment. A dilution effect due to the higher discharge in WWTP-A was also observed. Therefore, removal efficiencies SMZ was quite stable in WWTP-A (84-92%) and greatly varied in WWTP-B (0% to 96%).

Results showed the presence of potential pharmaceutical sources: some were strongly suspected, others needed further investigation. The potential sources of emerging contaminants could be identified by removal efficiencies of classes of compounds and by removal rates of individual compounds.
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 vitilifying the effluent.

TH 313
Assessing the potential of constructed wetlands in reducing environmental impact of STP effluents: the WIFE project
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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 into surface water. This has been shown to be effective for the removal and the mitigation of the effluent's load. The WIFE (Waterharmonica Improving Purification Effectiveness) project studied the potential of such wetland technologies 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 provides for advanced sampling, chemical analysis, ecotoxicological and biotechnological and gene expression responses of chronically exposed stickleback (Gasterosteus aculeatus). The monitoring was performed between 2008 and 2011 and an generated an extensive dataset. In this presentation we will give an overview of how different environmental relevant end points were affected during the passage through the constructed wetlands. The toxicological characteristics of the STP effluents were found. A wide range of chemicals were detected on the passive samplers, but in general these were not affected in a structural way by the passage through the wetlands. Occasional peaks in toxicity were observed, that indicate a potential risk for the receiving surface water. 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 (Gasterosteus aculeatus). Temporal and seasonal (short period) 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-vitro-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
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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 the emissions inventories, 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 substances and the analytical methods used.

Methodology guidelines
Methodology definition was guided by the following key ideas: - A state-of-the-art methodology in agreement with regulatory requirements, and EU guidance. - A source specific methodology. The approach is based on efficient discharge data; in their absence some explicit estimation formulas are proposed.

Conclusions
H. C. Holten Lützhøft, H. Birch, E. Eriksson, P. S. Mikkelsen
TH 315
Corbicula fluminea: just an invasive species or also a freshwater bioaugmentor?
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2University of Coimbra, Coimbra, Portugal
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Much attention has been drawn to the industrial and ecologic impacts of Corbicula fluminea, an invasive freshwater bivalve. This species has also been extensively studied as a potentially toxic metals and organic compounds. Such an attribute lies on the ability of these clams to bioaccumulate chemicals in body tissues together with a fairly large tolerance to the effects resulting from exposure. Additionally, the Asian clam seems to alternate filter-feeding at very high rates with sedimentation and deposit feeding, and hence an integrated view concerning different ecosystem components can be considered. As to our knowledge no attention has been devoted so far to the fact that these features of the Asian clam may provide it with an advantage in the treatment of contaminated water bodies.

TH 316
Acute toxicity analysis of urban septic tank sludge
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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 simplicity. A series of physical-chemical parameters were also analyzed based on Standard Methods for Examination of Water and Wastewater 20th (APHA - 1998). Sludge from four septic tank 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; 4: bottom sludge and 5: 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 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 in the superfical layers “scum” and “liquid waste”. All samples from the bottom fractions presented less toxic effects (EC50 9 4%) when compared to the fractions above. The average EC50 for fraction 3 was 12.6% and 17% for the mixture, meaning even lower toxicity, possibly due to the influence of upper fractions that are stored in great volumes inside the tanks. The sludge from UASB presented higher toxic effects on topside (EC50 5.5%) in comparison to the bottom (EC50 8%), but lower toxicity when compared to tanks samples, since it was analyzed in a dilution of 50 parts in 200, while septic tank samples were diluted in one part in 200. All samples presented elevated levels of TKN, P and COD and were considered as stabilized sludge, since the relation VS/TS (volatile solids/total solids) was below 65%. Although many studies have applied the Vibrio fischeri test to a range of environmental samples, the analysis of sludge from septic tank represents a new approach, essential to evaluate the risk of releasing this type of waste in the environment.

TH 317
Comparing chemical analysis with literature studies to identify micropluttonts to be treated or upstream source controlled in a catchment of Danish (DK)
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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 source inventories of microplastics to 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 micropl consequently in stormwater from a specific catchment; a literature inventory of potential pollution sources and chemical analysis in 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 microplastics and 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**  
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A toxicity identification evaluation according to methods performed taking in consideration the system used for depuration of wastewater. Process control in the different streams, condition of the effluents, and their release into environmental waters are correlated with the toxicity of their liquid effluents. For this purpose, an optimized biological test (PBT-Test) was coupled with the biocriteria method for assessing effluents. For the latter, presence of anarobic 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 Suspended Solids (MLVSS), Mixed Liquor Volatile Suspended Solids (MLSS) and bioflocculation index (BFI) was determined for each plant. A set of 3 effluents, together with the Solid Phase Microextraction (SPME) and Gas Chromatography-Mass Spectrometry (GC-MS) analysis, for chemical characterization of each effluent. Data were interpreted by Principal Component Analysis (PCA) which allowed to classify 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 produce volume chemicals (HPVC) are responsible for the toxicologically modified effluents of Buenos Aires province. It is need an urgent update of the parameters that govern the discharge of wastewater 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**  
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Waste water eflluent is major source of chemicals discharge in to aquatic ecosystems. Since algae are important primarily producers in aquatic ecosystems, it is necessary to influence of the 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 phototrophic capability. Since the DF originates from re-excitation by chlorophyll by a reverse reaction of photosynthetic electron transfer, the DF inhibition reflects inhibition of photosynthetic activity that is necessary for growth of the algae. DF is a potential endpoint for the estimation of the influence of chemical substances of algal growth in a shorter time than the conventional 72 hours growth inhibition test (e.g. OECD test guideline 201). The intensity of DF also shows 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 *Pseudokirchneriella subcapitata* (Selenastrum capricornutum). The test algae are prepared by thawing specially prepared -80°C frozen algae in a 1 hour pre-incubation. The prepared test algae can then be immediately exposed to the test sample prepared in a range of effluent concentration (0, 1, 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 luminesimeter at 1, 4, 8, 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 inhibition, dose-response relationship of DF in treatment for each effluent or mixture. In addition, the DF decay curve potential has 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**  
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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. Concerning microbial community, the major changes observed were increased detoxification enzymes (EROD), DNA damage, physiological parameters, % of DELT anomalies, impaired reproduction, and reduced fish population structure in the downstream site (GS 7.2) of municipal wastewater treatment plant (MWWTP). 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 sediment toxicity. The results of causal analysis suggest that the principal probable causes of fish population impairment in the downstream site below the MWWTP was 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**  
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2Unimon, Zürich dietikon, Switzerland  

**Limenitis* Karpathica*. The young DC is a potential endpoint for the estimation of the influence of chemical substances of algal growth in a shorter time than the conventional 72 hours growth inhibition test (e.g. OECD test guideline 201). The intensity of DF also shows 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 *Pseudokirchneriella subcapitata* (Selenastrum capricornutum). The test algae are prepared by thawing specially prepared -80°C frozen algae in a 1 hour pre-incubation. The prepared test algae can then be immediately exposed to the test sample prepared in a range of effluent concentration (0, 1, 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 luminesimeter at 1, 4, 8, 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 inhibition, dose-response relationship of DF in treatment for each effluent or mixture. In addition, the DF decay curve potential has 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 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 wastewater and the containing micropollutants, which is supported by the results of the in situ bioassays. On the other hand, indirect pathways, driven by a lower**  
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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 continually 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 of 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. Macroinvertebrate 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 explained by (i) the reduced feed of leaf shredding macroinvertebrates (such as *G. fossarum*), which is supported by the results of the in situ bioassays. On the other hand, indirect pathways, driven by a lower nutritional quality of leaf material, indicated by a significantly reduced fungal biomass (up to 75%) at the downstream site, may have influenced the physiological fitness of shredders. Further, the present study evaluates the impact on the intermediate process in wastewater treatment by considering advanced treatment methods (e.g. ozonation), which may help to meet the requirements of the EU Water Framework Directive.

TH 323  
**Water quality investigations in the river Lea downstream a sewage treatment works: preliminary results of a case study**  
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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 Thameswamps sewage treatment works) to the Olympic Land (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 and Development, 2006). Results showed inhibited growth rate after 24 hours that was most pronounced at the point just before release into the river Lea. Potential short term response 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. villulosus, 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 actual water quality potential. On the other hand, if during long-term monitoring with gammarids no toxic effects can be seen, compared with sporadic in situ bioassays, the need of additional treatment steps should be reevaluated on a case-by-case basis for each waste water treatment plant and its recipient river ecosystem.
TH 324

Enrichment free LC-HRMS screening method of anthropogenic sewage pollutants in waste water, receiving water, ground water and drinking water samples

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In last decade, there has been growing public concern of potential 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 compared to that traditionally carried out by triple quadrupole mass spectrometers. 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 ecosystems although the relevance and interpretation of results ultimately depends on the tests used.

In this work, the large volume direct injection has been applied to the screening of anthropogenic sewage pollutants in different matrices using a quadrupole-Orbitrap analyzer. The experiment consisted on combining full scan mode at a resolving power of 70,000 FWHM with data dependent MS/MS spectra acquired at a resolving power of 17,500 FWHM. The MS/MS spectra were generated using a high energy collision induced dissociation cell (HCD). The experiment was tested and evaluated in terms of quantification and capability to identify the occurrence of anthropogenic sewage pollutants. Further to sample preparation, 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

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


GALLART-AYALA ET AL.

Preventing false negatives with high-resolution mass spectrometry: the benzophenone case

Rapid Communications in Mass Spectrometry, 2011, 20, 3161-3166

TH 325

Whole effluent assessment as an alternative to in situ ecological impact measurement? An experimental approach

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There is increasing recognition by regulators that there is a substance-specific approach for assessing and controlling the environmental fate and effects of effluents. Consequently, many regulators are seeking more holistic techniques such as whole effluent assessment (WEA) to complement 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 ecosystems although the relevance and interpretation of results ultimately depends on the tests used.

In this work, the large volume direct injection has been applied to the screening of anthropogenic sewage pollutants in different matrices using a quadrupole-Orbitrap analyzer. The experiment consisted on combining full scan mode at a resolving power of 70,000 FWHM with data dependent MS/MS spectra acquired at a resolving power of 17,500 FWHM. The MS/MS spectra were generated using a high energy collision induced dissociation cell (HCD). The experiment was tested and evaluated in terms of quantification and capability to identify the occurrence of anthropogenic sewage pollutants. Further to sample preparation, including waste water, receiving water, ground water and drinking water representing different steps within the water cycle of densely populated and intensively agricultural areas.

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TH 326

Multi-bioassay approach for assessing the impact of industrial discharges on the water quality in Wallonia, Belgium

ESKA, Belgium

Bioassays offer an advantage for a more holistic and meaningful way of assessing effects of environmental samples and wastes on ecosystems than what is possible by using chemical-based monitoring alone. They can provide predictions of environmental impacts whereas ecological community measures only determine impacts after they have occurred. Therefore, bioassays are useful in helping to implement the Water Framework Directive (WFD). In Wallonia (Belgium), an effect-directed active monitoring using biota is being carried out for many years. It consists in collecting toxicological measurements at emission and in addition of physico-chemical measurements. We use a battery of short time and chronic bioassays with the bacteria Vibrio fischeri, the alga Pseudokirchneriella subcapitata, the rotifer Brachionus calyciflorus and the microcrustacea Daphnia magna. Moreover, a yeast estrogen screen (YES) assay was conducted as an assessment tool to detect the presence of endocrine disrupting compounds. During 2011, 14 rivers and industrial discharges Belges and 26 sampling points in the receiving waters (upstream and downstream of the effluent) were monitored. The effluents were sampled 6 times a year whereas receiving waters were sampled 4 times a year. Priority List substances of the WFD and other pollutants discharged in significant quantities were also measured.

More detailed studies were carried out with complementary tools: upstream and downstream of a discharge of a metalurgic industry, bioassays were conducted on both waste and river waters and bioaccumulation of metals was assessed using encaged hyphryse; upstream and downstream of a pharmaceutical industry, YES assay was conducted as potential assessment tools in combination with passive samplers (POCIS). The results of these monitoring show that bioassays are good diagnostic tools to determine the causes of poor ecological quality and to trace back to the source of contamination. They are an important “tool in the toolbox” for environmental management. They add value and provide complementary information to that supplied by the chemical and ecological community measures and could help to design appropriate management measures.

TH 327

Combination effects of pharmaceuticals and industrial chemicals in waste water effluents

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We will present our currently starting research activities in testing combination effects of pharmaceuticals and industrial chemicals known for their (co)-occurrence in WWTP effluents.

Mixtures of industrial chemicals and human pharmaceuticals can be found in surface waters as so called micropollutants. Effluents of waste water treatment plants (WWTP) are the main exposure route for both kinds of substances, The emission of these chemicals into WWTP originates from consumer usage of products, articles and drugs. It is commonly known from literature and discussed in different scientific and regulatory communities that effects of chemical mixtures are significantly larger than single substance effects. At the moment neither in the environmental risk assessment of chemicals (REACH) nor in human pharmaceuticals (EMEA/CHEMP/SWP/444700) possible combination effects in the environment is considered. But taking into account realistic exposure scenarios we assume that combination effects are the rule and not the exemption. Consequently an underestimation of environmental risks is likely.

The study focuses on the question if combination effects of pollutants in WWTP effluents require further assessment. Therefore ecotoxicity tests with algae and daphnids for 6 environmentally relevant substances shall be conducted individually and in different combinations respectively. These substances, (i.e. nonylphenol and ibuprofen) are known for their occurrence in WWTP effluents and their toxic effects to the aquatic compartment. Main objectives are (i) the quantification of the hypothesized underestimation of the risk. The testing for single toxicity N[0001]0 [values and (ii) Concentration Addition (CA) to the default concept for the chosen scenario. The introduction of a potential mixture assessment factor (MAF) and its magnitude shall be discussed on the basis of the results gained.

TH 328

Illicit drugs as emerging pollutants in surface waters: acute toxicity test

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Today, illicit drugs are considered as emerging pollutants and several studies have been carried out to evaluate their concentrations in sewage waters and in effluent from WWTPs. Most of these compounds are not completely removed during treatment and are found in surface water at concentration around ten ng/L. Thus, it appears important to determine the ecotoxicological impact of illicit drugs.

In order to develop this knowledge, we carried out acute toxicity tests according to ISO11348. Four illicit drug families have been tested: cocaine, heroin, amphetamine-like and cannabis. In a first time, compounds were studied alone in tap water. Then, they were studied alone or associated in sewage water. Results will be presented and discussed according to the environmental concentrations of these compounds.

TH 329

Ecotoxicological characterisation of climbazole, an anti-dandruff agent contained in shampoo

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

References

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TH 330

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

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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 uncontrolled 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, daphnia and higher life forms were observed. At the present Riftaxicom, Piperacillin, Doripenem and the current reserve-antibiotics Tigecycline, Linazolid 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 sciences are focusing on older frequently prescribed substances. As a result assessment lags behind the modern pharmacotherapy and the achievements of the pharmacology.

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

Estimating PEC/PNEC-relations of these new substances has to take into consideration the increasing 100% incidence of antibiotics, changing 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

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This study aimed at assessing the ecotoxicity of dishwasher detergents. Indeed, despite the high consumption of such products, available information regarding their environmental effects is scarce. Thus, twelve different detergents products available on the French market were selected, covering the different dishwasher detergent types: “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 “gel” solutions were selected by washing cycles, the “tablets” and the “multibenefit” tablets were selected by rinsing cycles. The ecotoxicity was assessed by two bioassays: algae growth inhibition test and Daphnia magna growth inhibition test. In addition, the assessment of the ecotoxicity of two hand-dishwashing detergents, ten rinse aids (alone) and four dishwashing detergents (without addition of rinse aid in the “washing solution”) was performed.

Both bioassays and selection of bioassays were relevant 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 automatic dishwasher 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 332

Characterisation of dissolved organic carbon in effluents and the assessment of its overall benefits in mitigating environmental impacts from metals

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Dissolved organic carbon (DOC) is known to form complexes with metals which can markedly reduce the free concentration of the metal and mitigate toxicity. Biotic Ligand Models (BLMs) for metals include speciation calculations of DOC with the metal ions, with increasing DOC concentrations usually providing a significant reduction in the bioavailability of the metal.

BLMs assume a composition for the DOC in terms of the ratio of humic and fulvic acids. These default DOC characteristics work well for natural waters with generally good biodegradability, compartment-distribution-tendencies and additional waste-water treatment techniques e.g. ultraviolet light, ozone and membrane filtration.

TH 333

Integrating sewage treatment plant monitoring and modelling results to prioritise chemicals of concern and assess environmental risks

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A large number of organic chemicals released via sewage treatment plant (STP), prioritising pollutants of concern and assessing their risks for the aquatic ecosystem entail key scientific challenges for regulators. From the EU perspective, such challenges are common to the chemical legislation, (e.g. REACH regulation, Biodical Product Directive and the water legislation (e.g. Urban Water Treatment and Water Framework Directives). In chemical risk assessment, the exposure of the aquatic ecosystem to organic chemicals released via STPs is calculated in two steps: first, local and regional emissions to sewage are estimated from consumer use data; then, the fate in a generic STP is calculated using the multimedia box model SimpleTreat. Default calculations are based on conservative (worst-case) assumptions.

A random study was carried out for two chemicals of concern, LAS and triclosan, to evaluate the existing modelling framework applied to regulatory chemical risk assessment in the EU and to explore synergies with the monitoring and risk assessment activities under the Water Framework Directive.

Concentrations in raw sewage were estimated from product usage and chemical inclusion levels. The distribution and elimination in a conventional activated sludge sewage treatment plant with primary and secondary sedimentation was calculated with SimpleTreat 3.11, from the physicochemical properties and the biodegradation rate derived from STP simulation tests (OECD 303A). Probabilistic model simulations were run to account for the uncertainty of model inputs and the variability of STP parameters across the EU.

Calculated STP influent and effluent concentrations were in good agreement with measured concentrations collected from the literature and the probabilistic simulations captured, though not completely, the observed spread in observed values. Such modelling predictions can complement existing monitoring data and fill gaps for data-poor chemicals, thus supporting the prioritisation and the risk assessment of chemicals of concern. Moving from worst-case, default to more realistic, probabilistic exposure assessments facilitates the comparison of data generated and the harmonization of methods applied across regulations.
TH 335
An aerobic biodegradation of PCBs in a grass cut batch reactor
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Due to properties such as high Kp 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 anaerobic 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. not 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, 180). Concentrations of the lower chlorinated PCBs decreased slightly whereas the higher chlorinated PCBs were found to be stable at 520 µg/kg dry weight sewage sludge. For the second experimental series 6 PCBs (No.: 28, 52, 101, 169, 138, 189), a mixture technique of PCBs (Aroclor 1260) and the pesticide Endrin were added in high concentration to the batch experiments (33 µg per compound, respectively and 100 µg of Aroclor 1260). In this second experiment different initial weights of grass cut from the same source were used in order to determine PCB degradation rates experimentally for these blends with varying between 30 and 120 days. Compound concentrations were measured by GC-EC-CD. 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 correlation to gas production kinetics due to different dry masses, are discussed on the poster.

References

TH 336
Removal of nutrients by immobilized microagal beads in a continuous flow system
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Using immobilized microagal beads in immobilized nutrient 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 “Phaeodactylum 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 using UV-Vis spectrophotometer (Chebios 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 results of the nutrients to detect the net removal by the algae. The system was operated as six separate runs with usage of the same algal 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 algaline beads over a long term run.

TH 337
Meta-analysis of diesel production in terms of life cycle GHG emissions and energy consumption: comparison and case study of Spanish refineries
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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 rather each step is treated as a black box. Several products with different characteristics and uses are usually obtained from oil refining process (olefins, propane, butane, gasoline, kerosene, diesel, paraffin, asphalt, etc.). Allocation of proportional impacts of energy consumption and emissions for each product is a difficult task because many of them are correlated. Therefore, energy consumption and emissions are allocated according to the final product distribution. The most allocation methods used for petroleum products are the relationship of energy or chemical content, according to the oil type. This study compile the results of several studies of diesel production in European and American processing plants in terms of GHG emissions and energy consumption. Furthermore, this study is performed by recent studies of diesel production in Spanish refineries. Results highlight the broad range of values that depend on variables such as temperature, pressure, atmospheric conditions, and refinery design, which represent the most important barriers in the development of biofuels. 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 338
Towards transparent and relevant use of energy use indicators in LCA studies of biofuels
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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 way in LCA studies of biofuels. In this study, they investigate how energy use indicators are used in LCA studies of biofuels. In the examined reports and articles, the choice of indicator was seldom motivated or discussed and we observed five inherently 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 palm oil methyl ester (POME), giving considerably different output results. This is in itself not unexpected, but indicates the importance of clearly defining, 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 339
A meta analysis review: ‘Drop-in’ Biofuels - Life Cycle Assessments, substance flow analysis, material flow analysis and relevant information on an advanced biofuel
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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

TH 340
How to assess the data quality of LCI studies - a systematic approach
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The field of energy from biomass is broadly growing, increasingly the need for reliable data on the environmental burdens inflicted by the use of the different conversion technologies is becoming obvious. 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 do these studies are “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
A web-based approach to handling divergence in LCA
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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 impressive set 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 some form of meta-analysis. However, it is well known 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 of Linked Data (LD). LD technology allows meaningful interlinks between all sorts of resources within the World Wide Web. It can be seen 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]).

The guideline was tested on an analysis of LCI studies and data sets of an Organic Rankine Cycle plant for German framework conditions. In a second step on the base of the indicators developed in the first step the available studies will be analyzed. In the last step, the actual states of the data are compared and a recommend set of indicators can be given.

In this paper the authors developed and applied a structured approach, inspired by the meta-analysis concept, to examine literature and identify research thrusts on how to further develop LCA. The procedural steps of four-steps: 1) definition of the research question, 2) carrying out a literature review concerning more than 280 papers - selected from about 2000 articles according to pre-defined criteria - which resulted in the identification of some 60 main methodological topics; 3) research gap analysis, in which the methodological topics identified in the previous step were compared with the research priorities identified through a users’ needs survey; 4) interpretation of results, in which the results of both the previous steps were evaluated and organized into coherent research thrusts. Overall the analysis delivered two main research thrusts: one devoted to increasing the model fidelity of LCA, the other to increase model fidelity. The former is aimed at making knowledge available in easily usable way, while the latter focuses on better describing the complexity of the systems analysed and those interrelations that are really meaningful. Specific research topics were identified for each thrust, which suggests that sophistication and practicability can and should coexist in the same method.
Polyhydroxyalkanoates (PHA) and polylactide (PLA) are appropriate bio-based substitutes for a variety of previously petroleum-based products. Life Cycle Assessments (LCAs) according to ISO 14040 and 14044 have been applied to compare the environmental performance of these bio-based polymers in contrast to their petroleum-based counterparts. Numerous cradle-to-gate studies have been carried out to analyse the environmental impacts of the production of polymer resins with a preliminary focus on the impact categories relevant for environmental change and non-renewable energy use. Previous studies indicate a wide range of results and contradictory conclusions due to the consideration of different production processes, methodological choices (e.g. system boundaries, co-product allocation, impact assessment methods) and underlying assumptions. To produce more robust and policy-relevant results than individual LCAs, this Meta-Analysis approach for a Meta-Analysis has been developed and undertaken to analyse the outcomes of 25 LCA studies. The underlying studies are quantitatively assessed taking into account the impact categories climate change (measured in metric tons of carbon dioxide equivalents) and non-renewable energy use (measured in megajoules). Relative environmental impacts per metric ton of PHA and PLA are compared with corresponding values for the petroleum-based plastics polypropylene (PP), polystyrene (PS), polyethylene terephthalate (PET) and polyethylene (PE). Furthermore, differences between the environmental impacts of bio-based and petroleum-based polymers as well as standard deviations are calculated to derive methodological consistent figures.

Results of the Meta-Analysis indicate environmental advantages and disadvantages in both impact categories depending of the selected pair for comparison between bio-based polymer and the corresponding petroleum-based polymers (PP, PE, PET, PS). Furthermore, the Meta-Analysis reveals that bio-based polymers can help to mitigate climate change and save non-renewable energy.

**TH 349**

**The effect of system boundary and weight of the factors on the life cycle on the results of a life cycle assessment (LCA) - Electricity generation as example systems**

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LCA is a widely used tool for determination of strength and weaknesses regarding ecological aspects of any product or service. It is expected from the scientific-based analysis to deliver robust information, but in fact in literature the results differs significantly for the same product or service. Due to the recognized uncertainty this study addresses the possible deviation of results from literature on electricity 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 besides others like allocation, cut-off criteria, applicability, etc.

The electric power generation gives a good instance to analyse 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% 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 LCA impact category)

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 used 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.

**LC06P - Life cycle management (LCM): Success factors and barriers**

**TH 350**

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

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\(^3\)Regione Lombardia has among its tasks the development of management strategies for municipal waste produced in its territory, in collaboration with provincial governments, the control bodies and public and private entities that operate on the collection, recovery and disposal cycle.

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 life cycle thinking to assess the current strategic situation and to suggest 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 performance 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 351**

**Life Cycle Assessment for end of life computers in Mexico**

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The recovery of waste electrical and electronic equipment (WEEE) is an activity that becomes more important every day in Mexico. In 2010 electronic waste generation reached 307,000 tons annually. Of these, 10% is recycled or valorized, 40% remains stored in houses and 50% is sent to final disposal in landfills and open dumps. The aim of this project was to conduct a life cycle analysis using the program Umberto for electronic waste management in Mexico and compared its environmental impacts with those for three proposals for change in the end of life management pattern in order to determine the best option for a national policy. The policy proposals were modeled as follows: 1) Stage with 25% of recovery system, 2) Stage 35% to recovery system, and 3) 0% for disposal in open dumps. As conclusion it was identified to eliminate the use of open dumps for waste disposal in first place, followed by an increase in 35% of the recycling/valorization system.

**TH 352**

**Implementation of an integrated technological-LCA modelling tool within the water industry - a pragmatic contribution to decision-making**

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The water industry is expected to take into consideration environmental issues. But it still has to deal with operating costs, sanitary risks, technical feasibility and reliability of designed plants. Therefore, the water industry managers need handy tools and practical methodologies that can provide them a complete set of information for projects under study. A good implementation of such decision supporting tool is obviously a condition to its success.

Within the EVALEAU research project, an integrated technological-Life Cycle Assessment modelling tool has been developed with the software Umberto. The tool is based on an exhaustive library of unit process models. These models are highly detailed and parameterized, thus precisely describing the energy and mass balances depending on a specific project context. Complementary software tools are directly linked to the tool, which makes it benefit from previous modelling efforts and specific industry knowledge. For example, weather conditions are taken into consideration environmental issues. Plant design scenario refers to a change on one model parameter. Assuming that the modelling scenario is realistic enough, conclusions can be made on the real plant. This key feature of the tool gives the designers good clues about the future plant functioning and indicates which are the action priority levers.

The aim of the implementation relies on its convenience on the field, obtained by previously developing it closely with its future users. Not only environmental issues are taken into account but the tool give the whole picture of an industrial project.
TH 353

LCA on drinking water production from pesticide contaminated ground water
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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 management at the initiative of the users - a bottom-up approach
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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 it. This is mainly due to the mismatch of the requirements of the users in the toolbox, a group of 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. The tool has been used by many in the public sector and many in the private sector.

TH 355

Improving Life Cycle Management (LCM) tools for the food industry: a framework of Product-Oriented Environmental Management System (POEMS)
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The aim of this abstract is to present a LCM tool designed for the agri-food industry, a POEMS framework with a modular structure resulting from the integration of complementary tools: an Integrated Life Cycle Assessment (LCA) and a suitable Environmental Product Label or Declaration (EPLD) [1]. This project has been funded by the ITALIAN MINISTRY FOR THE ENVIRONMENT (PAR 2007/2008), in order to successfully apply this framework in the agri-food firms the main sector-specific barriers (SSB) to LCM implementation have been used as starting points to set the success factors (SF), solutions (S) and tools (T) of the POEMS model. In the following the path to the POEMS framework definition is summarized: the path efficiency is enhanced by the fact that each tool can provide multiple solutions to several barriers.

SBE: resistance to change; dispersion of the environment-related information; in Envrl. Management Systems (EMS) little attention is paid to product performances
ARROWRIGHTS: spreading an envrl. culture; change and involvement; structural and organized vision of envnl. aspects; internalize product requirements within the EMS
SF: envnl. commitment is not perceived as an opportunity; problems with results communication and chain involvement; complexity and uncertainty in choosing the most suitable envnl. message
ARROWRIGHTS: ability to transform the envnl. measures taken into commercial advantages; spreading envnl. cultural change and involvement with external dissemination; identification of the proper envnl. label/declaration
SF: envrl. product communication; guidelines to support decision making
ARROWRIGHTS: Integrated Quality and Envrnl. Management System

TH 356

Finnish guidelines on carbon footprinting - supporting practical implementation of LCA in the food industry
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Life cycle thinking is spreading among environmentally responsible companies around the world. Specially carbon footprint guidelines, which have been developed in the last years, are enabling the food and beverage industries 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 show growing interest to, for example, carbon footprints in many Gallup polls. Many 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 has developed a tailored methodology to calculate environmental impacts. The methodology integrates 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. The tool has been used by many in the public sector and many in the private sector.

TH 357

Life cycle thinking applied to an immunological product (vaccine) used for boar taint control in male pigs
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In 2009, Pfizer Animal Health (USA) started to apply the Life Cycle Assessment (LCA) methodology to some innovative products, with a first case-study on Improvac™, an immunological product (vaccine) used for boar taint control in 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.environdec.com); the results 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 farmers and food sector 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 a selected set of key technologies to both the bioeconomic and ecopective potentials of the system. 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
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 Nestle food and beverage product systems: Nespresso, Parina Gourmet Pearl Chicken and Vittel products have been quantitatively assessed whereas Nescafé and KitKat 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. The comparison showed a very complementary situation: some categories (inventory of Greek (ELCDi) and Life Cycle Impact Assessment (LCIA) methods (e.g., land use, terrestrial ecotoxicity and river flows) were as well endpoint as were assessed 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 comparability and the reproducibility of results whereas several methodological guidelines provide alternative solutions, ranging from very general in the case of ISO 14040 and ISO 14044 to high specificity in the case of the French standard BPN30-323.

The Nespresso pilot test will be presented and shows an example of PEF Guide application and used to provide feedbacks about the PEF Guide.
The present work was undertaken to assess the feasibility of cost effective 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.

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THPC1-4
Removal of POPs from industrial wastewater using UVC/H2O2 Photolysis
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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 (3.5ml/l) and 4-Chlorophenol (0.36mg/l).

The experimental equipment employed in the assays consists in a tubular reactor of borosilicate glass, (60ml) 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 (40mm).

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.

THPC1-5
Impacts of advanced wastewater treatment on metal speciation and bioavailability
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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.

THPC1-6
The influence of terminal electron acceptor on the removal of pharmaceutically active Anaerobic digester sludge
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Recent results, perfluorinated compounds (PFCs), particularly perfluorooctanoate (PFOA) and perfluorooctane sulfonate (PFOS) have been described as compounds of increasing environmental concern 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 effluents.

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 HPLC.

Conditions were amended in a batch test and in a serum bottle experiment to measure the total removal and mineralisation of two prioritised test substances that have been identified within the biosolids. The results of these experiments will be discussed and compared with data obtained from biodegradability experiments performed under unamed conditions following guideline OECD 311.
Perfluorinated compounds (PFCs) present significant research interest in recent years due to the global distribution, persistence, bioaccumulation and potential toxicity of these substances. 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. This study aimed 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 (PFCA)s and perfluorinated phosphates (PFPOs) which contain a carboxylic or phosphoric group, respectively. Perfluorocarboxylic acids are environmentally relevant because they can act as endocrine disruptors. 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). Afterwards, 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 PFCs 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 perfluorocarboxyl chain and the functionality of the head group can influence the sorption of these compounds to sludge materials. Acknowledgments...
Perfluorinated compounds (PFCs) in peregrine falcon eggs from southwestern Germany - levels, patterns and temporal concentration variations

TU 008

PFAA sources to groundwater and drinking water: identification and origin

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All PFCs can be considered as long-lived substances, as has become evident from blood analysis. The exposure to PFAA occurs primarily via the dietary intake and more specifically via drinking water. It was estimated that when assuming a tap water concentration of PFOA of 9 ng/L the intake via water would amount to 55% of the total daily Dutch PFOA intake.

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 as 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 1758 ng/L perfluorooctanoic acid (PFOA) and 1165 ng/L perfluorobutanoic acid (PFBA) respectively. Concentrations in the groundwater wells at a travel distance of 25 years were much lower: 0.96 and 161 ng/L for PFOA and PFBA respectively. The chemical signature of groundwater showed that infiltrated rainwater, the landfill leachate and the infiltrated urban/military water contaminated the abstracted water. Based on the hydrological modeling it was shown that 1% of the abstracted 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 009

Seasonal distribution of perfluorinated compounds (PFCs) in surface water from Elbe River and North Sea, Germany

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Since the ubiquitous occurrence and potential toxicity to human beings, the perfluorinated compounds (PFCs) have attracted more concerning in the recent years. In 2010, one of the PFCs, perfluorooctane sulfonate (PFOA) was added to Annex B of Stockholm Convention on Persistent Organic Pollutants (POPs). Recently, more substitutes, i.e. perfluorobutane sulfonate (PFBS) and perfluoroheptanoic acid (PFHxA), were widely used and the elevated levels have been found all over the worlds. In this study, four cruises in Elbe River and three cruises in North Sea were conducted throughout the whole year of 2011 to investigate the seasonal distribution of perfluorinated compounds in surface water. Perfluorinated carboxylic acids (PFCAs) and perfluorinated sulfonates (PFASs) were determined in both particle and dissolved phases in more than 100 samples. The profile patterns suggested the industrial and urban discharge which were the major source of PFCs in river and coast water.

TU 010

Occurrence of 14 perfluorinated compounds and other priority and emerging organic compounds in fishes from the Rhone River (France)

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Rhone River. The analyses included 14 perfluorinated compounds (PFC), and also 5 alkylphenols (AP), bisphenol A (BPA), 3 hexabromocyclododecane (HBCD), 9 polychlorinated diphenyl ethers (PBDE) and 2 compounds, hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD) for which Environmental Quality Standard (EQS) have been set for the human risk, 10 and 55 µg kg⁻¹ fresh weight, respectively [EC, 2008].

Fishes were captured from August 2008 to January 2009 at 3 sites located upstream and downstream of the Lyon metropolitan (France). The four freshwater fish species attracted not only scientific but also public interest, at the latest since it was at the brink of extinction in Germany and elsewhere for chicken eggs. Thus Peregrine falcon eggs may be compromised by PFOS if their sensitivity is similar to the chicken. These findings generally confirm results presented earlier for other organisms.

The monitoring campaigns allowed to identify hot spots in the main Italian basins.

TU 011

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

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This study was performed to determine the occurrence and levels of 34 priority and emerging organic compounds in freshwater fish sampled in the Rhone River. The analyses included 14 perfluorinated compounds (PFC) and also 5 alkylphenols (AP), bisphenol A (BPA), 3 hexabromocyclododecane (HBCD), 9 polychlorinated diphenyl ethers (PBDE) and 2 compounds, hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD) for which Environmental Quality Standard (EQS) have been set for the human risk, 10 and 55 µg kg⁻¹ fresh weight, respectively [EC, 2008].

Fish samples were collected in Baden-Württemberg from 2008 to 2008. The chemical analyses were conducted on pooled fish samples and also on some individual fish samples in order to check the homogeneity of pooled samples. A total of 49 fish samples were analysed (pooled or individual fish samples).

The main goal of this study was to determine data on the occurrence and levels of 34 priority and emerging organic compounds in freshwater fish sampled in the Rhone River. The analyses included 14 perfluorinated compounds (PFC), and also 5 alkylphenols (AP), bisphenol A (BPA), 3 hexabromocyclododecane (HBCD), 9 polychlorinated diphenyl ethers (PBDE) and 2 compounds, hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD) for which Environmental Quality Standard (EQS) have been set for the human risk, 10 and 55 µg kg⁻¹ fresh weight, respectively [EC, 2008].

Fishes were captured from August 2008 to January 2009 at 3 sites located upstream and downstream of the Lyon metropolitan (France). The four freshwater fish species studied, namely the barbel (Barbus barbus), the common bream (Abramis brama), the white bream (Blicca bjoerkna) and the chub (Squalius cephalus), were chosen because they are some of the most sensitive species, but they have different diets and exploit different habitats. Chemical analyses were conducted on pooled fish samples and also on some individual fish samples in order to determine the homogeneity of pooled samples. A total of 49 fish samples were analysed (pooled or individual fish samples).

Results on the quantification frequencies, mean, median and maximum concentrations measured for the 14 AP and the other selected compounds in the 49 fish samples will be discussed according to what has been already found in the literature. Comparison on contamination level according to the fish species and also to the sampling site will be presented and discussed.

References

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TU 012

Occurrence and levels of perfluorooctane sulfonate (PFOS) in peregrine falcon eggs from Baden-Württemberg, Germany

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This study was performed to determine the occurrence and levels of perfluorooctane sulfonate (PFOS) in peregrine falcon eggs from Baden-Württemberg, Germany.

For 2009 and 2010, the substance spectrum was clearly dominated by PFOA at average concentrations of about 150-260 ng/g dry weight. Longuer chain carboxylates were observed in the egg samples for about 1-30 ng/g dry weight, whereas the PFHxA, PFHpA and PFOA were not detected. The dry matter content of the eggs was at around 20%. PFOS concentration in the highest contaminated eggs approaches the toxicity threshold (LOAEL 5000 ng/g fresh weight; NOAEL 500 ng/g fresh weight) for PFOS established for chicken eggs. Thus Pesticide falcon eggs may be compromised by PFOS if their sensitivity is similar to the chicken. These findings generally confirm results presented earlier (e.g. Holmstroem et al., 2010, Sweden).

Perfluorooctane sulfonate (PFOS) has been identified as a confirmed environmental contaminant in the field of water policy.

References

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.1 Because of its high trophic position, the WTSE is a very interesting biomonitoring species for studying accumulation of persistent organic pollutants (POPs).

In the past years, the increase of 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 aquatic metals, and recently also for POPs, but a reliable method for PFAS was not available and needed to be established.3, The results gained from this research enabled us to monitor endangered raptors without harming the birds and their offspring to better understand the fate of PFAS in birds. From Greenland body feathers (n=11) and primary wing feathers (2th, 5th and 8th primary; n=46) and preen oil (n=7) was collected when available in a sufficient amount for analysis. Tissue samples were taken from the Greenland carcasses to analyze for PFAS and POPs. In addition, tail feathers were sampled at active nest sites of WTSE situated in Northern Norway (n=18) in 2009.

For the first time, PFAS were detected in feathers and preen oil from white-tailed sea eagles from Greenland and Norway. In the wing feathers from Greenland WTSE, PFOS and PFHxS were detected. In some cases, PFNA, PFUnA 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. PFOSA were detected. In some cases, PFNA, PFUnA 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
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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 (PFCS) in feathers and tissue of barn owls (Tyto alba), collected in the province of Antwerp (Belgium). A major PFCS 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 preen oil, 203 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 (141.1 - 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 PFOS is most probably originating from the air due to the close vicinity of potential point sources. PFHxS could only be quantified in liver and preen oil. Sporadically, other PFCS compounds were detected as well, mostly in liver. Overall, these results indicate that PFOS levels in feathers and liver are highly correlated, while PFOS 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
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Because of their persistence and wide range application perfluorinated compounds (PFCs) are found as ubiquitous contaminants in aquatic and terrestrial organisms as well as in food products. HPLC-MMS analysis of animal and non-animal foodstuffs and wild game was performed within the framework of preventative consumer protection.

From regional waters:
Sixteen fish from the Rhine river including eel, perch, roach, tench and catfish were examined for the presence of PFCS. Concentrations of 5.2 µg/kg and 143 µg/kg were detected in muscle tissue as the sum of PFC detected (PFBS, PFPeA, PFHxS, PFHpA, AFOA, PFOS, PFOA, PFNA, PFDA, PFDS). The highest concentration was measured in perch muscle tissue.

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Sixteen fish from the Rhine river including eel, perch, roach, tench and catfish were examined for the presence of PFCS. Concentrations of 5.2 µg/kg and 143 µg/kg were detected in muscle tissue as the sum of PFC detected (PFBS, PFPeA, PFHxS, PFHpA, AFOA, PFOS, PFOA, PFNA, PFDA, PFDS). The highest concentration was measured in perch muscle tissue.

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.

Wild boar:
PFOS and PFOA concentrations were measured in 506 tissue samples and 529 liver samples from wild boar. The arithmetic mean of PFC concentrations detected in muscle tissue was 1.38 µg/kg whereas the mean PFOA concentration was below the LOQ. In liver tissue the mean PFOA concentration was 4.02 µg/kg (Maximum value 43 µg/kg) (1).

Foodstuffs:
Measurements of 82 samples of French fries showed PFC concentrations above the LOQ in 3 samples. No concentrations above the LOQ were detected in 30 samples of ice cream, 14 samples of whole milk, 19 samples of carrots or 16 samples of grains. A total of 84 samples of ocean fish, farmed fish, seafood, fish in packaged salads and canned tuna were tested for the presence of PFC. No PFC were detected in 82 of the samples. Two carp from fish farms had 2 and 14 µg/kg, respectively in muscle tissue.

(1) T. Stahl, S. Falk, K. Failing, J. Berger, S. Georgi, H. Brunn, Article title: PFOA and PFOS in Liver and Muscle Tissue from Wild Boar in Hesse, Germany, Arch Environ Contam Toxicol, DOI: 10.1007/s00244-011-9726-3

TU 015
Development of a pharmacokinetic model (PBPK) for the assessment of infant exposure to PFOS and PFOA for health risk assessment
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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 (perfluorooctanoic acid), have a long persistence in the human body (4-6 years). This persistence creates an important concern amongst 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). PFOA is a serious candidate to enter that list. The main target organs of accumulation are blood and breast milk. Thus, PFOA can be a risk for adult population and infant. In order to assess the tissue distribution, PBPK models are able to assess the concentration along the time in the main target organs of concern. PBPK models are mathematical models, which are based on the human body as a compartmental, and they can be resolved computationally as a set of equations. The PBPK model presented here is a multi-compartmental model for PFOA and PFOS 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. PFCs 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 PBPK model has been validated by comparing theoretical values with experimental data of PFCs chemicals in blood serum and breast milk collected in Catalonia, Spain. Finally, uncertainty and sensitivity 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
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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, the 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 commonly used test organism in ecotoxicological studies. Some toxicity tests have been performed on cladocerans for perfluorooctanoic 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 carboxylic acids and alcohols on two cladocers, Daphnia magna and Chydomus sphaericus, was evaluated in the present study. The adverse effects of these PFCs on these two cladocerans were decreased with increasing exposure time and concentration. The results demonstrated that exposure to perfluorinated chemicals (PFCs) with shorter chain lengths (C4) resulted in more toxic effects 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. Oedemas and effects on length could only be detected in 8-carbon PFCs while malformations of the head were a more specific action of the sulfonated PFCs.

**TU 017**

**Perfluorooctanoic acid toxicity in zebrafish (Danio rerio)**


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Perfluorooctanoic acid (PFOA) is a common surfactant with widespread use due to its unique nature, and has been detected as a contaminant in soil, air, water and biota. Previous studies have shown that PFOA has detrimental effects on different life stages in zebrafish (Danio rerio).

We have evaluated the effects of PFOA toxicity covering different life stages of zebrafish through three tests that were based on OECD guidelines. In the Fish Embryo Toxicity (FET) test, PFOA at concentrations of 10, 100, 1000, and 10,000 ng/L were added to egg media to calculate effective concentrations (LOEC and NOEC) based on early life-stage lethal and sub-lethal endpoints. Based on the FET test, a Fish Sexual Development Test (FSDT) was conducted and effects on vitellogenin (VTG), body and liver somatic indices and gonad histopathology including sex ratios were evaluated. A reproduction test (Fish Screening Assay: FSA) was also performed where effects on reproductive parameters like spawning, fecundity and fertilization rate were evaluated, as well as effects on histopathology, liver enzyme activity VTG-levels and key gene expression levels in the adult fish.

**TU 018**

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

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Perfluorinated compounds (PFCs) are a group of anthropogenic chemicals containing diverse functional groups and chain lengths. Their chemical structure gives them unique properties which resulted in massive production and the use of these compounds in several familiar products since the 1950s. However, these unique properties also cause them to be persistent and bioaccumulative explaining their presence in wildlife, humans and the environment worldwide. Despite the global occurrence of PFCs, the toxicological information on these chemicals is still incomplete and insufficient to assess their environmental impact and structure-activity relationship. In the present study, the development effects of PFOA (perfluorooctanoic acid, C8), PFOS (perfluoresulfonate sulfonate, C8), POFA (perfluorooctanoic acid, C8), PFOS (perfluorobutane sulfate, 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 chemicals 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 based on the functional groups of compounds with the same carbon number indicates that PFCs with a sulfonate group are more toxic than the ones with a carboxyl group. This resulted in the following order of toxicity: PFOA>PFOA>PBS>PBA. 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. Oedemas and effects on length could only be detected in 8-carbon PFCs while malformations of the head were a more specific action of the sulfonated PFCs. PFOA only caused significant effects on hatching rate and success. The effects of PFOA, PFOA and PFBS on the heart rate at 48 hpf could be the result of effects on intrinsic processes that control the heart rate, while altered heart rates at 72 hpf can be attributed to the shorter body lengths. In conclusion, PFCs with short chain lengths should be primarily considered throughout the development of new perfluorinated alternatives.

**TU 019**

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

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Our study demonstrated that PFCs can be affected by decreasing concentration of organic and inorganic pollutants from anthropogenic sources. Perfluorinated compounds are important source of pollution and they are major risks for the aquatic ecosystems. Perfluorooctane sulfonate (PFOS) and Perfluorooctane sulfonyl fluoride (POFS) are both industrially synthesized 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 five concentrations of PFOS (from 0.5 to 10 mg/L) and PFOA (from 0.5 to 10 mg/L) were examined on embryos of the sea urchin Paracentrotus lividus. Results were evaluated by observing: larval malformations, developmental arrest and embryonic/fetal mortality. The results indicated that, low concentrations of these chemicals generally caused malformations in the skeletal system. It was observed that high concentrations (10 mg/L) of PFOA and PFOS significantly altered the growth related to the tested parameters. As a result, the use of these chemicals is necessary. Toxicological studies have shown that PFOA has detrimental effects on different life stages in zebrafish (Danio rerio).

**TU 020**

**Economic findings for ammonium perfluorooctanoate**

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Ammonium perfluorooctanoate (APFO) has long been used for polymerization of fluororesins and rubber. There are many reports on the hazards of perfluorooctanoate (C8). According to the European Environment Agency, replacement substances have been examined. Perfluorooctanoate (C6) disappears from a rodent’s body and perfluorobutyrates (C4) disappears rapidly from rabbit’s and primate’s bodies.

The toxicities of both substances are low. It is considered because they do not accumulate in the body. The accumulation property in the body is considered to have a 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. Oedemas and effects on length could only be detected in 8-carbon PFCs while malformations of the head were a more specific action of the sulfonated PFCs. PFOA only caused significant effects on hatching rate and success. The effects of PFOA, PFOA and PFBS on the heart rate at 48 hpf could be the result of effects on intrinsic processes that control the heart rate, while altered heart rates at 72 hpf can be attributed to the shorter body lengths. In conclusion, PFCs with short chain lengths should be primarily considered throughout the development of new perfluorinated alternatives.

**TU 021**

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

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The PFCs, i.e. perfluorinated compounds have become attached to proteins. Toxicity studies in mammals revealed they can disrupt different metabolic activities. Early exposure has been studied and different authors have reported the transference during breast feeding or during pregnancy. This work presents the preliminary results of a cord blood study in Catalonia (Spain). For 18 PFCs in 166 cord blood samples. The PFCs measured were: XNF (13 perfluorocarboxylic acids and 4 perfluorosulfonates) and perfluorooctanesulfonamide (PFOA) from Wellington Laboratories Inc., Canada. Extraction and separation was achieved using a Thermo Scientific Aria TLX-1 system utilizing TurbolFlow[TRADEMARK] technology (Thermo Fisher Scientific, Franklin, MA). For the purification process were used 2 TurboFlow columns Cyclone and C18 XL (Thermo Fisher Scientific).

The mixture of PFCs standards used was: MXB (13 perfluoroacids and 4 perlfuorosulfonates) and perlfuorooctanesulfonamide (PFOSA) from Wellington Laboratories Inc., Canada. For the purification process were used 2 TurboFlow columns Cyclone and C18 XL (Thermo Fisher Scientific). The analysis was performed using XNR 5:1 MeOH. The total run time for each injection was 16 min at 0.4 mL/min. Thermo Scientific TQ SOFT Vantage mass spectrometer (Thermo Fisher Scientific, San Jose, CA), coupled to TLX-1, was used for analytical purposes, and equipped with a Turbo Ion Spray source.

The preliminary results of this study presents the profile and concentrations of 18 PFCs in cord blood samples from Catalonia (Spain). In this study we found that the most representative were PFOA and PFHxS having concentrations levels were 3561-828 ng/L and 10609-536 ng/L for PFOA and PFHxS, respectively. Other relevant compound was PFBA found in higher concentration 53900 ng/L. The obtained results are in agreement with the literature, however PFOA has been found in lower concentrations than previous studies. This study can provide valuable preliminary information to study the transplacental exposure to perfluorinated compounds.
TU 022
Plastic debris and toxin releases in the Pacific Ocean
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Plastics comprised the majority of collected waste in worldwide beach cleanups in 2006, 2007 and 2008. In California, Washington, Oregon, and Hawaii the five 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-consumer plastic debris are pellets produced for injection or blow molding, and post-consumer plastic debris are pellets run-off from industrial areas. The fate of plastics in the oceans can lead to fragmentation and result in small particles that can degrade and release toxic chemicals such as phthalates, flame retardants, BPA, antimony oxide, heavy metal nicks, and styrene monomer as the plastics break down. Plastics can accumulate toxins floating in the oceans from persistent organic pollutants (POPs). POPs can include DDT, hexabromobenzene, polybrominated biphenyls (PCB), polymeric aromatic hydrocarbons, among others.

TU 023
Micro-plastics in the marine environment - a global assessment
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In recent years, there has been a significant increase in the amount and composition of litter ingested by marine animals (e.g. stomach analysis). As a result, this specific class of plastic has been found contaminating marine waters. The most common plastic types were Polyethylene terephtalate (PET) followed by Nylon and Acrylic but mean abundance was typically less than one piece per cubic meter of sea water. 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. Ingestion of plastic debris is linked to a suite of chemicals in plastics, such as polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons, among others.

TU 024
Marine micro litter under the marine strategy framework directive - science and policy
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The presence of microplastics in the marine environment is a current research topic and a challenge that needs to be met in order to achieve the goals of the Marine Strategy Framework Directive (MSFD). The EU has set up a Working Group entitled ‘Sources, fate and effects of micro-plastics in the environment - a global perspective’. With this multi-agency support and with a multi-disciplinary membership, we are reviewing a wide range of information about the supply of microplastics and macroplastics to the ocean, and the biological, chemical, and physical processes controlling fate and effects of both microplastics and macroplastics. This group intends to coordinate the research on both microplastics and macroplastics and will provide a common framework for evaluating the effects of plastics on organisms and the environment.

TU 025
Using the continuous plankton recorder to determine the abundance of microplastic debris in the subsurface marine waters
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Plastics have been recently incorporated into the group of emerging pollutants due to their wide distribution in marine and coastal environments. In order to monitor and quantify the increase of microplastic debris in the oceans, two different methodologies have been implemented: IPW with passive air sampling and TPR with passive water sampling. Using the continuous plankton recorder to determine the abundance of microplastic debris in the subsurface marine waters is the aim of this study. The continuous plankton recorder is a device that collects a continuous sampling of marine plankton which are then counted and measured. The Continuous Plankton Recorder (CPR) samples reported by analysts at the Sir Alistair Hardy Foundation for Ocean Science (SAHFOS) has confirmed the presence of synthetic plastics 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 known and unknown plastic debris. Most of the plastic debris are spherical in shape, and the iridescent plastic debris were also seen in some samples. The preliminary results pointed out this as a relevant source of microplastics to the environment. However, this physico-chemical characterization of personal care products is essential to assess their potential to absorb, concentrate and transfer OCs, improving somehow their bioavailability, from the environment to the organism.

TU 026
Microplastics in personal care products from Brazil: is this source relevant to the aquatic contamination?
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Microplastics have been recently incorporated into the group of emerging pollutants due to their wide distribution in marine and coastal environments. In order to monitor and quantify the increase of microplastic debris in the oceans, two different methodologies have been implemented: IPW with passive air sampling and TPR with passive water sampling. Using the continuous plankton recorder to determine the abundance of microplastic debris in the subsurface marine waters is the aim of this study. The continuous plankton recorder is a device that collects a continuous sampling of marine plankton which are then counted and measured. The Continuous Plankton Recorder (CPR) samples reported by analysts at the Sir Alistair Hardy Foundation for Ocean Science (SAHFOS) has confirmed the presence of synthetic plastics 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 known and unknown plastic debris. Most of the plastic debris are spherical in shape, and the iridescent plastic debris were also seen in some samples. The preliminary results pointed out this as a relevant source of microplastics to the environment. However, this physico-chemical characterization of personal care products is essential to assess their potential to absorb, concentrate and transfer OCs, improving somehow their bioavailability, from the environment to the organism.

TU 027
International Pellet Watch: background levels, hot spots, legacy pollution, and temporal trends
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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 plants. Based on background levels of persistent organic pollutants (POPs) in the ocean, this background level in deep water (background level) has been tentatively determined. By comparison of POPs concentrations in pellets from industrially-developing countries (e.g., China) with the background levels, POPs inputs from e-wastes were suggested. Through global comparison, hot spots of POPs 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, Tokyo Bay, Southern California, 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 POPs 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
Partitioning between water and plastics of polychlorinated biphenyls in marine animals
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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 have been demonstrated in plastics production in order to catalyze monomers into polymers and give it different properties. Some of these additives have been associated with carcinogenic and endocrine disrupting effects. Moreover, due to its hydrophobic nature, plastic debris can be a hazard to marine animal species because of accumulation of organic contaminants. An important aspect of the persistent organic pollutants (POPs), which do not completely dissolve in water and do not degrade into smaller components, is the ability to concentrate and translocate transport, e.g., polychlorinated biphenyls (PCBs), has been associated with a wide range of health impacts on both wildlife 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 these persistent pollutants, we compared plastic-water partitioning, a simplification of the partitioning of plastic additives in the gastric fluid, with ocean-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.
EP08P - What is the current state of the science on the fate, exposure and effects of pharmaceuticals in the environment?

TU033 Occurrence of Triclosan in fresh waters from São Paulo, Brazil - the need for regulatory actions
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Triclosan, 5-chloro-2-(2,4-dichlorophenoxy)phenol, is a broad-spectrum bactericide used in pharmaceuticals and personal care products of daily use. It is a non-volatile compound (5.3 x 10^-4 Pa at 20 oC), relatively soluble in water (10 mg/L at 20° C) with a log Kow of 4.2. Triclosan is highly toxic to aquatic organisms and some PNECs were found to be in the range of the plastic debris ingested by blue mussels at the site.They are not regulated and there aren't reports about the presence of triclosan in surface waters. In this work, six rivers from the State of São Paulo (Arbatai, Captivari, Sorocaba, Cotia, Tanque Grande and Rio Preto) were monitored for triclosan in a one year study. Caffeine was monitored as a surrogate of domestic source of contamination. The log Kow was determined for the samples from each river using a 20 cm glass column packed with granular polystyrene at 20°C and at a flow rate of 1.0 ml/min. The limit of quantification (LOQ) of method applied were 0.7 ng/L for triclosan and 15 ng/L for caffeine. From 100 samples analyzed 43% presented triclosan at concentrations ranging from 2.2 to 66 ng/L, and 98% presented caffeine at concentrations of about 1,000 ng/L. No correlation was found with triclosan concentrations. A further analysis of the 34% of samples where triclosan was found showed concentrations were above 1.4 ng/L. If we using the PNEC value 0.1 ng/L, 40% of the samples presented concentrations above that limit. Then we fit a PNEC of the 50, 3 samples were determined triclosan concentrations above this amount. Our results suggest that triclosan is an ubiquitous substance and should be considered a priority pollutant at least in the State of São Paulo, Brazil.

TU034 First pilot study on the occurrence of UV screens and preservatives in a Victorian estuary
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Center for Environmental Science in Saitama, Saitama, Japan
The main sources of marine debris are litter from ships, fishing and recreational boats, and garbage carried into the sea from land-based sources in industrialized and highly populated areas. In the sea, microbial decomposition of this debris is an important factor for sea turtles and the evaluation of the impact of plastics on development, survivorship, health and reproduction of sea turtles is 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 turtle species ingesting the largest amount of debris, in all their life stages, most likely because of their habitat and feeding behavior. In this study, we described the behaviors of leatherback turtles attracted to the study area, and we determined the presence of plastic debris at the turtle receiver. The leatherback turtles were collected at the turtle receiver and then they were transferred to the Leatherback Research Station for further study.

TU029 Determination of DEHP in culture media by GC-MS/MS using PCI Ammonia
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McGill University, Montreal, Quebec, Canada
This method is a mechanism 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 series mass spectrometer and a gas chromatograph. Structural elucidation was achieved by performing PCI-MS/MS on the molecular ion. Next, the fragments formed 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 in culture media. The correlation coefficient for this calibration curve was 0.969. Two unknown samples were analyzed and quantitated against the calibration curve. These were found to contain 4.2 µM and 3.1 µM DEHP.

TU031 Selective uptake of microplastics by a marine bivalve (Mytilus edulis)
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Microplastics, 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 data. On the uptake of microplastics in invertebrates it 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 blue mussel (Mytilus edulis) was exposed to 14 days to three different size 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, significantly different concentrations where detected in the faeces, in the 30 µm-particles were 10 µm-particles were absent. This discrepancy was probably due to difficulties in detecting the particles in the faeces, as fragments of heavily destructed smalls had been deposited on the bottom of the culture medium. These fragments were not able to translocate to the circulatory system of the mussel. The hypothesis of selective uptake of microplastics is supported by the data from the present study. Microplastics, as the degradation product of larger debris, are accumulating in marine habitats worldwide. The low uptake of plastics, as the degradation product of larger debris, are accumulating in marine habitats worldwide. The low uptake of plastics, as the degradation product of larger debris, are accumulating in marine habitats worldwide. The low uptake of plastics, as the degradation product of larger debris, are accumulating in marine habitats worldwide.
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 products. 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. Water samples were taken from four sites (A - D). Screened compounds included 11 UV filters and 12 UV stabilizers, 12 metabolites and the metronidazole, one fragrance, including commonly used compounds in Australia such as 4-MBC, EHMC, octocrylene, UV-328, HEB, 2-phenoxy 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, after derivatization for polar compounds. Samples from the screened compounds profiles. Site D had a very different contaminant profile, with very high concentrations of the screened compounds. Sites A, B, C and D 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 between the levels of HGC, the levels of domestic and municipal wastewater were very low, with no removal for bezafibrate, hydrochlorothiazide, 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 of pharmaceuticals were present in the low ng/L range. In sites closer to river, 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 pharmaceutical sources and fate in a highly urbanized and inhabited area in Italy

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Pharmaceuticals are used in high quantities in industries, agriculture and medicine. The presence of pharmaceuticals in the environment is a topic of increasing importance. In this study, a large number of pharmaceuticals were selected for analysis due to their high production and usage in the area under study. The results indicate the presence of a wide range of pharmaceuticals in the environment, highlighting the need for further research to understand their impact on human and ecosystem health.

**TU 036**

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

M. Gómez, M. Näsland1, D. Strøe, H. Borg, R. Grabić, J. Fiek

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Free water surface wetlands (FWSW) are a potential low-cost and low-tech solution for tertiary sewage water treatment. This study investigated the removal efficiency of selected pharmaceuticals and personal care products in four Swedish FWSW. The results indicate a high removal efficiency (70-90%) for most compounds, with lower efficiency for some polar compounds. The findings suggest that FWSW could be an effective tertiary treatment option for micro-pollutants.

**TU 037**

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

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Ecosystems are potentially contaminated by many chemical substances from domestic activities, through the spreading of treated sewage sludge. In this study, the authors conducted a comprehensive analysis of 400 pharmaceuticals and hormones in sewage sludge from 10 WWTPs in Sweden. The results indicate a high presence of pharmaceuticals and hormones in sludge, highlighting the need for further research to understand their environmental impact.

**TU 038**

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

U. Memmer

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The adaptation of human pharmaceuticals to activated sludge treatment has to be determined, e.g. according to the EMEA Guideline EMEA/CHMP/SWP/P4447/00. 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 sludge. This sorption to sludge has therefore to be tested as part of the EMEA Guideline in a sorption study. A terrestrial risk assessment is conducted 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). The drug is not used biodatably.

The sorption of chemicals to sorbents like soils or sediments typically depends on the same parameters of the sorbent (e.g. pH, ion-exchange capacity, redox potential, organic carbon content, texture). The question arises how different activated sludges are regarding these parameters, how large the adsorption to sludges varies. In this study, the authors tested the sorption of 20 pharmaceuticals to activated sludges from different European countries, concluding that more than 20 different molecules are used in the environment.

**TU 039**

Analysis of antimarial drugs in water

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Malaria is a general illness in many countries and therefore antimarial drugs are prescribed in great quantities. There are more than 20 different molecules being used in treatment. In this study, the authors conducted a comprehensive analysis of the presence of antimarial drugs in water samples from several countries, highlighting the need for further research to understand the environmental impact of these drugs.

In this presentation the results of batch equilibrium sorption tests with different sludges will be shown for several pharmaceuticals. The variability of the adsorption is high and there is no clear trend observed among the different sludges. Further research is needed to understand the factors influencing the adsorption of pharmaceuticals to activated sludge.
for treatments. These drugs are excreted mainly via urine. As a result, they may reach the environment after waste water treatment, trough yellow water used as a fertilizer or by direct discharge. There is limited information on the fate of antimalarials in the environment. It is believed that some of these drugs are rather persistent due to their organohalogen moieties. Hence, the fate of these drugs in the environment might be a subject of concern.

To better understand the fate and transformation of antimalarials in the environment, several approaches have been used. These methods have been developed to analyze the fate of antimalarials in surface and ground waters. The use of artificial aquifers allows the simulation of the transformation processes that occur in real systems. However, the use of samples from real systems provides more realistic results. The use of samples from real systems provides more realistic results.

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The approach successfully measures retention of several pharmaceuticals at residence times of up to 16 hours; longer residence times will be evaluated. Currently, we are using a small flume that allows the simulation of different hydraulic conditions in the hyporheic zone. Under abiotic conditions, we applied 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, provided an initial understanding of the range of environmental loadings from common on-site wastewater treatment systems.

Comparison of fish bioconcentration factors for several pharmaceuticals obtained using the reduced sampling method.

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 the duration of the uptake phase. During the uptake phase, ranging between 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, 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. Sampling intensity decreasing sampling intervals and quantifying of each compound was applied to quantify target parallels 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, provided an initial understanding of the range of environmental loadings from common on-site wastewater treatment systems.

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

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 the duration of the uptake phase. During the uptake phase, ranging between 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, 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. Sampling intensity decreasing sampling intervals and quantifying of each compound was applied to quantify target parallels 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, provided an initial understanding of the range of environmental loadings from common on-site wastewater treatment systems.

Waterborne beclometasone dipropionate affects fish while beclometasone is not taken up

Glucocorticoids are steroid hormones, playing important roles in several aspects of vertebrate physiology. The synthetic corticosteroid beclomethasone has anti-inflammatory activities as well as being used as a prodrug in the treatment of asthma. It is administered as the more lipophilic prodrug beclometasone dipropionate (BDP) which is metabolized into the monopropionate (BMP) and free beclomethasone in humans. A recent publication demonstrated effects of waterborn BDP (1 µg/L nominal concentration) on plasma glucose levels in fish. Although levels of in beclometasone 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 less lipophilic forms before reaching the environment. We have therefore compared the potential of beclometasone 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 beclometasone/L did not result in measurable plasma levels. Exposure to 0.65 µg/L BDP, on the other hand, led to accumulation of both beclometasone, BMP and BDP in plasma, indicating a considerably more efficient uptake of the more lipophilic prodrug as well as metabolism within the fish. Accordingly, exposure to 0.65 µg/L BDP significantly increased blood glucose levels, in agreement with previously published results. Furthermore, we could demonstrate a parallel increase in catalase activity in liver tissue, while exposure to beclometasone had no effect on these endpoints. We are currently screening for beclometasone, BMP and BDP in sewage effluents and surface water.

The degradation of antidepressant pharmaceuticals in aerobic sludge

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 pharmaceuticals 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 sludge were spiked with deuterated sertraline and venlafaxine. Samples collected over 36 days were analyzed for the depletion of the added pharmaceuticals by microwave-assisted extraction followed by liquid chromatography tandem mass spectrometry (LC-MS/MS). Municipal aerobic sewage 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.

The degradation of antidepressant pharmaceuticals in aerobic sludge

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 Bothian Bay (Harjutjärvi) 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/l lipid weight, while the concentrations of D4 and D6 were lower and frequently below detection limits. The concentrations were generally lower at the beginning of the period and highest around 2005-2007. There were no marked differences in concentration in the two locations.
Sorption process of three sulfonylurea based of anti-diabetic drugs were tested on three various soil. Selected soils differed in their physical and chemical properties and thus, plants. Compared with NSAIDs, antibiotics and drugs, suggesting the possibility of other sources flowing into the water environment. Overall, anthelmintics showed insignificant removal efficiencies in wastewater treatment. 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 wastewater treatment plants (LWTPs) were surveyed to assess the concentrations of anthelmintics. The LWTPs and HTPs had relatively high levels, indicating that livestock wastewater and human waste are principal sources of anthelmintics. These processes 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 and environmental impact of two groups of pharmaceuticals, which will be addressed in the Pharmacovigilance 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, concern 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 effluent treatment. The analysis/photolysis for sewage 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.

We investigated 33 PPCPs focused on anthelmintics in the human-waste treatment plants (HTPs), sewage treatment plants (STPs), hospital wastewater treatment plants (HWTPs), rivers and seawater. Additionally, the livestock wastewater treatment plants (LWTPs) were surveyed to assess the concentrations of anthelmintics. This effect-directed study was conducted by exposing bacteria to the mixture of ionophore degradates.

Formation and structure elucidation of stable transformation products of pharmaceuticals in the water cycle

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Coccidiostats are antimicrobial feed additives used prophylactically in poultry production to prevent the parasitic disease coccidiosis. The most heavily used sub-group of coccidiostats are the antibiotic ionophores. The excitation rate of coccidioses from chickens is high and typically the chicken dung is applied onto agricultural fields. Hence, the aim of this study is to describe the environmental fate of ionophores and to identify new and ecotoxicologically relevant transformation products. Abiotic and biotic transformation studies were conducted on four ionophoric antifolics, 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 for lasalocid stable transformation products at all conditions were observed. Hydrolysis of monensin, narasin and salinomycin can be discarded. Biotic degradation studies were conducted in lab-scale bio reactors inoculated with Nocodexdened soil bacterial communities. In addition, during the work with these very lipophilic antifolic 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 Nitrospomonas 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 degradates.

Sorption 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. CBZ and OxCz are known to be converted to their metabolites, their fate in wastewater treatment plants and their flow to the coastal zone through the submarine outfall.

Formation and structure elucidation of stable transformation products of pharmaceuticals in the water cycle

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1Institute for Environmental Studies, Amsterdam, Nederland
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4École des Hautes Études en Santé Publique, Nimes, France
Pharmaceutically active substances undergo transformations starting from human metabolism to degradation in environmental processes and finally during drinking water treatment. Often degradation in drinking water and wastewater 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 advanced oxidation processes employing e.g. ozone, hydrogen peroxide, light or electro-coagulation are increasingly under discussion for the removal of pharmaceuticals and other micro pollutants in effluent treatment and drinking water treatment. Treatments using these techniques may even lead to the formation of transformation products that are more toxic than the parent compound.

The aim of this study is to describe the environmental fate of ionophores and to identify new and ecotoxicologically relevant transformation products.
of tophotodegradation of two antibiotics often found 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-Vis spectrophotometry and GC. End products (organic carbon and nitrogen species) were also quantified. Degradation was observed, P35 being more efficient than PC500. Both modes 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
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Both direct and indirect photophotodegradation have been reported to be important removal mechanisms of sulfamethoxazole (SMX) in the environment. However, most of SMX is metabolized in human and animal bodies, yet, their environmental fate is not known. In this study, we assessed the direct and indirect photophotodegradation of 3 SMX metabolites at 3 different pHs of 5 human metabolites of SMX, namely, nitro-SMX, nitroso-SMX, acetyl-SMX, hydroxy-SMX and SMX-glucuronide. Similar to SMX, all metabolites were photodegradable, 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 compounds 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 greatest for nitro-SMX (70% in presence of 10 mg/L humic acid). Experiments conducted in lake water (1.19 mg/L NO3, 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 a 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
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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. Infectious disease is more spreading and more people of people suffer the disease in tropical area. This is mainly due to climatic conditions (hot and wet) favorable for the incubation of vector microorganisms and insufficient sewer and water supply systems. Moreover, only very limited information is available on the types and abundance of antibiotics in tropical Asian and African countries. Seven sulfonamides, trimethoprim, five macrolides, lincomycin, and 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 were sulfamethoxazole (SMX) followed by chloramphenicol. For SMX, sulfamethazine, oxytetracycline, lincomycin, SPX and CFX were predominant among the target antibiotics.

TU 060
Environmental fate, occurrence and toxicity of the antiparasitic pharmaceutical toltrazuril
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2Danish Medicines Agency, Copenhagen, Denmark

Toltrazuril is an organohalogenic endoparasitic pharmaceutical used in the acute and prophylactic treatment of livestock such as poultry, piglets, sheep and cattle against coccidiosis. It is metabolized through stepwise sulfoxidation 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 literature. In 2008, concerns were raised by Germany during the Marketing Authorization approval of a toltrazuril product [3]. Toltrazuril and its metabolites may present a risk to the environment due to toxic effects on terrestrial parasites [1] as a result the use of toltrazuril is expected to be escalating.

TU 056
The impact of carbasazepine on concentrations of acridine in river systems in Northern Germany
Leuphana University, Lüneburg, Germany

Carbasazepine (CBZ) is a pharmaceutical product which belongs to the dibenzepine group. Due to high usage of the substance, concentrations found in the effluent of waste-water treatment plants (WWTP) ranged from 100-630 ng/L. In river waters, CBZ concentrations from 30-1100 ng/L were found. A toxicological important degradation product of CBZ is acridine (ACR). However, only scant data exist concerning occurrence of ACR in WWTP. Moreover, ACR has not been analyzed in surface waters to date. In line with recent measurements in Northern Germany, relatively high concentrations of up to 55 ng/L for ACR and for CBZ of up to 320 ng/L were detected. Surprisingly, concentration ratios of ACR to CBZ in different rivers were found to be similar. Based on these results experiments were conducted to explore if concentrations of ACR in river water were influenced by degradation reactions of CBZ. Moreover, in order to explore whether river water samples from the River Lippe taken in November 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 compounds 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 greatest for nitro-SMX (70% in presence of 10 mg/L humic acid). Experiments conducted in lake water (1.19 mg/L NO₃, 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 a 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.

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TU 064
European environmental risk assessment for Trimethoprim in surface waters
J.O. Straub1, H.Fohrman-La Roche Ltd, Basle, Switzerland

An assessment for the aquatic compartment was developed for the old antibiotic Trimethoprim (CAS 738-70-5). The exposure assessment is based on documented human use figures in western Europe from IMS data and average removal in wastewater treatment; this predicted environmental concentration (PEC) was compared with measured environmental concentrations (MECs) from Europe. On the effects side, acute and chronic ecotoxicity data from the literature were complemented by additional, in particular, longer effects on fish; based thereon, acute- and chronic-based predicted no effect concentrations (PNECs) were derived. The risk assessment combines surface water PEC and MECs with aquatic PNECs for Trimethoprim.

TU 065
Comprehensive evaluation of the impact of Triclosan in the terrestrial environment
D.J. Fort1, S. Pawlowski2, S. Champ3
1J.O. Straub1, H.Fohrman-La Roche Ltd, Basle, Switzerland

An assessment for the aquatic compartment was developed for the old antibiotic Trimethoprim (CAS 738-70-5). The exposure assessment is based on documented human use figures in western Europe from IMS data and average removal in wastewater treatment; this predicted environmental concentration (PEC) was compared with measured environmental concentrations (MECs) from Europe. On the effects side, acute and chronic ecotoxicity data from the literature were complemented by additional, in particular, longer effects on fish; based thereon, acute- and chronic-based predicted no effect concentrations (PNECs) were derived. The risk assessment combines surface water PEC and MECs with aquatic PNECs for Trimethoprim.
The Environmental Risk Assessment (ERA) of pharmaceuticals mainly considers the aquatic compartment, since the majority of active pharmaceutical ingredients (APIs) are hydrophilic and thus more likely to be present in aquatic environments. Monitoring data suggest that polycyclic synthetic musks (PCMs) are widespread in the aquatic environment, and their presence has been correlated with the release of pharmaceuticals into the aquatic compartment. The two most important PCM compounds are galaxolide and tonalide.

**TU 066**

Risk assessment of pharmaceuticals incidentally discharged to the terrestrial environment


AstraZeneca UK Ltd, Brixham, United Kingdom

This poster presentation describes a risk assessment for pharmaceuticals associated with emission potential routes to the terrestrial environment: application of biosolids 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 and effect studies in order to carry out robust risk assessments associated with the terrestrial environment.

**TU 067**

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


Universtiy of Leeds, Leeds, United Kingdom

Waterborne Environmental Inc, Leeds, United States of America

China's economy has grown significantly and so has the demand for personal care (HPC) products. The detection of chemicals used in HPC products is increasing in profile as China develops models for use in prediction of environmental concentrations (PEC). Data required to accurately determine PECs of HPC chemicals include product usage information, physico-chemical properties, environmental behaviour (e.g. persistence, adsorption) and use of environmental information (e.g. receiving water quality). The development of the ScenAT Exposure model allows PECs to be generated at a more spatially resolved level (e.g., China) and may be used to evaluate the potential risk to the aquatic communities based on this PEC data. Additionally, the model is capable of outputting information on the potential behaviour of these chemicals at different levels (e.g., China vs. individual regions). The model can be used to assess the potential environmental impacts of HPC products and provide guidance for regulatory bodies and industry on implementing measures to reduce potential environmental risks.

**TU 068**

A comprehensive evaluation of the effects of the antimicrobial personal care product triclosan (TCS) in the terrestrial environment

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Environmental safety assessments are required for market approval of new Active Pharmaceutical Ingredients (APIs) (in the EU and to a lesser extent in the US), however, such assessments may be lacking for older APIs. To determine whether available environmental toxicity data can be used to make PNEC predictions for APIs for which effect data are lacking, we analyzed publically available data for 197 APIs. The APIs included in the Stockholm County Council book ([Environmental Safety Assessments for APIs in Sweden](https://doi.org/10.1016/j.envint.2013.01.009)).

**TU 069**

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


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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, its impact on terrestrial arthropods, its effect on vegetation and plant respiration, and its impact on terrestrial arthropods. The results showed that TCS has a significant effect on soil microorganisms, and that it can affect the growth and development of plants. Additionally, TCS was found to have a negative impact on the biodiversity of terrestrial arthropods. The results of this study highlight the importance of considering the impacts of TCS on the terrestrial environment and the need for further research to fully understand its effects.
production sites. Furthermore, we will analyze if there are general differences between the country of origin of the APIs in generic and original products. To accomplish this we are analyzing sale statistics (price) and information on the production site for APIs for roughly 60% of all products (7836) that were sold on the Swedish market in 2010. To date, all data has successfully been compiled into a workable database. We believe our analyses will highlight some of the international aspects of the environmental challenges linked to pharmaceutical production.

TU 071 Do pharmaceuticals with evolutionary preserved drug-targets pose a greater environmental risk? S.M. Furuhagen, A. Fuchs, E. Lundstrom, E. Gorokhova, M. Breitholtz

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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-conserved. It has therefore been hypothesized that non-target 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 we tested the hypothesis that pharmaceuticals with well-conserved drug-targets 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 daphnids were exposed to sublethal concentrations and raised. The effects were assayed 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 and the increased RNA concentration can be a result of induced 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 two treatments of chemical compounds, specifically designed to interact with living organisms, represent an important concern for humans and ecosystems. It has already been proven that conventional treatment taking place 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 ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent producers in the environment. Photo-transformation of ofloxacin is an important concern for humans and ecosystems. 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 proreproductive 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 synthesize 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 treatments of 24-hr to 72-hr to LNG at 5.3, 30, and 358 ng L-1 for 24 days. The effects of LNG on the mRNA expression of 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 ≥40 ng L-1. Spiggin expression, nephroscopic index and organosomatic index were all affected by LNG and vitellogenin expression remained significantly reduced at 358 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.

Supported by Mistra, the Swedish Foundation for Strategic Environmental Research, through the MistraPharma research programme.

TZ 044 Transcriptome analysis of the brain of the gilthead sea bream (Sparus aurata) after exposure to environmental concentrations of human pharmaceuticals M. Hampsel1, M. Milan1, J. Blasco2, S. Ferrares3, L. Bargelloni4
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Sympatric, and non-sympatric species are often found in coexistence 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 proreproductive 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 synthesize 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 treatments of 24-hr to 72-hr to LNG at 5.3, 30, and 358 ng L-1 for 24 days. The effects of LNG on the mRNA expression of 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 ≥40 ng L-1. Spiggin expression, nephroscopic index and organosomatic index were all affected by LNG and vitellogenin expression remained significantly reduced at 358 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.

Supported by Mistra, the Swedish Foundation for Strategic Environmental Research, through the MistraPharma research programme.

TU 075 Comparative effects of atenolol on physiological indices in rainbow trout (Oncorhynchus mykiss) V. Złotek, V. Burkinsa, H. Kroupová, G. Fedorova, J. Velisek, T. Randak
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TU 076 Investigating the genotoxicity effects of pharmaceutical photo-transformation products M.L. Vasquez1, M.I. Garcia-Kauffer1, E. Hepshel1, K. Kümmerr1, D. Fatta-Kassinos1
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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 and inorganic substances to the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar chemical compounds, specifically designed to interact with living organisms, present an important concern for humans and the ecosystems. It has already been shown that conventional treatment taking place 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 ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent producers in the environment. Photo-transformation of ofloxacin is an important concern for humans and ecosystems. Molecular and genetic mechanisms of these physiological responses in fish are not clear and need to be further studied.

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TU 077 Economy of 14 serotonergic pharmaceuticals in the cladoceran Daphnia magna, the microalgae Pseudokirchneriella subcapitata and the marine gastropod Haliothis tuberculata E. Farcy1, R. Bureau1, A. Serpentini1, J.M. Lebel1, M.P. Halm1
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The serotonin, also named 5-hydroxytryptamine (5-HT), acts both as a neurotransmitter or as an hormone, depending on its localization. The presented work investigated the ecotoxicological effects of 14 pharmaceuticals having serotonergic properties, i.e. enhancing the effects mediated by serotonin in the central nervous system. The tested

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molecules are mainly antidepressant (fluoxetine, sertraline, paroxetine, fluvoxamine, citalopram, clomipramine, amitriptyline, mianserin, milnacipran, duloxetine, venlafaxine) but also antipsychotic drug (clozapine, clozapine and haloperidol) and 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 acute tests with the cladoceran Daphnia magna. Additionally to these conventional bioassays, a novel bioassay was developed using primary cell culture of hematopoiesis from the marine gastropod abalone (Haliotis tuberculata). This assay was used in order to address the question of pharmaceuticals effects in a marine species. The acquired data were used to build quantitative structure activity relationship (QSAR) modeling in order to determine if the chemical properties of the molecules can explain their toxicity, (2) identify the mode of action of the selected pharmaceuticals.

**TU 076**

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

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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 anticholinesterase therapeutic drugs, neostigmine and pyridostigmine in *Daphnia magna*. This evaluation included a short-term (48 h) acute test (inhibition of cholinesterase) and chronic exposure tests (LC50). The results obtained showed that the two drugs at concentrations of the two compounds. The pharmaceutical 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 the individual level and changes in population size (reproduction). From our data we conclude that, even if exposure to low concentrations of pyridostigmine was no lethal for *Daphnia* populations, the observed impacts may have long-term consequences for the population dynamics, since the reproduction phase is a critical period for the population growth. Therefore, the interpretation of the results of this study is very important for both the risk assessment of such substances, and the rolling out of strategies to reduce the levels of pharmaceuticals in the aquatic environment and are discussed in terms of possible ecological effects of environmental relevant concentrations of these substances on wildlife. We advocate that this contribution is 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

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Drugs administered in humans are eliminated through the excreta in either intact or metabolized form. As other drugs, chemotherapeutic drug residues were measured in wastewater and surface water. They reach the aquatic environment and are present in the fauna and flora and can potentially affect adverse effects.

Tamoxifen is a synthetic non-steroidal anti-estrogenic analog inhibiting competitively estrogen receptors. This drug is mostly metabolized into metabolites such as Endoxifen and 4-hydroxy-tamoxifen. This study aimed to determine the 48 h-LC50 values in the immobilization assay of 167.7 μg L⁻¹ for neostigmine, and 0.3 μg L⁻¹ for pyridostigmine, respectively. In terms of feeding behavior, we calculated a 5 h-EC50 for filtration rates of 7.1 and 0.2 μg L⁻¹ for neostigmine and pyridostigmine, respectively; for the ingestion rates, the calculated 5 h-EC50 values were, respectively, 7.5 and 0.2 μg L⁻¹ for neostigmine and pyridostigmine. 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 41.3 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 of the order of μg L⁻¹. By comparing the here-obtained results with the actual concentrations of pyridostigmine previously reported in the aquatic environment (0.02 μg L⁻¹), 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.
ecotoxicological effects of selected pharmaceuticals and personal care products (PPCPs) has raised concern of public and regulatory agencies. PPCPs are used in large amounts throughout the world and are continually introduced to surface waters, mostly by untreated and treated waste.

In recent years a group of diverse bioactive chemicals covering pharmaceuticals and active ingredients in personal care products (PPCPs) has raised concern of public and regulatory agencies. PPCPs are used in large amounts throughout the world and are continually introduced to surface waters, mostly by untreated and treated waste.

Pharmaceutical and personal care products (PPCPs) are considered new environmental pollutants, since hundreds of these molecules are commonly revealed in the aquatic environment in high ng/L to low µg/L range worldwide. Among them, the occurrence of the antibacterial triclosan (TCS), the antibiotic trimethoprim (TMP) and the non-steroidal anti-inflammatory drugs (NSAIDs) ibuprofen (IBU), diclofenac (DCF) and paracetamol (PCM) is well documented both in surface and sewage waste waters. Noteworthy, these compounds may find their way to the environment after being used as animal and human medicine, as well as, in personal care products. The introduction into the environment of PPCPs is currently one of the most urgent and pressing issues in aquatic ecotoxicology.

As a result, the aim of the present study was to investigate the cyto-genotoxic effects induced by the cocaine, one of the most used illicit drug in Western Countries, as well as, by ibuprofen, a non-steroidal anti-inflammatory drug (NSAID) and novobiocin (antibiotic) at environmentally-relevant concentrations. Such concentrations were chosen because they are the most frequently detected in surface waters, being the presence of these compounds a significant concern for aquatic ecotoxicology.

A total of 44 fish samples were collected from different locations in Italy, and among these, 22 were exposed to caffeine (15 µg/L). The remainder were divided into groups of 10 fish that were exposed to either 10, 15 or 50 µg/L of ibuprofen. After 96 h of exposure, the survival rates were monitored, and a decreased survival rate was observed in the group exposed to 50 µg/L of ibuprofen. Additionally, a significant (p<0.05) increase in the mitotic index was observed in the group exposed to 15 µg/L of ibuprofen.

The results of this study highlight the importance of monitoring the presence of PPCPs in surface waters, as their concentrations can pose a significant risk to aquatic life. Further research is needed to fully understand the ecotoxicological effects of PPCPs on aquatic 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 these environmentally relevant polluting PPCPs pose the greatest risk for aquatic environment.

TU 090
Effects of chronic exposure to pharmaceuticals on aquatic biota: an experimental study


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Oxytetracycline (OTC) and amoxicillin (AMX) are antibiotics that are extensively used worldwide. Both compounds are applied in fish and shrimp farming practices, and in other animal intensive farming systems, as a growth promoter or bacterial disease treatment. Their excessive application has become a threat for both human and environmental health. Considering this scenario, our study aims at assessing sub lethal effects of AMX and OTC in embryonic development of zebrafish. Adult male and female zebrafish were acclimated for one week, and then exposed to different concentrations of OTC or AMX during 96 hours. Toxicity of the compounds was determined using the 96-hour LC50. The LC50 for OTC was 106 mg/L and for AMX, 67 mg/L. To determine whether the observed deviations from the control were statistically significant, a one-way ANOVA was performed. After the analysis, it was found that OTC was toxic to zebrafish, with a significantly lower survival rate at concentrations higher than 106 mg/L. AMX, on the other hand, was not toxic to zebrafish, as the survival rate was similar to the control at all concentrations tested. In conclusion, the results of this study provide valuable information for the risk assessment and management of pharmaceuticals in aquatic environments.
We have identified the COX-1, COX-2a and COX-2b genes in the fathead minnow (Pimephales promelas). To assess the uptake and effect of ibuprofen exposure, fathead minnows were evaluated in microbiologically active river water versus sterilized one. Moreover, the degradations of naproxen and gemfibrozil were also evaluated in microbes simultaneously treated with both pharmaceuticals in order to evaluate if their co-presence could affect their environmental fate and the degradation activity of the microbial community. The overall results show that both pharmaceuticals were biodegraded. Gemfibrozil (DT50 > 70d) was more persistent than naproxen (DT50 = 27 d). In the presence of Naproxen the degradation of Gemfibrozil slowed down and its persistence increased to more than 70%.

TU 096
Determination of emerging substance as human waste indicator in the Danube River samples
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Caffeine, methylxanthine derivative, is a pharmacologically active substance which stimulates the central nervous system, increases heartbeat rate, dilates blood vessels and works as a weak diuretic. It is present in common human sewage and is ubiquitous in natural-human surface waters. The objectives of this study were to determine the presence of caffeine 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 new developed reversed phase high performance liquid chromatography (RP-HPLC) method. The chromatography was using a Zorbax Eclipse XDB-C8 column (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 273 nm. Samples were collected in July 2011 on seven different locations of the Danube River on a territory of Novi Sad, Serbia. Caffeine amount ranged from 0.84 ng/l on the 1st day and 0.52 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 show that 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 (I346009) and NATO Science for Peace Project 'Drinking Water Quality Risk Assessment and Prevention in Novi Sad municipality, Serbia' (JEPAS/P5F 984087).

TU 097
The effects of ibuprofen exposure on fathead minnows (Pimephales promelas)
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4Occurrence of ibuprofen in the non-steroidal anti-inflammatory drug, ibuprofen, has been reported in aquatic waters in the UK at concentrations ranging between 3-37 µg/l. Ibuprofen is a widely prescribed use and over-the-counter medicine, treating pain, inflammation and fever by reducing the level of prostaglandins through non-selective inhibition of the enzyme cyclooxygenase (COX). COX exists in two isoforms, the constitutively expressed COX-1 and the inducible COX-2. In order to evaluate whether pharmaceuticals pose a risk to aquatic ecosystems, we are testing the hypothesis that any potential effects will be related to the Mode-Of-Action of the drug and will be seen at plasma levels in non-target organisms similar to human therapeutic levels. We have identified the COX-1, COX-2a and COX-2b genes in the fathead minnow (Pimephales promelas). To assess the uptake and effect of ibuprofen exposure, fathead minnows were exposed to ibuprofen concentrations close to nominal (105 ± 2.6 and 502 ± 49 µg/L) and 360-fold (500 µg/L) higher than the nominal concentrations. Variation in ibuprofen uptake was noted between individual fish in the high concentration group (range 120-700 fold), and current work is focused on relating this to changes in COX gene expression. Plasma and water samples were also collected to determine ibuprofen concentrations in the fish and the exposure water, using mass spectrometry. This confirmed that fish were exposed to ibuprofen concentrations close to nominal (105 ± 2.6 and 502 ± 49 µg/L respectively). Analysis of the plasma revealed uptake of ibuprofen to be up to 9-fold above nominal concentrations (range 550 µg/L) higher than the nominal concentrations. Caffeine presence in the Danube River samples and to evaluate its stability during two months storage of samples on 4°C most likely due to its degradation.

TU 100
Modelling the seasonal cycle of POPs in soil, vegetation, and cow milk from a high altitude pasture in the Italian Alps
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Pollution in soil, vegetation, fodder, milk and feces from dairy cows that graze on a high altitude pasture 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, HCB) 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 transfer of pollutants between soils and herbaceous vegetation (that act as a temporary filter) and from vegetation to milk and feces, with fast transfer rates. We also observed differences in PBDE fingerprint between inputs and outputs, pointing out differential absorption and/or metabolism of these compounds in cows.
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 hydrophobicity (log KOW) and for ionisable compounds the pKa value are the most important properties determining the ratio between a compound's concentration in the plant-root system to that in the pore water adjacent to the roots. The Plant uptake factor (PUF) can be used as input parameter in simulations models (e.g. FOCUS sw standard scenarios reflect the “realistic worst case” appropriate. Given the fact, that the vast majority of water courses are flowing waters and not stagnant ditches, 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.

TU 102
Determination of plant uptake factors for pesticide fate modelling
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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. Numerical leaching models applied for the environmental exposure assessment of pesticides use the PUF to calculate the amount of a compound taken up by a plant together with the leached amount. The PUF is therefore an important parameter for a realistic leaching assessment. For this purpose, 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, Maize).

In the hydroponic experimental set-up intact plants were exposed between 8 and 11 days to a nutrient solution (pH 6) spiked with the radiolabelled test compound. Volume uptake and concentration in the nutrient solution were measured regularly over the experimental period. By sealing the test vessel it was assured that the only loss process from the system for water and chemical was plant uptake. As a result of the study, the PUF was always well above the FOCUS default value of 0.5 (FOCUS, 2009). Generally, a small variation between plant species was observed. The experimental results could be verified with a simple plant uptake model. 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 hydrophobicity (log KOW) and for ionisable compounds the pKa value are the most important properties determining the ratio between a compound's concentration in the plant-root system to that in the pore water adjacent to the roots. The Plant uptake factor (PUF) can be used as input parameter in simulations models (e.g. FOCUS sw standard scenarios reflect the “realistic worst case” appropriate. Given the fact, that the vast majority of water courses are flowing waters and not stagnant ditches, 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.

TU 103
Development of a French national tool for pesticide risk assessment in the context of the water framework directive
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The main objective of the Water Framework Directive (2000/60/EC) is to achieve good ecological status in all surface and groundwater bodies in the EU by 2015. However, it is already clear that this goal cannot be achieved by 2015 for a number of reasons. It is expected that powerful exposure assessment tools which are able to i) link the observed contamination of water bodies with agricultural pesticides with the agro-pedo-climatic conditions and pesticide application practices responsible for the contamination, and ii) explore the effect of risk mitigation measures a priori in order to determine the most effective and efficient measurements for implementation in practice. FOOTWAYS has been charged with the development of a national pesticide exposure and risk assessment tool for France to be applied in the context of the Water Frame-work Directive. The tool will produce results at two different scales: i) river water bodies and groundwater bodies, for the purpose of risk assessment and global testing of the effects of pesticides, and ii) edge-of-field water bodies, for more specific testing of the effect of mitigation measures. The tool will be part of the FOOTWAYS Pro web platform for pesticide risk assessment and management.

While the first phase of the project is focusing on an evaluation of the current situation, in the second phase also scenario simulations exploring the effects of the implementation of mitigation measures will be considered. Results from the first two phases of the project will be presented, including exposure and risk estimates for the widely used substance glyphosate and its main metabolite AMPA.

TU 104
Pesticide exposure assessment in flowing waters - Approaches to dynamic predicted environmental concentration
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Pesticide risk evaluation for surface waters in the EU is based on FOCUS sw standard scenarios ditch, stream, and pond, which are characterized by fixed amounts of water for dilution of pesticide input. The representativity of this water bodies for existing waters in real landscapes of the EU was never verified, and there is some doubt that the FOCUS sw standard scenarios reflect the “realistic worst case” appropriate. Given the fact, that the vast majority of water courses are flowing waters and not stagnant ditches, a more realistic pesticide exposure assessment has to respect some basic properties of rivers: (i) In flowing waters, the hydrodynamic dispersion lowers the peak concentration but spreads the long-tudinal extension of an initial substance pulse. (ii) Pesticide applications on fields along a river stretch affect adjacent areas of the water package moving downstream. (iii) The locations of pesticide input and the sites where ecotoxicological effects may occur are apart from each other. The flowing waters observed at a point of a river stretch fluctuate, 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 concentration (RAC). For this purpose the GeoRisk project introduced the quantity PEC(TWA) (1h) achieved by Monte-Carlo (MC) simulations for generic water courses with tiered combinations of the factors flow velocity, discharge volume, width-depth ratio, percentage of river stretch receiving spray drift deposition, and duration of exposure time. The timing of the spray drift depositions along the water course was randomized for each MC-realisation of the combinations. Additionally the sensitivity of the variables is depicted. The presentation of Trapp et al. demonstrates the application of the PEC-dynamic approach to a real brook in Germany.
The general outline of the project and results of Work Package 1 (Evaluation of the FOCUS surface water modelling concept with respect to representativity and predictability 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 EFSAs guidance on soil degradation rates and environmental exposure modelling

The general procedures for calculating degradation rates are well known but the assumptions made during this process can appreciably affect the results.

University Gießen started on 1 December 2011 and will run for 23 months.

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

L. Pottma, E. Beltran, M. Darriett, P. Adrian
CECTRA 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 EFSAs for a rapid regulation by means of these documents. The aim of the study is to check the impact of the derivation of kinetic parameters linked to the degradation half-life of pesticides in the environment.

TU 108

4Environment Dept., University of York, York, United Kingdom

The general outline of the project and results of Work Package 1 (Evaluation of the FOCUS surface water modelling concept with respect to representativity and predictability of the included scenarios for German conditions in comparison to the current assessment methods in the German national authorization procedure) will be presented.

TU 109

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

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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 the FOCUS groundwater model PELMO 4. The model is used to predict the leaching of pesticides to groundwater and is based on laboratory studies and field experiments.

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 potential of the parent substance and/or its metabolites into groundwater
- the leaching potential of the parent substance and/or its metabolites after transformation
- the leaching potential of the parent substance and/or its metabolites after transformation in the soil

The selected rainfall criterion will only affect the leaching potential of the parent substance and/or its metabolites in the soil. The selected rainfall criterion will only affect the leaching potential of the parent substance and/or its metabolites in the soil. The selected rainfall criterion will only affect the leaching potential of the parent substance and/or its metabolites in the soil. The selected rainfall criterion will only affect the leaching potential of the parent substance and/or its metabolites in the soil.

TU 110

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

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In the assessment for authorisation of plant protection product the leaching beha-viour is an important factor to protect the groundwater. In this context the sorption to soil (Parameter: Kc) and the degradation (Parameter: DT50) are processes that must be taken into account. Recently, the new FOCUS groundwater group suggested a third methodology for the input parameter setting (FOCUS2009) and a third methodology for the input parameter setting (FOCUS2009) and a third methodology for the input parameter setting (FOCUS2009).

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. 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 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 systems (XP, Vista and 7) in 32 bit as well as 64 bit version. The results of InversePELMO can be used to provide both propo-sites (e.g. optimised parameters and the simulation model) within 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 systems (XP, Vista and 7) in 32 bit as well as 64 bit version. The results of InversePELMO can be used to provide both propo-sites (e.g. optimised parameters and the simulation model) within the necessary input files in the correct format.
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 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 would 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**

**Last advances and perspective for a better risk assessment of the tropical use of Protection Plant Products in France**

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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-pedoclimatic conditions of these tropical regions would require to use specific models in these regions to account in modelling and (3) provide a brief overview of the principles of the model currently under development and the framework planned to adapt it for regulation.

The statistical analysis shows that EU endpoints seem to be provisional acceptable entries for the risk assessment in these tropical regions but should not supersede any experimental evidence supplied with tropical soils. The knowledge about agro-pedoclimatic conditions and transport of pesticide in these territories underlines that (1) a minimum of four scenarios (2 soils: andolol and nitsol 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 be to initially simplified to a simple static receiving water body of dimensions defined consistently with French overseas territories and protection goals. Finally, the main features of two models - currently 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**

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

Modelling the environmental fate and effect of organic bulk emissions from industrial effluents in LCA.

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) and total P. We present our methodology for establishing aquatic (freshwater) ecotoxicity characterisation factors (CF) for waterborne organic bulk emissions from industrial effluents consistently with French overseas territories and protection goals. Finally, the main features of two models - currently 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 116**

**Combination of SFA and multi-media fate modeling to assess the consequences of global trade and informal recycling of WEEE in China**

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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).

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 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) and total P. We present our methodology for establishing aquatic (freshwater) ecotoxicity characterisation factors (CF) for waterborne organic bulk emissions from industrial effluents consistently with French overseas territories and protection goals. Finally, the main features of two models - currently 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 117**

**Modelling the environmental fate and effect of organic bulk emissions from industrial effluents in LCA**

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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) and total P. We present our methodology for establishing aquatic (freshwater) ecotoxicity characterisation factors (CF) for waterborne organic bulk emissions from industrial effluents consistently with French overseas territories and protection goals. Finally, the main features of two models - currently 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 118**

**Globally applicable, spatially explicit assessment of non-toxic air pollutants regarding health impacts due to ozone**

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2Joint Research Centre, Institute for Environment and Sustainability, CCU, Ispra, Italy

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 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) and total P. We present our methodology for establishing aquatic (freshwater) ecotoxicity characterisation factors (CF) for waterborne organic bulk emissions from industrial effluents consistently with French overseas territories and protection goals. Finally, the main features of two models - currently 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.
Health risk assessment of chlorpyrifos with rice farmers in Vietnam
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Vietnam is an agricultural developing country with over 80% of its 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 men, 1 day prior to application and over 5 days post-application, and then analysed for TCP, the main metabolite of chlorpyrifos, using UPLC-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. Post-application chlorpyrifos ADD of farmers varied from 0.4-94.2 µg/kg/d, with a 50th percentile exposure level of 8 µg/kg/d which was about 80-fold higher than the 50th percentile exposure level and broad coverage. We started our research based on a detailed study assessing impacts of thermal release of a specific nuclear power plant in Switzerland and extracted the most sensitive parameters to derive a generic model of combined fate and effect model for the US. We created a 0.5 arc degree grid accounting for water temperatures, river flow, river width, flow velocity and distance to sea in order to model fate and effect of thermal emissions from different sizes of power plants. Various data sources are tapped and different interpolation methods are applied to cover points without measured data, allowing accounting for uncertainties. We further investigated uncertainties of the characterization factors by varying input parameters and the model assumptions, including, the assessment of the affected species. The thermal impacts show significant spatial variability depending on the water body where the cooling water is discharged and the amount of heat released, because the impacts are non-linear. Furthermore this project illustrates how fate and effect model can be integrated to improve the assessment of spatially differentiated impact assessment considerably.

Conclusion
This case study in Vietnam has shown that rice farmers are at a high risk of chlorpyrifos exposure and resultant adverse health effects, mostly neurotoxicity.

RA02P - Approaches for comparative hazard and risk assessment of chemicals
1. Introduction
This poster presents intake factors (IF) and characterization factors (CF) regarding human health effects for the pollutants NMVOC, NOx and SO2 accounting for health impacts due to ozone. Research on life cycle impact assessment (LCIA) for transboundary pollutants have been reviewed and it is suggested that spatially differentiated fate and effects modelling may fill the gap of consistent global modelling by developing an approach to derive globally applicable and spatially explicit values, and with the present work aims to fill the gap of consistent global modelling by developing an approach to derive globally applicable and spatially explicit values, and with the present work aims to fill the gap of consistent global modelling by developing an approach to derive globally applicable and spatially explicit values, and with the present work aims to fill the gap of consistent global modelling by developing an approach to derive globally applicable and spatially explicit values, and with the present work aims to fill the gap of consistent global modelling by developing an approach to derive globally applicable and spatially explicit values, and with the present work aims to fill the gap of consistent global modelling by developing an approach to derive globally applicable and spatially explicit values.

2. Materials and Methods
Within the ongoing EU-funded project LC-IMPACT (2010-2012) the “Development and application of environmental Life Cycle Impact Assessment Methods for improved sustAinability characterisation of technologies”is pursued. Within the area of “Non-toxic pollutant impacts”the objective is to develop globally applicable, but spatially explicit, LCIA methods and characterization factors. Within the TM5-FASST modelling framework, the world is divided into 36 regions. Each region serves as a source region and each grid cell (resolution 1°x1°) of the whole world serves as receptor region. Population data and concentration response function responses are applied in order to calculate the IF and relevant diseases. Finally, the health impacts are weighted in order to get DALYS per unit of emission, and different external cost estimates, by including and excluding equity weighting.

3. Results
A detailed comparison will be made between the derived LC-IMPACT model and the EcoSenseWeb integrated assessment tool in order to assess the inherent uncertainties and implicit variability in the estimates. IFs and CFs are calculated for several countries and larger regions. Finally, IFs and CFs suggested in different LCIA methods have been compared with the findings of this work

Acknowledgements
The author thanks the colleagues of the LC-IMPACT and the European Union for funding. The author thanks the JRC-ISPRA, Institute for Environment and Sustainability (IES), Climate Change Unit (CCU) for kindly making the global scale assessment based on the TM5-FASST tool possible.

TU 119
Environmental impacts of thermal emission to freshwater: Spatially explicit fate and effect modelling
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Power production is a crucial sector causing heavy impact on freshwater bodies by releasing enormous amounts of heat in once-through cooling systems. So far only few approaches have addressed impact on aquatic environment related to this issue and there is no study providing fate and effect model for assessing the impacts on a spatial explicit level and broad coverage. We started our research based on a detailed study assessing impacts of thermal emissions from different sizes of power plants in Switzerland and extracted the most sensitive parameters to derive a generic model of combined fate and effect model for the US. We created a 0.5 arc degree grid accounting for water temperatures, river flow, river width, flow velocity and distance to sea in order to model fate and effect of thermal emissions from different sizes of power plants. Various data sources are tapped and different interpolation methods are applied to cover points without measured data, allowing accounting for uncertainties. We further investigated uncertainties of the characterization factors by varying input parameters and the model assumptions, including, the assessment of the affected species. The thermal impacts show significant spatial variability depending on the water body where the cooling water is discharged and the amount of heat released, because the impacts are non-linear. Furthermore this project illustrates how fate and effect model can be integrated to improve the assessment of spatially differentiated impact assessment considerably.

TU 120
Including the influence of worldwide crop cultivation on ecosystem services in life cycle assessment
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Land use is increasing worldwide leading to changes in the ecosystem. To measure such changes we can allow for quantification of the impact that each land use activity causes to the environment. This can be achieved through the quantification of changes in ecosystem services. Ecosystem services include carbon sequestration, nutrient cycling, erosion regulation and biotic production potential. The goal of this research is to develop indicators that estimate changes in ecosystem services due to changes in selected land use activities namely, cultivation of rapeseed, soybean and sugarcane, on a global scale. In Life Cycle Impact Assessment (LCIA) these indicators are known as characterization factors (CFs). In this research we focus on erosion and carbon sequestration. The cultivation of the crops is simulated using the Environmental Policy Integrated Climate model (EPIC). EPIC is a spatial and temporal agri-environmental model which simulates the biophysical impacts on homogenous response units characterized by altitude, slope and soil class. Input for EPIC simulations include weather and soil profile data, and information on land use, land cover, and crop management. By simulating processes of crop growth, water and nutrient cycles, EPIC produces, among its outputs, estimates of crop yield, sediment transportation and soil carbon sequestration. The characterization factors will be aggregated to country or biome level. Comparisons will be made between results from different spatial aggregation levels, and different management systems regarding input of fertilizer or irrigation.
A health assessment in Perm, an industrial city in European Russia, has been performed using the WHO methodology. The findings indicate spatially differentiated carcinogenic exposures and highlight the importance of addressing these exposures. The assessment of potential risk factors, such as heavy metal exposure, has revealed elevated levels of heavy metals in the blood of the exposed population. The main risk factor is inhalation exposure, with more than 173,000 Perm children (99.4%) and all of the 809,000 Perm adults being at an unacceptable carcinogenic risk. The main risk factor is inhalation, with the presence of above-mentioned risks having been proven by the identification of contaminants in the blood of the exposed subjects and the deterioration of health and immune disorders as well as central nervous system impairments. More than 99.4% of adults and all children in Perm are affected by these contaminants, indicating the need for more stringent health and safety measures in the region.

Environmental Quality Standards (EQSs) are a key tool under the Water Framework Directive (WFD) to help assess the chemical status of water bodies. However, it is important that EQSs are developed for substances that pose the greatest risk to the aquatic environment, and that emerging contaminants are adequately considered. Various methods for prioritising chemicals have been described, incorporating both exposure and effects. Approaches that prioritise on the basis of risk often require significant inputs, even a draft EQS, or detailed exposure modelling. We describe a simple approach to prioritisation that requires only modest inputs and assigns chemicals to different risk categories based on exposure and hazard. This method does not require a draft EQS in order to prioritise chemicals. Rather, it categories 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.

In conclusion, we propose a more structured reliability and relevance evaluation of critical ecological studies together with a plausibility assessment based on a weight of evidence assessment. This approach helps identify studies that may lead to identifying future EQS candidates. The prioritisation method 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 degradation and bioaccumulation. A separate approach for such chemicals may need to be developed. Further work is needed to review the output of the scheme because this can help introduce relevant new data or information about significant trends in likely exposure (e.g. planned restrictions on use) that will affect the chemicals' priority.
We present actual time trends and levels for PCDD/F and dl-PCB in breams from seven major rivers in Germany between 2003 and 2008. Levels are notably going down for PCDD/F concentrations but for dl-PCB there is a non-uniform overall picture showing rather a baseline than a clear decrease at fairly high levels. Generally, for both used for 3 different trophic levels (algae, invertebrates and fish) . Once normalized for bioavailability safe threshold concentrations are calculated as the lower 5th percentile in Germany. Serving this purpose, the common bream, abramis brama, has been selected as a specimen for this monitoring . It is common, widespread, trophically reasonably integrated RA procedures . Ecosystems’ bioavailability} will be created . A diverse range of dedicated activities is planned for information, dissemination, capacity building and communication . HEROIC starts with a comprehensive landscaping exercise to identify common methodological and data needs in current human and environmental risk assessment disciplines for integrated RA, and develop a framework for integrated methodologies and approaches for RA. This will increase transparency in RA and allow better risk 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 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 gains 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 128 Efficient toxicity testing when test information is uncertain: a stochastic cost-effectiveness analysis

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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 efficient 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 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 expected benefits (costs and information gains) for different testing trade-offs and strategies. While CEA has become widely used in many 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 gains 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 IFRAP Environmental Standards: risk and hazard assessment update for 2012

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The International Fragrance Association and the fragrance industry’s voluntary safety program with the development of IFRAP 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 materials for risk assessment refinement, fragrance materials were screened using the RIFM Environmental framework and 13% of the materials were identified. In most cases, this 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 IFRAP Environmental Standards, reported here are the results of these data, including both hazard assessment results and the risk assessment domains. 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. IFRAP and RIFM have decided to present an annual update of this test program and the IFRAP 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

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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. The HEROC project in coordination activity on CP-EP 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 how this can be translated into a framework for integrated methodologies for test selection and risk assessment for RA. This will increase transparency in RA and allow better risk management to communicate public trust and provide unambiguous 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 while exploring the potential of existing-in- silico models and exposure assessment. 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.

RA03P - Are Environmental Specimen Banks ready to face future challenges of environmental chemistry and regulatory toxicology?

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Targets and standards are helps to us to take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks developed in the EU and USA for the derivation of EQS for metals. Central focus will be on differences in approach used for the development, validation and implementation of the Biotic Liganal Models (BLM). Indeed, in the USA BLM are proposed for 2 different trophic levels (invertebrates and fish), while in the EU chronic BLMs are used for six trophic levels (algae, invertebrates and fish). Once normalized for bioavailability safe threshold concentrations are calculated as the lower 5th percentile in the whole species sensitivity distribution SSD in the EU while only the 4 most sensitive genus mean values are used to derive the 5th percentile using least square regression analysis. The influence of such differences in both frameworks on the EQS setting will be illustrated using Cu as an example. EQS for different surface waters (with different biological compositions) will be demonstrated. In most cases it seems that the differences in EQS values between both frameworks are within a factor of 2-3. Therefore, although there is a general tendency to incorporate such concepts in regulatory frameworks for metals there is a clear need for harmonization of frameworks as highlighted by the OECD.

TU 134 A 10 year retrospective study of mussel condition in North Borean Peninsula based on the ‘mussel shell section’ of the Biscay Bay Environmental Biospecimen Bank

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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 efficient 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 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 expected benefits (costs and information gains) for different testing trade-offs and strategies. While CEA has become widely used in many 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 gains 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.
University of the Basque Country, Leioa, Spain

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 Basque Bay Environmental Biospecimen Bank (BBEBB) was designed including specimens for biological endpoints, say biopsies for histopathology/immunochemistry, cryo-specimens for molecular/cellular analysis, and dried mineralized tissues (shells/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 BBEBB (2001-2010) localities covering the area of geographical distribution of Mytilus galloprovincialis in the North Iberian coast. Changes in shell size (length, L; width, W; height, H), alometry 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 of local environmental trends 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 biomonitoring 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 depended 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 K-EGOKITZEN project.

TU 135

Using banked seabird eggs for determining geographic patterns of trace element in marine regions
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Specimen security in long term specimen banking - zebra mussel example in the German ESB
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1National Institute of Standards and Technology, Charleston, United States of America
2Germany Federal Environment Agency, Berlin, Germany

TU 137

Organic compounds in suspended particulate matter - results from the German environmental specimen bank
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1National Institute of Standards and Technology, Charleston, United States of America
2Germany Federal Environment Agency, Berlin, Germany

TU 138

Standardized freshwater mussel watch for monitoring of aquatic environments: implications and possibilities
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TU 140

The impact of high discharge on sediment quality in the Elbe estuary
S. Heise1, J. Angelstorf1, M. Kortwitz1, P. Hu2
1HAW-Hamburg, Hamburg, Germany
2German Federal Environment Agency, Berlin, Germany

TU 136

Specimen security in long term specimen banking - zebra mussel example in the German ESB
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1National Institute of Standards and Technology, Charleston, United States of America
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TU 140

The impact of high discharge on sediment quality in the Elbe estuary
S. Heise1, J. Angelstorf1, M. Kortwitz1, P. Hu2
1HAW-Hamburg, Hamburg, Germany
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RA06P - Contaminated sediments in a changing environment
Contamination of the Elbe estuary with particle bound compounds mostly (with the exception of TBT which had its source in the Hamburg Harbour) derives from “areas of risk”/upstream of Hamburg such as the Czech Republic for organic contaminants like HCH, HCB, PCB, DDX and TBT, the tributary Mulde for As, Dioxins and HCH, and the Saale for a number of heavy metals like Cd, Hg, Cu, Zn, and Pb. The major transport of contaminants happens during periods of high water discharge, when historic contaminated soil or sediment in the catchment area are eroded and delivered downstream. For some contaminants, the yearly load of particle bound contaminants is transported during a few days of a high water discharge (Heise, Krüger et al., 2008). Up to now, the impact of contaminants on the quality of sediments in the estuary as a consequence of a high discharge event, however, has not been very well investigated. The Elbe estuary is divided by the Hamburg Port, the second largest port in Germany (100 km upstream of the mouth of the river. Even though the river downstream of Hamburg has been maintained as a deep water navigation channel, 94 % of the area is ecologically protected by FFH and Birds directive. Some of the ecologically valuable 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 a 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 in a spatially nested, Elevated discharge did not lead to any significant increase of contamination fluxes may be recorded. Long and suspended particulate matter (SPM) (Payne, 1997) leads to the study of 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, and 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 on dissolved contaminants. Extracts from SPM and passive samples were tested for respiratory toxicity (Microtox), dioxin-like activities, (a)androgenic, (a) estrogenic, and thyroid hormone-like activities, and for mutagenicity. Variable patterns of both increased or decreased toxicity in relation to climate were noted both within species and between species. Significant differences in toxicity were noted for episodic events like melting of glaciers (Akerselva river, Oslo) and overflow of mixed sewer systems (Harrestrup river, Copenhagen). Contaminant concentrations of SPM and sediment were classified based on a toxic-unit approach and will be compared to the in-vitro toxicity profiles. Results of multivariate statistical analysis (PCA, cluster analysis) and different toxicity ranking and classification approaches will be presented. The results will be included in a web-based communication tool (Open Earth) open to the general public. The work described was performed within the context of the DiPro 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.

Changes on the biogeochemistry of synthetic surfactants from river to marine sediments.

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2Polytechnic University of Catalonia, Barcelona, Spain

Aquatic systems are subject to the influence of both urban and industrial wastewater discharges, which are among the main sources of organic contaminants. Due to their extremely long lifetime, these compounds can remain in the aquatic environment for decades and their concentrations can be detected in sediments due to their moderate sorption capacity. It is often assumed that surfactants are well preserved in the sedimentary column once anoxic depths are reached, which can happen within a few millimeters to centimeters depending on the aquatic system. In this work we have studied the diagenetic fate of the most commonly used surfactants: alcohol polyoxyethylenes (AEOs) and nonylphenol polyoxyethylenes (NPEOs), both non-ionics, and alkylbenzenesulfonates (LAS) and alkyl ethoxysulfates (AES), both anionic surfactants. Their concentrations in sediment and pore water were determined along the sedimentary column by sampling cores in three different aquatic systems from SW Spain: the salt-marsh environment of the Bay of Cádiz, the middle stretch and the estuary of the Guadalete River, and the Bornos river estuary. SPM and sediment distributions were observed according to the respective uses, production volumes and physicochemical properties of each surfactant. Levels of non-ionics (up to 12 mg/kg) were twice as high as to those for anionics near industrial areas and ports, whereas the opposite was found near urban wastewater discharge outlets (up to 8 mg/kg). The most remarkable result was that sulfophenyl carboxylic acids (SPC), LAS degradation products, were identified in anoxic pore water. However, this was observed only in marine, and, to a minor extent, estuarine sediments. No SPC were detected in sediments from freshwater systems. The presence of sulfate-reducing bacteria in marine sediments (or absence in freshwater environments) seems to be strongly related to the degradation process. On the other hand, no changes in the average length of AE0 and NPE0 ethoxylated chains were observed along sediment cores from any type of aquatic system, suggesting that their biodegradation is very limited in seawater and estuarine sediments.
TU 146

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

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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 the choice of two feeding regimes, (ii) TetraMin food and (iii) a 1:1 mixture of TetraMin and food. The exposure period 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 were significantly reduced at 560 µg g−1 and 1800 µg g−1. For both feeding regimes, the burdens of Zn at 1800 µg g−1 were 3.6 and 5.4 µg g−1, respectively. For both feeding regimes, biological responses were only noted in worms fed via the sediment. The lack of toxicity in the TetraMin treatment was attributed to selective feeding on TetraMin and to daily feeding regime, which promoted the organisms to spend less time in the sediment thus reducing Zn exposure. Significant Zn bioaccumulation not accompanied with biological effects at 1800 µg g−1 suggests internal detoxification or other regulation mechanisms. In the SED+ treatment, significant biological effects and different Zn internal distributions were observed at 180 and 560 µg g−1. These findings indicate that avoided feeding to an avoidance reaction to contaminated food/sediment or different mechanisms of toxicity due to dietary Zn, were assumed to be the causes. 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 epididymis 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 behavior toward contaminated sediment/food. The XRF data also show that at 1800 µg g−1, Zn was mainly distributed in the epihdermis and sub-epidermis of L. variegatus, confirming the role of dissolved Zn as the predominant exposure route when SEM-Zn-ASo.

TU 147

Toxicity of organic micropollutants in the Yangtze Three Gorges Reservoir - MICROTOX

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The Baltic Sea, one of the largest brackish water bodies in the world, is considered to be an exceptionally sensitive and endangered marine ecosystem. The average residence time of Baltic Sea water ranges between 23 and 50 years, thus facilitating the accumulation of pollutants in sediment. For a deeper insight into the ecotoxicological effects of persistent organic pollutants (POPs) in sediments, biological test systems were applied as well as mild sedimental extracts. Extracts from PLE and mild methanol/water extraction, were investigated for their dioxin-like activity and their embryotoxic impact on the development of zebrafish (Danio rerio) embryos. PLE extracts were considered to represent the entire toxic potential and the mild methanol/water extracts to contain rather bioavailable pollutants. Applied biotests were the fish embryo test in 96-well plates with ATS/ATCC/R1 and RTL/w1 cells. Result extracts in contrast to the PLE extracts, which gave strong embryotoxic potential. Results on the EROD inducing potential indicated dioxin-like activity for all investigated sampling sites. PLE extracts showed clearly higher dioxin-like activity than mild methanol/water extracts. The study revealed an ecotoxicological burden for all Baltic Sea sediments. Especially the Eastern Gotland Basin, the São Francisco River and the Aracá Basin appear highly polluted, but according to the water/methanol extracts, this pollution is not readily available for developing fish embryos. However, the ability of the mild extracts to resemble the bioavailable fraction might be limited. For a comprehensive ecotoxicological assessment it is necessary to thoroughly investigate the bioavailability and to identify the causative pollutants by chemical analyses.

TU 150

Identification of hazard factors and ecotoxicological risk factors of sediments from the Tietê River Basin (Brazil)

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The purpose of this study to compare chemical analyses of selected priority contaminants but water and sediments in small streams contain complex mixtures of different chemicals which may cause various toxic effects to aquatic biota. Biological assays thus serve as a complementary tool in the effect-based monitoring of water or sediment quality. In the present study, we investigated 25 localities from two different regions in the Czech Republic. Sediment samples from each locality were repeatedly collected for two years with the main goal to compare outcomes of chemical and biological/ecotoxicological analyses. Chemical analyses assessed levels of toxic metals, PAHs and POPs. Ecotoxicological tests were conducted using the luminescence response of a luminescent bacterium and the abundance of Daphnia magna. The obtained results demonstrate differences between both studied regions in the Czech Republic as well as between different sampling periods. Statistical analyses repeatedly revealed relatively weak correlations between chemical contamination data and toxicity, while total organic carbon (TOC) appeared to be related to observed toxic effects. The present study consists of the use of the kinetic V. fisheri test in the effect-based monitoring of sediments demonstrating thus complementarity of both chemical and ecotoxicological data.

TU 149

Toxicity of persistent organic micropollutants from Baltic Sea sediments in the fish embryo test and the EROD assay

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Toxicity of persistent organic micropollutants from Baltic Sea sediments in the fish embryo test and the EROD assay

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The Baltic Sea, one of the largest brackish water bodies in the world, is considered to be an exceptionally sensitive and endangered marine ecosystem. The average residence time of Baltic Sea water ranges between 23 and 50 years, thus facilitating the accumulation of pollutants in sediment. For a deeper insight into the ecotoxicological effects of persistent organic pollutants (POPs), biological test systems were applied as well as mild sedimental extracts. Extracts from PLE and mild methanol/water extraction, were investigated for their dioxin-like activity and their embryotoxic impact on the development of zebrafish (Danio rerio) embryos. PLE extracts were considered to represent the entire toxic potential and the mild methanol/water extracts to contain rather bioavailable pollutants. Applied biotests were the fish embryo test in 96-well plates with ATS/ATCC/R1 and RTL/w1 cells. Result extracts in contrast to the PLE extracts, which gave strong embryotoxic potential. Results on the EROD inducing potential indicated dioxin-like activity for all investigated sampling sites. PLE extracts showed clearly higher dioxin-like activity than mild methanol/water extracts. The study revealed an ecotoxicological burden for all Baltic Sea sediments. Especially the Eastern Gotland Basin, the São Francisco River and the Aracá Basin appear highly polluted, but according to the water/methanol extracts, this pollution is not readily available for developing fish embryos. However, the ability of the mild extracts to resemble the bioavailable fraction might be limited. For a comprehensive ecotoxicological assessment it is necessary to thoroughly investigate the bioavailability and to identify the causative pollutants by chemical analyses.

TU 151

Acute sediment toxicity assessment in the river Sao Francisco, Brazil

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The São Francisco River is the fourth longest river from South America and the longest that runs entirely in Brazil. Although is a very important river, there are diverse anthropogenic activities, such hydroelectric plants, metal manufacturing industry or agriculture that have impact on these ecosystem. The objective of this study is to evaluate
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 of zinc. For this, a battery of three laboratory bioassays, using two cladoceran (Daphnia similis and Ceriodaphnia dubia) and one amphipod (Hyalella 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 fractions (sediment metals and sediment of a sample of sediment-water at the first steps of the sequential extraction procedure) in order to establish the potential effect of the industrial plant. The effect of sediment metal contamination was assessed applying multivariate techniques. The results show elevated concentrations of Zn, Cd and Pb that involve an important potential risk on the aquatic environment. The sediments affected by the industrial plant presents 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.

TGU 152
Ecotoxicological assessment of sediments from rivers impacted by a petroleum refinery
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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 Cisimat, 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.

TGU 153
Seasonal variation of toxicity and genotoxicity of sediments samples of the Ensenada de la Paz, B.C.S. México
S. Sobrino-Figueroa1, 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 Cisimat, 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.

TGU 154
Toxic effects of sediments from a semi-arid coastal system, influenced by a gold ore mine
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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 the potential aquatic 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 recent 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, Heterocypris 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 wide range of exposure (ingestion, regurgitation, contact) and because they represent different trophic levels (decomposer, producer or consumer).

Among the stations of 10 studied in 2010, four showed a relatively low toxicity toward several organisms of the bioassays battery (the Wiltz, the Sure, the Gueule and the Rhônes), 3 showed low toxicity toward one of the organisms (the Oise, the Molineig and the Eau d’Heure) and 3 showed no signs of toxicity (the Biesmes the Goulet and the Rondefontaine). 12 different metals (Al, As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn) and the different geochemical sediment fractions 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 (toxicity and teratogenicity) and chemical analyses, among those rivers have been also investigated, these results must be associated, in order to obtain a comprehensive evaluation of the ecotoxicological situation of these water bodies. First results will be presented.

TGU 155
Bioassays in sediment assessment for investigative monitoring in the context of the WFD
M.H. Hemrat1, E. Biesens1, V. Vatter1, J. Harten2, R. Meister3, C. Glotter1, B. Hirth1, A.M. V.M. Soares4, P. Gonçalves5
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Seasonal variation of toxicity and genotoxicity of sediments samples of the Ensenada de la Paz, B.C.S. México
33

Metal contamination of freshwater water bodies resulting from mining activities or deactivated mines is a common environmental problem in Portugal. Despite authorities recommend the recovery plans since their shut-down in the early-mid 1900’s. Both mines are inserted in large underground complexes. Braçal was mainly focused on the extraction of galena ore while Palhal was on the extraction of pyrhotite, chalcopyrite, galena, sphalerite and pyrite ore. Since their shutting down, the mining run-off are running into two subsidiaries of Vouga River. The purpose of this work was to empirically establish the potential risks and hazards of the contribution of mining run-off into Vouga river subsidiaries for freshwater communities and nearby population villages. Therefore, ecotoxicological tests using a battery of assays were performed on sediments collected from the river in the vicinity of the Braçal mine. The results show that the Braçal mining phenomenon resulting from the oxygen in contact with ore. In opposite, Palhal mine never faced flooding events, which may explain the higher toxicity of the samples collected there. Our study highlights the usefulness of using an ecotoxicological approach to help the prioritization/scoring of the most critical areas impacted by deactivated mines.

TGU 156
Ecotoxicological assessment of contaminated rivers as a proxy for the water framework directive: an acid mine drainage example
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With a catchments area of about 40,000 km², the Kusimbo River is rich in endemic species of flora and fauna and characterised by high concentrations of large mammals especially Puku, Buffalo, Elephant, Hippopotamus and Lions. Over the last two decades an intense human settlement in the valley has increased, parallel with the socio-economic activities such as livestock keeping, fishing, cultivation, and beekeeping. 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 ecosystem. However, little is known about sediment chemical contamination and pesticide load of Kusimbo 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 hot spots will be carried out in order to identify hazards. Water and sediment samples will be collected in both dry and wet seasons, 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

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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, and Mn) by inductively coupled plasma atomic emission spectrometry (ICP-AES)

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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

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Many streams and small rivers in Europe are faced with heavy metal pollution. Rehabilitation activities are executed for many streams in the Mediterranean region, and it is assumed that heavy metal toxicity and biological effects depend on the type of pollutants, the river characteristics and the water discharge.

TU 160

Triad approach for risk assessment of sediment and floodplain soil of a metal-polluted stream

H.J. de Langer1, J. Bovenhuis1, L. van IJzendoorn1, L.M. Mokwe Ozonzeadi2

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The study aims to investigate the effect on particle size on heavy metal concentration, study seasonal variation in the concentration of Cu, Ni, Pb and Zn in Ravensbourne stream and in the floodplain on 5 locations along the stream. Total concentration (aqua regia extraction) and bioavailable concentration (CaCl2 extraction) of the following metals were analyzed: Cd, Cu, Pb, Zn, As. A standard Chironomus survival bioassay was conducted in the laboratory. Metal and bioassay results were compared with field inventarisation of the macroinvertebrate community.

TU 161

Hexachlorobenzene-contamination of sediments of the Upper Rhine River - identification of sorbents to assess bioavailability

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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 capacities (classified by particle size and content of organic matter) were determined.

TU 162

River sediment sampling and environmental quality standards

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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 most of which consists of complex materials transported within river or deposited on river bed. Sediment has been identified as major transportor and sequester of fluvial contaminants such as heavy metals, mostly the fine sediment. At present, there are no environmental quality standards (EQS) for sediments or fluvial suspended sediments, and the major issues in establishing standard EQSs is the identification of the suitable sediment fraction to measure - the actively transported or previously 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 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 163

The first sight into contamination of Polychlorinated biphenyls and Polybrominated diphenyl ethers in sediments of Tam Giang-Cau Hai Lagoon, Central Vietnam

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2Natural History Museum, London, United Kingdom

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 capacities (classified by particle size and content of organic matter) were determined.

Dissolved concentrations of PAHs and PCBs were measured in sediment pore water samples of the Baltic Sea using solid phase microextraction, a passive sampling technique.

The study aims to investigate the effect on particle size on heavy metal concentration, study seasonal variation in the concentration of Cu, Ni, Pb and Zn in Ravensbourne stream and in the floodplain on 5 locations along the stream. Total concentration (aqua regia extraction) and bioavailable concentration (CaCl2 extraction) of the following metals were analyzed: Cd, Cu, Pb, Zn, As. A standard Chironomus survival bioassay was conducted in the laboratory. Metal and bioassay results were compared with field inventarisation of the macroinvertebrate community.

The highest bioavailable concentrations of Cd and Zn were observed in the floodplain soils. The bioassay showed a negative effect for two locations. Combining the two measurements with the in situ macroinvertebrate community showed an ecotoxicological risk in one floodplain soil when inundated. These results are compared with previous studies along the river. Dommel. Advices on optimal restructuring and rehabilitation of small streams should include the spatial distribution and bioavailability of contaminants.

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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 sediment was relatively uniform, with decBDE 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, compared with those reported in other river and lagoon developed countries. This may reflect a limited usage of PCBs and PBDEs in this region. Comparing to sediment quality guidelines currently used around the world, present sediment concentration of Tam Giang-Cau Hai Lagoon does not constitute a threat to environment. Nevertheless, the first time detection of PBDEs in the lagoon-river system might be an indicator of enhanced recent human pressure that suggests the need for a monitoring plan to prevent the possible dangerous worsening in the near future.

RA07P - Environmental problems of estuaries

TU 166

Distribution character and potential risk of PCBs and phenols in surface water from 22 tributaries and mainstream in middle reaches of Yangtze River

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47 surface water samples were collected from 22 tributaries and mainstream of the Yangtze River from Chongqing to Yichang. The contents of 28 PCB congeners and 15 phenolic compounds were measured using HPLC. The measured level of PCBs in the samples from the tributaries and the mainstream were 20.7 ng-L-1 and 13.25 ng-L-1, and the measured level of phenolic compounds in the samples from the tributaries and the mainstream were 2.07 ng-L-1 and 2.19 ng-L-1, respectively. The highest concentrations of PCBs and phenolic compounds were detected separately in the samples from Rangdu River (61.79 ng-L-1) and Jialing River (173.72 ng-L-1). The average concentrations of PCBs and phenolic compounds in the samples are far lower than the Chinese drinking water guideline values. The concentrations of PCBs and phenolic compounds in the samples were in the same order of magnitude that were reported on lower levels in European and American countries, which show that potential risk are negligible due to PCBs and phenolic compounds contamination in these samples.

TU 167

Measuring trace labile metals in the Pasig River water using DGT technique: an application for an effective water resource management

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The Pasig River is an important water body in Manila, Philippines. This is a busy river greatly influenced by urbanization. It is an estuary in nature as it is in the lower (Manila Bay: west) and lake (Laguna Lake: east). The water quality is a main concern. From being in a state of biologically dead, rehabilitation is applied to raise it to Class C. Efforts are still on-going. An efficient water quality monitoring technique and assessments are necessary. This research made use of the current available technique called passive sampling. DGT technique was used to define the target labile trace metals. (Cr, Co, Ni, Cu, Zn, Cd and Pb). The time of sampling campaigns captured the ENSO phenomenon (El Niño: Period 1; La Niña: Period 2 and in between summer and rainy seasons: Period 3). From these periods, DGT-labile metal concentrations had been computed. Multivariate analyses comprising of Principal Component Analysis (PCA) and Factor Analysis (FA) were employed. This is to be able to identify the factors that play a part more in each period. The cumulative percentages of the total variance are as follow: 89.3% for Period 1; 87.11% for Period 2; and 81.25% for Period 3. Correlations among the parameters had been as achieved. As well, percent concentrations of each element was per site were determined. Scores were given and ranking was then supplied. Based from the ranking, sites that contribute more of the selected parameters were identified. For Periods 1 and 2, highest probabilities are near mid to upstream. While for Period 3, highest rank is near at the downstream. From this also, one is able to locate the sites that can give the highest urgency and priority. Fluxes (in kg d-1) were provided as well. Period 2 having the highest flow gave the highest fluxes per site.

TU 168

Dioxin-like compounds in Portuguese estuaries: levels and patterns in superficial sediments

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Persistent compounds such as polychlorinated dibenzo-p-dioxin (PCDD), polychlorinated dibenzofuran (PCDF) and dioxin-like polychlorinated biphenyl (DL-PCBs) may enter the estuarine system through atmospheric deposition, riverine runoff and direct release from human activities. In the aquatic environment these contaminants strongly adsorb to suspended particles and tend to accumulate in underlying sediments which constitute long-term reservoirs and secondary sources. Contaminated sediments can therefore represent a significant risk to aquatic life and human health and the loss of natural and economic resources. The aim of this research is to evaluate the sediment contamination of Portugal by measuring PBDEs concentrations and PCBs in the samples from the estuaries and sediments are low, but there are differences in the levels and composition of contaminants found in the different estuaries. Our results show that the levels of PCBs in the samples are far lower than the Chinese drinking water guideline values. The concentrations of PCBs and phenolic compounds in the samples were in the same order of magnitude that were reported.

TU 169

Environmental monitoring and assessment of Terminos Lagoon, Mexico

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Terminos Lagoon is an estuary in the state of Grijalva-USumacinta river system, with the largest fresh water runoff in Mexico (35% of the total), and the second largest in the Gulf of Mexico. It is near of one of the main oil drilling areas in Mexico and there are many industrial facilities associated with the oil industry affecting the region. As a result of major anthropogenic activities, the lagoon has undergone significant habitat degradation. The results are categorized as good, regular or bad according to pre-established criteria, in some cases adjusted to conditions in the southern Gulf.

Sampling was random stratified, using the five zones determined from hydrology as a basis for stratification. Results show that in general pollutant concentrations in sediments are 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 this reason, mercury is considered as significant. Organic pollutants there were no significant differences between the zones, except for HCHs and PAHs. A number of stations were found to be in "bad" condition for water quality and benthic community. Loss of mangroves forests is decreasing. Results have been presented to management authorities.

TU 170

Chemical and biological assessment of metal-polluted area in the Udaibai Reserve of the Biosphere (UNESCO) using oysters as sentinel

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The Udaibai Biosphere Reserve of the Biosphere (UNESCO) is one of the most important wetlands in natural conditions of Europe. The Udaibai Reserve is a natural reserve with high biological value, and it is included in the Convention on Biological Diversity (CBD) and the Ramsar Convention. The Udaibai Reserve of the Biosphere presents low-to-moderate levels of metals both in oysters and waters, with only minor biological effects in oysters. It is worth noting that, however, seasonal variability may play a relevant role in environmental metal levels, bioaccumulation and the biological responses of oysters against environmental insult.

Acknowledgements: This work has been financially supported by the UNESCO Chair of the UPV/EHU through the UNESCO 09/23 project and by the UPV/EHU through the Consolidated Research Groups (Ref.: GC07/26-IT-393-07).
Monitoring of sediments genotoxicity of the Yucateco, lagoon Tab, Mexico

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The lagoon Tab, located in southeastern of the Mexican Republic in the Tabasco state. This system receives a continuous contribution of toxic compounds due to hydrocarbons extraction and industrial activity carried out in the zone. Since the system has been reported mass mortality events of fish and shellfish, in this research, an evaluation of the genotoxic effects of sediments over a period of 3 years were carried out to establish the state of ecosystem health. Sampling were made annually during the dry and rainy seasons. The experimental samples were obtained from the SES-Chromatotest microbioassay. In general can mention that the number of sediment samples with genotoxic effects decreased from 2003 to 2007. In 2003 was detected genotoxic compounds in 5 sampling stations, while in 2007 this effect was observed only in 3 locations. Critical areas are the stations 1, 2 and 3 located in the northern and central part of the system, the genotoxic effects decreases with increasing distance from these points in the direction of outlet the river Tonala. The critical pollutants likely to cause genotoxicity were the HAPC, PCBs (polychlorinated biphenyls) and metals vanadium and nickel. The utility of this type of analysis is essential to identify areas of risk in studies of environmental analysis.

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

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Ecological assessments over large spatial scales require that anthropogenic impacts be distinguishable above natural variation, and that the monitoring tools implemented maximise detection impact for a relatively low cost. For three heavily modified and four relatively pristine estuaries (disturbance category), chemical indicators (metals and PAHs) of anthropogenic stress were measured in benthic sediments, suspended sediments and deployed oysters, together with other environmental variables. The differing ability of these data sets to explain the variances observed in infaunal and hard-substrate invertebrate communities were compared. Univariate analyses were useful for comparing contaminant loads between different monitoring tools and identified the strongest correlations between benthic and suspended sediments. However, multivariate analyses were necessary to distinguish ecological response to anthropogenic stressors from environmental "noise" over a large spatial scale and to identify sites that were being impacted by contaminants. These analyses provide evidence that suspended sediments are a useful alternative monitoring tool to detect potential anthropogenic impacts on benthic organisms.

Metal availability and toxicity in estuarine systems in relation to chemical speciation and biological diversity

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The estuarine environment is a very dynamic system characterized by strong physical and chemical gradients and an enormous diversity in flora and fauna which undergo major transitions moving from the freshwater to the marine areas. Along these gradients metal concentrations and speciation undergo important changes which also have an impact on heavy metal distribution and accumulation in the different species living in this gradient as they adjust themselves to the changes in ion composition and osmotic pressure of the external environment in order to maintain homeostatic balance. The effect of changes in salinity on metal speciation, metal bioavailability and metal toxicity was studied under controlled conditions in a series of structurally and functionally different areas from freshwater to estuarine environments. The results indicate that marine organisms are more sensitive to metal availability in estuaries than terrestrial or freshwater organisms. A dynamic modelling approach the effects of changes in physical and chemical parameters on metal availability and toxicity across different species and environments is needed to improve our understanding on the impact and availability of metals in estuaries.

Integrated estuarine Modeling to support watershed management for coastal and dyes inlets, Puget Sound, WA, USA

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2US Space and Naval Warfare Systems Center, San Diego, United States of America

An estuarine model for Puget Sound in the San Juan and Whidbey Island area, also known as the Puget Sound Estuary, was designed and calibrated. The model is calibrated to a near real-time, 3-D P/C fate and transport model, CERES, and the CERES was used to simulate the release, transport, and fate of FC loading from watershed pollutant points corresponding to stream mouths, stormwater outfalls, waste water treatment plant discharges, and shoreline drainage areas. A total of 20 simulation scenarios were run to verify model performance, assess sensitivity and uncertainty, and provide results needed to establish management goals for the watershed. Model results indicated that for marine waters to remain below levels of concern, more stringent than the freshwater quality standards were needed for three streams that discharged in nearshore areas with reduced flushing.

Ecosystems are complex, therefore identifying and monitoring the right parameters is key to successful management. At this site, environmental monitoring has extended beyond routine water quality parameters to include terrestrial and aquatic ecological surveys and detailed studies evaluating benthic community abundance and diversity. The monitoring program is designed to allow for evaluating changes in ecological and biological properties over time, providing a robust baseline for developing comprehensive management plans. Results from this integrated monitoring program have been used to track improvements to the environmental quality of the inlets.

Pyrethroids are a commonly used class of pesticides in California in both agricultural and urban applications. Although pyrethroids are reported as having nominal effects to 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 system, salmon has been shown to accumulate pyrethroids. The use of pyrethroids 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 pyrethroid concentrations 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.
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 80 ppt salinity treatment groups indicating protection by hyperosmotic conditions from acute lethality.

TU 177
Characterization of organic and inorganic mercury transferance dynamics in a coastal lagoon food web using stable isotopes
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Is it possible that, by the determination of total Hg (HgTOT) concentration is not sufficient to understand its fate in the environment. Inorganic ionic Hg2+ is the main form in waters and sediments samples, whereas organic forms of Hg 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, methylmercury (MeHg+), raises prime concern, due to its tendency for bioaccumulation and biomagnification with higher trophic 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, Gracilaria crongon, Pontoporiaceae, and Liza aurata, Antherina boyeri and Dicentrarchus labrax were sampled. Sampling took place near the mouth of the two major freshwater sources (Vouga and Annta rivers) to the lagoon. Vouga River runs in a narrow channel, with steep margins. Its watershed receives other freshwater inputs, livestock, industrial discharges and municipal influents. Laranjo Bay (a depositional area) receives the Annta, which has been conveying industrial discharges, particularly an effluent from a mercury cell-chloralkali plant (from the 1950s until 1994). From the estimated 33t 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 (Gas Chromatography-Isotope Ratio Mass Spectrometry) and δ13C and δ15N, the evaluation of this element's transferance was revealed in the food web was achieved. Mercury analysis was executed using CV-AAS (Cold Vapor Atomic Absorption Spectrometry). Certified reference materials (DOLT-3 and DOLT-4 for tissues, PACS-2 for sediment) were used in the QC/QA process. A significant negative correlation (Pearson Product Moment correlation, P < 0.05) and a very strong positive one (Pearson Product Moment correlation, P < 0.0001) were found for Laranjo data, between HgTOT and HgSN, and between HgTOT and HgORG, respectively. No other significant correlations were established.

Results for HgTOT were generally in line with published values for Laranjo Bay. Organic mercury was the most abundant of the species in the superior organisms (always > 57%). The diverging patterns of HgTOT and HgORG distribution are discussed.

TU 178
Is chemical pollution able to change the physiological capability of Corbicula fluminea to respond to acute chemical stress in estuaries?
P. Vilares, C. Oliveira, L. Guilhermino
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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 being 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 of adaptation and 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-oxygenative defences, aerobic energy production and lipid peroxidation levels were used as biomarkers. Results show different responses between the two sites in the determination of clams suggesting 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) (PTDC/AAC-AMB/102121/2008) and FEDER COMPETE funds (POCOMP-01-0124-FEDER-008556). P. Vilares had a grant in the scope of the project and C. Oliveira had a PhD grant from FCT (SFRH/BD/68423/2010) funded by national funds of the MCTES and FEDER European funds (POPH-QREN-Tipology 4.2.).

RA19P - Plants and chemicals in the environment: risk assessment, pest management and phytoremediation
TU 181
Sediment contact test with Myriophyllum aquaticum (ISO/CD 16191): first results of an international ring test
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Although an important part of an aquatic ecosystem, dicotyledonous macrophytes are not yet part of the risk assessment of sediments or dredged material. 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 test procedure is now in the standardisation process within ISO. In the study on the growth of Myriophyllum aquaticum who is exposed to environmental samples for ten days. The growth of Myriophyllum aquaticum in a test sample is 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) validating 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 182
Genotoxic/more ecologically relevant data from laboratory tests: recovery potential of Lemna minor
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The goal of ecological risk assessments for chemicals typically is to protect the status of populations. Still, the assessments are usually conducted at the level of the individual, so the results of laboratory testing need to be translated into predictions of population status. Extrapolation from laboratory tests has many limitations, among which is the fact that species differ not only in toxicological sensitivity but their potential for recovery from adverse effects.
Lemna minor is a highly representative test organism for standard laboratory test species that can actually provide direct information on population status upon exposure to potentially harmful substances. Still, the standardized laboratory protocols are typically completely ignoring the recovery potential after exposure. Such ecologically relevant information can be gained already from suitable minor adaptations of standard laboratory tests. In the study on sensitivity and recovery potential after exposure to atrazine (Teodorovic et al., in press) we suggested that standard test procedures with Lemna could be adapted by a) adding a recovery phase after the exposure phase and b) potential directly from suitable laboratory tests would add more ecological realism into worst case scenario responds typically obtained by single species laboratory toxicity test procedures with Lemna. 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) (PTDC/AAC-AMB/102121/2008) and FEDER COMPETE funds (POCOMP-01-0124-FEDER-008556). P. Vilares had a grant in the scope of the project and C. Oliveira had a PhD grant from FCT (SFRH/BD/68423/2010) funded by national funds of the MCTES and FEDER European funds (POPH-QREN-Tipology 4.2.).

A number of new developments in mesocosm testing with herbicides: recent experiences and recommendations
A. Taylor, T. Bennett, S. Priestly, R. Bromley, J. Forsyth, E. Bateman, H. Walton
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A number of new developments in mesocosm testing have taken place since the most recent revisions to guidance for these complex studies (e.g. HARAP, 1998 & CLASSIC, 1998). Much of this progress in the area since this guidance was produced has been in the design and conduct of freshwater mesocosm studies to evaluate the toxicity of herbicides to algae, periphyton and macrophytes. This assistance will highlight some of the developments in this area using examples drawn from recent state of the art mesocosm studies. We will highlight our recent experiences in this area in which we have developed to evaluate the herbicidal effects of exposure over a variety of macrophytes with different morphology and life histories. We will also provide recommendations for the evaluation of effects of algae and periphyton drawing on our experience in this area. It is hoped that the information provided will advance mesocosm study design and offer advice to those considering conducting mesocosm studies with herbicides whilst providing a catalyst for discussion in this developing area of higher tier aquatic ecotoxicology.

TU 184
Unforeseen effects of herbicides on wetland and terrestrial plant communities: time to vegetative and reproductive recovery following exposure
D. Hayase, T. Itai
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University of Aveiro, Aveiro, Portugal
University of Porto, CIIMAR & ICBAS, Porto, Portugal
Is chronic exposure to pollution able to change the physiological capability of Corbicula fluminea to respond to acute chemical stress in estuaries?

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Standard plant toxicity tests rely on the evaluation of species in short-term (ST) studies; long-term (LT) effects of low doses of herbicides on wild vegetation, or the recovery potential of plants is often not assessed. The ability of wild species to recover following sub-lethal exposure to herbicides was examined using the sulfonylethyl herbicide chlorimuron ethyl. Eight wetland and nine upland species were tested with eight doses of chlorimuron (+ controls) ranging from 1 to 107% of the recommended label rate
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 for all species using the LT plants. Reproductive parameters were also recorded for 13 species. Inhibition concentrations (IC50) were determined 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 as 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. In the ST plants, affected species 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 (0.1%, 0.2% to 1%). Species exposed to these low rates were often above 50% for over 1 year. While recovery did occur in this greenhouse experiment, it may not 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 aquatic watershed
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3Faculty of Soil Science, Moscow, Russian Federation

The aim of the study was: a) to evaluate the extent of pollution in stream waters and sediments at Água Forte and at Roxo, and b) to assess the potential of the macrophyte community (a) to evaluate the extent of pollution in stream waters and sediments at Água Forte and at Roxo, and b) to assess the potential of the macrophyte community to remediate pollution

TU 186

The five sulfonyl-urea herbicides to aquatic macrophytes - implications of results from outdoor growth inhibition studies for the risk assessment
P. Sowig1, M. Dollinger2, A. Solga2, J. Hogberg3, A. Kirkwood3
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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 (HC5).

TU 187

Ecological functions of plant growth regulators in the stability of agroecosystem
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The aim of the study was: a) to evaluate the extent of pollution in stream waters and sediments at Água Forte and at Roxo, and b) to assess the potential of the macrophyte community to remediate pollution

TU 188

Biological responses in the aquatic macrophyte Myriophyllum quirinus exposed to the strobilurin fungicide azoxystrobin
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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 (HC5).
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 as metal ions are extremely toxic, with very EC50 values. Although high As, Cu, 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 foodoral developmental gradients
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Lemnaeae are used to represent all macrophytes in standard 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 evaluating the photosynthetic performance of aquatic plants. In the present study the effects of zinc on Lemnaeae plant age and developmental stage strongly influence the effects of macrophytes 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 zinc accumulation. The main aim of this study was to 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 a developmental gradient within a single frond. Zinc accumulation was also 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 homogeneous impact in single Lemna fronds. Single colony, time-point or leaf-zone analyses may not show the full biological picture of the impact of a toxicant, especially not in L. punctata.

TU 192
Alternative effects of magnesium on copper rhizotoxicity to grapevine: macroscopic and microscopic point of view
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2National Chiayi University, Chiayi, Taiwan

The effect of pharmaceutical active compounds on oxidative stress response enzymes of the marcohyte Ceratophyllum demersum
E. Saenen1
1E. Saenen
Dose-dependent effects induced by uranium (U) at pH 4.5 in Arabidopsis thaliana
TU 193
Metal effects in Fraxinus angustifolia and its endophytic communities
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Arabidopsis thaliana
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3ICT Okoekotoxicologie GmbH, Bottgerbr, Florsheim, Germany
4MAR-CIC, Department of Zoology, University of Coimbra, Coimbra, Portugal
5University of Sultan Moulay Slimane, Faculty of Science and Techniques, Beni-Mellal, Morocco
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Soil contamination with metals is a serious problem requiring urgent measures to counteract the impacts. The conventional soil remediation techniques are mostly inefficient and expensive. Phytoextraction comes as a promising alternative for a great potential for recovering ecosystem services. Besides looking for the best suitable plant, remediation programs should also focus on the microbial communities associated with the roots of the plants, namely endophytic and rhizosphere bacteria. In this work, we studied the effect of different metal species Fraxinus angustifolia for the phytoextraction of metal contaminated soils. From the Cunha Baixa uranium mine (Mangalide, Portugal). The strategy consisted of the exposure of the plants to the contaminated soil, a reference soil and a control soil, for a period of about 3 months. To access the ability of F. angustifolia to tolerate the contamination and its physiological performance, a set of parameters (above-ground growth, leaf area, relative water content, maximum efficiency and quantum efficiency of Photosystem II and leaf chlorophyll a and b, carotenoid, proline, and malondialdehyde contents) was measured during the test. Furthermore, the genetic profiles of the endophytic communities from the roots of the plants were also analyzed. This analysis was made via PCR-DGGE technique, targeted for a conserved region of 16S rDNA, pre- and post-exposure. Only above-ground growth was a suitable indicator of the negative effects of the contamination on the plants throughout the experiment. Furthermore, the tolerance to the metals was able to indicate the capacity of the bacterial profiles pre- and post-treatment showed notable changes, mainly for plants exposed to the contaminated soil. The bacterial profiles from the control and reference soils showed similar changes with each other and with the pre-exposure profiles than with those from the contaminated soil. This study showed that F. angustifolia plants have the ability to resist and adapt to the adverse conditions of contamination, revealing a potential which can be exploited for phytoremediation. It also showed that changes exerted on the bacterial root communities exposed to contamination, resulted in profiles considerably different from those of the remaining communities. The performance of the plants might be related to these microbial alterations.

TU 194
Dose-dependent effects induced by uranium (U) at pH 4.5 in Arabidopsis thaliana
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Arabidopsis thaliana
1School of Agricultural Sciences, Universitat Autònoma de Barcelona, Spain
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To evaluate the environmental impact of U-contamination, it is important to unravel the mechanisms by which plants respond to U-stress. It was already shown that U-exposure at pH 5.3 can disrupt the cellular redox balance and induce oxidative stress related responses in Arabidopsis thaliana plants (Vanhoudt et al., 2008). However, U-exposure and as such also U-related environmental parameters such as pH. In a previous experiment, it was shown that U-toxicity at pH 4.5 was higher than at pH 7.5. Therefore, we want to investigate dose-dependent effects at low pH.

Arabidopsis thaliana plants were exposed to U-concentrations ranging from 0 to 100 μM at pH 4.5 during 3 days. U-concentration, fresh weight, lipid peroxidation and photosynthetic efficiency were analyzed. On protein level, the enzymes of the antioxidative defense system were analysed to evaluate the importance of the cellular redox balance in Arabidopsis thaliana plants exposed to U.

Results indicate that the U-content in roots and shoots increased with increasing U-concentration added to the nutrient solution. However, there was a low root-to-shoot transfer. Fresh weight increased dose-dependently from 0 to 50, 75 and 100 μM U. In contrast, plants exposed to 6.25 and 12.5 μM U had an increased fresh weight as compared to the control plants, which alludes to a hormesis effect as was observed before (Vanhoudt et al., 2008, Straczek et al., 2009).

One of the most important physiological processes in plants is photosynthesis. Apparently, the photosynthetic efficiency of plants exposed to 25-100 μM U was increased. This indicates that the photosynthetic system is not damaged but in contrast try to optimize their photosynthetic unit under U-stress. In addition to the reduced biomass production, plants exposed to 25-100 μM U showed an increased lipid peroxidation. This increase indicates an affected membrane integrity and functionality. Assessing antioxidative enzyme capacity of the plants indicated an increased defence against ROS in the U-exposed plants as evidenced by increased activities of ROS scavenging enzymes. The increased activity of guaiacol peroxidase could indicate an increased cell wall lignification as a defense reaction that limits the entry of toxic metals. In conclusion, this study indicates that elevated U-concentrations at low pH can cause important morphological, physiological and biochemical effects in Arabidopsis thaliana seedlings.

TU 195
The effect of pharmaceutical active compounds on oxidative stress response enzymes of the macrophyte Ceratophyllum demersum
S. Dridi1, D. Hassen2, N. Vanhoudt3, H. Vandenhove3, G. Berneman3, M. van Hees1, J. Wannijn1, J. Vangronsveld1, A. Cuypers4
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1School of Agricultural Sciences, Universitat Autònoma de Barcelona, Spain
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The effect of pharmaceutical active compounds on oxidative stress response enzymes of the macrophyte Ceratophyllum demersum

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329
The toxicity of ion nanomaterials to aquatic and terrestrial plants

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Zero-valent iron (Fe0) as well as ferrate (FeV, FeIV) nanoparticles are well known especially for the ability to degrade a wide range of contaminants in both soil 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 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 > FeIV > Fe0. We used the frosn 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 photofiltration of arsenic-contaminated water

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The work presented here is part of a larger on going study about the metals and metalloids accumulation in aquatic plants of uraniferous 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 broteri (436.92 mg/kg DW), Callitriche stagnalis (354.03 mg/kg DW), Callitriche hamosa (160.37 mg/kg DW), Ranunculus trichophyllus (268.53 mg/kg DW), Ranunculus peltatus (101.98 mg/kg DW), in the free-floating Lemna 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 nodiflorum, 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 Callitrichaceae family, namely, Cu by Callitriche verta 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

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Silene vulgaris is a facultative metallophyte with multifaceted co-tolerance to heavy metals, capable of colonizing contaminated sites due to its fast and vigorous growth by producing seeds and rhizomes. 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. Analitical tools based on the identification of useful genetic diversity are needed for plant genotype selection aimed at enhancing metal accumulation 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 tntf and polA genes was amply with the primers tntf/GUG and polA/B. All PCRs produced a major robust band per primer pair in all samples studied. Two size variants were detected for ccmp1 (120 and 121pb), two for ccmp4 (113 and 114pb), five for ccmp2 (190, 191, 192,193 and 198pb) and six for tntf/hbpa (328, 338, 349, 354, 355 and 357pb).

Regarding cpDNA diversity, ten unique cpDNA haplotypes were identified and seven of them were private, being found in only one population. Despite of limited number of clones examined, a considerable intraspecific 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
Biosorption of Pb by Chlorella vulgaris (Chlorophyceae) at laboratory scale

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In the present study we analyzed the efficiency of Chlorella vulgaris (Chlorophyceae) to remove Pb at laboratory scale. The microalgae were harvested in experimental growth phase, centrifuged and resuspended twice in ultrapure sterile distilled water. After measure of algae concentration, we used three real concentrations of Pb2+ (NO3)2 1.951 (C1), 2.862 (C2) and 4.830 (C3) mg/l with their respective controls, all in triplicate (50 mL). The vessels were maintained in an incubation chamber under controlled temperature (23±1°C), continuous illumination (3000 lux) and daily shaking. At 10 and 30 min, 1, 12 and 24 h of exposure, they were centriuged for 10 min at 3000 rpm, separating the supernatant from the pellet of algae. Both matrices were analyzed by atomic absorption spectrophotometry. For the measurements and concentration, we calculated the % of removal, the concentration factor (CF= [metal algae]/[metal water]). Pearson correlations were performed to study the relationship of PO2 accumulated by C. vulgaris and the remaining in the supernatant.

C. vulgaris removed 50% and 47% of Pb at 10 min of exposure; 100% and 87% at 1 h exposure in C1 and C2 respectively. The maximum percentage (72 %) was obtained at 12 and 24 h in C3. After 12 h, we observed sorption of Pb, with concentrations ranging from 2.62 mg/l to 2.58 between 12 h and 24 h in C2. In C3, 3.27 mg/l-1 (12 h) and 3.01 mg/l-1 (24 h). The CF in C1 was <1 at 1 h of exposition, in C2 at 12 h was 0.93, falling slightly at 24 h. In C3 the CF was <1 in all the treatments, with higher values at 12 h (0.66-0.68) and decreasing at 24 h (0.61-0.63). There were significant negative correlations between the final concentration of Pb in algae and in the supernatant: r=-0.849, p<0.0001; r=-0.880, p<0.0001; r=-0.880, p<0.0001 in C1, C2 and C3 respectively. C. vulgaris is efficient to reduce Pb concentrations from the order of ppm to ppb from aqueous solutions, so it is recommended for wastewater treatment at a large scale.

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

D.V. Erasmus, B.G. Nynman, J.P. Oldendal

Cape Peninsula University of Technology, Cape town, South Africa

Selected macrophyte Ceratophyllum demersum, introduced to the Diep River, Cape Town, South Africa. The Diep River passes various possible sources of metal pollution before reaching the Atlantic Ocean. Previous studies on this river have shown high levels of metal contamination, however, studies on metal bioaccumulation in aquatic biota such as plants are limited. Plants were obtained from a reference site and placed in baskets at two sites along the river (one upstream and one downstream from urban pollution sources). Plants, sediment and water were collected every fortnight for twelve weeks. Samples were analyzed for aluminium, iron, zinc and copper using nitric acid digestion and analyzed by means of ICP-MS. The results generally indicated that plants collected upstream had significantly higher concentrations of all four metals, compared to those collected downstream, possibly due to intensive agricultural activities upstream and the filtering effect of aquatic macrophytes on runoff. Additionally, Cu and Zn were generally rapidly bioaccumulated higher concentrations of metals in its leaves, compared to stems, possibly as a result of having a greater surface area for uptake. Additionally, metal-laden leaves may be shed as a detoxification mechanism. In conclusion, it is clear that the metals in the Diep River are bioavailable for uptake in aquatic biota. Also, C. demersum may be used in bioaccumulation programmes. However, further research is necessary to investigate the toxic effects of the metals and how it relates to metal exposure.

TU 201
Selenium pathway in water moss Fontinalis antipyretica

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Water mosses are good indicator of poor Pb accumulated by C. vulgaris and the remaining in the supernatant.

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such as DE, DK, ES and SE.

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

in water, in fact. differences were registered among, overpopulated and poor populated areas, industrial and agricultural developing areas. On one hand we found higher

Uruguay River, samples of water from the Rio de la Plata were characterized by abnormalities in mitosis. Classical end points might be masked by abundance of nutrients

detected.

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

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 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 microscus assay (MNC) were determined for genotoxicity evaluation. Moreover, developmental and physiologic parameters were analyzed

in 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 genotoxic effects.

The results 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.

T2U 204

Acute and chronic in vitro biosauros vs. autochthonous plants used as sentinel: comparing genetic biomarkers as tools in ecological risk assessment in Del Plata basin

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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, Brasil, 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 to the water.

Samples of surface river water from along 1200 km of river coast were analyzed according authenticated APHA, AWWA, WEF (1992): water quality indexes (WQI) were calculated Value were adjusted to Argentine guidelines and sampling sites were qualitie, being Excellent (95-100) 11%, good (80-94) 21%, Fair (65-79) 26%, Marginal (45-64) 26%and Poor (0-44) 10%.

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 it 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.

In our work we evaluated different soils from the Uruguay river basin and we characterized the B content, the selenium content, the toxicity of the B polluted soils by cellular and molecular biomarkers.

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.

T2U 205

Can we possibly derive environmental quality benchmarks for chemical mixtures?

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In ecological and environmental risk assessments, the concentration of contaminants in the aquatic environment. For example, many antifouling biocide residues are often detected as a cocktail in water and sediment samples collected from coastal environments. Based on literature review of documented studies on the combined ecotoxicity of antifouling biocides, we found that both additive and synergistic effects together account for 80% of all cases in which about 35% cases are synergistic. To allow more accurate risk assessment of the

water and sediment samples collected from coastal environments. Based on literature review of documented studies on the combined ecotoxicity of antifouling biocides, we found that both additive and synergistic effects together account for 80% of all cases in which about 35% cases are synergistic. To allow more accurate risk assessment of the

water and sediment samples collected from coastal environments. Based on literature review of documented studies on the combined ecotoxicity of antifouling biocides, we found that both additive and synergistic effects together account for 80% of all cases in which about 35% cases are synergistic. To allow more accurate risk assessment of the
The various frameworks and decision trees are easier to apply for risk assessment on higher biological organization, i.e. easier to apply to environmental risk assessment than 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. The interpretation of DPD+ (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 law 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
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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 used as a benchmark to indicate concerning levels. The thresholds to be derived from experimental data on structural or de minimis considerations, even in the absence of effect data. Originally it was applied to toxicological evaluations of substances such as pharmaceuticals, food contact materials, and REACH chemical substances, which are concerned by their classification for environmental hazards. The TTC concept has been further elaborated and included in a method to assess the risk of mixtures. The interpretation of DPD+ is not to substitute the data better and avoids the contradictions inherent in the DA-CAOS concept. The proposed approach recommends application of independent action for phthalates and human health and environmental risk assessment.

TU 209
Relevant potency threshold: reducing uncertainty by calibration of cumulative risk assessments
L.S. McCarty, E.V. Sargent, G. Cassee, U. Diether, H. Golden

Relative approaches, i.e., toxic equivalent (TEQ)-like approaches, for mixtures risk assessment have been established for some time. TEQ-like approaches assume that certain premises are met; e.g., chemicals are true congeners, are metabolized and detoxified by the same biological processes, produce the same spectrum of biological effects by the same mode of action, and exhibit parallel dose response curves for the biological effect being modeled (Safe 1990), then those chemicals may be assumed to be dose additive (DA) for specific toxic effects. This concept is not very useful in real-world situations where there are multiple contaminants of concern. One way to start is the “Phthalate Risk Assessment Research Initiative” work of 2009-2010, or to consider contaminant concentrations for cumulative risk assessment practices at the U.S. EPA. The Panel rejected the underlying premises of TEQ-like approaches, asserting that cumulative risk assessment should be conducted by applying DA to chemicals that produce “common adverse outcomes” (CAOs) rather than to chemicals with similar modes of action. Using only those substances with classification for environmental hazards and human health risk assessment that used the DA-CAOS concept were evaluated to determine how firmly the concept is supported by the data and with what level of certainty the results may be extrapolated to lower doses and to humans. The underlying assumptions of the model and the risk assessment were probed for consistency with available human data, using data from high exposure settings as test cases. The predictions were compared with those from human clinical experience to determine whether those predictions are verifiable and consistent. Based upon this analysis, an alternative approach was developed - the Human-Relevant Potency-Threshold (HRPT) - that appears to fit the data better and avoids the contradictions inherent in the DA-CAOS concept. The proposed approach recommends application of independent action for phthalates and other chemicals with potential anti-androgenic properties at current human exposure levels. This example should be instructive for the inevitable discussion of the suitability of DA-CAOS for addressing environmental cumulative risk assessment for hormonally active agents, and environmental mixtures in general.

TU 210
Application of delayed fluorescence to estimate influence of chemical mixtures on alga
M. Katsumata, K. Bennett, A. Takeuchi, Y. Kobayashi, K. Kazumura, Y. Sato, T. Kosue, N. Tatarazako, Y. Sugaya

TU 211
Species sensitivity distribution for the prediction of herbicide mixtures toxicity on benthic diatoms
E.A. Glouch, T. Juffernholz, A. Reihlen

Species sensitivity distribution for the prediction of herbicide mixtures toxicity on benthic diatoms and 2 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 nonmonospecific 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.

The effects of atrazine and 2,4-D mixtures on *L. minor* R. T. Tagun

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Thailand is a country where 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 bioassays will be 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 dicots and monocots. The test was carried out on L. minor in the laboratory.

The effects of atrazine and 2,4-D on their own and in mixtures were assessed using OECD method 221. For the single compound studies, the effects of a range of concentrations of pesticide on the growth of *L. minor* were studied. For atrazine the test concentrations were 0.05, 0.1, 0.2, 0.4 and 0.8 mg/L-1 and 2,4-D were 5, 10, 20, 40, 80 and 160 mg/L-1. The test was carried out over 7 days.

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 shown to occur more frequently in 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.

Predictive mixture toxicity assessment of pesticides in Swedish water samples

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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 (SCHER) 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's database for single chemical toxicity and predicted toxicity profiles of QPSARs 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 751 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 risks but also the temporal and spatial patterns. Among these the average false negative rate when ignoring mixture effects as well as the sensitivity of the risk assessment to different ecotoxicological data has been determined. The results show that the average risk quotient of the mixtures from the six different sites range between 2.3 and 18.9, thus calling for additional assessments. The study also show no effect on risk from season implying that potential for recovery from pesticide stress is very limited. Finally the high ratio between predicted risk of the mixture and the average risk of the individual substances clearly demonstrates the need for going beyond the standard compound-by-compound assessment.

A proposal for considering mixture toxicity with EQS compliance checking

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Environmental quality standards (EQS) are used under the EU Water Framework Directive to determine the chemical status of a water body. At present, compliance with EQS is assessed based on the single substance approach, a lack of evidence from mixture toxicity studies indicates that this procedure might underestimate the toxicity of the chemicals present in a water body, as the effect of mixtures has been shown to be higher than the highest single substance effect in the majority of cases. This propensity to underestimate potential effects of mixtures is underlined by a recent review published by Kortenkamp and co-workers. Two approaches have been proposed to date to account for mixture toxicity in assessing the chemical status: (i) application of a default assessment factor of 100 as used for EQS derivation by RIVM (NL) and (ii) application of mixture toxicity models based on species sensitivity distributions (SSD). The latter method predicts the ‘multi-substance potentially affected fraction’ (msPAF) of species proposed by Posthuma and co-workers. In this paper we propose a third approach for cases where the EQS was not derived from SSDs for all mixture components, which allows more accurate assessment of environmental mixtures even where there is incomplete SSD information. The approach is based on the identification of one or several representative toxicological species that can be used to evaluate the mixture by applying the multi-concentration method (MCM) to the mixture as a whole. The individual concentration effect on each taxonomic group and can be combined with the mixture cumulative risk (MCR) approach recently proposed by Price and Han. It will also take into account the fact that specifically acting substances will only be specifically toxic to some taxonomic groups while exerting baseline toxicity to other taxonomic groups. This novel approach will be illustrated using case studies based on real monitoring data and published EQS values. The everyday applicability of the approach will be discussed along with the decrease in uncertainty that it achieves when assessing the chemical status of water bodies containing more than one substance of concern.

Increasing the number of data points does not necessarily reduce the probability of erroneously conclusions about interactive effects in mixture toxicity experiments

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The importance of mixture ecotoxicity studies is increasing exponentially. Developing requirements in regulatory risk assessment are further fuelling the need to gain more knowledge about mixtures, mixture experiments and the subsequent data analysis. In particular, little attention has been given to the choice of an appropriate experimental design for a given reference model (e.g. independent action and concentration addition). Indeed, it has been shown that some experimental designs might not be able to detect (false negative) or erroneously conclude (false positive) deviations from a reference model. In this study, we simulated experimental data from a full factorial and equitox design and subsequently tested if these data deviated significantly from the concentration addition reference model. Experimental data were simulated for synergistic, antagonistic and additive mixtures. We then determined false positive and false negative rates for each experimental design. The number of data points, the loading concentration of each chemical and the step size between two subsequent concentrations were varied. Results demonstrated a marginal increase in false positive rates with increasing number of design points. This contrasts with the general belief that adding design points will reduce the false positive rate. Varying the two other parameters resulted in a significant decrease in false positive rates. An optimal combination of these two parameters leads to the lowest false positive rates for a given design. In conclusion, we have shown that an optimal experimental design for mixture toxicity focuses on optimizing the lowest tested concentration and the concentration step size rather than increasing the number of design points. Furthermore, datasets based on suboptimal or imperfect designs lead to erroneous conclusions and care should be taken in analyzing and evaluating such datasets.

Proposed PAH relative potency factors will greatly increase risks at all sites with PAH mixtures

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The United States Protection Agency (USEPA) is proposing to modify the approach that it has been using since 1993 to evaluate polycyclic aromatic hydrocarbon (PAH) mixtures. While USEPA previously considered seven PAHs to have carcinogenic potential, the proposed approach increases the number to 26. In addition, many PAHs are being assigned a Relative Potency Factor (RPF) that is greater than 1 relative to benzo[a]pyrene. Several proposed RPFs are greater than 10, including benzol[ghi]fluorene (20), dibenzo[a,l]pyrene (30), and benz[a]acecthenylene (60). If this approach is adopted, it will be necessary to quantify all 26 compounds in media at contaminated sites, despite the low concentration of each individual PAH. In addition, it may be necessary to re-open and reassess sites that have already received regulatory closure. However, there are many serious scientific criticisms of the proposal. Most importantly, no Weight of Evidence Evaluation was performed. Second, USEPA assumed that all PAHs act by a similar mode of action with no supporting evidence. USEPA also failed to validate the derived RPFs using cancer response data from real world complex mixtures, such as coal tar. This paper summarizes the USEPA's approach to assigning RPFs to PAH mixtures and discusses risk observed when the interactions between components are inherently taken into account in mixture studies. Lastly, there were many technical problems with proposed RPFs; many RPFs were based on a single study or “low confidence” studies; some RPFs were based on in vitro assays; some RPFs were derived from studies with no confirmation of the chemical identity of the test substance; some RPFs were based on studies with unusual modes of administration, such as long implantation; and many studies exceeded the Maximum Tolerated Dose. This paper presents the proposed approach to evaluating PAH mixtures and discusses key scientific criticisms.

Derivation of environmental risk limits for polycyclic aromatic hydrocarbons (PAHs) based on internal residues

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The assessment of risks related with contamination of soils and surface waters by different fractions of shale oil based on the obtained results will be presented. This research provides evidence for the existence of the genes and the associated efflux activities of ABC transporters in juvenile stages of D. magna. Specific inhibitors of P-gp and/or MRP transport activities including cyclosporine A and verapamil but not MK571 and reversin 205 resulted in a dose dependent inhibition of rhodamine 123 transport in gills. Furthermore the ability of twelve pollutants to inhibit P-gp and MRP pumps was tested. In addition to calcium-AM, also assays with rhodamine B, supposedly a substrate of P-gp but not MRP, were performed. Most tested pollutants had an equal or greater inhibitory effect on rhodamine B efflux than on calcium-AM, which indicates that they are specific P-gp inhibitors. However, e.g. perfluorooctane sulfonate (PFOS) had a greater inhibitory effect on rhodamine B transport than on calcium-AM, pointing to a xenobiotic effect. The results presented here will aid future research using mass balance analysis of environmental samples and bring additional knowledge regarding mixture effects of P-gp and MRP transporters via the Ah receptor.

TU 219

Hazard evaluation of shale oil to the environment

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This work aimed at identifying P-glycoprotein (P-gp; ABCB subfamily) and multidrug resistance related protein (MRP; ABCC subfamily) efflux activity in gill tissue of zebrafish (Dreissena polymorpha) and determining protein inhibitory effects of chemicals on P-gp and MRP efflux activities. Calcium-AM, a substrate of both pumps, was used as proxy dye for P-gp and MRP activity along with the specific inhibitors Reversin 205 for P-gp and MK 571 for MRP. Then, a calcium-AM uptake assay was applied to study single and combined effects of the inhibitors on the efflux transporters. Enhanced accumulation of calcium in the gill tissue as reflected by increased calcium fluorescence indicated decreased efflux activity. Next, joint effects were modeled using the independent action and concentration addition concepts. Reversin 205 and MK 571 showed a distinctive substrate-specific inhibitory pattern. Therefore, the results indicate that the studied inhibitors targeted different transporters and that both pumps are involved in calcium resistance in zebrafish.

TU 220

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

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P-gp and MRP are two important transmembrane transport proteins belonging to the so-called “ABC family” of transporters. It is therefore important to develop tools that can simultaneously assess the activity of these transporters. The Simulated Earthworm Gut (SEG) is an in-vitro test that can be used to estimate the bioaccessibility of contaminants found in soil. It is a method that has been used for several decades to assess the bioavailability of contaminants in soil. However, the SEG test has not been widely used in the assessment of shale oil.
TU 223  
Prediction of mixture toxicity for metals in soil: a reality-check  
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Today, soils and their use are regulated by a wide variety of local, national and international laws and regulations. These are based predominantly on assessments carried out on individual substances. However, mixture toxicity is an upcoming issue in the regulatory area because of growing concern about the potential adverse effects of interactions between substances when present simultaneously. Only a few models are available so far to predict mixture toxicity (dose/concentration addition and independent action), and dose/concentration addition seems to be commonly selected as a default for the prediction of higher order mode of action. A recent study on the medici- 

define a test system in order to define the minimum information that is needed to compare the mixture toxicity of metals in soils and the selection of the number of metals to be included, based on exposure data for several metals in arable land and grassland soils across Europe (data from the GEMAS project). The distribution of the natural total risk ratio across arable land or grassland in Europe is evaluated in respect to the mixture model applied, the number of metals included, the incorporation of baseline corrections, etc.

TU 224  
Toxicological evaluation of chemical mixtures posed to human and environment  
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Exposure to the chemical mixtures found in the environment can occur in different forms, with regard to reason of the contact and composition of the chemical mixture. Beyond all doubts is the fact that the chemical risk assessment, due to higher and more intensive contamination of environment with multi-component chemical mixtures, plays crucial role in toxicology and ecotoxicology.

This work presents the most important issues concerning toxicology of chemical mixtures, with reference to an experimental design and special attention paid to the types of study methods, mainly acute and chronic studies, as well as legal aspects relating to European regulations connected with REACH and CLP.

TU 225  
Assessing human health risk from farmed milkfish consumption: considering toxic interaction among arsenic, copper, and zinc mixture  
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Various studies indicated that a strong association between cultured fish and waterborne metals of arsenic (As), copper (Cu), and Zinc (Zn) in coastal areas of Taiwan regions. Generally, the impact of mixture toxicity of metals on the aquatic ecosystems is higher than that of single metal. The purpose of this study was to assess the human health risk for adults and children from As, Cu, and Zn mixture exposure (Chanos chanos) consumption in blackfooted mice (BFM)-endemic area in Taiwan. The interaction risk assessment model proposed by the United States Environmental Protection Agency (EPA) and Agency for Toxic Substances and Diseases Registry (ATSDR) was used to estimate the interaction-based hazard index (HI) of non-carcinogenic mixture toxicity. The mixture toxic interactions of As/Cu and As/Zn were both antagonistic, whereas Cu/Zn was additive. The HI values were in the range of 94.86 to 30.79 in the mixture of single compounds, and 0.85 to 3.07 in the mixture of As, Cu, and Zn, respectively. Our study indicates that As, Cu, and Zn mixture exposure may pose potential non-carcinogenic risk to human consuming farmed milkfish. The present interaction risk assessment model provides an illustration for assessing the potential threat to human health posed by the mixture toxicity of metals from seafood consumption.

TU 226  
Whether BDE209 interacts with Cd hepatotoxicity?  
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During the last ten years, mixture toxicity has undergone a remarkable and productive development. In fact, combined toxicity, which more accurately represents real environmental conditions, can be assessed in the demineralization of toxicologically relevant effects. The aim of this study was to examine whether decabromodiphenyl ether (BDE 209) influences cadmium (Cd) hepatotoxicity. Wistar rats (200-240 g) were exposed orally to BDE 209 (1000 mg/kg/bw), Cd (2.5, 7.5 or 15 mg/kg/bw) or their three combinations, by gavage, for 28 days. Control groups were exposed to saline or DMSO as vehicle. The following end points were examined: liver weight, morphology, histology as well as liver function activities (aspartate aminotransferase-AST, alanine aminotransferase-ALT and γ-glutamyltransferase-γGT). Study was approved by Ethical Committee of Military Medical Academy (No. 9687/11). Liver weight increased in all groups comparing to controls. Interestingly, the highest increase was seen in Cd groups (20-42%), than in BDE209 group (28%), while in mixture groups it ranges between 96 and 115%. Morphological changes in liver were not observed while histological analysis indicated degenerative changes in hepatocytes, bile ducts, vascular bleedings and disruption of vascular membranes. Average histological scores on scale from 0 to 5 were: 0.13, 1.26, 2.26, 3, 3.4, 2.203 and 2.26, for control, BDE2091000, BDE91000+Gd2.5, BDE9201000+Gd7.5, BDE9201000+Gd15, Gd2.5, Gd7.5, and Gd15, respectively. AST values in general did not change, although AST was significantly lower in Cd groups, while in mixture and BDE209 groups decrease in ALP activity was observed, but not so intensive like in all three Cd groups. Activity of γGT was higher in mixture than in Cd groups.

TU 227  
Waste recovery - a special treatment under REACH  
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According to a manufacturing process is considered any production or extraction of substances in the natural state. This includes chemical modification as well as mechanical processes. Although the entry products at recovery companies are mainly waste (covered by the Waste Regulation), the status of the end products might "cease to be waste", and thus fall under the REACH regulation, and thereby having a major impact on the legal obligations of the recovery operator. However, under certain conditions recovery operators can benefit from registration exemption by applying Article 2.7(d) of the REACH regulation.

As the end products at recovery plants are often complex mixtures containing substances whose presence is not always intended, the process of substance identification is challenging. Each compound in the mixture has to be identified as either substance (mono-constituent, multi-constituent or UVCB), or impurity.

As the end products at recovery plants are often complex mixtures containing substances whose presence is not always intended, the process of substance identification is challenging. Each compound in the mixture has to be identified as either substance (mono-constituent, multi-constituent or UVCB), or impurity.

One should stimulate the re-introduction of former waste products on the market, because this contributes to the recycling of natural resources and the products may have economic benefits in the time of raising commodity prices. Nevertheless, sufficient efforts should be made to assure safe use of these, potentially heavily classified, mixtures. In addition, the hazard and risk assessment should be performed in such a way that overestimation due to the application of conservative assumptions and worst-case scenarios is avoided. While these concerns mainly address issues related to metal-based waste products, some may also apply to other types of recycling industries.

TU 228  
Toxicity evaluation of disperse red 1 textile dye using freshwater organisms from different trophic levels - a PNEC proposal  
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Azo dyes have been found in surface water and wastewater, and their biological effects depend on the dye structure. 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-nitrophenylazo) aniline, CAS number 2872-52-8, was obtained by PCIL industries Ltda, Brazil. This product is used for dying synthetic fibers. Previous data showed the main dye was responsible for the diphosphorylation toxicity at least for Daphnia. This same dye was found in an effluent and a receiving water sample collected in Americana region, São Paulo State, 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 (Daphnia magna, Pimephales promelas). Zebrafish (Danio rerio) used as a bioindicator for aquatic life. Chronic tests, the NOEC (72h) obtained for Pimephales promelas 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 Hydra 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 neonates 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 screening assay. Based on these results (N-Ethyl-N-(2-hydroxyethyl)azo-4-(4-nitrophenylazo) aniline of 0.6 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.

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The biocide activity of the cationic polymer polydiallyldimethylammonium chloride (polyDADMAC) against the Asian clam has been previously demonstrated. In this study, binary mixtures of polyDADMAC and potassium chloride, the molluscicide niclosamide, and the insecticide 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 combined toxicity of the mode of action of the individual chemicals. The extent to which this is found to be antagonistic and, therefore, these mixtures are not promising control tools. In understanding the antagonism of the chemical, 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 osmotic regulation of the cells as suggested by the literature for other surface-active molecules nor interacts with the hydrolytic activity of the enzyme cholinesterase, which is the specific target of dimethoate.

Industrial enzymes - an example of the environmental risk assessment of an UVCB (unknown or variable composition, complex reaction products or biological materials)

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Industrial enzymes for technical applications like for example detergent enzymes have to be safety assessed and registered under REACH. Enzymes are categorized as UVCBs 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. In contrast to the majority of ecotoxicity tests required for REACH registration data waiver can be applied including long-term aquatic toxicity testing and toxicity to terrestic organisms. These tests are considered not relevant due to the fast biodegradability of the enzymes, the low absorption and bioaccumulation potential and because enzymes are primarily active in an aqueous environment, thus only short-term aquatic toxicity tests are considered relevant for today's 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 UVCBs like enzymes requires an alternative approach compared to the risk assessment of 'classical' chemicals or well defined mixtures due to the biological origin.

A partial least squares based integrated addition model for estimating mixture toxicity

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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 exposure of the chemicals. However, in a risk assessment frequently focuses on individual chemical substances, although most living organisms are substantially exposed to chemical mixtures rather than single substances.

The concepts of additive toxicity, concentration addition (CA) and independent action (IA) models, are often applied to predict the mixture toxicity of similarly- and dissimilarly 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 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.
country level data might not considerably add to uncertainty. Such information helps to improve efficiency when dealing with regionali zed LCA. Overall spatial aggregation added considerable uncertainties.

**TU 234**

Sensitivity analysis for archetypes development in impact assessment of chemicals

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Emission of chemicals is increasing over years and the related impacts are greatly influenced by spatial differentiation. Chemicals are usually emitted locally but, due to persistence and physical chemicals properties, may exert global impact. Variability of environmental parameters may affect the fate and the exposure up to orders of magnitude of impact. Accounting for spatial differentiation of chemical impacts requires the use of multimedia models, at various levels of complexity (from simple box model to computational intensive and high spatial resolution model). Trade-off between complexity of high detailed models and global applicability requires the development of suitable archetypes.

In the study, sensitivity analysis techniques have been applied to MAPPE (Multimedia assessment of pollutant pathways in the environment) to build archetypes of emissions and fate. MAPPE is an advanced, multimedia, spatially resolved (1x1 degree) model, that allows the evaluation of chemicals removal rates from air, water and soil. We evaluate the relative influence of substance properties and of environmental characteristics on the variability in the environmental fate. In particular, using a MonteCarlo framework and applied variance based sensitivity analysis techniques to find out those environmental parameters explaining the highest share of the variability (namely the variance) in the model outputs. This information is crucial in order to define the environmental dimensions to be used for the definition of the archetypes of emissions and fate, accounting for major differences in the potential impact of the different pollutants.

We present the results 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 the eleven environmental parameters proposed in the model. These four parameters were then used as basis for building archetypes.

**TU 235**

Dealing with uncertainties in UNEP SETAC toxicity model

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In the field of LCA, the issue of uncertainty generates a growing interest. Although this issue has not yet been systematically addressed in existing databases and models, neither can be neglected, nor addressed too simply. Although uncertainty has been partly quantified in USEtox model, several questions remain open to date. A significant share of this uncertainty arises in model itself, based on the relationship between the data and the intended reality being modeled.

As regular users of the USEtox model, we identify the following sources of uncertainties:

- substance for which no data is available, or missing input parameter value
- parameters for which an inappropriate or inaccurate value is available
- data for which more than one value is available (multiple sources and conflicting information)

Given the relative complexity of the mathematical model, uncertainty propagation has been performed using a numerical method. Well known monte-carlo simulation has been used to propagate the variability of the input parameters (substance data and landscape model).

This approach allows us to describe statistical properties of a characterization factor value, based on input data uncertainties. It can also be used to study parameters sensitivity.

Taking into account the fact that uncertainty in USEtox database cannot be fully captured within the input parameters variability, other approaches have been studied, which aims at reducing uncertainty.

In approaches to reduce uncertainty, database documentation, substance coverage, as well as user interaction are key issues.

The assumption of the true value for a parameter requires research, experiments and therefore time. Involving stakeholders, discussing and finally deciding on a consensus, so has the current model been built, so the database should be.

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 possibility to discuss and validate 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.

**TU 236**

Standard information modules as basis for LCA reliability in the manufacturing context

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In standard information models, modules approach is presented as methodology to reduce uncertainty in the Life Cycle Assessment. In particular such approach aims to 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 and studied energy flows. The use of standard modules for environmental profile characterization seems to improve the comparison of different studies by polarizing the improvement analysis on key life cycle stages.

**TU 237**

Taking into account variance of primary data in decision making: a method for the building sector

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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 regarding building energy consumption. 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 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 for environmental profile characterization seems to improve the comparison of different studies by polarizing the improvement analysis on key life cycle stages.

**TU 238**

Uncertainty evaluation of LCA models input data using Monte Carlo Method

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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 uncertainty in LCA models. Stochastic LCA models that enable practitioners to validate their results. The case study consists of an acoustic panel made up of cotton fibers, polyethylene and scrap of jeans. Its LCA model is developed with SimaPro® software. The Monte Carlo tool available in this software is used in order to perform Monte Carlo simulations for the decision problem. Another model, called Monte Carlo Inventory model, is developed in Matlab® codes, with the model inventory table and in the CML 2 baseline 2000 impact assessment tables, all exported from SimaPro®. The same approach is followed for both models. First, a sensitivity analysis is made in the determined LCA model. Next the random parameters are chosen as modeled random variables associated to a probability density function. Next, the Monte Carlo Method is applied and the convergence is observed. Finally, the results are analyzed. Both approaches are compared in order to observe if the method based on the inventory has the same performance of the model based on the input data. The objective is to obtain a basis of comparison for the stochastic LCA model and the focus is on the methodology development.

**TU 239**

How certain can we be about LCA after 20 years of harmonisation and standardisation? A critical comparison of methodology and results from ten LCAs comparing disposable cups

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Harmonisation and standardisation of LCA-methodology started in the 1990ties. It happened more than once in this period that contradictory LCA-results were released for a same product (particularly packaging materials). This resulted in intensive scientific debate, and also heated societal debate, especially where product claims were involved. Differences in LCA-results at that time could often be traced back to different decisions and assumptions related to product system boundaries, functional unit definitions, technology choices, data sets etc. 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 specifies the assumptions and decisions to be made in LCA. Comprehensive and detailed guidelines are provided by national handbooks that still show few differences, but far greater 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
Halogenated flame retardants in the marine atmosphere from Southeast Asia towards Antarctica

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Halogenated flame retardants (HFRs), which are applied to reduce the inflammability of various consumer products have been industrial chemicals of growing worldwide environmental and political concern in the last three decades. The present study aimed to determine the occurrence and concentrations of these organic contaminants in respective avifauna. One expedition was performed in February, 2010, where 16 liver samples of two species: Anous stolidus (n=14) and A. fuscatus species and 20.5-27.9 ng g⁻¹ d.w. in the adult individual of A. stolidus in value of 0.65 ng g⁻¹ d.w. for the A. fuscatus and 20.5-27.9 ng g⁻¹ d.w. for the A. stolidus species with predominance of lighters congeners (tri-, tetra- and pentachlorinated). The pb- and pbBDE occurred in 88% of the samples of O. fuscatus and in the two samples (100%) of A. stolidus with respective ranges from <0.19-2.45 ng g⁻¹ d.w. and 0.30-3.15 ng g⁻¹ d.w. HCB was found in 49% of samples of O. fuscatus with a mean value of 0.35 ng g⁻¹ d.w. in the adult individual of A. stolidus in value of 0.65 ng g⁻¹ d.w. Dechlorane Plus (DP) ranged 0.23 to 11 pg m⁻³ while other Dechloranes ranged 0.22 to 0.74 pg m⁻³ (HBB), 0.30 to 1.3 pg m⁻³ (PBT), 0.15 to 0.23 pg m⁻³ (P-TPX) and 1.5 to 3.6 pg m⁻³ (DDPDE). For the purpose of comparison hexabromocyclododecane (sum of n, β-, γ-HBCCD), polybrominated diphenyl ethers (sum of 7 congeners BDE28, BDE 47, 99, 100, 153, 154, 183) and BDE 209 were also determined. Concentrations ranged from 7 to 12 pg m⁻³ (HBCD), 0.72 to 1.5 pg m⁻³ (sum of 7 PBDE BFRs) and 0.45 to 9.5 pg m⁻³ (BDE 209). The financial support of the Bavarian State Ministry for Environment and Public Health (project number 70403) is gratefully acknowledged.

EC05P - Occurrence, fate and impact of atmospheric pollutants on environmental and human health

TU 241 Urban background levels of novel brominated flame retardants in ambient air in Southern Bavaria, Germany

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After the technical pentab- and octabrominated diphenyl ether mixtures (PBDE) were banned in the European Union in 2004 and deca brominated diphenyl ether is not any longer permitted in electrical and electronic equipment since 2008, there is an increasing demand of ‘novel’ brominated flame retardants. At present, little is known about the concentrations of these substances in ambient air. Therefore, ambient air was collected between March and September 2011 at the urban background air monitoring station on the premises of the Bavarian Environment Agency, Augsburg, Southern Germany.

TU 243 Contamination of the marine biological reserve of atol das Rocas (Brazil) by persistent organic pollutants

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The Biological Reserve of Atol das Rocas shelters the largest seabird population of Brazil and despite be 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 these organic contaminants in respective avifauna. One expedition was performed in February, 2010, where 16 liver samples of two species: Anous stolidus (n=14) and Ocytornis 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 classical adsorption column and GC column as clean-up stages. OCPs and PCBs/PBDEs were respectively analysed by gas chromatography with electron impact detection and mass spectrometry. The concentrations of POPs were below the detection limit (B.D.L.) for all samples.

TU 244 Seasonal variation of specific toxic effects of organic air pollutants from year-long sampling campaign in Alberta, Canada

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Air pollutants in the atmosphere are described to produce 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 utility 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 503/01P249 and CETOCEN (CZ.1.05/2.1.00/01.0001).

TU 245 Profiles and cold trapping of polycyclic aromatic hydrocarbons and polychlorinated biphenyls in Canadian mountain soils

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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 10 Polychlorinated Biphenyls (PCBs) from four mountain ranges in the province of Alberta, Canada, including the Teton, Cypress Hills, Monarch, and Busy Beaver mountains. The results are presented as average concentrations and their standard deviations. The obtained data were then compared to evaluate the influence of altitude and distance from urban areas on the concentration of PAHs and PCBs in soil samples. The highest concentration of PAHs and PCBs was found at lower elevations near urban areas, while the lowest concentrations were found at higher elevations far from urban areas.
3. Results and discussion

3.1. Concentrations

The average values of the total PAHs (ΣPAH) concentrations of gaseous and particle phase was 1860 and 1761.4 mg m⁻³ for the forest, and 1230 and 123 mg m⁻³ for the cleaning. Seasonality, the PAH concentrations in the mountain atmospheric decrease dramatically from R1 to R4 at a factor of 3800 for gaseous phase and 5.3 for particle phase, respectively, which indicated that the forest filter effect (FFE) was much higher for particle associate PAHs than gaseous phase PAHs.

3.2. Altitudinal Distribution

PAH amounts in the PAS samples (ng PAS⁻¹) were generally declining with the increasing of altitude alone the slopes of Mont Mars. The declination rate for the forest was much lower than that at the cleaning area. For example, the rate was 0.003 for forest and 0.006 ng PAS⁻¹ m⁻³ for clearing, respectively. This may due to strong forest filter effect at lower sites where corresponding to high PAH concentrations in the atmosphere.

3.3. Effect of canopy

Most of the F/C values in the atmosphere were > 1 from active samples, however, F/C values were generally < 1 in the PAS samples, which could responsible for a lower sampling rate of PAH in the forest because of lower wind speed. As shown in Figure 2, log F/C and log KOA showed different correlations in the gaseous (green line) and particle phases (black line).

4. Conclusion

The filter effect of canopy was observed alone the Mont Mars and higher factors was related to low altitudinal sites and atmospheric particle. Kₑ values can influence the effect of forest canopy.

TU 249

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

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Although polyaromatic 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 objective 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.

Atmospheric samples from urban and rural sites in the Czech Republic were collected between October 2009 and October 2010 using a high volume air sampler equipped with a cascade impactor (separating particles into 6 size fractions: < 0.49 µm; 0.49-0.95; 0.95-1.5; 1.5-3.0; 3.0-7.2; 7.2-10 µm). All filters and polyurethane foam (PUF) plugs capturing the gas phase were exchanged weekly, and the individual samples of each fraction were combined into 4 composite seasonal samples. PAHs in gaseous and particulate fractions were determined by automatic solvent extraction, silica-gel clean-up and fractionation techniques and GC-MS instrumental analysis.

Interpretation of the data suggests that proximity to primary sources drives PAH concentrations as the concentrations measured in the urban site were significantly higher than those measured in the rural site. Seasonality of concentrations levels (higher winter than summer values) as well as the gas-particle distribution (more compounds associated with particles in winter) was well pronounced at both sites for most of selected chemicals. It has been shown before that PAHs are mostly associated with the fine fraction of atmospheric particles, however, seasonal variability of this size-specific presentation is distinct for the first time.

TU 250

Size-specific particle-gas distribution of the atmospheric POPs on the spatial and temporal scales

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A presence of the particulate matter in ambient (especially of the particles with less than 10 µm in diameter) has a negative impact on human health as it can induce various respiratory diseases. The fine and ultrafine particles are of special concern as they can penetrate the lungs to the greatest extent and even enter blood stream.

Another factor that has to be considered when assessing human respiratory risks is presence of chemicals that are associated with the atmospheric particles and represent additional risk when released in human bodies. Size-specific distribution of these chemicals is an important parameter for their behavior, fate and effects. Size-specific partitioning of organic chemicals between various fractions of the atmospheric particles has been previously studied for polyaromatic hydrocarbons and it has been demonstrated that they are mostly associated with the fine and ultrafine fraction. However, there is not much known about other groups of compounds, especially emerging pollutants. As such distribution affects the fate of compounds not only from the toxicological point of view but also from the point of the long-range transport of pollutants to the pristine environments, new data are desperately needed.
The concentrations of linear and cyclic volatile methyl siloxanes (lVMS and cVMS) were determined in air sampled close to the Swedish background monitoring station in Borlänge, some 100 km south of Stockholm. Parallel samples were collected with daily resolution over one month during November 2011. The sampling rate was 16 m³ d⁻¹. The method was based on an existing method for decamethylcyclopentasiloxane (D3). Modifications were made to account for the strong sorption of hexamethyldisiloxane (D3). The method was shown to be applicable to the iVMS, whereby L3, L4, L5 and L6 were analysed using tetraakis(trimethylsilyl) ester as the surrogate standard. The concentrations were of the order of 1 ng m⁻³ for D3, 1 ng m⁻³ for D6, 5 ng m⁻³ for D4, and 15 ng m⁻³ for D5. The concentrations of the iVMS were markedly lower, of the order of 0.2 ng m⁻³ for L3, 0.04 ng m⁻³ for L6, and 0.02 ng m⁻³ for L4 and L5. The difference between the concentrations measured in the parallel samples was in almost all cases < 10%. The influence of air mass on the temporal variability of the concentrations of the different analytes will be explored.

Analysis of cyclic and linear volatile dimethylsiloxanes in aqueous samples and biota

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The efficiency and validity of several extraction methodologies (Soxhlet, ultrasonic extraction, microwave-assisted extraction, solid-phase extraction, liquid-liquid extraction) were compared. The new analytical methods were validated for their application to the analysis of water, wastewater and biota samples, conducted by ultrasound-assisted extraction for biota samples, and liquid-liquid extraction for water and wastewater samples followed by gas-chromatography coupled to tandem mass spectrometry (GC-MS/MS) or liquid-liquid extraction for water and wastewater samples followed by gas chromatography coupled to tandem mass spectrometry (GC-MS/MS). The analytical methods were developed for the analysis of cyclic and linear volatile methyl siloxanes (lVMS and cVMS) as well as for the analysis of linear cyclic volatile methyl siloxanes (lVMS and cVMS) in air, water, and wastewater samples collected from different locations in Catalonia (NE, Spain). The methods were demonstrated to be rapid, sensitive, and selective.

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Finally, the occurrence of siloxanes in more than 30 wastewater treatment plants in Catalonia (NE, Spain) was assessed, and the results confirmed the presence of the selected siloxanes at concentrations of ng/L in the final effluents. On the other hand, the analysis of biota samples using an extraction step by ultrasound-assisted extraction was carried out. The new analytical methods were validated for their application to the analysis of water, wastewater and biota samples, conducted by ultrasound-assisted extraction for biota samples, and liquid-liquid extraction for water and wastewater samples followed by gas-chromatography coupled to tandem mass spectrometry (GC-MS/MS). The analytical methods were developed for the analysis of cyclic and linear volatile methyl siloxanes (lVMS and cVMS) as well as for the analysis of linear cyclic volatile methyl siloxanes (lVMS and cVMS) in air, water, and wastewater samples collected from different locations in Catalonia (NE, Spain). The methods were demonstrated to be rapid, sensitive, and selective.

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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. Non-agricultural pesticide use may also challenge the ecosystems. One possible agricultural pesticide release to the atmosphere after application 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. \( L . L . \) Mcconnell, H. Huang, E. Razote, W.F. Schmidt, B.T. Vineyard, A. Torrents, C.J. Hapeman, R. Maghirang, S. Trabue, C. Zetzsch, H.U. Krüger, C. Zetzsch, H.U. Krüger

Emissions of particulate matter (PM) from animal feeding operations (AFOs) pose a potential threat to the health of humans and livestock and can lead to decreased air quality. Current efforts to characterize PM emissions from AFOs generally examine variations in mass concentration and particle size distributions over time and space, but these methods do not provide information on the sources of the PM captured. Raman microscopy was employed to characterize the distribution of sources present in PM captured by dry and wet deposition over a two-week period at a cattle feedlot over approximately 20% and then feed materials. Results indicate this approach could be used in a number of different atmospheric emission characterization scenarios.

**TU 258**

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

L. Han, W.U. Palm, H.U. Krüger, S. Bleicher, C. Zetzsch

In this work, we applied both mechanisms in the analysis of the reaction of aerosol-borne terbuthylazine with OH radicals in our simulation glass-smog chamber. Home made silica particles were used as carrier material. Compared to previous \(<10 \text{ nm particles (Aerosil 200), these larger particles (diameter about } 160 \text{ 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 could be explained by the Eley-Rideal mechanism, while 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.

Acknowledgments: This work is supported by 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**

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

M.S.de Dobbeleer, A.G. Mayer, J. Gummersbach, H.J. Hueschmann, P. Silescki

In this study, an analysis of the reaction of aerosol-borne terbutylethane with OH radicals in our simulation glass-smog chamber. Home made silica particles were used as carrier material. Compared to previous \(<10 \text{ nm particles (Aerosil 200), these larger particles (diameter about } 160 \text{ 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 could be explained by the Eley-Rideal mechanism, while 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.

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Distribution of linear and cyclic volatile methyl siloxanes in indoor air samples and implications for human exposure

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Cyclic (D3, D4, D5, D6) and linear (L2-L5) volatile methyl siloxanes are widely used in personal care products and cosmetics, as well as in industrial applications (biomedical products, surface treatment agents, plasticizers and construction materials). These compounds are of environmental concern due to their volatility, persistence and tendency to bioaccumulate.

The purpose of this study was to investigate their occurrence and distribution in indoor air environments, including domestic (i.e. bathrooms, living rooms, boy/girls rooms) and occupational (i.e. offices, schools, etc.) environments. An extensive indoor sampling campaign was performed contemporarily in the UK and Italy, between May and August 2011. Indoor air samples (n = 100) were collected on adsorption Tenax GR cartridges (60/80 mesh, Markes) using conventional portable air sampling pumps (i.e. GilAir3, Gilian- Sensidyne), operating at a flow of about 120 mL min-1. Sampling cartridges were desorbed using the Automatic Thermal Desorber UNITY2 coupled to a GC/MS-system. Concentrations of total siloxanes ranged from 20.6 to 467 µg/m3 and from 55.7 to 424 µg/m3 in Italian and UK samples, respectively. Cyclic volatile methyl siloxanes (in particular D3 and D5) accounted for ~90% of total volatile siloxanes found in both Italy and UK adult and living rooms. No significantly different concentrations in indoor domestic environments. The daily inhalation exposure (DIE) to cyclic and linear volatile methyl siloxanes was also evaluated.

Source contribution of atmospheric PAHs at urban and industrial locations in the city of Novi Sad, Serbia

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Data on cyclic volatile methylsiloxanes (C6) in ambient air released at urban and industrial locations in the city of Novi Sad, Serbia, have been analyzed in order to determine emission sources and their contributions to the concentrations of particle-bound PAHs. Previous studies have established that the major contributors of PAHs in urban areas are the emissions from vehicles exhaust, and emissions releases from industrial processes like aluminum production, creosote and wood preservation, waste incineration, cement manufacture, petrochemical and related industries, commercial heat/energy production etc. The sampling campaigns have been conducted at three sampling sites, during the 124 days period from January 1st to September 14th, 2007. The first site was situated near industrial area in the city of Novi Sad, the second site was located nearby the heavy traffic area, especially busy during the rush hour. The third site was residential district. Non-heating sampling period lasted from June 26th to July 9th 2008, while sampling of ambient air during the heating season was undertaken from January 22nd to February 4th 2009. 104 air samples were collected using a high volume air sampler TEC Tecora 1504/4901/ECO HVl with quartz fiber filters (QFFs). 16 US EPA polycyclic aromatic hydrocarbons were determined in all samples using a gas chromatograph Shimadzu GC-2014 with a flame ionization detector. 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 0.681 ng/m3 in the heating period. Various techniques, including diagnostic ratio (DR) and principal component analysis (PCA), have been used for source analysis and the analysis indicated that vehicles, diesel or/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 principal source of particle-bound PAHs in Novi Sad, Serbia. Less dominant emission of PAHs comes from stationary combustion sources such as home heating during the winter and oil refinery processes during the whole year.
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. The Yes-Test was employed to determine potential estrogenicity of particle samples. were applied in a concentration range of 0.001 - 1.0 mg/mL. Particle sizes (5-10 µm) in these suspensions were measured by dynamic light scattering. The control contained health risks for the population living nearby. Finally, a fate and transport model was also executed to validate the acquisition of data from outdoors, as well as comparing of VOCs was found in the third campaign (45.7 μg/m3), with values between 4.55 and 120.9 μg/m3. For these chemical compounds, the greatest concentrations were found negative bacteria and the more specific Aspergillus fumigatus) was rather low, with a lack of temporal/seasonal differences. On the other hand, the highest mean concentration (summer 2010 and 2011, respectively) versus 60 and 61 cfu/m3 (winter 2010 and 2011, respectively). The concentration of the remaining microbiological agents (gram-diseases, as well as allergies and toxic effects or generating malodorous and hazardous properties. In 2010, a program was initiated to monitor air levels of VOCs and microorganisms in different periods of the year, with the objective of monitoring the presence of microorganisms both in the air and on the documents stored, the temperature, humidity and light conditions, and the detection of toxicology and the documents stored, the temperature, humidity and light conditions, and the detection of Toxins, as well as volatile organic compounds (VOCs), were generated during waste composting and similar processes. Some of these contaminants can be the cause of a variety of infectious diseases, as well as allergies and toxic effects or generating malodorous and hazardous properties. In 2010, a program was initiated to monitor air levels of VOCs and microorganisms in different periods of the year, with the objective of monitoring the presence of microorganisms both in the air and on the documents stored, the temperature, humidity and light conditions, and the detection of toxicity levels. Furthermore, considering the notable consumption of fossil fuels by the cement industries, the European Union is encouraging the enhancement of the amount of alternative fuels used in cement kilns. In the present work, the result of a 3-year (2008-2011) environmental monitoring campaign around a cement plant located in the metropolitan area of Barcelona ( Catalonia, Spain) was presented. The aim of this study was to evaluate the potential changes in the environmental levels metals and polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) in the vicinity of a cement plant before and after using sewage sludge as alternative fuel. The concentrations of PCDD/Fs and metals were determined in soil, herbage and air samples around this facility before and after the partial fuel substitution. The potential changes on the health risks for the population living around the facility were also assessed. In general, no statistically significant differences in the pollutant values were found between the 2 scenarios (before and after the partial fuel replacement), with the exception of a few significant decreases in some metals. Besides, the carcinogenic and non-carcinogenic risks due to the exposure to metals and PCDD/Fs were below the national and international safety limits.
Clean air is a basic requirement for human health and well-being. An average daily inhalation of 20 m³ of air is characterized by an exposure to many different pollutants. Apart from the classic gaseous pollutants airborne particulates continue to pose a significant threat to human health worldwide.

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 airborne PM from different sites in the Region of Aachen. A497 cells were exposed to increasing PM concentrations followed by analyses of cell viability, pro-inflammatory and oxidative stress response.

The results showed a scattered location dependant variability of the PM concentration for both particle fractions. Chemical analysis of these particles indicated the presence of 21 elements, water-soluble ions and a multitude of different PAH. The major inorganic components are the crustal elements (Ca, K, Mg, Na) and the (transition) metals Al, Fe, Zn. In contrast to metals and PAH, the concentration of ionic species is only approx. 50 % higher at the rural site, compared to the urban site. Water-soluble particle-bound PAHs demonstrated a concentration decrease in cell viability and an increase in pro-inflammatory and oxidative stress markers. The samples of the urban traffic location, characterized by a high concentration of elemental/organic carbon and metals, induced the highest pro-inflammatory and oxidative activity. Due to the combination of chemical-analytical and toxicological methods a characterization of PM induced cause and effects are possible.

The environmental PM extracts induced a concentration-conditioned decrease in cell viability and an increase in pro-inflammatory and oxidative stress markers. The results show that the quality control criteria of EPA Method 1668 can be met using a GCMS triple quadrupole system. Advantages for the laboratory are the reduction in cost of the equipment relative to high-resolution GC-MS systems, along with the ability to use the system for more than just specialized applications. In addition, a library of transfers for the PMs and other compounds simplifies method development and verification, simplifying the adoption of GC-triple quadruple MS for this analysis.

EC06P - Sorption and bioavailability in sustainable remediation of organic chemicals

TU 276

Simulating the bioavailability of mineral hydrocarbons for earthworms using different extraction methods
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In the context of assessing the habitat function of contaminated sites only the bioavailable contaminant fraction is of relevance. Information on the habitat function, therefore, can be obtained in ecotoxicological tests performed with representative soil organisms. Depending on the test organism the duration of effect measurements varies between several weeks and several months. In order to obtain results focusing on bioavailability faster, chemical methods are being developed to predict the amount of contaminant that can be taken up by a specific organism. Suitable methods have to simulate the respective exposure pathways and represent the bioavailable fraction of the contaminant. Extraction procedures for mineral hydrocarbons were regarded with respect to their suitability for simulating the bioavailable fraction for soil organisms. As effect parameter the earthworm activity according to OECD Test Guideline 222 was selected. The test was performed in eight sandy soils that had been contaminated with mineral oil for many years. The results obtained in the earthworm studies were compared with the concentration of the mineral hydrocarbon contamination using different extraction procedures: (I) total content using exhaustive extraction (C10 - C40 fraction); (II) fraction of C10-C222 performing exhaustive extraction; (III) water based extraction - shaking; (IV) water based extraction - shaking using shaking chromatography procedures. The earthworms are soil biogenic organisms and exposed to contaminants mainly via soil pore water and skin. For mineral hydrocarbons the mobile fraction of C10-C22 of the 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. Values exceeding this content may indicate that there is concern for a reduced habitat function.

TU 279

Impact of geosorbents on bioavailability of polycyclic aromatic hydrocarbons to humans by oral uptake
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To assess the health risk from human uptake of contaminated soil from hand-to-mouth activity, it is prerequisite to know the oral bioavailability of the contaminants. Soil-bound contaminants can be mobilized by digestion juices and hence become available for absorption through the intestinal wall [1]. With a physiologically based model [2] simulating the bioavailability of PAH in natural site samples [1], reasons for these variations are unknown. Apart from worldwide use of varying PBET models, we assume that quality and quantity of present geosorbents in the samples lead to variabilities. The studies described in this talk focus on differences in bioaccessibility of PAH from single-constituent geosorbents. The aim of the study is to show differences in bioaccessibility of PAH from single-constituent geosorbents. The results are expected to lead to a better understanding of variabilities in PAH bioaccessibility in natural site samples.

In this study, the geosorbents sand, clay, peat and charcoal, which had been characterized in various previous studies, spiked with 16 deuterated EPA-PAH, were extracted with benzene for determination of bioaccessible fraction. The bioaccessible fraction of PAH was determined by gas chromatography-mass spectrometry.

The results show that the differences in bioaccessibility vary significantly from the expected from the aqueous phase. Pyrene-d10 often showed highest bioaccessibilities: 45.5% ±11.1 (LOD ranging 0.2 to 3.5 ng/L), 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. 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 pesticides were tested to be present throughout the entire period. Nevertheless, post-application period showed concentrations of atrazine, acetochlor, endosulfan, endosulfan sulfate and cypermethrin 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, cypermethrin and endosulfan sulfate 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.

TU 280

Sorption and bioavailability measurements in risk assessment - conformity of methods
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Bed sediments often act as a sink for nonporous organic pollutants released into the aquatic environment. When sources of contamination cease or when emissions are strongly
The present results indicate that the weight of accessibility data obtained with single-substance spiked soils may have to be re-evaluated. Soils with and without the absorption sink clearly showed that a sink is needed and makes a substantial difference. It is therefore crucial to develop practical bioaccessibility extraction approaches that combine both mobilization and consumption processes. This was accomplished by the enrichment of soils with highly sorbing constituents (e.g., soot, cf. MGP soils). In the present study, weak binding of PAH in spiked soils (aged and freshly contaminated) was observed for Benzo(g,h,i)perylene only. Several experimental boundary conditions may serve to explain the lack of an absorption trap occurring in all soils was observed for Benzo(g,h,i)perylene. To increase the number of carcinogenic PAHs with RPFs from 6 to 26. Several proposed RPFs are 10x or greater 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 significantly overestimates the amount of pollutant absorbed by humans resulting in an overestimation of risk. PAHs 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.”

References
(2) Goularmou, 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.

TU 282
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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 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 significantly overestimates the amount of pollutant absorbed by humans resulting in an overestimation of risk. One of the main pathways for humans exposure to contaminated soils is direct ingestion as a result of hand-to-mouth activity. To address a number of issues in vitro physiologically-based extraction test has been proposed for metal and organic pollutants. In recent work we developed a colon extended physiologically-based extraction test (CEPET), 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 CEPET bioaccessibility test with a charcoal containing trap in order to maintain a full diffusion gradient for the desorption 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 bioaccessibility trapping significantly enhanced PAH desorption from incubated soils, reducing gut medium concentrations to < 5% of the no trap values within the appropriate physiologic time scales. This clearly identifies the need for a sink in bioaccessibility extractions. The complete configuration of the CEPET system is required as the COL significantly increases pollutant desorption. A configuration of CEPET is now required that combines the ‘trap’ with the ability to actually measure the bioaccessible 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 CEPET with animal studies.

TU 283
Bioavailability studies: the last available tools for evaluating PAH risks realistically E.H. Magee, G.C. Hoeger
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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), benz[a]anthracene (10x), and benzo[e]pyrene (20x). 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 1x10^-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 adjusted RPFs. However, the literature has long 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 soils. The study was designed to include field collected (in situ and sampled), lab-exposed, and model media (blood, urine, feces, other tissues), pharmacokinetic issues (single time point versus area under the curve), and utilizes of interest (parent PAHs versus PAH metabolites vs DNA or protein adducts).

TU 284
Desorption-resistant fraction in PAH-contaminated soils: aged spiked soils can not resemble historically contaminated soils K.E. Schüller, A. P. Lobner, P. Mayer
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2 CSIRO, Adelaide, Australia
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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. A need has arisen to evaluate the relative risks of PAHs in terms of their bioaccessibility. 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.

TU 285
Highways versus pipelines - modelling the contributions of two fungal transport mechanisms to efficient bioremediation A. A. K. Johnson, K. Johst, L.Y. Wick, S. Forj, H. Harns, K. Frank
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Based on experimental studies, two fungus-mediated transfer processes have been suggested to facilitate the biological 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. 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 vectors (‘pipelines’) or as a combination of both. We analyse biodegradation improvements compared to the situation without networks, and systematically test a variety of spatially heterogeneous and heterogeneous network designs. In turn, this provided results that each mechanism can improve biodegradation performance. The degree of improvement, however, may vary distinctly depending on the environmental conditions, and may also be negligible under certain conditions. Particularly, networks acting as ‘highways’ allow bacteria to overcome mobility restrictions and reach remote areas, whereas networks acting as ‘pipelines’ may initiate degradation by bringing remote contaminants into proximity to bacteria. As a consequence, highest biodegradation improvements often emerge from the combination of both mechanisms. We therefore conclude that ‘fungal highways’ as well as ‘fungal pipelines’ should be considered for developing novel bioremediation strategies based on fungus-mediated transport. Future experimental studies should focus on detection and appropriate stimulation of the two mechanisms in typical bacteria-fungi associations in contaminated soils.

TU 286
Influence of rhizosphere oomyctee mycelia on bacterial biodegradation of phanenanthrene present in nonaqueous-phase liquids (NAPLs)

E. Caviglia, J. J. Ortega-Calvo, J. J. Ortega-Calvo, M. C. Tejeda-Agredano

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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 287
Sunsensors in rhizospheres: a possible alternative for improving the bioavailability of PAHs in soils

M. C. Tejeda-Agredano, J. J. Ortega-Calvo, P. Mayer

The results of this study indicate the potential to engineer rhizoremediation processes by using rhizobacterial and oomycetous bioremediation agents.

TU 288
Combining synthetic fluorescence, liquid scintillation and passive dosing for studying the bioavailability of pyrene in the presence of dissolved humic substances

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In this study, we focus on the capacity of thionolipid biosurfactants, produced by Pseudomonas aeruginosa 195J5, to enhance the bioavailability of different soil-sorbed 14C-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 14C-labeled PAHs present in soil. Desorption kinetics of 14C-labeled PAHs from soil were performed by Tenax solid-phase extraction and compared to mineralization kinetics by a PAH-degrading soil bacterium (Mycobacterium gilvum VLM532) in the presence of surfactants. 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 taxis and sustainable remediation: effects on bacterial dispersal

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In this study, we focus on the capacity of thionolipid biosurfactants, produced by Pseudomonas aeruginosa 195J5, to enhance the bioavailability of different soil-sorbed 14C-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 14C-labeled PAHs present in soil. Desorption kinetics of 14C-labeled PAHs from soil were performed by Tenax solid-phase extraction and compared to mineralization kinetics by a PAH-degrading soil bacterium (Mycobacterium gilvum VLM532) in the presence of surfactants. 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 291
Behavioural responses of Tetrancyhena pyriformis exposed to microgradients of hydrophobic organic chemicals

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Behavioural changes of microorganisms may reveal subtleth 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 polyaromatic hydrocarbons (PAHs) on the behaviour of the ciliate Tetranyhena pyriformis. Motile cells and organisms that are able to sense chemical signals may directly influence movement 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 infrared-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 swimming behaviour of the cells, was used to determine 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.

TU 292
Sorption of ionized and polar contaminants to natural dissolved organic matter

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Concentrations of dissolved organic matter (DOM) have been rising in the environment over the past decades due to climate change and decreases in acid rain. The transport properties of DOM can be affected by sorption of contaminants to DOM concentrations in surface water. It is therefore relevant to gain more insight into the mechanism of organic contaminant sorption to DOM. In this study, the interactions between polar organic contaminants (neutral and ionized forms) and DOM were studied to assess the
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 polyacrylate passive samplers to determine aqueous contaminant concentrations. The DOM samples were characterized by chemical and physical fractionation methods to elucidate the charge and solubility characteristics of the DOM and solid-phase interactions with PAH sorption. Since PAHs are present as mixtures in the environment, this study also aimed to provide a more realistic and comprehensive understanding about PAH sorption behavior to DOM, which is critical for the environmental fate and transport of PAHs. The PAHs used were polycyclic aromatic hydrocarbons, including 6, 10, or 16 components, depending on the DOM sample. The PAHs were selected to represent a range of hydrophobicity and molecular structure to cover both aquathenic and nonaquathenic PAHs.

The solubility of the C10 - C21 n-alkanes, however, exhibited very odd and complex behavior and was found to be significantly enhanced (p < 0.0005), 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 n-alkanes and aromatic compounds in the presence of fatty acid soap solution. They reported that, in the aqueous phase of dilute fatty acid soaps, the solubility of the n-alkanes is markedly higher, and that of aromatic hydrocarbons is lower. These observations are found to be consistent with 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 petroleum/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 295 Enhanced mass transfer of hydrophobic organic compounds from NAPLs into the aqueous phase by dissolved organic carbon K.E.C. Smith1, M. Thullner1, L.Y. Wick2, H. Harns3

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Biodegradation plays a key role in PAH fate, and understanding kinetics as a function of (bio)availability 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 limitations, an experimental approach based on dynamic passive dosing is presented which avoids using co-solvent for introducing the PAHs, substrates for biodegradation of PAHs, and sorptive losses. The core of the experimental approach is the use of dynamic passive dosing (DPD) to increase the PAH aqueous concentrations. DPD is a technique that allows for the controlled release of PAHs from non-aqueous phase liquids (NAPLs) into the aqueous phase, thereby increasing the PAH aqueous concentrations. The technique involves the use of passive samplers, which are devices that can release PAHs into the aqueous phase at a controlled rate. The use of DPD in combination with biodegradation experiments allows for the investigation of the effect of PAH aqueous concentrations on biodegradation rates. The study was conducted using a laboratory-scale column experiment with NAPLs of different PAH concentrations and with and without DOX. The results showed that DOX increased the PAH biodegradation rates, indicating that DOX facilitates the biodegradation of PAHs. These findings have important implications for the remediation of contaminated sites, where the presence of DOX can enhance the biodegradation of PAHs and reduce the remediation time and costs.
solubles 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 HHIE-luc 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 project ETCOCDEN (European Regional Development Fund no. CZ.1.05/2.1.00/01.0001).

TU 298
Influence of sorption on bioavailability and biodegradation of secondary alkane sulfonates (SAS) in marine sediments
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Coastal sediments 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 the marine environment. Various studies on this topic deal with the distribution and fate of aliphatic polyethoxylates (APEO) in aquatic systems, as some of their degradation intermediates are endocrine disruptor compounds (EDC). Linear alkylbenzene sulfonates (LAS) have also been studied as they show a high pollution in many worldwide production volumes. Environmental data on many other surfactants, however, are still scarce. This is the case of secondary alkane sulfonates (SAS), one of the major anionic surfactants used in the market of dishwashing, laundry and cleaning products. Although this compound is easily removed during wastewater treatment, previous studies have shown that SAS and other anionic surfactants such as LAS accumulate in sludge as they are hardly biodegradable by aerobic digestion. Recently, anaerobic biodegradation 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/gk). Distribution coefficients from 0.05 to 0.15 log Koc were observed in the case of SAS homologues with a carbon number higher than those homologues having lower alkyl chains (e.g., C17-SAS) rather than for more polar homologues such as C14-SAS. Later, biodegradation experiments using anoxic marine sediments and sewage 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
Reclamation of PBZ- and PAH- contaminated soil with modified clays
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Contamination of soils and sediments by polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) is a major concern worldwide. This is connected with their persistence and the threat they pose to the environment and human health. Development of efficient and reliable strategies to reduce PCB and PAH concentrations in contaminated soils has been a crucial task for scientists. Immobilization of these organic contaminants is very preferred since total removal of pollutants is hardly possible. This study is therefore aimed at evaluating the potential of modified clay minerals (with surfactants, humic acid and papaya seed) in the retardation of PAHs and PCBs in soils.

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
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Iodinated X-ray contrast media (X-RCM) occur in concentration ranges of several hundred ng/L in many surface waters used for drinking water production. To clean up surface water, sustainable water treatment techniques like river bank filtration or artificial groundwater recharge (AGR) are used, but some X-RCM like amido-trizoic acid are known to be very persistent. Due to low sorption tendency of X-RCM, their fate is rather related to biodegradation, as proved by the detection of metabolites reported in literature [1]. To simulate the process of AGR, the fate of six iodinated X-ray contrast media (C10-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 301
Effect of pH and electrolyte concentration on soil adsorption of pesticides
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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, several vegetables 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 pestilicide is strongly influenced by soil organic matter contents. 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, 9) and CaCl2 solutions (0.01, 0.1, and 1 mol/L) and correlated 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-hour equilibrium period for all experiments. Increasing the CaCl2 concentration from 0.01 to 1.0 mol/L had a significant effect on soil adsorption of pesticides, but the Kd values with 1 mol/L CaCl2 solution were slightly higher than those at the other two concentrations. Pesticide adsorption is affected by pH level. In general, Kd values were negatively correlated with pH levels, and the rate of Kd change, divided by changing 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 implicated that crops can take up the pesticide from soil at high pH compared with at low pH.

TU 302
Relationships between soil adsorption of pesticides and pesticide/soil properties
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The positive list system for pesticide residue in food, such as crops, was applied in Japan in 2006. For pesticides for which maximum residue levels were not set, the residue limits in food must not exceed 0.01 mg/kg (uniform limit). Pesticides, which are applied to foliage and soil at the crop cultivation, remain in soil after harvest, and pesticides remaining in soil may contaminate the succeeding crop. Crop, for which growing cycle is short, are rotated in Japan. Therefore, the residue levels of some pesticides in succeeding crops have exceeded 0.01 mg/kg in Japan. To prevent excess of the residue level 0.01 mg/kg in the succeeding crop, the succeeding crop must be cultivated in consideration of (b) the physicochemical properties of pesticides applied to the preceding crop, (2) the soil properties affecting the pesticide residue in soil, and (3) the pesticide’s uptake into the succeeding crop.

The succeeding crop may take up the pesticide in soil solution from the root or the stem as a kind of a pesticide’s uptake into the crop. Data on the distribution of a pesticide in soil/solution (pesticide sorption) is important for assessing the risk of pesticide contamination of the succeeding crop. Soil adsorption of nonionic pesticides
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 present.

TU 303

Leaching of aged DDTs and current use pesticide residues in undisturbed soil columns: non-ionic surfactant and carboxylic acids effects

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Soil pollution by Persistent Organic Pollutants such as DDTs (p’-DDT and its metabolites p’-DDE and p’’-DDE) represents a continuous source to the environment. As a consequence of their high persistence DDTs occur up to 60 cm on agricultural soils. The Current Use Pesticide (CUP) endosulfan is characterized by its high persistence potential and very low Kow value. Therefore, soil leaching considering irrigation or flooding events as well as plant growing may modify pesticide availability and leaching. Surface waters receive discharges from industrial, urban and agricultural uses that will account for a variety of compounds such as surfactants, effluents and organic acids. This work studies the vertical distribution and movement of aged and current DDTs and endosulfan in undisturbed soil columns irrigated with riverine water and the following solutions: 1-control (riverine water), 2-Tw-80 (riverine water + Tween 80 0.5 cmc), and 3-acids (riverine water + sodium citrate and sodium oxalate, 0.05 M). Experiments were carried out with 13 cm x 30 cm soil columns taken from Aridisol soils from a fruit field in Patagonian, Argentina. Columns were saturated with distilled water and solutions (4L) were added under saturated condition. One L leaches (n=4) were collected for pesticide residues analysis. After elution, columns were dried (24 h), opened and sampling on 5 cm sections. Pesticide desorption was performed by batch technique and residues analysis by GC-ECD. p’-DDE/p’’-DDE ratios in eluates showed that endosulfan-p’-endosulfan pattern was found in all soil sections. p’’-DDE levels ranged between 2.7-2.5, 2.0-2.7, and 1.0-1.6 g kg⁻¹ dry weight in control, Tw-80 and Acids, respectively. Under all conditions pesticide levels decreased concomitantly with depth and sand increase. In control and Acids, p’’-DDE and p’-DDT desorption from soil was observed. In Tw-80 the order of percentage mass loss in control. Under all conditions and for acids, p’-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 all in elution solutions.

TU 304

Sorption of cationic organic compounds to soil as the sum of soil components

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Many emerging contaminants are strong bases that under environmental conditions mostly occur as cationic species. The environmental fate of these compounds depends strongly on their sorption behavior to soil. The sorption behavior of these compounds can be described by their Henry constant in water or in soil of different properties. To determine the $H$ values of sorbed compounds, the equilibrium sorption at different conditions is usually determined, e.g., by batch technique and residues analysis. However, it can be shown that sorption of these compounds is additionally influenced by soil properties. The $H$ values of sorbed compounds are strongly dependent on soil properties and can even vary with time. We examined to what extent sorption of cationic organic compounds (cations) to soil can be predicted based on sorption to individual soil components alone. In general, sorption of primary amines to clays mineral was weak relative to quaternary ammonium compounds (quats), whereas sorption of primary amines to SOM was strong relative to quats. Such relative sorption affinity differences between test compounds between SOM and clay minerals were used to evaluate soil sorption.

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

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Sunscreens agents, also known as UV filters, have become very popular chemicals since they have shown to have a protective role against photocarcinogenesis and photoaging of human skin. These compounds are usually used in personal care products, but are also present in a wide variety of industrial goods such as paints, plastics, or 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 skin due to their high hydrophobic character, and later spread on agricultural fields. A solid-state treatment of WWTP sludge from the fungal fungi Trametes versicolor is reported in the present work as feasible to degrade them in a range from 87 to 100%.

TU 306

Degradation of toxic hydroxylated compounds.

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Concentration levels of phtalates in water and sediment samples from Nadela river basin, Vojvodina region was measured. Polyesters with the white-rot fungi Trametes versicolor is reported in the present work as feasible to degrade them in a range from 87 to 100%. This experiment 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 sterilized.

Degradation studies of 3-(4-methylbenzyldiene) camphor (4MBC) in liquid medium were also done in particular and complete removal was achieved in less than 24 h. The main metabolites 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 defensive mechanisms that fungi activate against toxic hydroxylated compounds.

TU 307

Concentration levels of phthalates in water and sediment samples from Nadela river basin, Vojvodina region

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Phthalates belong to the group of dominant industrial pollutants and are ubiquitous overdispersed class 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. After degradation, the phthalates may enter the soil environment where they can act as sorptive, plastic and plastic-coated fabrics. Phthalates are also included as plasticizers for binders in different kinds of paint and adhesives. Within the Project the concentration levels of phthalates in sediments from Nadela River basin 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 pollutants. The field survey was done in 9 sampling sites in the catchment area of the Nadela in the early spring 2009. The laboratory work was performed in the Environmental Laboratory Institute, Environmental Engineering, Kos, Slovenia 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-n-ethyl phthalate (DEP), diisonobutyl phthalate (DIBP), di-n-butyl phthalate (DBP), and DEHP. The concentrations varied in the range: for DEP from 0.01 µg/L till 0.2 µg/L, DIBP from 0.08 µg/L till 0.95 µg/L, DBP from 0.3 µg/L till 2.5 µg/L and DEHP from 0.7 µg/L till 2.987 µg/L. In sediment, three of selected phthalates were determined in all sampling sites. All tested samples were positive on DBP in the range of 24 - 80 µg/kg, DBP in the range of 21 - 96 µg/kg and DEHP in the range of 124 - 779 µg/kg. On 5 of 9 sampling sites the concentration levels of DEHP and this phthalate is listed to be a human carcinogenic. In the case of sediments concentrations of standards have not been exceeded 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 (I446009 and TR40141).

TU 308

Increasing levels of PBDEs, PCBs and organochlorine pesticides in fish following a mega-flooding episode in the Negro River basin, Argentine Patagonia

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A mega-flooding event in the Negro River basin, Argentine Patagonia, caused a significant outflow of contaminants from the surrounding soils. Agriculture, hydroelectric power plants and industrial-urban contaminates are the most important activities in the basin. This study evaluates the effects of flooding events on the levels of persistent organic pollutants (POPs) (PBDEs, endosulfan, DDTs and polychlorinated biphenyls (PCBs) levels in females of silver (Odontesthes batti) hatchers). Muscle, liver, gills, gonads and stomach content were analyzed by GC-MS. Levels in water, suspended particulate matter (SMP) and sediments (SS) were also measured. Post- and pre-flood fish showed the following patterns of contamination levels at 3 different sampling points: PBDEs levels in post-flood fish increased until 23 times (from 63.2 to 1,478.6 µg lipid in liver), which were dominated by penta- (PCB-110, 118) and hexa- (PCB-138, 153) congeners. These results could have stemmed from historical usage of Arochlor 1254 and 1260 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
Polychloro-dioxins, furans and biphenyls in fish, crabs and clams from the San Jacinto River Waste Pits, TX
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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 (Supercritical Fluid Extractors), cleanup with florisil, and a high performance liquid extraction. Final analysis was completed with gas chromatography negative chemical ionization mass spectrometry. The method detection limits ranged from 2.0 to 10 pg/g ww in fish tissues. Ten out of twelve priority dl-PCBs (Identified by World Health Organization, 2005) were measured with concentrations ranged from 2.0 to 948 pg/g ww. Average dl-PCBs concentrations were at least an order of magnitude higher than that of PCDD/Fs. Average PCDD/Fs fish tissue concentrations were at least an order of magnitude than that of crabs and clams. TEQfound was to be limited at 25X higher than TEQfish. Biomagnifications factors and Biota Sedimentation Accumulation Factors were also calculated.

TU 309
Effect of humic substances on remediation of soil- phosphogypsum mixtures
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Phosphogypsum (PG) is a byproduct of production of phosphoric acid. Due to high content of nutrients (calcium, phosphorus and sulfur) it is sometimes used as a fertilizer for poor unfruit soils. But besides nutrients, PG also contains toxic impurities, such as fluorine, strontium and some others. One of contemporary tools to reduce the ecotoxicity of polluted soils and soil-APG mixtures is to use phosphogypsum in mixtures with humic substances (HS). The objective of this study was to evaluate the detoxifying ability of a number of HS humates towards PG applied to model soil mixtures.

Model soil (MS) contained (wt, %) 20% of kaolinite, 10% of peat and 70% of sand with particle size 0.2-0.4 mm (ISO 11268-1). PG was carefully mixed with MS at concentration 3.3 and 7.5 wt, %. Humates from peat - Pe-FlexK, Pe-EcoK, coal - BC-EnK, BC-HumNa and lignosulphonate - OW-LhK introduced into the MS in the form of aqueous suspension (distilled water) to achieve a concentration in soils 0.005 and 0.020 wt, % . The ecotoxicity was evaluated in water extracts using three species of test-organisms from different taxonomic groups: microalgae Scenedesmus quadricauda (decrease of cells population growth, 72h), crustaceans Daphnia magna (mortality, 96h), and higher plants Sinapis alba (root elongation, 120h). Toxicometric parameters (EC50, the median PG concentration that caused a 50% test-reaction reduction, and NOEL - no observed effect level - the PG-concentration that caused test-reaction reduction below the toxic level) and detoxification indexes D were calculated.

Analyzes of average detoxification indexes DAV (averaged over three test-organisms) showed that influence of humates depended both on PG-concentration and humates’ nature. Thus, application of PG at concentration 7.5 wt, % was toxic for all the test-cultures at all treatments and humates were not able to decrease the toxicity. At lower rate of PG (3.3 wt, %) some humates decreased the toxicity (DAV is 0.5-0.8), whether other did not. Among all humates tested the highest detoxifying ability was observed for S. alba EC50 and NOEL values increased in 1.3-1.8 times for S. Magna, in 1.6-2 times for S. alba for 0.005 wt, %, humates content.

Aknowledgement - This research was supported by Russian Federal Science (GK 02.740.11.0693), Russian Foundation of Basic Research (project 10-04-01681)

TU 310
ETOP - A Systems Biology approach to predictive Ecotoxicology

TU 311
Sludge toxicity of water treatment stations 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 (WTP) that are suspended solids, bacteria, heavy metals and other toxic substances present in the untreated water. The amount of sludge generated in treatment is directly proportional to the amount of treated water, a WTP that treat 1500 L/s of water generates approximately one ton of sludge/day, which returns to the origin river. The aim of the present study was to evaluate the sludge toxic potential located in Piracicaba, São Paulo, Brazil. The samples were collected in two phases of treatment called: flocculation (first phase of treatment) and decanter (second phase), in July and October 2009 and September 2011. The toxicity tests were carried out with the bioindicators: Pseudokirchneriella subcapitata and Hydra attenuata, and the dates were compared to the physical and chemical determinations, such as: pH, electrical conductivity and dissolved oxygen (DO). For P. subcapitata and H. attenuata tests were prepared an elutriation solution mixing the sample with distilled water (1:4 ratio). The elutriate samples was used as 100% diluted to 75, 50, 25, 12.5 and 6.25% with specific culture medium. The samples collected in October 2009 were slightly more toxic for P. subcapitata and H. attenuata. Both samples were high toxicity for P. subcapitata, showed IC50 of 11%. However for H. attenuata showed IC50 of 15.8 % between 19.1% and 17.7 % and 64.6% (flocculation and decanter, respectively) which correlated with the highest electrical conductivity determinations (460 and 404 mS cm-1) and DO (0.79 and 3.87 mg L-1). The proximity of the EC50 results for H. attenuata indicate the predominance of acute affects, or lethal stages (rulip and crumbling), showing the effective power of the toxic sludge, mainly the one collected in the flocculation tank. It’s possible to conclude that both species tested were adequate to characterize the toxicity of the sludge generated by WTP. Both sludge were very toxic to these organisms and the toxicities were strictly correlated with the increase of electric conductivity, the high concentration of heavy metals and the lowest concentration dissolved oxygen in elutriate.

TU 314
Inhibition of the fatty acid synthesis in chlorophytes by triclosan - a metabolitism approach
K. Reider1, H. Heilmeier1, R. Altenburger1, M. Schmitt-Jansen1
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TU Bergakademie Freiberg, Freiberg, Germany
TU 315
Inhibition of the fatty acid synthesis in chlorophytes by triclosan - a metabolitism approach
K. Reider1, H. Heilmeier1, R. Altenburger1, M. Schmitt-Jansen1
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TU Bergakademie Freiberg, Freiberg, Germany
Triclosan is an antimicrobial substance which is used in many pharmaceutical and personal care products such as soaps, toothpaste and mouthwash. Because of this broad application it has been detected in streams, seawater and sediments in concentrations up to 0.007 µmol L-1 [Singer et al., Environ. Sci. Technol., 2002]. In a prior study Franz et al. [Metabolomics, 2008] observed that isolated chlorophytes are one of the most 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 vacuolatus [Küster et al., Metabolomics, 2009]. Therefore we exposed a synchronised culture of S. vacuolatus with different concentrations of triclosan (range from 0.002 to 0.071 µmol L-1) for 14 hours to derive concentration-dependent changes in total lipids, fatty acid profiles, and photosynthetic activity. After harvest and derivatization hydrophilic and lipophilic metabolite extracts were analysed with GC-MS and evaluated by multivariate
statistics (PCA). Two concentration dependent response patterns could be identified. Metabolites from the hydrophobic phase showed comparable 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 the response of the organisms. These findings give new insights in the response of organisms to xenobiotics and to the known mode-of-action of the toxicant in bacteria, the inhibition of the Enoyl-ACP-reductase during the fatty acid elongation [McMurry et al., Nature, 1998].

In conclusion, the shift of the number of lipophilic metabolites at low concentrations. These findings will be discussed in the perspective of the connectivity of response pathways to the known mode-of-action of the toxicant in bacteria.

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In conclusion, the shift of the number of lipophilic metabolites at low concentrations. These findings will be discussed in the perspective of the connectivity of response pathways to the known mode-of-action of the toxicant in bacteria.
Accordingly, the present study investigated two cryptic *Gammarus fossarum* lineages - namely type A and type B - for differences in their sensitivity towards chemical stressors. Two size classes of each cryptic lineage type were exposed to 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 global analysis revealed that a meta-analysis approach for 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 exposure periods 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**

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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 polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) in South Africa, the study on PAHs is still having a lot of gaps. The presentation gives an overview of some modern 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 in sediments. Detailed information of the possible sources of PAHs 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 1

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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 of expression and relate this to the cellular distribution of BaP and the physiological or toxicological response. Exposure to BaP has been linked to an increased peroxidation and synthesis of storage lipid bodies. Global analysis of the transcriptome and proteome not only gives an insight into the mechanism of toxicity of silver but also, by linking them to ecologically relevant phenotypes, a better ability to predict environmental risk.

**TU 324**

**Insights into the effects of silver by transcriptomics and proteomics in Chlamydomonas reinhardtii**

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Eawag, Dübendorf, Switzerland

Ecotoxicology aims to identify effects that toxicants elicit upon the environment. A major challenge is to understand the toxic mechanisms at a molecular level and how these relate to the organism and population level. Integration across various levels of biological organization, molecular, cellular and organismal, is required to draw conclusions on impacts in populations, communities and ecosystems [1].

Our research deals with the analysis of silver induced alterations in gene and protein expression in the algae Chlamydomonas reinhardtii and anchoring of these changes to specific phenotypes. This involves coarser datasets like transcriptomics, proteomics, metabolomics and bioinformatics. The transcriptome of silver exposed algae were analysed using C. reinhardtii wild genome microarray. The global protein profile of silver exposed C. reinhardtii (5h exposure point) was done by Multidimensional Protein Identification Technology (MudPIT) which consists of 2D-IC and mass spectroscopy. The transcriptome analysis determined that 1299 significantly regulated transcripts were those of metabolic pathways of photosynthesis, teratoprene synthesis, mitochondenal electron transport, protein transport and oxidative stress response. Similarly, the proteome profile showed these biological processes being significantly regulated indicating that silver affects key functional pathways in C. reinhardtii. The regulation of several transcripts/proteins involved in the photosynthesis and ATP synthesis could be correlated with inhibition of photosynthesis. This study is multidisciplinary and involves conventional toxicology analysis, transcriptomics, proteomics, metabolomics and bioinformatics. The results of this study could be linked to the physiological endpoint of lipid membrane peroxidation and synthesis of storage lipid bodies. Global analysis of the transcriptome and proteome not only gives an insight into the mechanism of toxicity of silver but also, by linking them to ecologically relevant phenotypes, a better ability to predict environmental risk.

**TU 325**

**An integrative approach to understanding the response of Caenorhabditis elegans to valproate exposure**

H.H. Munasinge, J. Byrne, A. Wagemakers, M. Viant, R.C. May, S. Hayward, F. Falciani

University of Birmingham, Birmingham, United Kingdom

C.elegans has been extensively used to study the effects of chemical exposure, aging, pathogenicity and reproductive development. With a well annotated genome, well characterized cell lineages, ease of making knockouts, availability of mutants and short life span, it is a good model system to study the effect of chemical exposure on the organism. In this study, wild type N2 C.elegans were treated with sodium valproate, a known teratogen and a histone deacetylase inhibitor used as a first line treatment in the management of epilepsy, psychiatric disorders and schizophrenia. Global gene expression analysis with the GeneChip C. elegans Genome Array microarray. The results show that the most significantly regulated transcripts are those of metabolic pathways of photosynthesis, tetrapyrrole synthesis, mitochondrial electron transport, cellular dysfunction accompanied by early ROS production and lipid droplet modification.

**TU 326**

**Development of a resource for the collection, analysis and integration of ecotoxicological-related high throughput data**

D. Madureira, L. Borràs, F. Marsano, A. Viarengo, F. Mignone

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In environment, the presence of chemical pollutants or climate changes can induce organism responses at the cellular and molecular level. Beside more traditional analysis systems like 2D gel electrophoresis, researchers can nowadays benefit of high throughput technologies (i.e. microarray, deep sequencing, 2-DE) that allow very large scale investigation. Data deriving from these technologies offer snapshots of the changes induced by the presence of environmental variations.

Management, analysis and interpretation of the massive data obtained from high throughput technologies can be quite challenging and requires bioinformatics skills still beyond the capabilities of many laboratories or researchers. To face this challenge, a web based resource has been recently developed. The resource is being fed by an extensive database of publicly available data, including metadata, and allows to perform an exhaustive overview of the real cellular response and of changes in gene expression. Indeed they do not consider the relation between mRNA level, protein concentration and metabolite levels which are known to poorly correlate. Finally it would be very useful to compare the biological effects induced by the same environmental stress on different organismal and cellular systems. This work is part of an ongoing project and additional datasets are being progressively added to the resource. Here we propose a web based system that works as a centralized resource for the collection, analysis and integration of ecotoxicology related high throughput data.

The system is called “Aggregated” information is accessible by means of simple web based data mining tools and is supported by effective and simple graphic representations to facilitate the understanding of biological response mechanisms.

We have benchmarked our platform with data obtained by high throughput analysis techniques- microarray and 2-DE - applied on the social amoebae Dictyostelium discoidum 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 specialist databases (e. g. genomic databases, metabolic pathways, Gene Ontology).
On the appropriateness of using the common mixture toxicity models CA and RA on species sensitivity distributions: a theoretical approach
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4Environmental stretch only exposes to single substances but typically to mixtures. Therefore it is of great importance to assess the ecological risk not only by substance by substance but also for mixture effects. For this reason 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 two models have also been proposed to be applied on 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 then (ii) the RA model is applied on the predicted SSDs by CA between groups of similarly acting compounds. However, it was mentioned above that validity of mixture models were less satisfactory for single species when applied on single dose-response curves and not on multiple single SSDs. For a validation of this approach, one should thereby 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 highlight the difference between the two methods by applying the mixture models for each species, then constructing the mixture SSD to calculate the 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
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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 either individuals have different concentration thresholds 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 their respective NOEC values (here the thresholds 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 95% of the population would be 2 to 4 times inferior to this standard threshold. We believe that our approach is able to provide a more realistic and focused approach in determining the exposure threshold.

**TU 331**

Incorporating data quality scores and acute-to-chronic ratios in the construction of SSDs
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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 and data quantity, SSD is not yet widely used in regulatory and policy-making. In fact, SSD is only rarely used in regulatory context. This is mainly due to the requirement of a very high number of individual data points which is extremely time-consuming and costly. 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: model assumptions, critical endpoints, data quality, data quantity, and calculation of the resultant uncertainty. We recently proposed a method to incorporate quality scores into the construction of SSDs, in particular the number of data points and the inherent experimental uncertainty. This method was previously applied for fish species. In the present study, we extended the method to incorporate multiple quality scores and we compared the results with the classical SSD method.

**TU 332**

Investigating the replacement of NOEC and LOEC values with regression-based ECx values
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Among the different endpoints used to assess ecotoxicity, NOEC and LOEC are the most commonly used. However, these endpoints are not always appropriate, as they may not reflect the actual adverse effect concentrations. In addition, NOEC and LOEC values can be difficult to interpret and may not be reflective of the dose-response relationship. Therefore, there has been a growing interest in using regression-based endpoints, such as ECx values, to replace NOEC and LOEC. The objective of this study was to assess the feasibility of using regression-based endpoints as alternative to NOEC and LOEC. We used a Monte Carlo simulation approach to generate dose-response curves for different species and endpoints. We then fitted different regression models to these curves and compared the results with NOEC and LOEC values. We found that regression-based endpoints were more sensitive to small changes in the dose-response curve, and that they provided a better estimate of the actual adverse effect concentration.

**TU 333**

Statistical approach to select soil bioindicators for soil monitoring, risk assessment and soil characterization. Results from the French national programme ‘Bioindicators’
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1INRA, Versailles, France
2ESITPA, Mont saint aignan, France
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The Randomized Fritz 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-geo-climatic contexts covering different sampling protocols, (ii) manage high numbers of biological and meta-data in a database enhancing data analysis, (iii) develop a data mining 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 with regard to the targets (characterisation, monitoring, risks) using a statistical method (IDOTIS), that may assess risks of soil contamination to ecosystems. Most ecotoxicological 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, using 47 different conditions in terms of land use historic and origin of contamination (PAPI, ETM, pesticides). As a first step of statistical analyses, our results showed the importance of checking correlations between biological variables in intra and inter-groups. Then discriminated analyses using random Forest revealed sets of relevant indicators for land use (crops, pastures, woods and forests), levels of metal contamination (high, medium and low) as well as...
organic contaminations.

TU 334
Advanced non-linear regression methods for concentration-response curves in R
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Norwegian Institute for Water Research (NIVA), Oslo, Norway
A recent report by the Institute for European Environmental Policy (IEAM) has suggested to ban the use of traditional no-observed-effect levels (NOELs) and lowest-observed-effect levels (LOELs) as basis for risk assessment and decision making, and instead use curve-fitting for estimation of concentration-response relationships. This should motivate an evaluation of current concentration-response modelling approaches in ecotoxicology, and adoption of new methodologies for curve-fitting that are used in other fields of environmental science. The River Clyde Water Framework Directive (WFD) has triggered much research on non-linear relationships between physico-chemical stressors and ecological responses during the last decade. For example, thresholds in stressor-response relationships are particularly relevant for assessment of ecological status of water bodies. Basic statistical methods such as linear regression or ANOVA are not suitable for estimating such relationships. The response may also be more complicated than e.g. a simple sigmoid curve, therefore circular regressions (non-linear) have been used for exploring the shape of the response curve without a priori assumptions. Moreover, we may be interested in estimating an extreme part of the response rather than the average. In this presentation, I give examples of ecological responses to eutrophication and acidification stress in lakes. The ecological responses are univariate indices representing community composition of phytoplankton, macrophytes, macroinvertebrates and fish. Building upon basic linear regression methods, I introduce some techniques which enable more flexible curve-fitting: (1) Using a non-linear link to the response variable (generalised linear model); (2) Using a piece-wise linear function for the stressor variable (generalised additive model); (3) Analysing a quantile of the response variable instead of the average (e.g. 90%; quantile regression). All analyses are carried out in the free statistical programming software R.

TU 335
An interfaced R-package to fit SSDs
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2Environmetrics, Melbourne, Australia
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Species Sensitivity Distributions (SSDs) rely on the assumption that aquatic species of a community or assemblage differ in their sensitivity to a hazardous chemical. Toxicity values are used as indicators of the sensitivity and are assumed to follow a theoretical distribution accounting for the inter-species variability. A Hazardous Concentration (HC) is then derived using a low-order percentile of the SSD fitted to a limited (and often small) set of toxicity values, the latter being assumed to be a representative sample of species sensitivity among the community to be protected.
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 is still debated, including: (1) whether parametric or non-parametric methods should be preferred - the applicability of the latter being limited by the small size of toxicity data sets available and (2) in the parametric cases (2a) the choice of the distribution shape - this is often decided on the basis of mathematical properties, especially on the existence of analytical results, and (2b) the choice of the method for estimating HCs and their confidence interval.
Several softwares have been provided through environmental protection agencies for estimating HCs and their companion uncertainty, such as BURRiO in Australia and New Zealand, or DeBtox in the U.S. Those three softwares have been developed as turn-on-key tools for the application of regional regulatory recommendations and rely on different choices regarding the three points aforementioned. Besides, it appears that none of these programs allows censored data to be accounted for. For users interested in examining the impact of the methodological choices made in existing softwares (and in the corresponding regional guidance documents), we are currently developing a new and open source tool enabling the comparison of several distributions and also the use of both pointwise and interval-censored data (or a mix of both).

TU 336
A probabilistic model for species sensitivity distributions taking into account inherent uncertainty and variability of effects to estimate environmental risk
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Toxicokinetics-Toxidynamics survival model, from theory to practice
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Toxicokinetics-Toxidynamics (TKTD) models simulate the time course of processes leading to effects on organisms. Even for an apparently simple endpoint such as survival, a large number of TKTD models exist. They have been reviewed by Jager et al (2011) who proposed a unified theory (GUTS) for TKTD threshold models and the use of a likelihood approach for estimating model parameters. Here, we focus on a TKTD threshold model in the GUTS framework called DeBtox (Dynamic Energy Budgets in toxicology) survival model. This model assumes an effect above a threshold concentration. We examine a simple question: is it possible to estimate parameters of this model by maximum likelihood approach from standard survival data sets?
We analyzed survival data sets of the freshwater invertebrate Daphnia magna exposed during at least 21 days to nine different contaminants. We tried to fit 4 nested DeBtox survival models to each data set by maximizing the log-likelihood function to estimate model parameters. 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 are used as indicators of the sensitivity and are assumed to follow a theoretical distribution accounting for the inter-species variability. A Hazardous Concentration (HC) is then derived using a low-order percentile of the SSD fitted to a limited (and often small) set of toxicity values, the latter being assumed to be a representative sample of species sensitivity among the community to be protected.

TU 337
Statistics Service - a new tool for efficient data analysis
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1LIEEB - CNRS UMR 7146, Metz, France
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4Département Biogéochimie et Ecotoxicologie, IFREMER, Nantes, France
5Multibiomarker approaches are widely used for in situ assessment of ecotoxicological effects of contaminants and to understand the relationships (1) between biomarkers and (2) between biomarkers and contamination sources. Several tools have been proposed to integrate these responses in a single and simple measure. Among them, the Integrated Biomarker Response (IBR) is a promising method that provides both a graphical synthesis of the different biomarker responses and a numeric value that is still debated, including: (1) whether parametric or non-parametric methods should be preferred - the applicability of the latter being limited by the small size of toxicity data sets available and (2) in the parametric cases (2a) the choice of the distribution shape - this is often decided on the basis of mathematical properties, especially on the existence of analytical results, and (2b) the choice of the method for estimating HCs and their confidence interval.
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TU 338
The IBR revisited: optimization to avoid misuse
S. Devin1, C. Cossu-Leguille1, A. Geffard2, L. Giamberrini3, L. Minguiez4, E. Rodius5, T. Burgeot6, S. Pain-Devin1
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TU 339
Statistics Service - a new tool for efficient data analysis
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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.
Long-term effects of an early exposure to PCBs on zebrafish behavioural responses

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Polyaromatic hydrocarbons (PAH) emission in the environment is constantly increasing with human activity. The goal of this study was to assess long term consequences of fish early exposure to PAH on behaviour. Eggs were collected from AB zebrafish strain and were placed at 4 hours post fertilization (hpf) until 96 hpf in a 3 cm diameter Petri dish containing 3 g reference sediment either plain (control) or spiked with a mixture of Benzo[a]pyrene, Pyrene and Phenanthrene at environmental concentration based on values measured in the Seine Estuary (France), a highly polluted site. Thereafter, larvae were transferred in clean water and raised until adulthood. Behavioural tests such as locomotion during 24-hrs, sudden dark change challenge and T-maze exploration were performed at adults’ stage (F0) and sudden dark change on larvae produced by F0 adults. In adults, during night or dark period, contaminated fish were significantly less active than control fish. A similar observation was made for contaminated F0 in Teraze safe area. Contaminated F1 larvae were more active when light was on than control and less active when the light was off. This study indicates that contamination of zebrafish using environmentally relevant concentration during the very first stage of development with a PAH mixture of 3 molecules induced late behavioural effects measured at the adult stage. Further, effect was transmitted to the next generation and behavioural responses of F1 larvae were different to that of F1 control larvae. Consequences on fish abilities (e.g. predator escape, food search, courtship) will be discussed.

Long-term food-exposure to PCB mixtures induces reproductive and behavioural disruptions in zebrafish

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3INRA, APEX UMR703, ONIRIS, Nantes, France

Although the use of polychlorinated biphenyls (PCBs) has been banned for several decades, they are still present in the environment. Field analyses have established correlations between exposure to PCBs and alterations in fish physiology including reproductive function and behaviour. In the present study, we performed a life-cycle exposure using zebrafish and mixtures representative of some environmental situations in terms of dosages, composition and containing mainly non dioxin-like congeners. Exposure was performed through diet which is the main contamination route in the wild. We demonstrated a bioaccumulation of PCBs in males and females as well as a maternal transfer to the eggs.

Several reproductive traits were altered after exposure to a PCB-contaminated diet, including a reduction in the number of fertilized eggs per spawn as well as an increase in the number of poorly fertilized zygotes. This was related to modifications of ovary histology revealing a decrease of maturing follicles and an increase of atretic follicles in the ovaries of females exposed to PCBs.

In addition, several behavioural traits were monitored. Fish exposed to the highest dose (equivalent to that found in the Seine Estuary) displayed an increased swimming activity during the last day of the night. Fish exposed to an intermediate dose (equivalent to that found in the Loire estuary) displayed behavioural disruption analogous to hyperactivity that showed some similarities to a human behavioural deficit syndrome known as attention deficit / hyperactivity disorder (ADHD), which can be observed in humans after exposure to PCBs.

These results indicated that exposure to PCBs mixtures mimicking some environmental situations, can lead to a dramatic reduction in the number of offspring produced by a female as well as a disruption of behaviour. Potential ecological consequences are discussed with regard to reproduction, fitness and survival.

Indirect estimation of population-level effect of pollutants based on tolerance evolution and fitness cost of tolerance

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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 because of 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.

Despite the importance of using the tolerance evolution as 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 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 study 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, and estimated 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.

Triclosan toxicity: a multi-generational and demographic assessment using Daphnia magna

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Triclosan is a ubiquitous compound in wastewater treatment plant effluents and biosolids and is commonly detected in surfaces 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 72 d magna neonates were exposed to TCS (0.5 to 150 µg/L) in six successive 21-d life cycle tests. Brood random collected from 5 replicate battleks within each treatment on day 21 were used to seed the next generation. Survival across the 6 generations exceeded 80% in all treatments across all generations. A slight but non-significant trend was observed for the TCS 7.9 µg/L and 15.9 µg/L treatment groups in the second and the fourth generation. The 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.

Assessing the chronic aquatic toxicity of phthalate ester plasticizers

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2Eastman Chemical Company, Kingsport, tn, United States of America
3BASF Corporation, Pasadena, tx, United States of America
4TextoMobil Biocidal Sciences, Inc., Alvin, tx, United States of America
5Evonik 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 phthalates C5 to C10 phthalate esters are used as plasticizers. The purpose of the primary endpoint study 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 C8 or higher phthalate esters. Secondary endpoints, including molecular, biochemical, and/or histochemical responses to chemical exposure, do not appear to be related to 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 with DEHP, DINP, and DIDP have concluded no risks to aquatic organisms due to aqueous solubility constraints, low expected surface water concentrations, and metabolic biotransformation capabilities. Important aquatic toxicology studies that have included transgenerational exposure have shown that the next generation and those that are assessed are presented here. The data from the present study, support the earlier risk assessment conclusions. The data also provide further support for a narcosis-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.
Eco-toxicological studies need to consider not only short term effects of pollution, such as changes in life history traits of organisms, but also its long term effects, such as genetic diversity. This loss of genetic diversity may reduce the potential of populations to adapt to changing environments.

Chlorophyll a has been shown to decrease genetic variation in populations of several species alongside with adverse effects on the physiology of organisms. This loss of genetic diversity may lead to the loss of evolutionary potential and thus it is of crucial importance to assess the evolutionary consequences of changes in genetic variability.

In the project, we aimed to assess the micro-evolutionary 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 role do generational shifts of this altered genetic variability due to pollution in terms of fitness costs?

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In the project, we aimed to assess the micro-evolutionary 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?
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webs linking primary producers to consumers. The negative effects of Daphnia are well understood; toxic cyanobacteria affect growth, survival and reproduction. However, one possibility to ameliorate toxic effects is to biotransform MC by conjugation to glutathione via glutathione S transferase, thereby reducing toxicity and aiding excretion. This process is thought to underlie the ability to withstand MC in Daphnia and could explain the enhanced tolerance found in the offspring of Daphnia exposed to low cyanotoxin concentrations.

In this study, multigeneration exposures were conducted, we exposed the parental generation to MC-LR for 1 or 7 days and determined the enzyme mediated tolerance to MC in their offspring, a) by assessing the acute effect of MC-LR on biotransformation, antioxidant and energy metabolism enzyme activities, and b) through 21 day chronic toxicology tests on the same concentrations of MC-LR.

Seven day exposure of the parental generation to MC-LR induces higher activity of glutathione S transferase and malate dehydrogenase in the offspring and enables it to increase the catalase activity when challenged with the toxin. In offspring from the 1 day exposed parental generation those effects were less pronounced or not visible. Offspring from the 7 day exposed parent generation suffered from malate dehydrogenase activity loss, when compared to the control. However, offspring from the 7 day exposed mothers showed higher survival. Higher survival of the offspring is correlated with the elevated activity of glutathione S transferase, malate dehydrogenase and catalase, suggesting maternal transfer of activation factors.

These parental transgenerational 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
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 mitochondrial genome.

The effects of mtDNA damage caused by environmental agents are exacerbated by decreased mitochondrial fusion and autophagy. Mutations in mitochondrial fusion and autophagy genes exacerbate the larval arrest, suggesting a potent gene-environment interaction in which the 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 endpoint (embryo toxicity). The aim of this work was 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.

TU 355
The enzymatic functional stability of zinc-tolerant microbial communities: a new approach to detect terrestrial ecotoxicity of metals
IJ. Trenti1, M.V. Vandeghecht1, J. Asselman1, J.C. Colin1, T.D. de Meyer1, K.A.C. De Schampheleire2
Ghent University, Gent, Belgium

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 effects which would have not been found out by common microbial bioindicators. A method which assesses soil health by analyzing the functional stability of soil enzymes is developed and we have called it the RSSI (Resilience of Soil Stability Index).

Our long-term aim is unravelling the potential functional role of DNA methylation in the stress response of D. magna, this study aimed at sequencing the entire cytosine methylation. For the comprehensive profiling of DNA methylation a methylated binding domain (MBD) protein based sample preparation technique was used. Since this technique is very specific and works well with fragments densely methylated, it was decided to use also a less specific technique on DNA digestion with a novel restriction endonuclease. This endonuclease recognizes the CNNR (R=GA) methylated sites and cleaves DNA at fixed distances generating DNA fragments easily identified on gel.

Bioinformatics analysis (i.e. mapping with the most recent D. magna genome assembly) was performed in order to generate the methylene map. Ongoing bioinformatics analyses are now focused on determining structural, functional or evolutionary relationships among the methylated sequences and to determine if methylated sequences occur in genes or pathways that may be relevant for dealing with chemical and ecological stress.

TU 356
The functional stability of zinc-tolerant microbial communities: a new approach to detect terrestrial ecotoxicity of metals
I.J. Trenti1, S. Schatz1, M. Loïs2
1AWI, Bremerhaven, Germany
2Stockholm University, Stockholm, Sweden

To assess the ecological and or reproductive disorders indicators have been studied in several marine organisms like fish and amphipods to address the question of the impact of contaminated exposure on wild populations. This focuss is focused on the characterisation of the progress of toxic effects from subcellular damage at the individual level of the parental generation to deterioration of the offspring in the amphibian species Monoporia affinis. Monoporia affinis have been sampled at differently polluted and reference areas in the Bohemian Bay. Reproduction success is determined by fecundity, sex ratio and offspring viability. Embryo abnormalities in terms of malformed and membrane damaged embryos, undifferentiated and dead eggs and broods, and stage of embryo development, are recorded. In addition, amphipods 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 isoschizomers that recognize the tetranucleotide sequence 5'-CCGG-3' but that show differential cleavage pattern. 7 days exposure of freshwater snails (Physa acuta) to benzo[a]pyrene and vinclozolin induced DNA damage and changed DNA methylation in the offspring. The effects of such persistent damage are also unknown; we hypothesized 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.
TU 358
Does genetic adaptation matter? An hypothesis tested using life-history consequences of adaptation and acclimation to copper of Daphnia longispina
C.B. Barata1,2, M.D. Marques1, A.R. Agra1, A.M.V.M. Soares1
IDAE-CEIC, Barcelona, Spain
Universidade de Aveiro, Aveiro, Portugal
University of Aveiro & CESAM, Aveiro, Portugal

The present study was conducted to test the hypothesis that genetically adapted clones of Daphnia longispina showed a higher fitness performance under copper exposure than acclimated clones. Genetically tolerant and sensitive clones were selected from a reference and a historically exposed populations to an acid mine drainage from an abandoned pyrite mine. Four sensitive and resistant clones from reference and impacted populations were exposed to a range of copper exposure levels and their life history responses in terms of survival, reproduction and population growth rates compared. In another experiment the most sensitive clone was exposed during four generations to the same range of copper concentrations and its life-history performance compared. The genetic differences between the resistant and sensitive clones were that in the polluted environment the resistant clone 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 rates. After four generations acquired individuals from the sensitive clone reproduce earlier, had greater clutches at first reproduction and higher population growth rates than non-acclimated ones but apparently there were no fitness costs. Therefore, our results showed that life history changes due to adaptation and acclimation were compatible under the polluted environment but not under a clean environment. This results support the view that genetic adaptation is ecologically costly but acclimation not.

TU 359
Evaluating effects of pollution on Caenorhabditis elegans' population dynamic through a bio-energetic approach
B. Gousse1, A. Péry2, R. Beaudouin1, M. Dutilleul1, C. Lecomte3, J.M. Bonzom1
INERIS, Saint-paul-lez-durance cédex, France
INERIS, Verneuil en halatte, France
INRS, Saint paul lez durances, 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 individual data. 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 stresses (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 curve, egg laying curve, survival until end of egg laying. We showed that uranium impacted C. elegans growth curve 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 generations.

ET11P - Marine environmental chemistry and ecotoxicology

TU 361
Biotechnological potential of impacted scenarios for the restoration of TBT contaminated environments
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TSTM and GIBM, Polycyclic 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 released into 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 analytical chemistry, although essential, may not present ecological relevance, as it might not give information on 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 bioindicators to 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 Gibbula umbilicalis at 48 and 96 hours was 61.45 µg L-1, and 15.69 µg L-1, respectively. Are TBT sources migrating from harbors to marinas in Latin America?

TU 362
Biodiversity on Portuguese ports: TBT degrading bacteria
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Polycyclic Institute of Leiria, Peniche, Portugal
Instituto Politécnico de Leiria, Peniche, Portugal
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Tributyltin (TBT) 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 September 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 and imposex levels in areas close to marinas, despite the general reducing 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 out of 31 stations 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 (when 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 1.36 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. This year, another marina located near a small harbor showed imposex, and the three stations in the harbor area and the small marina showed imposex incidence of 100% whereas no gastropods were found during 2008 sampling. Thus, although the international restrictions on TBT use are apparently reducing the impacts from harbors, 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 L.B. Oliveira1,2, A.C.A. Sousa1, S. Takahashi1,2, S. Tanabe3, K. Thomas4, M.J.F. Suter4, C. Barroso1
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4Chime University, Matsushima, Japan
5Norwegian Institute for Water Research (NIVA), Oslo, Norway

Eawag - Swiss Federal Institute of Aquatic Science and Technology, Dubendorf, Switzerland

The use of valve rhythm-based antifouling paints (TBT-based AJP) is globally forbidden since the 17th September 2008 by the ‘International Convention on the Control of Harmful Antifouling Systems on Ships’ (AFC 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 Nucella lapillus at fourteen stations along the Portuguese coast in 2011. 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), TBT, diphenyltin (DPT), triphenyltin (TPT), monocrotyl (MOT) and diocrotyl (DOT) were quantified in the soft tissues of whole females by GC-MS. The OSPAR Ecological Quality Objective (EcoQO) 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 (0.3 < VDSI < 2) with a single exception in the Southwestern coast of Portugal - Ribeira de Ovar (site 15) – this 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, 2.1-30ng Sn/g dw for TBT and <0.2ng Sn/g bioa 1.4ng Sn/g dw for DPT, TPT, 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 analysed for the period 2000-2011 in order 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. Eklund
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. Today, the use of TBT-based paints on most ships is legally prohibited (since 2007). The phaseout of TBT has been implemented as a consequence of the International Convention on the Control of Harmful Anti-fouling Systems on Ships (AFC Convention). This Convention 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 Nucella lapillus at fourteen stations along the Portuguese coast in 2011. 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), TBT, diphenyltin (DPT), triphenyltin (TPT), monocrotyl (MOT) and diocrotyl (DOT) were quantified in the soft tissues of whole females by GC-MS. The OSPAR Ecological Quality Objective (EcoQO) 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 (0.3 < VDSI < 2) with a single exception in the Southwestern coast of Portugal - Ribeira de Ovar (site 15) – this 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, 2.1-30ng Sn/g dw for TBT and <0.2ng Sn/g bioa 1.4ng Sn/g dw for DPT, TPT, 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 analysed for the period 2000-2011 in order to assess the evolution of TBT pollution levels in the Portuguese coast.

TU 366 Comparing anadara trapezia exposure, dose and response to metal contaminated estuarine sediments using laboratory and field exposures and resident molluscs
M. Taylor, W.A. Maher
University of Canberra, Act, Australia

Evaluating 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 biomonitors of metal contamination. Identification of this portion of the metal cycle is critical for further investigations to elucidate the mechanisms of organism stress responses to metals in ecological systems. Understanding of the mechanisms of organism stress responses to metals in ecological systems is needed to develop predictive capability of ecological risk assessment improved.

Assessing the relationships between tissue metal exposure and biological response of estuarine sediments using laboratory and field exposures and resident molluscs

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Chronic exposure of young spat of the Pacific oyster (Crassostrea gigas) to zinc

The summer mortality syndrome which sporadically threatens oyster farming appears to be due to a combination of several intrinsic and extrinsic factors including physiological changes 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 oyster spat (Crassostrea gigas), aged 2 weeks, reared at the laboratory conditions for 10 weeks. Zinc was 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 cycle were analysed. In our study, chronic exposure showed 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 by zinc. The goal of this study was to provide an environmental risk assessment 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.

Our results contribute to the understanding of whether chronic exposure of pharmaceuticals causes a real threat to aquatic organisms, their habitat and, ultimately, to humans health.

TU 370

Chronic exposure of young spat of the Pacific oyster (Crassostrea gigas) to zinc

M. L. Mahaut1, C. Caplat1, A. Serpentini1, J. M. Lebel1, K. Costil1

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The summer mortality syndrome which sporadically threatens oyster farming appears to be due to a combination of several intrinsic and extrinsic factors including physiological changes 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 oyster spat (Crassostrea gigas), aged 2 weeks, reared at the laboratory conditions for 10 weeks. Zinc was 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 cycle were analysed. In our study, chronic exposure showed 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 by zinc. The goal of this study was to provide an environmental risk assessment 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.

Our results contribute to the understanding of whether chronic exposure of pharmaceuticals causes a real threat to aquatic organisms, their habitat and, ultimately, to humans health.

TU 371

Assessment of sacrificial anode impact by zinc accumulation in oyster Crassostrea gigas: comparison between a long- and short-term laboratory tests

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Zinc is an essential metal for all 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 oyster Crassostrea gigas by exposing two in vivo tests. The first test was conducted over a period of 10 weeks at a concentration of 0.3 mg Zn L-1, after a period of 2 weeks of zinc exposure, and another one lasted for 168-hours at a concentration of 2 up to 2 mg L-1. Both exposure experiments did not change immune parameters in exposed oysters. Even if the exposure time is limited compared to the life-span of the organism, if exposure starts at the very beginning, it covers the whole lifetime up to the end of the experiment, which is relevant in terms of chronicity. In addition, early stages of development are often more sensitive to zinc than adults, so using them for ecotoxicology obviously makes sense. Zinc is an essential trace metal in living organisms but 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-1, as of 1 day post-metamorphosis 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 EC20, 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 concentrations. However growth was assessed 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 372

Effect of herbicides on embryo-larval development and metamorphosis in the Pacific oyster, Crassostrea gigas

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The summer mortality syndrome which sporadically threatens oyster farming appears to be due to a combination of several intrinsic and extrinsic factors including physiological changes 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 oyster spat (Crassostrea gigas), aged 2 weeks, reared at the laboratory conditions for 10 weeks. Zinc was 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 cycle were analysed. In our study, chronic exposure showed 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 by zinc. The goal of this study was to provide an environmental risk assessment 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.

Our results contribute to the understanding of whether chronic exposure of pharmaceuticals causes a real threat to aquatic organisms, their habitat and, ultimately, to humans health.

TU 373

Ecotoxicity of nitramines, important transformation products of amines used in carbon capture

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Acetylcholinesterase (AChE) activity was 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 cycle were analysed. In our study, chronic exposure showed 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 by zinc. The goal of this study was to provide an environmental risk assessment 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.

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TU 374

Effects of arsenic on physiological parameters of mussels (Mytilus edulis) from the Scheldt Estuary (Belgium)

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Our results contribute to the understanding of whether chronic exposure of pharmaceuticals causes a real threat to aquatic organisms, their habitat and, ultimately, to humans health.
Arsenic is widespread in the marine environment and involves various chemical forms, principally as arsenate (As V), and to a lesser extent as arsenite (As III) in more toxic forms of arsenic. Arsenic introduced into the environment often contaminates aquatic ecosystems, where the residence time has been estimated at about 50 years. This study aimed to determine whether exposure to specific heavy metal arsenic has an effect on the cells of mussels. The effect of arsenic in mussels was analyzed in an experiment that was provided in 7 different groups and exposed to arsenic 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 it is exposed, especially at high concentrations. Several biomarkers were not affected or did not show any relation, but we have had experiments. The present study has shown that the arsenic accumulated in the body of mussels does not have adverse effects to the mussel, at least in a short period of time and for those physiological parameters measured, but after 10 days of exposure some parameters (lipid and SFG) have positive correlation with arsenic in sea water, suggesting an effect of arsenite. 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

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Aim of the study was the assessment of metal exposure in coastal areas under indirect or direct influence of maritime activities and nautical tourism (port and marinas) using integrated hyphenated analytical approach toward indicator species. The mussels (Mytilus galloprovincialis) were collected from seven localities which were classified as the lowest to the highest polluted areas: 2 in the Portuguese Coast (NICP) over one year (April, June, October 2010 and in February 2011); 4 in the NW Coast of Portugal (Vila Chã, São Bartolomeu de Mar, Viana do Castelo and Carreço) and 3 in the Basque Coast (Arriñu, Gorliz, Mundaka). In each locality, a battery of biochemical and chemical and tissue-level biomarkers were applied: acetylcholinesterase (AChE) and glutathione S-transferases (GST) enzymatic activity, levels of lipid peroxidation (LPO), lysosomal enlargement (lysosomal volume fraction, LVF), cell membrane stability (membrane potential, M.P.), cell type representation (volume density of basophilic cells, VbRAS) in digestive gland epithelium, and changes in the morphology of digestive alveoli (mean luminal radius to mean epithelial thickness MLR/MET). These biomarkers were integrated in the Integrative Biomarker Index (IBI), which was developed within the framework of the Prestige spill oil (POS). The IBI index revealed that mussels’ health was affected in chronically polluted locations. Star plots accompanying IBI provided complementary information concerning mechanisms of biological response to environmental insult. The IIBP is a high risk area for marine species due to intense marine traffic. This is an important integrative field study to understand the present environmental health status and to determine the levels of general stress on core localities which provide reliable assessment of future impacts of pollutants. This study was supported by the Government of the Basque Country through a post-doctoral grant to L. Garmenda (ref. FP09 214) and K EGOKITZEN project and by the Portuguese Foundation for the Science and Technology and FEDER funds through the project RAMOS (ERA-AMPERA/0001/2007; EU AMPERA ERA-NET; ERAC-CT2005-01163).

TU 377

An improved on-line clam-based behavioral monitoring system allows an approach to estimate dose-response profiles of clams exposed to waterborne copper

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The aim of this study was to develop an improved on-line clam-based behavioral monitoring system. The system included a valvometry apparatus and three kinds of valve closure analytic programs that can offer a real-time and cost-effective method to construct an approach for estimating dose-response profiles of clams (Corbicula fluminea) exposed to waterborne copper (Cu). The valvometric technique can reduce the environmental stress of observed bivalves to promote a measuring precision in the spontaneous status of recording daily valve movements. The clam-based on-line behavioral response monitoring system was used to respectively monitor the valve closure responses of C. fluminea exposed to unolluted and various Cu concentrations. In this study, a probabilistic-based approach describing the valve behavioral response of C. fluminea exposed to unolluted environment and Cu was developed. The magnitude of shell gape of 20 and 50% were respectively adopted as the determining thresholds of the closing (VC) and siphon extension (VS) thresholds to dichotomize the valve movements in histogramming the time-variation dose-response profiles (VC and VS) based on a simple three-parameter Hill model. It also allowed the estimation of the integration time-specific E50 and E25 values as a bioassay approach. The daily valve opening and closing rhythm were characterized by a three-parameter lognormal function. The time-specific E50 and E25 values were estimated using a maximum likelihood estimation method. The results revealed that the RVC-based valve behavioral observation has a better sensitive response for detecting a lower waterborne Cu concentration than that of RVC within one hour. The results also demonstrated that the response sensitivity of clams exposed to Cu depended on the initial valve closing (VC) and siphon extension (VS) times of C. fluminea. A decreased response in response to their exposure concentration resulted in various valve closing rates. In the future, an estimation of dose-response profiles of clams exposed to waterborne contaminant should take into account the related response characteristics of valve activities to promote the predictive capabilities of this bioassay approach.

TU 378

Glutathione S-Transferase, glutathione peroxidase and acetylcholinesterase activities in mussels transplanted to harbour areas

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As part of an integrative monitoring campaign involving water and sediment chemistry, in situ bioassays, and mussel bioaccumulation and biomarkers, Mytilus galloprovincialis mussels of standard size were transplanted from a clean location to five sites in two important harbours from the Atlantic coast of Spain (Vigo and Pasaia) at the time of current exposure level. Some of the potential effects are discussed in the life cycle of Mytilus galloprovincialis (M. galloprovincialis) genus and Mytilus edulis (M. edulis) species. The authors have focused on the oxidative stress (GST, GSH and AChE) in the gills of transplanted mussels (n=12). GST activity is induced by organic pollutants, Gpx activity is induced as a response to oxidative stress, and AChE activity is specifically inhibited by organic pesticides such as organophosphates and carbamates. The concentrations of major contaminants (trace metals, polychlorinated biphenyls and polycyclic aromatic hydrocarbons) accumulated in the mussel tissues were also measured. Mussels from the most polluted sites consistently exhibited a significant increase in body contaminants compared to clean stations (p<0.001). Both biomarkers showed the same pattern of response (p<0.001) and was significantly induced in polluted areas. Both biomarkers showed the same pattern of response (p<0.001) and was significantly induced in polluted areas. Both biomarkers showed the same pattern of response (p<0.001) and was significantly induced in polluted areas.
Impact of suspended particles on bioavailability of petrogenic PAH in cod (Gadus morhua), mussels (Mytilus edulis) and passive samplers exposed to produced water. M. Pampmannon1, C. Bjorkholm1, C. Harmann2, S. Vingen3, B.F. Godal4, R.C. Sundt4
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Caged organisms and passive samplers are routinely used to monitor environmental impact of operational discharges from offshore oil and gas production. Comparison of experimental conditions and time may be required between studies. This poses challenges to the interpretation of data obtained in different studies, especially if the discharges are composed of oil and produced water (PW). The present study was undertaken to assess the impact of PW and algae mix at low, medium and high concentrations. The following parameters were analysed: PAHs in water; PAH concentrations in SPMD and mussel soft tissues. The biomarkers used were DNA strand breakage (comet assay, a biomarker of exposure), induction of micronuclei (a biomarker of effect), histopathology and expression of several key genes known to respond to oxidative or toxicological stress. Nickel accumulated in mussels at all concentrations, in the tissue-specific order byssus > digestive gland > gills > foot > adductor muscle > mantle. A significant genotoxic damage was observed by both the comet assay and micronucleus test, but only at 3600 µg l-1 nickel. Correspondingly, a semi-quantitative analysis of histopathology in the mussels indicated an increase in structural damage at concentrations ≥ 1800 µg l-1 Ni. Quantitative RT-PCR revealed an increase in the gluthathione-transferase (GSTM) and metallothionein (met205) genes in gill tissue after exposure to 3600 µg l-1 nickel, compared to the controls. Expression of these genes is known to be induced following xenobiotic exposure, especially to metals. The p-glycoprotein (ppg) gene, which has been implicated in multi-xenobiotic resistance (MXR), was markedly overexpressed in all exposed mussel gills with the highest exposure to 18 µg l-1 Ni. These results suggest that nickel is an effective stressor at 3600 µg l-1 nickel and may correlate with responses at the molecular level (i.e. biomarker of exposure) as well as at the level of expression. As a result, we recommend that effort is made to accurately quantify nickel concentrations in highly polluted waters near nickel mines (e.g. the New Caledonian lagoon), and that remedative measures may be necessary at higher values such as 3600 µg l-1 nickel.

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table

Mechanisms of acute toxicity of metals in estuarine and marine invertebrates

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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 mining activities. Nickel is concentrated in the byssus of Mytilus galloprovincialis, a key biomarker organism. Mussels were exposed to sublethal concentrations of nickel (0-3600 µg l-1) for 5 days. In addition to determining tissue-specific nickel accumulation, the biomarkers analysed were DNA strand breakage (comet assay, a biomarker of exposure), induction of micronuclei (a biomarker of effect), histopathology and expression of several key genes known to respond to oxidative or toxicological stress. Nickel accumulated in mussels at all concentrations, in the tissue-specific order byssus > digestive gland > gills > foot > adductor muscle > mantle. Significant genotoxic damage was observed by both the comet assay and micronucleus test, but only at 3600 µg l-1 nickel. Correspondingly, a semi-quantitative analysis of histopathology in the mussels indicated an increase in structural damage at concentrations ≥ 1800 µg l-1 Ni. Quantitative RT-PCR revealed an increase in the gluthathione-transferase (GSTM) and metallothionein (met205) genes in gill tissue after exposure to 3600 µg l-1 nickel, compared to the controls. Expression of these genes is known to be induced following xenobiotic exposure, especially to metals. The p-glycoprotein (ppg) gene, which has been implicated in multi-xenobiotic resistance (MXR), was markedly overexpressed in all exposed mussel gills with the highest exposure to 18 µg l-1 Ni. These results suggest that nickel is an effective stressor at 3600 µg l-1 nickel and may correlate with responses at the molecular level (i.e. biomarker of exposure) as well as at the level of expression. As a result, we recommend that effort is made to accurately quantify nickel concentrations in highly polluted waters near nickel mines (e.g. the New Caledonian lagoon), and that remedative measures may be necessary at higher values such as 3600 µg l-1 nickel.

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stronger responses.

Studying both types of stressors and its interaction with contaminants can be crucial to provide improved interpretation of ecological effects of relevant scenarios for environmental risk assessment.

TU 387

Effects of mercury contamination on acute and chronic parameters of exposed sea snail Gibbula umbilicalis

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The Minamata (Japan) incident in the 1950’s triggered the global concern regarding the mercury contamination hazard. Mercury is a very common contaminant in the environment, having natural sources, such as volcanism, and anthropogenic origins, such as mine tailings or industrial effluents. 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

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The problem of anthropogenic impact on marine aquaria is one of the most actual nowadays. Synthetic detergents has 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 detergents’ 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 performance 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 rate. Our results have indicated that concentration of 0.5 mg/l is the detrimental threshold of SDS in mussels, which could affect physiological as well as structural valve 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 RBRF 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

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The concentration of trace metals (Fe, Mn, Cu, Zn, Cd and Pb) in the mussel Mytilus galloprovincialis Lam. Continuous recordings of the heart rate and valve movements in the mussels were carried out along the west coast of the Cape Peninsula, Cape Town, from autumn to winter 2010 to autumn 2011. Sampling took place at Scarborough (considered an unpolluted site), Hout Bay, Green Point, Milnerton and Bloubergstrand. The mussel carapace and soft tissue were analysed using 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 Bioaccumulation 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


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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 efficiency indicated by the PAM, without clear visual signs of impairment in coral structure, was generally followed by necrosis of parts of the colonies; this shift might lead to severe implications in population dynamics. For seagrass, there was correlation between RLC data and visual observations, such as high epiphytic 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 bioaccumulative Phytoplankton

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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. 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, xenobiotics are increasingly present in everyday life and are easily integrated into marine ecosystems. In aquatic systems macroalgae are continuously exposed to xenobiotics and their development and validation is key to assess macroalgae chronic toxicity - a case study with Ulva lactuca.

Xenobiotics are increasingly present in everyday life and are easily integrated into marine ecosystems. In aquatic systems macroalgae are continuously exposed to xenobiotics and their development and validation is key to assess macroalgae chronic toxicity - a case study with Ulva lactuca.
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 sentinels 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 macroalgae Ulva lactuca was used as a model species. When exposed to xenobiotics, can show signs of decay by losing their colour and their texture. This can be quantified by very sensitive and accurate methods. To be sure the algae are in decay and correctly assessed, it is performed 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 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

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Common salt marshes are most of the times coastal ecosystems that can jeopardize their populations. Therefore, contamination by organic compounds discharged by nearby industries and cities has attracted considerable attention from multiple research areas of both basic and applied aspects. Our first objective in this work was to develop a fast, easy and low-solvent 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) were coupled to gas chromatography tandem mass spectrometry (GC-MS/MS) were used for determining polycyclic aromatic hydrocarbons (PAH), polychlorinated biphenyls (PCB), organochlorine and organophosphorus pesticides, triazines, plasticizers and some personal care products (tricosan, UV filters and fragrances). Briefly, 10 mm stir bars coated with polydimethylsiloxane (PDMS) were placed in 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 optimised: 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 micropolllutants 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

Mixity of antibiotic and natural algae in microbial communities

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Primary production by micro-algae embodies the carrying capacity of marine ecosystems and is primarily linked to nutrient availability and light. However, recent studies indicate that certain industrial chemicals may have a direct impact on the development of coastal communities and hence on the carrying capacity of estuarine and marine ecosystems. At the same time the frequency and intensity of toxic algal blooms is increasing globally, resulting in increased levels of natural toxins expecting to affect coastal ecosystems. These different chemical stressors are hypothesized to disturb regulatory mechanisms within algal communities, modifying the competitive abilities of individual species and resulting in shifts from highly nutritious to unfavourable algal species that destabilize the food chain. Therefore, increasing their potential antagonistic or synergic interactions. To this end, we performed binary mixture toxicity assays in the algae species Ulva lactuca and Protococcus sp. to test their binary mixture toxicity to different chemicals. Results of laboratory experiments underlined that, due to the short time and simplicity of the test procedures, the percentage nitrogen was negatively correlated with diversity while the percentage carbon was positively correlated with abundance and richness. The mean grain size was negatively correlated with richness, diversity and abundance, although these correlations were low.

In our study as they might be bioavailable in naturally occurring polluted sites. Exposures to binary mixtures of all studied pollutants were performed 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 optimised: 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 micropolllutants 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 396

The use of protozoa in ecotoxicology: from biological model to environmental biomonitoring application

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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 is it crucial to discover tools that will identify adverse effects of sediment contamination on benthic organisms as well as link toxicity mechanisms to biological effects. Due to their nature as a eukaryotic cell/organism and their position in the food web, ciliated protozoa have proven to be suitable models 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 the cell mortality, replication rate, lysosomal membrane stability and endocytosis rate of the marine ciliate 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 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 optimised: 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 micropolllutants 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 397

Can foraminifera be reliably used as environmental indicators?

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Sediment samples around the Robben Island sewage pipeline and a fish factory pipeline in St Helena Bay were examined for foraminifera as well as for a suite of environmental factors. X-ray analysis was conducted on “live”foraminiferal tests to determine correlations with trace metals within the sediments. The species diversity, richness and abundance were negatively correlated with trace metals. The percentage nitrogen was negatively correlated with diversity while the percentage carbon was positively correlated with abundance and richness. The mean grain size was negatively correlated with both. The percentage carbon, percentage nitrogen, and the mean grain size most influenced community structure. The dominant genera in St Helena Bay were negatively correlated with trace metals and percentage nitrogen. The dominant genera from around Robben Island were most strongly correlated with the mean grain size. Bolviana, Elphidium and Quinqueloculina appeared to be most strongly affected by environmental factors than the other genera and may be regarded as good bio-indicators. Ammonia, although dominant was less correlated with environmental factors and because it is considered an opportunist.

No significant correlations could be found with environmental factors and concentrations of the tests and the sediments. It appears that foraminifera can regulate the concentration of toxic metals within their tests, evident in the low concentrations of trace metals in tests despite high concentrations in the sediments. St Helena samples also displayed a higher concentration of trace metals but a lower Ca:Mg ratio than those of Robben Island. Trace metal concentrations appear to interfere with the laying down of calcium carbonate within foraminiferal tests.

Sediment and water toxicity normally found in benthic meiofauna, trends found in foraminiferal assemblages could be related to environmental conditions, particularly the trace metal concentrations within the sediments. Despite the trace metal tests not being significantly correlated with the trace metals in the sediments, trace metals do appear to have an effect on Ca:Mg ratios within the tests.

TU 398

The effect of a Copper and Zinc mixture on Dunaliella tertiolecta


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Toxicity experiments with one compound, but contamination in the field generally consists of mixtures of contaminants. Of this aim was this study was therefore to determine the effect of a Ca:Zn mixture usually on the marine alga Dunaliella tertiolecta. Growth rate (cell count) and photosystem II efficiency (Pulse Amplitude Modulation fluorescence) of D.tertiolecta were determined after three days of exposure to Ca, Zn and equitoxic mixtures of Ca:Zn, composed according to the Toxic Unit concept. Our results showed that growth of D. tertiolecta was more sensitive to Zn than to Ca. Photosystem II efficiency was less sensitive to the metal(mixtures) than heterotrophic. The relative
These results highlight that protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecotoxicology.

To test whether and understand how chronic exposure to pollutants affects the resistance capacities of marine organisms, we imposed a 4-days air exposure to crabs sampled in a polluted area, and a reference site at low tide. Proteomic profiles showed significant differences according to animal origin despite high individual variability. A small set of proteins showing different expression or polyubquitination levels will be identified by mass spectrometry in order to elucidate the mechanisms underlying stress response.

The shore crab (Carcinus maenas (L.)) represents 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.

Polybrominated diphenyl 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 and the accumulation of FLU (measured by GC-MS, ß = 5.21, P < 0.001, R2 = 0.993) in the soft tissues and FLU-type metabolites (measured by ELC, R2 = 6.045) were detected in the digestive gland. A strong positive linear relationship (R = 1.15, P = 0.003, R2 = 0.91) between accumulation of FLU (GC-MS) and FLU-type metabolites was found. Consequently, the acute toxicity of PBDEs (shown by the degree of bromination) increases in the order of BDE-47 < BDE-99 < BDE-154. 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.

Toxicological effects of three polybromodiphenyl Ethers (BDE-47, 99 and 154) on growth of marine algae Isochrysis galbana

Polybrominated diphenyl 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 and the accumulation of FLU (measured by GC-MS, ß = 5.21, P < 0.001, R2 = 0.993) in the soft tissues and FLU-type metabolites (measured by ELC, R2 = 6.09, R = 0.002, R2 = 0.931) were detected in the digestive gland. A strong positive linear relationship (R = 1.15, P = 0.003, R2 = 0.91) between accumulation of FLU (GC-MS) and FLU-type metabolites was found. Consequently, the acute toxicity of PBDEs (shown by the degree of bromination) increases in the order of BDE-47 < BDE-99 < BDE-154. 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 403

A short-term in situ sediment assay based on the postexposure feeding of the estuarine isopod Cythera carinata

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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 single species and single test approach. In situ tests 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 Cythera carinata, a secondary prey, 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 and then tested in four different field trials conducted in selected areas which have a high anthropogenic impact. The present study shows that, although it is a short-term assay, it can be useful in monitoring the contaminants status of different areas and should be further developed to be used as a tool for high throughput screening of contaminants in areas with high anthropogenic impact.

TU 404

Toxicity of the biotransformation products of four methylated PAHs and one PAH produced by Nereis diversicolor and Nereis virens

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Assessment of the toxicity of PAHs and their biotransformation products is important due to the toxic effects that these compounds can have on marine organisms. The methodology for feeding quantification was first developed and optimized under laboratory conditions and then tested in four different field trials conducted in selected areas which have a high anthropogenic impact. The present study shows that, although it is a short-term assay, it can be useful in monitoring the contaminants status of different areas and should be further developed to be used as a tool for high throughput screening of contaminants in areas with high anthropogenic impact.

TU 405

Vitellogenin and Zona Radiata gene expressions in three different species of catfish from Termisos Lagoon

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The objective of this study was to determine the toxicity of the biotransformation products of 1-methylphenanthrene, 3,6-dimethylphenanthrene, 1-methylpyrene, 3-methylchrysen and phenanthrene produced by the two benthic invertebrates Nereis diversicolor and Nereis Virens, and 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 at different times. The water soluble transformation 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 conjugation 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 406

Polydisulfonated diphenyl ethers and their methoxylation analogs in sea bass (Dicentrarchus labrax) from Bizerte Lagoon, Tunisia

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The aim of this study was to determine 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 sediments by deconjugation reactions, but they 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 was therefore to do 1) assess the toxicity of the biotransformation products of 1-methylphenanthrene, 3,6-dimethylphenanthrene, 1-methylpyrene, 3-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 at different times. The water soluble transformation 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 conjugation 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 407

Seasonal pollutant monitoring in discarded fish species: is valorisation appropriate?

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Increased competition for fish has driven aquaculture to increase the use of by-catch and 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.

Several studies in the 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 byphenylns-PCBs, organochlorinated pesticides-OCs and heavy metals) in several cases for commercial species of different fisheries. In fact, it is likely that 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 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].

TU 408

First evidences of suboptimal health status of red mullets from the priority polluted Mediterranean area of Portman (SE Spain)

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The Mediterranean Sea is one of the most heavily polluted Mediterranean Sea and highly impacted by emissions from oil-related and chemical industrial activities in the eastern Escombreras Valley. An integrated assessment was conducted of the health status of red mullet (Mullus barbatus) from three priority pollution areas of the Spanish Mediterranean coast, including Portman. A suite of general physiological indicators (lipid content in muscle tissue, condition factor, fatty acid profile, vitamin E, kynurenines, total thiols, and total and oxidized glutathione), an oxidative stress parameter (catalase activity, metallothionein concentration and DNA damage) were determined. In addition, fish muscle tissue and sediment samples were taken and analysed for concentrations of arsenic, trace metals, Polychlorinated Biphenyls (PCBs), chlorinated pesticides (dichloro-diphenyl-trichloroethane (DDTs), α-chlorohexachlorocyclohexane, lindane, hexachlorobenzene, cycloneides insecticides and trans-nonaclor) and polycyclic aromatic hydrocarbons (PAHs). Our results showed that fish from Portman accumulated the highest concentrations of mercury, lead and arsenic and also of suboptimal health status that warrants further study. The integrative assessment strategies, including chemical, (eco)toxicalogical parameters used in this study can contribute
to the assessment of Good Environmental Status under the Marine Strategy Framework Directive.

TU 410
Characterization of selected Metals in United Arab Emirates coastal fish and locally produced foodstuff.

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Heavy metal pollution of coastal environments has long been recognized as a serious environmental concern. A lack of published literature on heavy metals contamination of local fish and a proper fish advisory in the United Arab Emirates (UAE) is in current need. Moreover, seafood and locally produced foodstuffs 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, shellfish (sardine, shakelie, trevaly), mushrooms, cucumbers, peppers, among others) using Inductively Coupled Plasma-Optical Emission Spectrometer (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-exposure contact of medaka eggs to a PAH model: Combined chemical, toxicological and proteomics approaches

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Exposure of aquatic species represents a major concern 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. In this study, the effects of fluoranthene decreased linearly with time. In water, concentrations were globally constant, with the sediment acting as a reservoir of pollutant. In embryos, the concentrations were more erratic and were dependent on stage of development more than concentrations in sediment or water with a fast clearance after hatch. At the same time, the highest tested concentration led to hatch failure associated with one day delayed hatching. The rate of several abnormalities increased such as heart edema, skeletal deformities, heart defects and abnormally reducing of yolk sac. These pathologies, related to blue sea disease syndrome, explained the dose-dependent increase of teratogenicity. The proteomic map exhibited 600 proteins. Among these, the expression level was modified for 77 proteins. The change in expression was related to cell physiology, pathy or 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 study. Exposure to environmental concentrations of a single PAH in a realistic way could lead to proteomic modulations, with macroscopic teratogenic effects. This study was supported by region Haute Normandie and Aquitaine, GIP Seine Aval and University of le Havre.

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

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The effects 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 parent-offspring exposure investigations as gametogenesis and spawning of a population are highly synchronized. Heavy metals interact with sediment in many ways and spiked sediment has been used frequently to aid in the development of concentration-response relationships. In this study, we investigated the effects of copper on the later stages of the gametogenic cycle of the estuarine polychaete N. virens in spiked sediment to 500 and 1000 mg/kg dry sediment concentrations. Copper was present in sediments experienced by macrofaunal polychaetes. Subsequent adult mortality and the numbers and timing of spawning events were quantified as well as the effects on oocyte development. Finally, sperm and oocytes were extracted from the adults and using in vitro fertilizations we assessed the developmental success. BCR 3-step standard sequential extraction confirmed that much more labile copper (in actual and percentage terms) was present as spiked concentrations increased, although the residual fractions had similar amounts and this is comparable to those levels found in the tissues of the exposed worms. Adult mortality was not dependent on the exposure time, but higher concentrations induced greater mortality for both sexes. Oocytes were significantly smaller at higher concentrations although pairwise comparisons did not show statistical significance. Numbers of eggs was variable. More frequent was the number of embryos developing normally after exposure. In vitro fertilizations of oocytes fertilized with sperm from exposed males and not exposed males showed that sperm were more susceptible, but oocytes were also affected at the highest concentration. Exposure of adults to copper may have significant implications for adult survival, embryo development and larval recruitment and subsequent colonization of polluted sediments.

TU 413
Oxidative stress, genotoxicity and histopathology biomarker responses in sea bass (Dicentrarchus labrax) liver from Bizerte Lagoon (Tunisia)

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The aim of the 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 lagoon (Bizerte Lagoon) in comparison to a reference 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 Tunisian coastal waters. Antioxidant enzymes were lower in livers from the polluted site compared with fish from the reference site, suggesting deficiency of the antioxidant system to compensate for oxidative stress. DNA damage was higher in fish from the contaminated site indicating genotoxic effects. The liver 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) testis: an in vitro study

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Aquatic hypoxia (dissolved oxygen levels less than 2.5 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 have not yet been determined using primary culture of fish. We therefore cultured the testes of male medaka (O. melastigma) to study the effects of acute hypoxia 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 testicular cell differentiation (spermatocytes and spermatagonia) at 48h (p<0.05, n=4), and this was associated with significant down-regulation of expression of steroidogenic gene (CYP11A1) and AR. REPS-1 expression was significantly increased by hypoxia in testis at 24 and 48h and also by Hypoxia treatment at 24, 48h and 72h as analyzed by flow cytometry after labelling with Annexin V and PI. Furthermore, there were no changes in expression of the pro-apoptotic gene BAX and the anti-apoptotic gene BCL2 at these time points. Our results suggest that spermatogenesis and steroidogenesis in fish can be impaired under acute hypoxic conditions, and future developmental and reproductive studies can be performed to understand the molecular mechanisms of hypoxia-induced teratogenic effects observed following hypoxia exposure. These molecular changes may potentially reduce reproductive success of males and lead to a decline in natural fish populations.

TU 415
Toxic effects of ZnO nanoparticles towards marine algae Dunaliella tertiolecta

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ZnO nanoparticles are among the most promising nanomaterials being developed for commercial applications in a variety of fields. The main objectives of this study were to evaluate the effects of ZnO NPs on the growth rate and intracellular changes in the marine microalgae Dunaliella tertiolecta. The nanoparticles were characterised by HRTEM and XRD, and their size was measured by DLS. The ZnO NPs were treated with different concentrations (10, 100 and 1000 mg/L) for 24h, and their effects on the growth rate and intracellular changes were evaluated using a range of techniques, including fluorescence microscopy, flow cytometry, and TEM. The results showed that the ZnO NPs caused a significant decrease in the growth rate of D. tertiolecta, with the highest concentration (1000 mg/L) resulting in a 30% reduction in cell viability. The intracellular changes included an increase in the number of apoptotic cells, as well as a decrease in the fluorescence intensity of the chlorophyll a, which is a common indicator of stress in microalgae. These results suggest that ZnO NPs can have significant effects on the growth and health of marine microalgae, and that further research is needed to fully understand the mechanisms underlying these effects.

TU 416
PBDE accumulation in muscle of Whitemouth Croaker (Micropogonias furnieri) exposed to BDE 99 and BDE 153

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PBDEs are persistent organic pollutants that are widely used in various commercial applications, including as flame retardants. They are known to bioaccumulate in the food chain, resulting in high levels in the tissues of long-lived species such as fish. The main objectives of this study were to evaluate the accumulation of two PBDEs, BDE 99 and BDE 153, in the muscle tissue of Whitemouth Croaker (Micropogonias furnieri) exposed to these congeners in a flume tank. The PBDEs were added to the water at concentrations of 0.1 mg/L and 1 mg/L, and the fish were exposed for 12 weeks. The results showed that BDE 99 accumulated at a higher concentration in the muscle tissue than BDE 153, with a maximum concentration of 1.2 mg/kg wet weight observed in the fish exposed to the 1 mg/L concentration. The PBDEs were also found to bioaccumulate at similar concentrations in the muscle tissue of fish exposed to both congeners, with a maximum concentration of 0.3 mg/kg wet weight observed in the fish exposed to the 0.1 mg/L concentration. These results suggest that PBDEs can bioaccumulate at high levels in the tissues of marine organisms, and that exposure to these pollutants can have significant effects on the health and welfare of the affected species.
Inhibition of GST, GPs and AChE activities in marine mussels by exposure to the dissolved polybrominated diphenyl ethers BDE-47

TU 416

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The environmental presence of polybrominated diphenyl ethers (PBDEs), among which BDE-47 is the most abundant, make toxicity data necessary to assess the hazard risk posed by PBDEs to marine organisms. In this work, BDE-47 and PBDE congeners were analyzed in the mussels Mytilus galloprovincialis from two Laborele stations; the mussels were allowed to depurate in clean sea water for 10 days. Samples were collected at time 2, 5, 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 (GP) and acetylcholinesterase (AChE) activities. GST and GPs 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 water the three enzymes recovered the initial levels of activity.

TU 417

Differential gene transcription in Pocelidia vivipara exposed to copper

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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 gills and excreted via bile and kidneys. The aim of this study was to identify genes differentially expressed in liver of Pocelidia 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 were up regulated, earlier studies have established that some fish can debrimate certain PAHs congeners, Whitemouth croaker (Micropogonias furnierii) is 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 Whitemouth 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, 9, 15, 20 and 30 muscle samples were collected from at least three fishes. Overall, the Whitemouth croaker exposure to BDE 99 ended up accumulating BDE 47 in its muscle, indicating their capacity for processing BDE 99. On the other hand, BDE 153 accumulated without any transformation.

TU 418

Spatial distribution and accumulation patterns of cyclic methyl silicones (cVMS) in fish from Northern Norway

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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 (PAH), 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 ozamethylocyclosiloxane (D4) and decamethylocyclosiloxane (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 concentration of D6 between collection sites. Concentration of D5 within cod liver was found to be negatively correlated with age. No correlation was observed between D4 and D6 concentrations and age; however, negative 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.

TU 420

Organochlorine pollutants in oceanic migratory birds: influence of body condition in PCBs and DDTs concentrations among different tissues

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Albatrosses and petrels (Procellariiformes) are migratory oceanic birds of considerable conservational interest. Polychlorinated biphenyls (PCBs) and organochlorine pesticides (DDTs) are ubiquitous contaminants with the potential of bioaccumulating in the food chain. This study investigated the accumulation of organochlorine contaminants in coastal and migratory populations of Albatrosses and petrels to understand their bioaccumulative significance in these species. The influence of body condition during the migration period in the distribution of organochlorine contaminants was evaluated, showing that it is a significant factor in the variation and redistribution of these compounds in the tissues of these birds. Birds with good body condition had higher PCB and DDTs concentrations than birds that were in poor body condition (21% of the specimens with signs of starvation, such as the depletion of fat reserves had higher DDTs and PCBs concentrations in the liver than in the fat tissue, although the difference in the concentrations of these two tissues did not achieve statistical significance. These findings suggest a tendency toward an increase in the concentration of these substances in the liver and muscle of birds with poor body condition. The concentration of these compounds is influenced by the body condition of the bird at the time of collection and the analysis of different tissues may generate different findings regarding contamination in birds. Lipid reserves are extremely important to the achievement of these compounds in the liver and muscle of birds with poor body condition. 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 gills and excreted via bile and kidneys. The aim of this study was to identify genes differentially expressed in liver of Pocelidia 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 were up regulated, earlier studies have established that some fish can debrimate certain PAHs congeners, Whitemouth croaker (Micropogonias furnierii) is 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 Whitemouth 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, 9, 15, 20 and 30 muscle samples were collected from at least three fishes. Overall, the Whitemouth croaker exposure to BDE 99 ended up accumulating BDE 47 in its muscle, indicating their capacity for processing BDE 99. On the other hand, BDE 153 accumulated without any transformation.

TU 421

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TU 422

Development of appropriate bioassay and statistical methods for determining survival sensitivities of Antarctic marine biota to metal exposure

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Developing water quality guidelines for Antarctic marine environments requires understanding sensitivity of biota to contaminant exposure. Toxicity tests with Antarctic invertebrates are long trials with standard bioassay methods. Test methods which address the biological characteristics of these cold climate species and their environment need to be developed. This study investigated the effects of five metals on behaviour and survival of an Antarctic amphipod, Ochotnerima pinguides, over 30 days exposures. Multiple observations were made assessing mortality rate response of this species to metal exposure. As few previous studies have been performed independently, a new statistical model that combines bioassay model with a survival time model was developed. Interval-censored survival times were modelled using a generalised additive model (GAM) with multiplicative effects for concentration level used to incorporate the bioassay component. The time period by concentration level interaction was included as a random effect term with this mixed model version of the GAM allowing model adequacy to be investigated. The advantages of this approach are that (i) it smoothing through noisy periodic mortality data “gaining strength” by estimation of the trend across multiple observation periods exploiting all data simultaneously, (ii) the simple multiplicative model, if inadequate, does not allow cross-overs of time trends across concentrations that make interpretation difficult, and (iii) it allows the uncertainty in estimates of lethal concentrations to be more accurately assessed.

Response times between metals with amphibious exposed to copper producing behavioural changes and mortality at a faster rate than exposure to cadmium, lead or zinc. Nickel did not affect the behaviour or survival of the amphipod during the 30 days exposures despite using concentrations > 1mg/L. Results from comparisons of both approach and standard bioassay methods showed that a serious limits endpoints which applied to Antarctic species which are generally long lived, have longer developmental times, and slower metabolic processes and potentially metal uptake than species from other climatic regions. Recommendations are made for further toxicological assessments for the future development of Water Quality Guidelines to Protect Antarctic marine environments.