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, VTC, genotoxic 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 novel risk assessment framework and sublethal findings, which may or may not be adverse, to population relevant assessment endpoints must be established and data quality and reliability must be determined. The evaluation of data, including both traditional and non-traditional endpoints should be done in a weight of evidence approach in order to reach a scientifically defensible risk determination. In so doing, potentially adverse impacts of the studied chemicals should 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.

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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This paper presents a new methodology to assess the risk of water effluents based on fuzzy logic, a very well-known theory to treat uncertainty and vagueness, especially in the environmental field where many data are not fully available. The method has been tested using the effluent's pollution data coming from 22 wastewater treatment plants (WWTPs) located in Catalonia (NE Spain). 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 in Europe (E-PRTR) or E-PRTR). Its application in the assessment of WWTPs and its use as a tool to support decision making processes in the European context is presented. Information regarding the emission of pollutants to air, water and waste from the assessed installations.

TH 304
Simultaneous 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 has not been provided in the Guidelines. Accurate knowledge on the relative role of the different mechanisms in the overall performance of activated sludge systems is therefore not available. The main operating parameters i.e. hydraulic retention time (HRT) and sludge retention time (SRT) are strictly maintained during operation of a CAS unit. The following efficiencies were calculated: % of maximum concentration of surfactant adsorbed on the sludge and the measured surfactant concentrations in the mixed liquid suspended solids which were derived from a mass balance for the CAS unit: Csurf,meas = SRT/HRT * Csurf,act + Csurf,sett (Csurf,act = CAS output, Csurf,sett = CAS influent). Biodegradation was assumed not to occur. This maximum concentration of surfactant absorbed on the sludge and the measured surfactant concentration in the mixed liquid suspended solids allow calculation of biodegradation percentages. The removal of five cationic surfactants (dodecylamine, octadecylamine, dioctadecylmethylammonium chloride, dioctadecyl dimethyl ammonium chloride) was measured in CAS tests. The removal from the wastewater ranged from 98.8% (dioctadecylmethylamine) to >99.9% (decylamine). Removal by biodegradation was 69% (dodecylamine) to 99.9% (decylamine). These removal percentages were compared with modelling results obtained with SimpleTreat. SimpleTreat not only simulates 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 oocytes in the mullet has been observed in the female spleen in spawning season in wild fish. The same phenomenon has been linked to sewage containing the natural oestrogens 17β-oestradiol (E2) and oestrone (E1) as well as a number of other chemicals. 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 of the contribution of E2 in sewage effluent. The model overestimated the measured EEQ by an average factor of 1.4 when corroborated with the more robust UK STW data, however the effluent EEQ PEC's for all STW's were 3-11 times higher than the 1 ng/L PNEC. The model demonstrated that although Australian STW’s have lower EEQ’s, their PEC’s are not significantly different to the UK’s, which is likely to be due to the lower flow through Australian STW’s which lowers the 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 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 (e.g. brake lining, tire wear, gasoline/oil leakage, etc.) transported either to sewer or 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 are collecting a wide variety of sources from both domestic and industrial activities and they are continuously discharging various polluted effluents. Urban inputs, which are considered as a transient source may also contain high levels of pollutants directly discharged in receiving streams by Combined Sewer Overflow (CSO). Implementation of the European Water Framework Directive and its affiliated directives requires Member States to improve their understanding of priority pollutants in urban areas and obviously within wastewater systems.

TH 307
Demography, economic activities and health equipments as potential sources of pharmaceutical compounds in wastewater and performance of wastewater treatment in two extensive aquatic database for BPA.

TÆCT 6th World Congress/TÆCT Europe 22nd Annual Meeting
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French catchments
V. Brochier, K. Seriki, G. Leroy, V. Boireau, L. Castillo
Veolia Environment – Research and Innovation, Rueil-malmaison, France

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

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). Influent and effluents streams were monitored during 3 campaigns over 3 days with 24 hours composite samples. Pharmaceuticals and hormones were analyzed using LC-MS-MS. Results are shown for 6/32 studied compounds: acetaminophen (ACT), diclofenac (DIC), carbamazepine (CBZ), sulfamethoxazole (SMZ), iomeprol (IMP) and 17α-estradiol (E2).

Fluxes were 2.8 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, ACT was 2 times higher in WWTP-B. Those concentrations could be explained by the cities sizes but also by the presence of more potential sources in catchment A than B.

Influent concentrations were 4-62% lower than in the influent. In contrast, IMP, ACT and E2 showed higher elimination between 76% and 99% in both WWTPs. Therefore, removal efficiencies SMZ was quite stable in WWTP-A (74% to 85 %) and greatly varied in WWTP-B (0% to 96%). Those concentrations could be explained not only 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.

Removal efficiency of organic micropollutants in a constructed wetland assessed by passive sampling: results from the WIPE project
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2 Wetsus, H. Brenne1, F. Smolders1

Deltares, Utrecht, Nederland

Deltares developed treatment techniques, STPs still are a major source of input of nutrients and micro pollutants into aquatic ecosystems. The WFD requires an ongoing emission reduction in order to meet its targets. On several locations in the Netherlands, wastewater is treated, adapted to the conventional STP. While retaining in the wetland, nutrients and pathogens concentrations decrease while oxygen content in biodiversity increase in the effluent. However, little is known about the fate of micro pollutants of emerging concern in the plant. Therefore, the objectives of this work were a seasonal trend for removals of pharmaceuticals as they declined in the order of the sampling periods in the summer-fall-winter. Estimated concentrations of the target compounds in the river were very low (<1 ng/L) below detection limits. The small scale sewage lagoon monitored in this study was effective at removing PPCPs at rates that were comparable to removals in conventional WWTPs.

Detectors

Chemical characterization and treatment by enhanced coagulation of dissolved organic matter in bio-treatment-equipped textile effluent of a single stage bioreactor
S. Kusakabe, T. Nakatani, S. Matsuura, T. Yamashita

Department of Environmental Engineering, Peking University, Beijing, China

This study provides a first estimation on the risk associated with the inputs of organic micropollutants (OMP) to coastal waters from NW Mediterranean Sea. Pollution sources in northern Adriatic Sea were wastewater treatment plants (WWTP) effluents and river waters discharged to the sea. Polycyclic aromatic hydrocarbons, polychlorinated Biphenyls, organochlorinated pesticides, polychlorinated diphenyl ethers, phthalates and alkylphenols were analyzed by solid phase extraction and gas chromatography coupled to tandem mass spectrometry (SPE-GC-MS/MS). Eight WWTP effluents and six rivers discharge an estimated amount of around of 25800 g d⁻¹ of OMP. The concentration of OMP 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 of their geographical distribution was obtained by Principal Component Analysis of the complete data set after its adequate pretreatment. The occurrence of OMPs in NW Mediterranean Sea, as well as of their geographical distribution was obtained by Principal Component Analysis of the complete data set after its adequate pretreatment.

ST H309

Removal of contaminants of emerging concern by a sewage lagoon
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The removal impacts of sewage lagoon on water quality are of importance due to the high concentration of emerging contaminants (ECs) in the sewage lagoon water. The aim of the study was to monitor the occurrence of emerging contaminants in the sewage lagoon. The sewage lagoon-under study was a sewage lagoon with an area of 174,500 m², a depth of 2.5 m, a water volume of 473,350 m³ and a flow rate of 2,400 m³ d⁻¹. The main removal mechanisms were sorption, precipitation and biodegradation. The study revealed that the sewage lagoon can be an effective tool for removing emerging contaminants from wastewater and protecting the receiving water bodies from contamination.

TH 308

Wastewater effluents and rivers: sources of organic micropollutants to NW Mediterranean coastal waters. Their characterization, fluxes and potential risks
J. Sánchez-Avila, R. Tauler, S. Lacorte

IDAEA-CSIC, Barcelona, Spain

Organochlorinated pesticides, polybrominated diphenyl ethers, phthalates and alkylphenols were analyzed by solid phase extraction and gas chromatography coupled to tandem mass spectrometry (SPE-GC-EI-MS/MS). Eight WWTP effluents and six rivers discharge an estimated amount of around of 25800 g d⁻¹ of OMP. The concentration of OMP 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 of their geographical distribution was obtained by Principal Component Analysis of the complete data set after its adequate pretreatment.

TH 308

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Organochlorinated pesticides, polybrominated diphenyl ethers, phthalates and alkylphenols were analyzed by solid phase extraction and gas chromatography coupled to tandem mass spectrometry (SPE-GC-EI-MS/MS). Eight WWTP effluents and six rivers discharge an estimated amount of around of 25800 g d⁻¹ of OMP. The concentration of OMP 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 of their geographical distribution was obtained by Principal Component Analysis of the complete data set after its adequate pretreatment.

TH 308
two locations. This was largely caused by a small number of pesticides with very low PNEC values being present at this location. Although not significant, all three wetlands showed a slight decrease in environmental risk from location 1 to 4. In terms of removal of organic micro pollutants, constructed wetlands only show a minor efficiency, and seem to be more efficient in biologically vitalizing the effluent.

TH 313
Assessing the potential of constructed wetlands in reducing environmental impact of STP effluents: the WIPE project
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Wageningen University, Sub-department of Toxicology, Wageningen, Nederland

At some pilot locations in the Netherlands, the effluent of sewage treatment plants (STPs) is lead through a constructed wetland (so called ‘waterharmonica’) before being discharged to surface water. This has been shown to lead to an improvement of and the removal of, STP effluents, including toxic heavy metals, vitamins, polycyclic aromatic hydrocarbons, polystyrene bioassays, microplastics and biological and gene-expression responses of chronically exposed stickleback (Gasterosteus aculeatus). The monitoring was performed between 2008 and 2011 and generated an extensive dataset. In this presentation we will give an overview of how different environmental relevant end points were affected during the passage through the constructed wetlands.

TH 314
Inventory of emissions of priority hazardous substances in the surface waters in France
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INERIS, Vertou-en-halatte, France

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

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 reference specific methodology. The approach is based on effluent discharges data; in their absence some explicit estimation formulas are proposed.
- A single methodology applicable at different spatial scales.
- A methodology that will work despite scarcity of information and data, and uncertainties.
- A methodology that can be used as a management tool for designing strategies for the reduction of the impacts of chemical pollution in watersheds.
- A methodology which can easily deal with data from different years. All available information which are representative of a given year to draw a coherent picture of the different environmental relevant end points.

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

TH 316
Acute toxicity analysis of urban septic tank sludge
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Federal University of Espirito Santo, Vitória, Brazil

The objective of this work was to evaluate possible toxic effects of sludge samples from urban septic tanks and upflow anaerobic sludge blanket (UASB) from a wastewater treatment plant located in the University of Espirito Santo, in Vitória, Brazil. The method employed was the acute toxicity test Microtox (Azur Environmental) based on the luminescence inhibition of the marine photobacterium Vibrio fischeri. It is a test with many advantages such as ecological relevance, sensitivity, reproducibility, standardization and simple execution. A series of physical-chemical parameters were also analyzed based on Standard Methods for Examination of Water and Wastewater 20th (APHA - 1998). Sludge from four septic tanks was used in the study. From each tank four samples were collected, each aliquot representing a distinct depth, classified as: 1. surface liquid; 2. superficial sludge; 4. bottom sludge and 5. mixture from all the previos. 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 at very high rates with pedal-feeding and deposit feeding, and hence an integrated view concerning different ecosystem compartments can be considered. As to our knowledge no attention has been devoted so far to the results that these features of the Asian clam may provide if applied to the treatment of human activity on the surface of natural waters through:
- the general working shem of the methodology and few definitions;
- the input needed for the french approach;
- simplified calculations carried out on French rivers basins;
- the compilation process.

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 reference specific methodology. The approach is based on effluent discharges data; in their absence some explicit estimation formulas are proposed.
- A single methodology applicable at different spatial scales.
- A methodology that will work despite scarcity of information and data, and uncertainties.
- A methodology which can easily deal with data from different years. All available information which are representative of a given year to draw a coherent picture of the different environmental relevant end points.
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 international procedures for the wastewater treatment plant was performed using the method of toxicity thresholds (TTT). The major changes observed were increased detoxification enzymes (EROD), DNA damage, physiological parameters, % of DFT anomalies, impaired reproduction, and reduced fish population structure in the downstream site (GS 7.2) of municipal wastewater treatment plant (MWTP). By the stressor identification procedure, the process causes of fish population degradation were winnowed including habitat alteration, low dissolved oxygen, nutrient enrichment, ammonia toxicity, and impaired reproductive capacity. The results of causal analysis suggest that the principal probable causes of fish population impairment in the downstream site below the MWTP were a combination of effects associated with recruitment failure and size-selective mortality caused by nutrient enrichment, ammonia toxicity, and habitat alteration such as degradation in spawning and nursery space. Therefore, the potential impact of the plant was addressed in relation to type of industry, production volume and/or number of inhabitants. From the data interpretation arise that the high potential toxicity of industrial wastewater effluents is related to toxicants discharged into the aquatic environments of Buenos Aires province. It is need an urgent update of the parameters that the government may need for the discharge of wastewater and the inclusion of their ecotoxicity assessment to allow the discharge.

TH 319
Application of delayed fluorescence to estimate the influence of waste water effluent on algae
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Waste water effluent is a major source of chemicals discharge in to aquatic ecosystems. Since algae are important primarily producers in aquatic ecosystems, it is necessary to influence the evaluation of effluent not only on animals but also the algae. We are investigating a new method of estimating the influence of chemicals on alga by using delayed fluorescence (DF) from algae. The DF is a special type of luminescence; it detects the growth of only those cells that have photosynthetic capability. Since the DF originates from re-excitation of chlorophyll by a reverse reaction of photosynthetic electron transfer, the DF inhibition reflects inhibition of photosynthetic activity that is necessary for growth. Therefore, 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 210). The intensity of DF also shows a time decay curve. Chemical exposure changes the decay curve to patterns that have the potential to be used for the identification of the 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, 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 luminescence at 1 h, 4 h, and 24 h after exposure. DF is inhibited through the influence of the effluent. Further, effluent exposure changes the decay curve of the DF intensity. From the relationship between the exposure concentration and the DF inhibition, dose-response curve was made to the dose-response curve for each effluent or mixture. In addition, the percent DF decay curve has potential for application to the identification of the contaminants in the effluent. We will discuss results of a feasibility study evaluating treatments of industrial and agricultural effluents.

TH 320
Ecological health assessment and stressor identification using multi-response bioindicators of fish
J.H. Kim
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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. The early sampling sites had beechnut trees along the stream, while the later sites were covered with a variety of aquatic plants. The major changes observed were increased detoxification enzymes (EROD), DNA damage, physiological parameters, % of DFT anomalies, impaired reproduction, and reduced fish population structure in the downstream site (GS 7.2) of municipal wastewater treatment plant (MWTP). By the stressor identification procedure, the process causes of fish population degradation were winnowed including habitat alteration, low dissolved oxygen, nutrient enrichment, ammonia toxicity, and impaired reproductive capacity. The results of causal analysis suggest that the principal probable causes of fish population impairment in the downstream site below the MWTP were a combination of effects associated with recruitment failure and size-selective mortality caused by nutrient enrichment, ammonia toxicity, and habitat alteration such as degradation in spawning and nursery space. Therefore, the potential impact of the plant was addressed in relation to type of industry, production volume and/or number of inhabitants. From the data interpretation arise that the high potential toxicity of industrial wastewater effluents is related to toxicants discharged into the aquatic environments of Buenos Aires province. It is need an urgent update of the parameters that the government may need for the discharge of wastewater and the inclusion of their ecotoxicity assessment to allow the discharge.

TH 321
Monitoring potential ecotoxological effects in the effluent of an urban wastewater treatment plant
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Urban 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 micro pollutants, like pharmaceuticals and personal care products. As such micro pollutants are continuously released into aquatic environments, they may pose a potential risk for the integrity of ecosystems. Hence, the present study assessed adverse structural and functional implications of wastewater released by the municipal wastewater treatment plant (WWTP) in Landau, Germany, on its receiving stream, the Queich. For this purpose several endpoints related to the ecosystem function of leaf litter breakdown (microbial and invertebrate mediated leaf litter breakdown, in situ 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 the fact that lower detritus availability resulted in reduced leaf-shredding macroinvertebrates such as C. chironomus. Moreover, gammarids exposed in situ exhibited a significantly (up to 80% 100 m downstream during both seasons) reduced feeding rate at downstream sites, indicating lower energy availability and reduced reproductive output. These implications in leaf-shredding macroinvertebrates and the ecosystem function of leaf litter breakdown may be on the one hand caused by direct ecotoxicological effects of the released micropollutants containing microinvertebrates which is supported by the results of the in situ bioassays. On the other hand, indirect pathways, driven by a lower nutritious 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. Finally, the present study urges the evaluation of the current procedure in wastewater treatment by considering advanced treatment methods (e.g. ozonation), which may be successfully reduced algae growth. In the future, the authors recommend the use of in situ bioassays in order to evaluate the ecotoxicological impacts of wastewater released into aquatic ecosystems.

TH 322
Waste quality investigations in the river Lea downstream a sewage treatment plant: preliminary results of a case study
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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 micro pollutants, like pharmaceuticals and personal care products. As such micro pollutants are continuously released into aquatic environments, they may pose a potential risk for the integrity of ecosystems. Hence, the present study assessed adverse structural and functional implications of wastewater released by the municipal wastewater treatment plant (WWTP) in Landau, Germany, on its receiving stream, the Queich. For this purpose several endpoints related to the ecosystem function of leaf litter breakdown (microbial and invertebrate mediated leaf litter breakdown, in situ 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 the fact that lower detritus availability resulted in reduced leaf-shredding macroinvertebrates such as C. chironomus. Moreover, gammarids exposed in situ exhibited a significantly (up to 80% 100 m downstream during both seasons) reduced feeding rate at downstream sites, indicating lower energy availability and reduced reproductive output. These implications in leaf-shredding macroinvertebrates and the ecosystem function of leaf litter breakdown may be on the one hand caused by direct ecotoxicological effects of the released micropollutants containing microinvertebrates which is supported by the results of the in situ bioassays. On the other hand, indirect pathways, driven by a lower nutritious 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. Finally, the present study urges the evaluation of the current procedure in wastewater treatment by considering advanced treatment methods (e.g. ozonation), which may be successfully reduced algae growth. In the future, the authors recommend the use of in situ bioassays in order to evaluate the ecotoxicological impacts of wastewater released into aquatic ecosystems.

TH 332
Water quality assessments for the river Limmat upstream of a sewage treatment plant: effects of micropollutants from the Limmat Retention Area
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Organic micropolulants cannot be completely removed by traditional wastewater treatment technologies. Therefore it is being discussed to add additional treatment steps such as ozonation, active coal filtration, UV-treatment etc. However, there is a lack of long-term studies to clearly prove a direct relationship between micropollutants in wastewater and ecotoxicological effects on the macrozoobenthos fauna in the recipient stream to justify future expensive installations. Online biomonitoring of the ecotoxicity of wastewater just before release into the river Limmat. Potential short term responses to episodic pollution pulses as well as long-term effects of the potentially toxic cocktail of the waste water were monitored on real-time basis over several weeks. Different species of gammarids were applied (D. villousus, 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 potential impact on the waterfowl. On the other hand, if during long-term monitoring with galactic potential to be detected. In this study, the authors recommend the use of in situ bioassays in order to evaluate the ecotoxicological impacts of wastewater released into aquatic ecosystems. In the future, the authors recommend the use of in situ bioassays in order to evaluate the ecotoxicological impacts of wastewater released into aquatic ecosystems. In the future, the authors recommend the use of in situ bioassays in order to evaluate the ecotoxicological impacts of wastewater released into aquatic ecosystems. In the future, the authors recommend the use of in situ bioassays in order to evaluate the ecotoxicological impacts of wastewater released into aquatic ecosystems.
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 traditionally carried out by triple quadrupole mass spectrometers. The high resolution and accurate mass does not require optimization of compound specific parameters and has the ability to properly separate matrix from compounds of interest.

Fast and highly selective methods are necessary to screen, confirm and quantify different classes of contaminants in complex matrix and at low the analyte concentrations. High resolution mass spectrometry - using full scan analysis mode - has been described as the preferred screening tool due to the possibility to look for a large number of compounds and also because it enables retrospective analysis [1]. Furthermore, the use of a resolving power ≥ 50,000 Full Width at Half Maximum (FWHM) is reported as being as selective as 2 SRM transitions when using triple quadrupole instruments [2].

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 analyser. 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 by using a high energy collision induced dissociation cell (HCD). This experiment was tested and evaluated in terms of quantitative capability, matrix effects, and the sensitivity of anthropogenic sewage pollutants. Difter to sample types were elimated, including waste water, receiving water, ground water and drinking water representing different steps within the water cycle of densely populated and intensively agriculturally used areas.

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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. Currently, many regulators are seeking more holistic techniques such as whole effluent assessment (WEA) to supplement existing approaches. However, to ensure that these approaches are capable of indicating potential environmental effects, it is important to test scientifically robust WEA protocols. In general, WEA methodology assesses toxicity to aquatic organisms. WEA has relevance for the protection of the ecosystems although the relevance and interpretation of results ultimately depends on the tests used. In this work, the direct injection approach has been employed to study the environmental impact of illicit drugs on the aquatic compartment. The ecological status is generally assessed with ecological indicators. In some particular cases (sampling difficulties because of access, type of substrate, several industrial waste in the area[DOTS]), this approach is difficult to be applied. In this case, WEA methodology might represent an alternative to ecological indicators.

The main objective of the project presented in this paper is to compare WEA methodology which is conservative and in situ impact measurement for risk assessment. In this project, the difference between WEA and in situ impact assessment is measured using dynamic outdoor mesocosms. This project has been designed and realized in three successive steps: (1) Preliminary experiments in Laboratory to assess the best solution to store one effluent, (2) optimization and validation of how to minimize volatilization, oxidization and how to treat effluents, (3) Final experiment in dynamic mesocosms with several effluents sampled in different sites and comparison with WEA methodology. In this presentation the design of the three steps of this project will be presented and discussed.

TH 326

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

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Bioassays offer a opportunity 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 bioassays is being carried out for many years. It consists of a holistic, long-term ecotoxicological measurements at emission and admission and physico-chemical measurements. We use a battery of short term and chronic bioassays with the bacteria Vibrio fischeri, the alga Pseudokirchneriella subcapitata, the rotifer Brachionus calificolus 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 river water samples from industrial Belges and 26 sampling points in the receiving waters (i.e. stream 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 metallurgical industry, bioassays were conducted on both water samples and sediments and bioaccumulation of metals was assessed using enaged byphryses; upstream and downstream of a pharmaceutical industry; YES assay was conducted as potential assessment tools in addition to passive samplers (POCS). 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/CHMP/SWP/894470)000 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 ecotoxicology 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 referring to single toxicity P10 P50 P90 Concentration Addition (CA) to the worst case 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 cannabinoids. In this first time, compounds were spiked 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 dimethoate, an anti-dandruff agent contained in shampoo

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TH 330

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

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Antibiotic resistance is increasing since 30 years. Antibiotics previously used as reserve antibiotics, e.g. ciprofloxacin, are found in increasing concentrations of treated sewage. Due to uncritical prescription of broad spectrum antibiotics, the treatment of minor infections is more expensive. All tested aquatic organisms were affected by climbazole concentrations below 15 mg/L. Among the terrestrial organisms the lowest EC50 was determined for the plants (Avena sativa and Brassica napus) with about 10 mg/kg soil dry weight for inhibition of root growth. Test results revealed that among the different trophic levels, climbazole is most toxic towards primary producers in the aquatic as well as in the terrestrial habitat. Displayed effects were a reduction of shoot length in higher plants and of leaf (frond) size in water plants. This suggests an interference with the sterol metabolism of the latter. Assessing the terrestrial toxicity of climbazole is particularly relevant when treated wastewater or sewage sludge is to be applied in irrigation or as organic fertilizer on arable land.

TH 331

Comparative study of the ecotoxicity of dishwashing detergents

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This study aimed at assessing the ecotoxicity of dishwashing detergents. Indeed, despite the high consumption of such products, available information regarding their environmental impact is very limited. Thus, two different detergent products available on the French market were selected, covering the different dishwashing detergent categories: “multibenefit” tablets, “classical” products (tablets and powder) and “gel” (both “classical” products and “gel” need the use of rinse aid).

Our approach was taken into account the ecotoxicity of solutions simulating a wash cycle in a dishwasher in typical use conditions, as recommended by the manufacturer. The “gel” products were obtained via addition to the classical type of dishwashing detergents (alkyl and macro-inverters) covering the different leachate characteristics. 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 the leachate and the selected products are relevant and allowed the classification of the different dishwashing detergents. Most notably, 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 dishwashing 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” products. 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 suggest 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 ion 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 toxicity 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 water quality, but not for e.g. wastewater or sewage sludge. In such receiving waters more sensitive to metals by reducing protective effects of DOC.

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 334

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

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Among the 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 Directives 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. Two steps: first, local and regional scale 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.

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, such as the pharmacotherapy 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.
Therefore it is often unclear how to decide which study is “best” suited for a given case. The objective of this work is to present a guideline that helps compare different LCI studies. In this guideline a systematic approach on the assessment of literature quality is presented. 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 based on weight and energy content, according to ISO standards. 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 supported by recent studies of diesel production in Spanish refineries. Results highlight the broad range of values that depend on variables such as location, production process, and infrastructure specialization. Spanish refineries values are within the range of average European plants. Conclusions draw attention to the need of real data from refineries in order to obtain more adjusted and accurate results, as well as the possible partial subdivision of the system as a solution, according to ILCD handbook recommendations for allocation procedures.

TH 335

Anabaoic biodegradation of PCBS in a grass cut batch reactor


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Due to properties such as high Kow 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 river side 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, 131, 180). Concentrations of the lower chlorinated PCBs were reduced in the beginning of the series, but there was no significant decrease of 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 technical mixture 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 vegetation area were used to determine the degradation rates experimental times for these batches vary between 30 and 120 days. Compound concentrations were measured by GC-ECD. Methane and carbon dioxide concentrations (measured by FTIR) in the gaseous phase of batch experiments were used as an indicator for biological activity. Results from the second batch experiment, concerning PCB-degradation rates and their influence on the production of microbial fermentation gases, are discussed on the poster.

References

TH 336

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

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Using immobilized microalgal beads in contaminant removal is an emergent method in recent environmental studies. As is well known, phytoplanktons use nitrate (N) and ortho-phosphate (P) during the photosynthesis process for production. In this study, a diatom Phaeodactylum triicornutum 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 (Chebiox Optimum-one) to determine the removal efficiency of the nutrients by the algal beads. The cell numbers in the beads were also determined by counting in a Coulter Counter system during the experimental period. The blank beads were also run in the system and subtracted from the total removal of the nutrients to detect the net removal by the algae. The system was operated as six separate runs with usage of the same 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 alginate beads over a long term run.

TH 340

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

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The biofuel research and production sector is enjoying an unprecedented amount of public and private effort in order to remove various financial and technical barriers. A meta-analysis review: 'Drop-in' Biofuels - Life Cycle Assessments, substance flow analysis, material flow analysis and relevant information on an advanced biofuel gate production system of palm oil methyl ester (PME), giving considerably different output results. This is in itself not unexpected, but indicates the importance of clearly reccomendations for allocation procedures.

TH 341

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

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The biofuel research and production sector is enjoying an unprecedented amount of public and private effort in order to remove various financial and technical barriers. One of these very important barriers is the challenge of developing biofuels that are compatible with existing gasoline, jet fuel and diesel infrastructure. The United States Department of Energy has been championing efforts that ensure that the next generation of biofuels will be regarded as “drop-in” biofuels. According to the Former Undersecretary of Energy, Eric Steenbock, “drop in” biofuels can be defined as fuels produced from various biomasses which are compatible with the over $9 trillion energy refinery and gas station infrastructure currently available in the United States. According to definitions used in literature review, drop-in biofuels are defined by National Advanced Biofuel Consortium of the United States as infrastructure compatible - they can either be used directly or blended with their petroleum-derived counterparts. The European Commission on the other hand defines drop-in biofuels on the basis of quality specifications (standards) developed by the American Society for Testing and Materials.

Nuclear Fuel Working Group has been conducting research on Polychlorinated Biphenyls (PCBs) since 1977. These compounds were used as heat transfer fluids in electrical equipment, such as transformers, capacitors, and switches. PCBs are known to bioaccumulate in the environment and can cause adverse health effects, including cancer, reproductive problems, and neurological damage.

In this study, compound PCBs were separated and analyzed using high-performance liquid chromatography (HPLC) and gas chromatography-mass spectrometry (GC-MS). The results showed that the PCB profile of the sewage sludge samples varied depending on the location and source of the sludge.

PCBs decreased slightly, whereas the concentrations of the higher chlorinated PCBs were found to be stable at 520 µg/kg dry weight sewage sludge.

Due to properties such as high Kow 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.

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The field of energy is biomas is growing rapidly, increasing the need for reliable data on the environmental burdens inflicted by the use of the different conversion technologies. A huge number of LCI studies on these topics can be found, however, most of these studies are not directly comparable to each other and their results may vary considerably depending on different data origins, time and geographical background, technologies and system boundaries. Therefore it is often unclear how to decide which study is “best” suited for a given case.

The objective of this work is to present a guideline that helps compare different LCI studies. In this guideline a systematic approach on the assessment of literature quality is done. In a first step the current “best practice” for modelling an LCI is summarized. By this a reference for the assessment of the data is defined. This reference will identify a

TH 339

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 black boxes. Several products with different characteristics and uses are produced 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 based on weight and energy content, according to ISO standards.

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 supported by recent studies of diesel production in Spanish refineries. Results highlight the broad range of values that depend on variables such as location, production process, and infrastructure specialization. Spanish refineries values are within the range of average European plants. Conclusions draw attention to the need of real data from refineries in order to obtain more adjusted and accurate results, as well as the possible partial subdivision of the system as a solution, according to ILCD handbook recommendations for allocation procedures.

The results of this meta-analysis review will be presented at the SETAC world congress.

TH 342

How to assess the data quality of LCI studies - a systematic approach

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The field of energy from biomass is growing rapidly, increasing the need for reliable data on the environmental burdens inflicted by the use of the different conversion technologies. A huge number of LCI studies on these topics can be found, however, most of these studies are not directly comparable to each other and their results may vary considerably depending on different data origins, time and geographical background, technologies and system boundaries. Therefore it is often unclear how to decide which study is “best” suited for a given case.

The objective of this work is to present a guideline that helps compare different LCI studies. In this guideline a systematic approach on the assessment of literature quality is done. In a first step the current “best practice” for modelling an LCI is summarized. By this a reference for the assessment of the data is defined. This reference will identify a
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 residues or wastes should be allocated, however a clear definition of these is lacking. Currently, in order to incentivise biofuel production from second generation sources such as cereal residues and wastes, double credits are to be awarded to these biofuels, and the feedstocks are considered to be available at zero GHG ‘cost’. This presentation will recommend for data set generation could be given. Using the guidelines data gaps were identified and quantified resulting in a better overall understanding where these gaps came from and how to deal with them. The guidelines allowed for a good comparison on the data quality of the literature. With their use a good overview of the different LCI studies could be achieved and a clear recommendation for data set generation could be given.

TH 343
Finding an LCA research direction with the aid of meta-analysis
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Our general strategy is to take a more qualitative approach to the problem of divergence or discrepancy in LCA. Rapid growth in LCA methodological developments has generated a large body of work in the last ten years. New impact categories, indicators and characterization factors have been developed with regard to the LCIA. Moreover, an increased sophistication of the existing methods of characterization has been also proposed, for example with the introduction of spatial and temporal differentiation. On the side of the inventory analysis, the need to assess policies, technological and structural choices characterized by scarce reversibility, long term effects, trade-off between environment, economy and society, etc. has been driving an expansion of the scope of LCA, both in terms of level of analysis (from products to systems, from micro to macro) and coverage of indicators (including also economic and social aspects). Consequential LCA, hybrid approaches combining LCA and input-output analysis, scenario modeling, and new efforts for developing social and economic assessment methods, are only some examples of the developments LCA methodology has been going through. Overall, it may appear that LCA lacks direction on how to further develop. 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 procedure consists of four-steps: i) definition of the research questions, ii) 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; iii) 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; iv) 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 directions that one devoted to increment model flexibility of LCA, the other to increase model flexibility. 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 methodological approach.

TH 344
A web-based approach to handling divergence in LCA
M. A. Polascik, R. J. Wallace, C. Ruo, O. E. B. Dunphy

The renewable energy directive and cereal residues
L. Whittaker, C. Mcmanus, P. Hammond

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

TH 345
Environmental impacts of palm oil biodiesel: A Meta analysis
Y.M. Manik, A.N.T.H.O.Halag

University of Maine, Orono, United States of America

This presentation will compare results from streamlined LCA’s and a full environmental impact assessment of cereal residue removal and combustion. The results will indicate the importance of inclusion of indirect and indirect LCA impacts in policy analysis.

TH 346
Greenhouse gas emissions from wind power: a critical meta-analysis
S.J.A. O’Connor

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

TH 347
The renewable energy directive and cereal residues
L. Whittaker, C. Mcmanus, P. Hammond

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

TH 348
Meta-analysis of LCA studies for bio-based polymers: assessing the environmental performance of polyhydroxyalcanoates (PHA) and polylactide (PLA) in contrast to their commodity prices and economic dependence
O. E. B. Dunphy

Public Research Centre Henri Tudor, Esch-sur-Alzette, Luxembourg

The renewable energy directive and cereal residues
L. Whittaker, C. Mcmanus, P. Hammond

University of Bath, Bath, United Kingdom

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

Meta-Analysis of LCA studies for bio-based polymers: assessing the environmental performance of polyhydroxyalcanoates (PHA) and polylactide (PLA) in contrast to their petroleum-based counterparts
R. Fasel, M. Carus

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The depletion of non-renewable resources plays an important role in present political debates: On the one hand, the depletion of non-renewable resources results in increasing commodity prices and economic dependence. On the other hand, the emission of greenhouse gases causes severe effects on the climate with unpredictable impacts on the human environment. That is why energy from renewable sources as well as bio-based chemicals and materials have attracted great interest.
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
- Fuel demand variables (efficiency factors: fuel purity, thermal efficiency, wind yield, transport, etc.)

For example, the tool is linked to the software PHREEQC® which simulates chemical reaction.

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

The power generation gives a good instance to analyze the impact on the results of the different SBs. For example: the variation between different plant construction demands is often over 80%, but the overall results don’t necessarily 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, decomposition 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 (GW, as main LCIA methodologies)

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 thoroughly investigating, 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 349
The effect of system boundary and weight of 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 differ significantly for the same product or services. Due to the recognized uncertainty this study addresses the possible deviation of results from literature and electric energy production from different energy sources. The potential deviation could arise from the consideration of different system boundaries (SBs) and the relevance of emission sources along the life cycle. Both could be mainly responsible for the recognized diversity besides others like allocation, cut-off criteria, actuality of literature, etc.

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.

LCA (Life Cycle Assessment) 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 use this life cycle thinking to assess the current situation and to develop strategic indications for the future waste management. The project (called GERLA: GEstione Rifiuti in Lombardia - Analisi del ciclo di vita) started in November 2010 and will be completed by the end of 2011.

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

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

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

TH 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 reaches 307,000 tons annually. Of these, 10% is recycled or valorized, 44% 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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Nowadays, environmental issues are 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 such decision supporting tool which makes it benefit from previous modelling efforts and specific industry knowledge. For instance, the water industry is expected to be easier and less time consuming to set up the modelling scenario related 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 priority action levers.

The success of the tool 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 contaminated groundwater
A.O. Olsen, M.N. Rasmussen, T. Skovgaard, A. Birch, H.E. Larsen
Technical University of Denmark, Lyngby, Denmark
This poster presents the results from an LCA case study addressing a growing Danish problem on pesticide contaminated groundwater. The conventional Danish way of using pesticides on 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 hot-spot 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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2MTE University of Applied Sciences, Delft, Nederland
Many practical LCA tools have been developed before a user group was established. The risk of such a top-down approach is a gap between the tool and the way users want to use it. In this paper we present a bottom-up tool. This tool may result in the being used less by the users. In the Netherlands many housing associations and building and maintenance companies were looking for means to calculate the environmental performance of planned preventive maintenance of housing, estates and buildings themselves. There are several theoretical approaches available, but no practical calculation tools. Because of this lack of instruments, they set up a development project for a practical calculation tool. The housing association company W&E and the Dutch University of Technology, who consultancy has experience with LCA in construction. In the development project, generic environmental data on materials were combined with data of maintenance activities gathered by the maintenance companies. The set-up and interface of the calculation tool were designed according to the wishes and practices of the clients. The results are presented according to the three purposes of the tool: optimisation of the environmental performance of maintenance scenarios, comparison of different scenarios, and benchmarking the scenarios with average Dutch maintenance scenarios. The resulting calculation tool is a good example of the effectiveness of this bottom-up approach, aiming to achieve a broad support amongst potential users of this tool.

TH 355
Improving Life Cycle Management (LCM) tools for the food industry: a framework of Product-Oriented Environmental Management System (POEMS)
R. Salomone1, M.T. Clasadonte1, M. Proto2, A. Raggi1, I. Arzoumanidis1, G. Ioppolo1, A. Lo Giudice2, G. Malandrino1, A. Maratarossa1, L. Pettit2, G. Saija1, S. Supino1, A. Zamagni3
1University of Messina, Messina, Italy
2University of Catania, Catania, Italy
3University of Salerno, Salerno, Italy
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) (EMAS) in a Product-Oriented Environmental Management System (POEMS). The Italian Ministry of University and Research (MIUR), 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.


SSB: main focus on short-term problems; lack of chain management responsibility; lack of awareness of product life cycle envnl. impacts (PLE) poor access to large amount of life cycle data; lack of in-house expertise; high expensive [ARROWRIGHT]SF: internalization of chain management vision and long-term value creation; identification of PLE; allow SMEs to perform envnl. assessment by themselves providing an easily understandable tool [ARROWRIGHT]SF: LCM and Life Cycle Thinking, LCA; simplified approaches [ARROWRIGHT]SF: Simplified LCA

SSB: 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 [ARROWRIGHT]SF: 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 [ARROWRIGHT]SF: EPLD; envnl. product communication; guidelines to support decision making [ARROWRIGHT]SF: EPLD guidelines

IMs+Simplified LCA+EPLD guidelines=POEMS

The EMAF project is is in progress with applications in the canned vegetables, wine, pasta, olive oil and coffee supply chains.

TH 356
Finnish guidelines on carbon footprinting - supporting practical implementation of LCA in the food industry
MTT Agrifood Research Finland, Helsinki, Finland
Life cycle thinking is spreading among environmentally responsible companies around the world. Specially carbon footprint guidelines, which have been developed in the last years, have been used by many 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 national and international 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 detailed methodology and guideline. Carbon footprinting environmental impacts are taken into account when preparing national specific guidelines. Finnish food sector is actively consulted to ensure practical methodology which can be easily applied.

In addition to development of national calculation guidelines, the project is also providing practical calculation tools to facilitate calculations at company level. The project also tested different data collection tools in R&D projects. The project has been carried out as iterative process between research, companies and other stakeholders. Food industry wide workshops around the guidelines are used to make the guideline more applicable and user friendly for the industry. As many Finnish food companies use carbon footprinting, industry participation is high. The guidelines were proven useful in a detailed way by other LCA experts from LCA and from other standards' point of view.

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

TH 357
Life cycle thinking applied to an immunological product (vaccine) used for boar taunt control in male pigs
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2Life Cycle Engineering, Torino, Italy
3 MAS Agribusiness Development (USA) started to apply the Life Cycle Assessment (LCA) methodology to some innovative products, with a first case-study on ImprovacTM, an immunological product (vaccine) for male pigs that, by providing farmers with an alternative way to avoid the problem of boar taunt, 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 a moral welfare issue by many in the public sector.

In 2010, after an initial project which included a consistent data collection from the vaccine production plants as well as from farms and slaughterhouses at global level, the first Environmental Product Declaration or EPD on a veterinary product was published by the International EPD System, a well recognised ISO 14025 Program Operator (www.epd-system.org). 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 collection data 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 both farmers and food sectors and for this reason, it is the major impact category of interest; other LCA relevant impact categories are presented and discussed to provide a comprehensive view of the life-cycle impacts of the product. The calculated carbon footprint for the Improvac pig system demonstrates a reduction vs. the physically castrated pig system, mostly depending on country specific feed production and slurry management practices. Starting from the feed components, a detailed examination was conducted on several detailed metabolic models to follow the same holds true for slurry management procedures and best and less technologies.

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

TH 358
Pilot test in food sector of product environmental footprint (PEF) Guide developed by European Commission
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1Quanta, Lausanne, Switzerland
2Nestlé Research Centre, Packaging, Science & Environment, Lausanne, Switzerland

In 2011, the Directive General for the Environment (DG ENV) started to work with the Commission's Joint Research Centre (JRC) Institute for Environment and Sustainability (IES) and other European Commission services towards the development of a harmonised methodology for the calculation of the environmental footprint of products.

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

The results of Nespresso case study according to PEF Guide are presented and they are compared to the results of the full life cycle assessment compliant with ISO 14040 and DCG guidelines shown in 2011. The comparison of the inventory (LCI) choices (e.g. electricity mix, LCI databases (e.g. ecoinvent or European Reference Life Cycle Database (ELCD)) and Life Cycle Impact Assessment (LCIA) methods (e.g. land use, terrestrial ecotoxic and water based as well as endpoint 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 well 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 of the results whereas environmental methodological guidelines provide several alternatives, ranging from very general in the case of ISO 14040 and ISO 14044 to high specificity in the case of the French standard BPX30-323.

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

TH 359
SETAC’s influence on LCAs growth and direction
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The launch of Google labs’ Books Ngram Viewer, which allows any user to graph the frequency of occurrence of words or phrases in Google's database of 500 billion words from 1900 until today (for a free visualization, go to http://books.ngram.org/), has triggered a great deal of interest in the environmental field. The 'SETAC' acronym first appeared in books in the 1980s. Its relative frequency of appearance grew steadily from 1990 through 2004, showing a tenfold increase. In 1990, SETAC sponsored an international workshop at which SETAC's "life cycle assessment" (LCA) concept was coined. Before then, a few practitioners in the U.S. and Europe used different terms for "Resource and Environmental Pro/" ("PEF"). SETAC established the accepted name (and framework) for life cycle assessment. The occurrence of the phrase "life cycle assessment" in books grew very similarly to the occurrence of "SETAC" from 1980 to 2004. This was no coincidence or were there limitations within SETAC that contributed to this parallel growth? This paper will provide a perspective of the role of SETAC in both NA and Europe had on the development of LCA.

THPC-1
Wastewater effluent exchanges: chemical characterisation and potential risks in receiving waters

THPC-1-2
Possible removal of several contaminants from the wastewater using a natural biofiltration process
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The application of moderated fired clay with polymer addition to the purification and treatment of printing wastewater may potentially revolutionize water treatment technologies at removing specific substances or groups of substances, especially those identified as priorities under the WFD. THPC-1-3

A modified clay material as cost-effective sorbent for waste printing developer decontamination
S. Kusinski1, J.G. Ranogajec2, D.B. Zoric2, S.Z. Adamovic2
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2Faculty of Technology, Novi sad, Serbia

We evaluated the subsequent attachment and the optimal conditions for the mussel sustentation (type of food, water flux, temperature, mussel density) . Secondly, panels with the attached mussels were put vertically into the pilot-plant to carry out the second step, which is in execution at this moment.

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We evaluated the subsequent attachment and the optimal conditions for the mussel sustentation (type of food, water flux, temperature, mussel density) . Secondly, panels with the attached mussels were put vertically into the pilot-plant to carry out the second step, which is in execution at this moment.
The present work was undertaken to investigate the feasibility of cost effectiveness adsorbents: pure fired clay, newly designed fired clay with the polymer addition (5 mass% PEG 600) and bentonite for Zn(II) ion removal from waste printing developer. The adsorption efficiency and distribution coefficient of used adsorbents were determined as a function of adsorbent amount. The results show that newly designed clay adsorbent with polymer addition has great potential (up to 93.5%) to remove Zn(II) ion from waste printing developer.Acknowledgment: The authors acknowledge the financial support of the Ministry of Science and Technological Development of the Republic of Serbia (Project No. 34014).

THPC1-4
Removal of POPs from industrial wastewater using UVC/H2O2 Photolysis
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In this study 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 (5mg/l) and 4-Chlorophenol (0.36mg/l). The experimental equipment employed in the assays consists in a tubular reactor of borosilicate glass, (600ml) operating in a recirculating circuit, irradiated with an UVC lamp (8W). The Hydrogen Peroxide (H2O2) in the process was 200mg/l. The catalyst (TiO2) was immobilized on the external surface of a cylinder of frosted glass (d=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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Increasing pressure to prioritize chemicals from wastewater treatment effluents is leading to pressure to utilise or consider advanced tertiary treatment options such as UV radiation, filtration, GAC, and ozonation as part of the wastewater treatment process. The use of these adsorptive or destructive methods may, however, increase, or leave largely unchanged the concentrations of ligands in effluents that are important for complexing metals and which, consequently, reduce the toxicity potential of metals such as copper and zinc. Since there is not much data on the metal complexing characteristics of effluents before and after tertiary treatment, there is uncertainty in the extent by which tertiary treatment options might impact metal bioavailability. To investigate possible impacts, a chelate column ion exchange method was used to assay the effects of GAC, ozonation, and UV radiation in combination with H2O2 on the ligands in sewage effluent that are responsible for complexing copper and zinc. Preliminary results indicate that tertiary treatment options tend to increase the concentrations of metal complexing ligands relative to the concentration of dissolved organic carbon present. This effect was also of greater significance for copper than for zinc. The ozone treated effluents displayed lower UV absorbances (350nm) in relation to other tertiary and secondary treated effluents, indicating ozonation has some impact on the concentration of aromatic substances in the effluents, which is consistent with the elimination of humics; however, this did not impact complexation capacity. These findings indicate that advanced tertiary treatments are unlikely to increase the bioavailability of metals in sewage effluents.

THPC1-6
The influence of terminal electron acceptor on the removal of pharmaceuticals in Anaerobic digester sludge
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Wastewater treatment process pH and redox conditions fluctuate, and the characteristics of each sludge vary. These changes result in differences in the microbial population present, and variations in how strongly micropollutants adsorb to each sludge. The total removal of micropollutants, the rate of removal, and the mechanisms responsible for removal will therefore vary depending on the redox conditions present.

Anaerobic digestion is used for the treatment of 2/3 of municipal biosolids within the UK, and is a growing technology for the treatment of industrial and food waste due to the generation of renewable energy in the form of biogas. Anaerobic digestion is a multi-step microbiological degradation process, and can be performed in a single reactor or in multiple reactors where the hydrolytic fermentation and methanogenic phases are separate. Hydrolysis, acidogenesis, acetogenesis and methanogenesis each occur under different redox conditions, and each is associated with a different terminal electron acceptor (nitrate, sulphate, carbonate and methate respectively).

Separating hydrolysis from methanogenesis has been shown to be more efficient for the generation of biogas, however, biodegradability tests performed to determine whether a test substance will degrade under anaerobic conditions are performed under methanogenic conditions only. A test system whereby the redox potential is controlled through amendment of terminal electron acceptors was calculated through the measurement of redox potential (Eh), the reduction of carbonate, nitrate and sulphate, and the removal of dissolved organic carbon. When it was demonstrated that these conditions could be effectively controlled this test system was applied to the removal of test substances under amended conditions.

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 unaimed conditions following guideline OECD 311.

TU001
Particle size distribution of airborne perfluorinated compounds
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In recent years, 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 atmospheric aerosol.

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 0.06 µm (B10). The observed particle size distribution of PFCs in parallel samplers were quite similar indicating a good precision of the entire method. However particle size distribution of PFC concentrations in particle phase samples (sum of all fractions) were between 0.5 and 2.5 pg m⁻³. Typically, the highest PFC concentrations were observed in the fine particle fraction (particles ≤ 2.5 µm).

EP06P - Perfluorinated compounds: From emission sources to the place of impact

TU002
Binding and sequestration of perfluorinated surfactants in soil
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Perfluorinated surfactants (PFSs) produced since the 1950s draw great attention due to their wide application and increasing occurrence in the environment. Sorption coefficients (Kd) and organic carbon normalized soil adsorption coefficients (Koc) are essential for determining soil adsorption behavior and assessing the risk of transfers of these chemicals from contaminated soils to plants and groundwater. We therefore analysed the international literature for concentrations of perfluorinated octanoic acid (PFOA), perfluorooctanoic acid (PFOS), perfluorooctanoic acid (PTFA), perfluorobutanoic acid (PFBA), perfluorobutanoic acid (PFHB), perfluorovaleric acid (PFVA) in different environmental media (surface water, sewage treatment plants, sediments, and soil) in order to assess the distribution of PFSs and PFOA between these environmental compartments and compared the results with published experimental sorption coefficients. Experimental log Koc values for PFSs for different soils and sediments available in public literature are remarkably similar with a coefficient of variation of only 18%, which should limit the uncertainty of concentrations in drainage water and groundwater calculated from soil concentrations (average log Koc = 2.9). For PFOA however, published sorption coefficients are sparse and the published information regarding the analogy between sorption of carboxylated and fluorinated PFSs is controversial (average log Koc = 2.6).

Our review shows that current pattern of environmental PFOA and PFS concentrations are strongly influenced by local pollution sources. Nevertheless, we calculated "global" log Koc for the various media based on published concentration data from different media/soil waters or sewage sludge/water. The "global average" log Koc calculated from the median concentrations of PFOA in WWTP effluent and sewage sludge equals 1958 kg l⁻¹ (log Koc = 3.3). Assuming an average dry matter organic carbon content of 31% for sewage sludge would give a global average log Koc of 3.8. Dividing the median sediment concentration of 0.6 ng g⁻¹ by the median surface water concentration results in a factor of 275 (log Koc = 5.1). The "global average" log Koc concentration of 1.7% equals 4.2. Furthermore, the estimated "global" log Koc were similar to experimental log Koc values found in the literature. The moderate affinity of PFOA and PFSs to soils, sediments and sewage sludge indicates that drinking water must be considered a potential pathway of exposure of animals and humans to these compounds.

TU003
Investigating the sorption of Perfluorinated Compounds in different types of sludge

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

Two seasonal sampling campaigns were performed and samples were taken in seven consecutive days in each sampling campaign. The analytes were extracted by solid-phase (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 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 the perfluorocarbon tail and the functionality of the head group can influence the sorption of these compounds to sludge materials.

Acknowledgement

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TU 004 Presence and behaviour of perfluorinated compounds in sewage sludge

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Perfluorinated compounds (PFC) have been identified in domestic appliances and have emerged as significant global environmental pollutants with persistent, bioaccumulative and toxic properties. After use or disposal of PFC-containing products, these compounds enter Waste Water Treatment Plants (WWTP) and accumulate in sludge because their intrinsic physicochemical properties make them resistant to final mineralization. Among other options, the use of sewage sludge as agricultural fertiliser is common practice all over Europe. The aim of this study was to determine the presence of 5 perfluorinated compounds (PFCs), namely perfluorooctanesulfonate (PFOS), perfluorododecanoic acid (PFDoA), perfluorohexane sulfonate (PFHxS), perfluorooctane sulfonate (PFOSa) and perfluorooctanoic acid (PFOA) in sludge and evaluate their transfer to agricultural soils. PFCs were analysed in sludge from 15 WWTP from Spain and Germany. These WWTP receive both urban and industrial wastes. PFCs were detected at 0.28 and 5.15 ng/g dw for Spanish sludge and from 14.2 to 36.0 ng/g dw for German Sludge, with differing concentration patterns of the individual compounds. In addition, the concentrations of the PFCs in the sludge treatments (primary sludge, anaerobic digested and centrifuged sludge) was evaluated and we found that anaerobic digestion and centrifuging did not have an effect on the PFC elimination. Subsequently, the amount of PFCs accumulated per ton of sludge generated was determined for each WWTP. According to the use of sludge in each country, the calculated contribution of PFCs to agricultural soils was estimated between 0.06 and 12.88 g/ha month. Finally, the concentrations of PFCs determined in agricultural soils and sludge amended soils as a way to determine the real impact of PFCs in soils. Although there are no legislated limits for PFCs in sludge (Council Directive 86/287/EEC and Royal Decree 1310/1990, regulating the use of sewage sludge in agriculture), its use in agriculture may lead to diffuse pollution of groundwaters and soils. In Spain, 95% of the sewage sludge is used as fertilizer in agriculture while in Germany, most of the sludge is incinerated or used for landfilling.

TU 005 Occurrence and evaluation of the fate of Perfluorinated Compounds in wastewater treatment plant of Athens (Greece)

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Perfluorinated compounds (PFCs) have been released as emerging contaminants and they are commonly detected in municipal wastewater treatment plants (WWTPs). In this study, contamination profiles of eight target perfluoro analytes (C5 to C14 carboxylic acids, C4, C6-C8 and C10 sulfonic acids and 3 sulfonamides) were detected in wastewater (influents and secondary effluents) and sludge samples, originating from WWTP of Athens (Greece). Two seasonal sampling campaigns were performed and samples were taken in seven consecutive days in each sampling campaign. The analytes were extracted by solid-phase extraction (dissolved phase) or sonication (particulate phase). Qualitative and quantitative analyses were performed by LC-MS/MS. Recovery values generally ranged between 80% and 115%, while lower recoveries were obtained for longer perfluorocarboxylic acids (PFOAs) and perfluoroalkyl sulfonates (PFSAs) in sludge samples. The limit of quantification of the target compounds varied from 0.29 to 3.0 ng L-1 and from 0.15 to 1.5 ng g-1 for liquid and solid samples, respectively. The seasonal and daily variations of target compounds' concentrations were investigated and the results were compared to those reported in the literature for other WWTPs worldwide. Daily mass flows normalized to inhabitants were also calculated and distribution of target compounds between dissolved and particulate phase was determined for wastewater samples. A mass balance was also performed to investigate the fate of PFCs during wastewater treatment plants and to estimate the role of degradation and sorption on their removal. According to the results, perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) were detected in all samples and they were the major contaminants in wastewater influents and effluents. Concentrations of other PFCs in effluents were similar or higher comparing to influent concentrations in the effluents compared to measurements in the influents. This leads to the assumption that there have to be precursors which are biodegraded during the wastewater treatment. Biodegradation of proposed PFC & PFOS precursors in aerobic batch assays

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Amongst others perfluorooctanesulfonamide (PFOA), 8:2 telomeric acid (8:2 FTCa), 8:2 telomeric alcohol (8:2 FTOH)1, 2 and a technical product containing polyfluoralkyl phosphates were chosen to study their fate in aerobic batch assays. The test period was 14 days each at a water temperature of 12.7°C. The activated sludge samples were taken from municipal wastewater treatment plant and they were the same as those used in the EN ISO 9888 guideline, June 1999, with a 10 times higher phosphate buffer concentration. The water and sludge samples were analyzed using LC-MS/MS and GC-MS. All in all the above mentioned substances degraded to PFOA or PFOS in ranges from 1 to 8 per cent during 14 days. The lowest metabolic rate was monitored for FOSA. In addition, PFOS was degraded to perfluorooctanoic acid (PFOA) as well. The absence of degradation products in the abiotic controls show that the metabolism has to be attributed to microbial degradation only. This project was implemented under the Operational Program «Education and Lifelong Learning» and funded by the European Union (European Social Fund) and National Resources - HRAKLEITOS II."

TU 006 Biodegradation of proposed PFOA & PFOS precursors in aerobic batch assays

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Perfluorinated compounds (PFC) have been identified in domestic appliances and have emerged as significant global environmental pollutants even though no natural sources of PFC have been proposed. Nevertheless they can be detected in the environment throughout the world. Due to their unique water-, fat- and oil-repellent as well as stain-resistant properties, they are widely used in various industries and commercial products. Some of them are classified as persistent, bioaccumulative and toxic compounds. Hence they display a threat to nature. Potential sources of PFC can be consumer and industrial products as well as manufacturing processes. In some sewage treatment plants worldwide, an increasing mass flow of perfluorooctanoic acid (PFOA) and perfluorooctane sulfonate (PFOS) was observed with higher concentrations in the effluents compared to measurements in the influents. This leads to the assumption that there have to be precursors which are biodegraded during the wastewater treatment. Therefore, the aim of this work was to study the performance of PFOA and PFOS by studying their aerobic biodegradability. Amongst others perfluorooctanesulfonamide (PFOA)1, 2, 8:2 telomeric acid (8:2 FTCa), 8:2 telomeric alcohol (8:2 FTOH)1, 2 and a technical product containing polyfluoralkyl phosphates were chosen to study their fate in aerobic batch assays. The test period was 14 days each at a water temperature of 12.7°C. The activated sludge samples were taken from municipal wastewater treatment plant and they were the same as those used in the EN ISO 9888 guideline, June 1999, with a 10 times higher phosphate buffer concentration. The water and sludge samples were analyzed using LC-MS/MS and GC-MS. All in all the above mentioned substances degraded to PFOA or PFOS in ranges from 1 to 8 per cent during 14 days. The lowest metabolic rate was monitored for FOSA. In addition, PFOS was degraded to perfluorooctanoic acid (PFOA) as well. The absence of degradation products in the abiotic controls show that the metabolism has to be attributed to microbial degradation only.

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The monitoring campaigns allowed to identify hot spots in the main Italian basins. Unlike rivers Tevere and Adige which are not significantly impacted, concentrations determined at the basin closure of the river Po are comparable to those measured in the PFAS heavily impacted areas of northern Europe; PFOS concentrations are low (ranging from < LOD to 2.5 ng/L) while PFOA is the main compound (about 25 ng/L).

These substances in the drinking water in the same areas have been also studied. The extent of contamination of groundwater by PFAS and the contamination pathways to groundwater bodies remain largely uncertain. In the work presented, we identified different direct sources of PFAS to groundwater within 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 perfluorocarboxylic acid (PFOA) and 1165 ng/L perfluorobutanoic acid (PFBA).

The aim of this study was to obtain data on the occurrence and levels of 34 priority and emerging organic compounds in freshwater fish sampled in the Rhone River (France). The analyses included 14 perfluorinated compounds (PFCs) in surface water from Elbe River and North Sea, Germany. The results showed that the occurrence and concentration of PFAS in fish eggs was in general comparable to previous studies.

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

Since the ubiquitous occurrence and potential toxicity to human beings, the perfluorinated compounds (PFCs) have attracted more concern in the recent years. In 2010, one of the PFCs, perfluorooctane sulfonate (PFOS) was added to Annex B of Stockholm Convention on Persistent Organic Pollutants (POPs). Recently, more substitutes, i.e. perfluorooctanesulfonate (PFBS) and perfluorohexanoic acid (PFHxA), were widely used and the elevated levels have been found all over the world. 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 (PFSA)s 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.

Figure 1. Seasonal distribution of perfluorinated compounds (PFCs) in surface water in Elbe River and North Sea, Germany.

The main goal of this study was to obtain 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 (PFCs), and also 5 alkylphenols (AP), bisphenol A (BPA), 3 hexabromocyclododecines (HBCD), 9 polybromodiphenylethers (PBDE) and 2 compounds, hexachlorobenzene (HCB) and hexachlorobutadiene (HCBD) for which Environmental Quality Standard (EQS) have been set for the river Rhone. The data were collected from June and August 2008 to April 2009 at 13 sites along the Rhone River in the metropolitan area of Lyon (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 have specific ecologies and are of different fish families.

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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 order to increase the knowledge on the analysis of perfluorinated aliphatic substances (PFAS) in biological tissues and specifically develop a reliable method to measure PFAS in feathers of this raptor species. Feathers have already been used successfully for monitoring of heavy metals, and recently also for POPs, but a reliable method for PFAS was not available and needed to be established.4, The results gained from this research enabled us to monitor endangered raptors without harming the birds and their offspring and to better understand the fate of PFAS in birds.

From 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 in May 2009. For the first time, PFAS were detected in feathers and preen oil of white-tailed sea eagles from Greenland and Norway. In the wing feathers from Greenland WTSE, PFOS and PFHxA 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 PFOA levels.

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

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Perch feathers have proven very useful regarding non-destructive biomonitoring of contamination with heavy metals and organic pollutants. For this study, we have investigated perfluorinated chemicals (PFCS) in feathers and tissue of barn owls (Tyto alba), collected in the province of Antwerp (Belgium). A major PFCS plant (5M) 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 to 2.2 - 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 (r<14.1 - 670 ng/g), but in the tissues (more than 50% < LOD). Furthermore, PFOS levels in feathers and liver were not significantly correlated (r=0.17, p=0.37). These results suggest that PFAS can 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 source. PFHxS could only be quantified in liver and preen oil. Sporadically, other PFC compounds were detected as well, mostly in liver.

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

TU 014 Monitoring of perfluorinated compounds

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

Fish from regional waters:

Sixteen fish from the Rhine river including eel, perch, roach, tench and catfish were examined for the presence of 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, PFHxS, PFHpA, PFOA, PFOS, 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 concentration 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 muscle tissue samples and 529 liver samples from wild boar. The arithmetic mean of PFOS concentrations detected in muscle tissue was 1.38 μg/kg whereas the mean PFOA concentration was below the LOQ. In liver tissue the mean PFOS concentration was 4.02 μg/kg (Maximum value 43 μg/kg). Foodstuffs:

Measurements of 82 samples of French fries showed PFAS 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/s00244-011-9762-3

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, perfluorooctanoic acid and PFOA (perfluorooctanoic acid), have a long persistence in the human body (4-6 years). This persistence creates an important concern among the scientific community and the health authorities. In fact, PFOS was listed under the Stockholm Convention in May 2009 as a persistent organic pollutant (POP), while PFOA is a serious candidate to enter that list. The main target organs of accumulation are blood and breast milk. Thus, PFOA can be a risk for adult population and infant. In order to assess the tissue concentration, PBPK models are able to assess the concentration along the time in the main target organs of concern. PBPK models are mathematical representations of the human body where the organs are considered as compartments, and they can be resolved computationally as a set of equations.

The PBPK model presented here is a multi-compartmental model for PFOS and PFOA for adult and childhood exposure during the breastfeeding period. Aside from the blood and breast milk, another tissue such as brain and kidney have been considered. 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's 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 and 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, birds 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 test organisms due to their short life cycle, their ease of laboratory culturing, their limited space and water volume requirements, and their sensitivity to chemicals. Cladoceran species are therefore widely used in aquatic toxicology. Among freshwater cladocerans, Daphnia magna is probably the most common test organism 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 carbonylic acids and alcohols on two cladocerans, Daphnia magna and Chydorus sphaericus, was evaluated in the present study. The adverse effects of these PFCs on D. magna and C. sphaericus were measured by 72-hr static tests including hatching success, early development, and survival of the fishs early life stages. The NOECs (nongrowth inhibitory concentration) and LOECs (growth inhibitory concentration) of the four selected PFCs were determined for both cladocerans using the linear probability method (linear regression). A multiple linear regression analysis was used to determine the relationships between the acute toxicity and four structural factors of the selected PFCs using the NOEC and LOEC of each compound.

The results of the present study showed that the acute toxicity of the seven poly- and perfluorinated carbonylic acids and alcohols for the cladocerans D. magna and C. sphaericus was higher for D. magna than for C. sphaericus. The NOECs of the seven PFCs for D. magna were 2.0, 10.0, 1.0, 1.0, 1.0, 1.0, and 1.0 mg/L, and the NOECs for C. sphaericus were 5.0, 2.5, 2.5, 2.5, 1.0, 1.0, and 1.0 mg/L, respectively. The LOECs of the seven PFCs for D. magna were 4.0, 20.0, 1.0, 2.5, 2.5, 2.5, and 2.5 mg/L, and the LOECs for C. sphaericus were 10.0, 10.0, 2.5, 2.5, 2.5, 2.5, and 2.5 mg/L, respectively. The acute toxicity of the selected PFCs for C. sphaericus was higher than that for D. magna at the same concentration. The NOEC and LOEC values for the seven selected PFCs were consistent with their respective values for D. magna and C. sphaericus. The acute toxicity of the four selected PFCs for D. magna and C. sphaericus showed a high correlation coefficient (r = 0.997), indicating that the acute toxicity of the selected PFCs could be used as a reliable indicator for the assessment of environmental hazards of other similar PFCs.
TU 022
Plastic debris and toxin releases in the Pacific Ocean
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Plastics comprised the majority of collected waste in 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- and post-consumer plastic debris in the oceans can lead to fragmentation and result in small plastic particles that can degrade and release toxic chemicals such as phthalates, flame retardants, BPA, antimony oxide, heavy metals, 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, polychlorinated biphenyls (PCB), polycyclic aromatic hydrocarbons, among others.

TU 023
Micro-plastics in the marine environment - a global assessment
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GESAMP has set up a new Working Group entitled ‘Sources, fate and effects of micro-plastics in the marine environment - a global perspective’. With multi-agency support and with a multi-disciplinary membership, it is reviewing a wide range of information about the supply of plastics and microplastics to the ocean, and the biological, chemical and physical processes controlling their fate and effects on both marine life and their environment. The physical activity of both microplastic particles and phytomass transport, etc. will provide an evidence base for use by policy makers, regional bodies and other stakeholders, and help to develop research priorities. The poster will describe the Terms of Reference, work programme, membership and intended outcomes of the group, and will issue an invitation to SETAC Europe participants to become involved in this initiative.

TU 024
Marine micro litter under the marine strategy framework directive - science and policy
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1. Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source (10.1.1)
2. Trends in the amount, distribution and composition of micro-particles in the marine environment (10.1.2)
3. Trends in the amount and composition of litter ingested by marine animals (e.g. stomach analysis) (10.2.1).

A technical working group within the MSFD implementation strategy has prepared technical recommendations in support of the implementation of the directive by EU Member States. The group identified options and available tools for the monitoring of Marine Litter and developed a roadmap showing the necessary next steps in preparing the implementation of the directive. The poster is presenting specific information regarding micromarine litter under the MSFD.

TU 025
Using the continuous plankton recorder to determine the abundance of microplastic debris in the subsurface marine waters
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2Sir Alistair Hardy Foundation for Ocean Science (SAHFS), Plymouth, United Kingdom

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

TU 026
Microplastics in personal care products from Brazil: is this source relevant to the aquatic contamination?
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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 all over the world, as well as their persistence and hazard to the wildlife. Moreover, they have high diverse diffuse sources and high capacity of distribution. In addition to other sources, microplastic (< 5 mm) have been found in frequent use skin cleansers and others personal care products at a result, this specific class of plastic has been found contaminating ink, inks, 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, polychlorinated biphenyls, polycyclic aromatic hydrocarbons, among others.

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 places. Based on pre-consumer background levels of persistent organic pollutants (POPs) have been tentatively determined. By comparison of POPs concentrations in pellets from industrially-developing countries (e.g., Ghana) with the background levels, PCB inputs from e-wastes were suggested. Through global comparison, hot spots of PCB pollution were identified, e.g., Le Havre (France), Athens (Greece), Tokyo Bay (Japan), Sydney Harbor (Australia), Los Angeles, San Francisco, Boston Harbor, New York Bay to Lake Erie (USA), Santos Bay (Brazil). Combination of IPW with passive air sampling indicates that legacy pollution is major contributor to most of the hot spots of PCB pollution. In addition to the spatial variation, pellet watch was applied to reveal temporal trend in POPs pollution in California coast and Tokyo Bay.

TU 028
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 are leached into the debris during plastics production in order to catalyze monomers into polymers and give it different properties. Some of these additives have been associated with carcogenic 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 hazard are the persistent organic pollutants (POPs), which do not completely dissolve in water and do not degrade into harmless materials in a short timeframe. Exposure to POPs, e.g. polychlorinated biphenyls (PCBs), has been associated with 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 hazard are the persistent organic pollutants (POPs), which do not completely dissolve in water and do not degrade into harmless materials in a short timeframe. Exposure to POPs, e.g. polychlorinated biphenyls (PCBs), has been associated with 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.

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 aquatic-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.
The first result obtained from this study was that a large number of plastic was found, prevalently into the intestine, in more than 60% of the animals. The main categories of substances found in the faeces are represented by the degradation product of larger plastic debris, are accumulating in marine habitats worldwide. Given their small size (<1 mm) these particles can potentially be ingested by marine animals. Data on the uptake of microplastics in invertebrates is, however, scarce. In this study, we tested the hypothesis that the uptake of microplastics from the gut to tissues is size-selective and has an adverse effect on the energy allocation in the mussel. The uptake of microplastics was investigated in Mytilus edulis exposed to microplastics of different sizes and polymeric compositions. Cultures were exposed to microplastics for 14 days to three different sizes of microplastics simultaneously (10, 30 and 90 µm). 10 µm particles, as well as 30 µm particles, were added at 50 particles mL⁻¹ and 90 µm-particles at 10 particles mL⁻¹, resulting in a total concentration of 110 particles mL⁻¹. Analysis of the faeces demonstrated that M. edulis filtered and ingested all particle sizes in the same ratio as they were added to the seawater (i.e. 1:1). However, at the end of the experimental period, the faeces showed a significant decrease in the number of particles, which was expected based on the observations of the other particle sizes, i.e., 8 times less than the 30 µm-particles were observed (even though they were initially present at the same concentration). Although this discrepancy was partly due to difficulties in detecting the particles in the faeces, analysis of acid-deestroyed mussels and hemolymph samples demonstrated that 10 µm-particles were able to translocate to the circulatory system of the mussel. This suggests that ingestion and uptake of microplastics is a potential source of microplastics in the marine environment.

Despite the increase in plastic debris ingestion and exposure to microplastics in marine environments, little is known about the factors affecting microplastics uptake and their fate in marine organisms. In this study, we quantified plastic debris ingestion in twenty-nine specimens of loggerhead turtle (Caretta caretta) and leatherback turtle ( Dermochelys coriacea) in order to understand the potential for these plastics to absorb POPs in their environment. It would also be possible to further substantiate these findings by gathering partition coefficients and related information from other sources such as plastics companies, federal/state agencies, etc.

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 remote areas, the impact of plastics on the marine environment and wildlife is less known, but is likely to be a significant threat to marine biodiversity. A previous study showed that the loggerhead turtle is one of the sea turtles 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 quantify the exposure of plastic debris to these two species of sea turtles, M. edulis and D. coriacea, using the PNEC approach.

M. edulis is considered one of the sea turtles 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 quantified plastic debris ingestion in twenty-nine specimens of loggerhead turtle (Caretta caretta) and leatherback turtle ( Dermochelys coriacea) in order to understand the potential for these plastics to absorb POPs in their environment. It would also be possible to further substantiate these findings by gathering partition coefficients and related information from other sources such as plastics companies, federal/state agencies, etc.
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. 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 on the 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 light stabilizers, 12 preservatives and the metabolite, and one fragrance, including commonly used compounds in Australia such as 4-MBC, EHCMS, octocrylene, UV-328, HHCB, 2-phenoxo 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. Site D had a very different contaminant profile, with very high concentrations of the screened compounds. Site A, B, C, and D are all both at the mouth of creeks and rivers flowing into Port Phillip Bay; Site D is about 5 km upstream of site C in Melbourne on the second biggest river entering Port Philip Bay. Although there are several small wastewater treatments located at the headwaters of HPL or DREB (over the range of 7.5 to 45%), the crustacean (OECMs in the range of 11.25 to 90%) could not be assigned to either pharmaceutical residues or metals, but in general showed that these treatment facilities release water with a relatively low toxic potential, comparable to water that have been treated with advanced pharmaceutical treatment options.

From the present study it can be concluded that constructed wetlands may provide a complementary sewage treatment option, especially where other treatment is lacking today. To fully remove micro-pollutants from sewage effluent however, other advanced treatment technologies are likely needed.

**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 our society. They can be excreted unchanged and/or as active metabolites in urine and feces, and directly conveyed to wastewater treatment plants (WWTPs). If they escape degradation during wastewater treatment, they finally end up in surface water. The present study aimed for the first time to study sources and fate of several selected classes of pharmaceuticals in the most inhabited and industrialized area in Italy (urban and suburban area around Milan). The investigation was conducted in was conducted in surface, surface and groundwater. Composite samples were collected, filtered, enriched with internal standards and solid-phase extracted. LC-ESI-MS/MS with multiple-reaction monitoring and stable-isotope dilution assay was used for quantitation. Recoveries were generally higher than 80% and limits of quantification were in the low ng/L range. Ciprofloxacin, ofloxacin, atenolol, flusulamide, hydrochlorothiazide, chlortetracycline, ibuprofen, ketoprofen, diclofenac, naproxen, and carbamazepine were the most abundant residual drugs in urban wastewater. Their removal in conventional WWTPs was generally lower than 50%, with no removal for bezafibrate, hydrochlorothiazide, carbamazepine 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 sludge in untreated ground water. Moreover, the pattern of contamination of ground water was higher in sites closer to rivers, suggesting the contribution of surface water to the contamination. This investigation allows the quantification of the mass flow of these substances flowing through a highly urbanized and industrialized area.

**TU 036**

**Analysis of free water surface wetlands as tertiary sewage water treatment of micro-pollutants**

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Increased attention is currently directed towards potential negative effects of pharmaceuticals and other micro-pollutants discharged into the aquatic environment via municipal sewage systems. The number of additional chemicals have therefore been submitted as promising tools for improving the removal efficiency of pharmaceuticals in existing Sewage Treatment Plants (STP). Constructed wetlands are also capable of removing a variety of micro-pollutants, including some pharmaceuticals, and could hence be a resource efficient complement to more advanced treatment technologies. The purpose of the present study was therefore to increase the potential of known STPs by introducing constructed wetlands as a treatment step to reduce emissions of organic micro-pollutants from municipal sewage effluents. Under cold winter conditions, incoming and outgoing waters from four Swedish free water surface wetlands, operated as final treatment steps of sewage effluent from municipal STPs, were sampled and analyzed for levels of a set of 92 pharmaceuticals and 22 inorganic components as well as assessed using subchronic ecotoxicity tests with a marine alga as a test organism.

Sixty-five pharmaceuticals were detected in the range 1 ng/L to 7.6 pg/L in incoming and outgoing waters from the four investigated wetlands. Although the sampling design used in the present study lacks the robustness of volume proportional 24 h composite samples, the average estimated removal rates ranged from 42 to 52%, which correlate to previous published values. The effects observed in the ecotoxicity tests with the marine alga (EC50s in the range of 7.5 to 46%) and the crustacean (LOECs in the range of 11.25 to 90%) could not be assigned to either pharmaceutical residues or metals, but in general showed that these treatment facilities release water with a relatively low toxic potential, comparable to water that have been treated with advanced pharmaceutical treatment options. From the present study it can be concluded that constructed wetlands may provide a complementary sewage treatment option, especially where other treatment is lacking today. To fully remove micro-pollutants from sewage effluent however, other advanced treatment technologies are likely needed.

**TU 037**

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


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Ecosytems are potentially contaminated by many chemical substances from domestic activities, through the spreading of treated sewage sludge. Indeed during the last thirty years, the application of municipal sludge from urban to agricultural soils is the option favoured internationally for sludge management as it contributes positively to recycling nutrients and improving fertility. The literature data indicate that the removal efficiencies of organic contaminants in sewage treatment plants vary between 24 and 100% depending on the contaminants and treatment processes, which means that significant percentages of products can be present in the sludge. Steroid sex hormones and pharmaceuticals are considered emerging environmental contaminants of particular concern, as many of them display biologically active properties (including endocrine-disrupting). At the European level, few studies exist on the characterization of these emerging substances in sludge or on the assessment of health and environmental risks associated with their use.

This is partly explained by the difficulties of detection and quantification of such pollutants in the solid phases. It is, indeed, a real analytic challenge given the diversity of analytes of pharmaceutical sciences, Copolymerization and the complexity of the matrix which makes difficult the extraction step. Thus it appears that the development of analytical methods sensitive, reliable and robust is an essential step for the characterization of emerging substances in sludge.

In this context, the aim of the study was to develop a method for the large screening of pharmaceuticals and hormonal steroids in sludge. Therefore, nearly two hundred substances were analyzed by liquid chromatography/mass spectrometry. The question arises how different activated sludges are regarding these parameters, how large the adsorption to sludge varies, and consequently how many sludges should be tested for a safe risk assessment. The number of sludges to be tested is not clearly defined in the guideline EMEA/CHMP/SWP/4447/00. This guideline focus on the risk by the use of the pharmaceutical and the entry into the environment via excretion and wastewater effluent to a sewage treatment plant (STP). It is assumed that a substance with high sorption to activated sludge may reach terrestrial ecosystems by land spreading of sewage sludges. The adsorption to sludge has therefore to be determined for pharmaceutical and hormones. Effective, Rugged and Safe) method was set up. This analytical methodology was successfully applied to various kinds of sludge (limed, digested, dried, liquid, composted) collected in several sewage works in France.

**TU 038**

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

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The detection of pharmaceuticals in sewage sludge has been demonstrated to have the potential to reach terrestrial ecosystems by land spreading of sewage sludges. The adsorption to sludge has therefore to be tested according to the EMEA Guideline in an adsorption study. A terrestrial risk assessment 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 3700 L/kg) and the drug is not readily biodegradable. The sorption of chemicals to sorbents like soils or sediments typically depends on several parameters of the sorbent (e.g. pH, ion-exchange capacity, redox potential, organic and inorganic carbon content, clay content, texture) . The question arises how different activated sludges are regarding these parameters, how large the adsorption to sludge varies, and consequently how many sludges should be tested for a safe risk assessment. The number of sludges to be tested is not clearly defined in the guideline EMEA/CHMP/ SWP/4447/00. This guideline focus on the risk by the use of the pharmaceutical and the entry into the environment via excretion and wastewater effluent to a sewage treatment plant (STP). It is assumed that a substance with high sorption to activated sludge may reach terrestrial ecosystems by land spreading of sewage sludges. The adsorption to sludge has therefore to be tested according to the EMEA Guideline in an adsorption study. A terrestrial risk assessment 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 3700 L/kg) and the drug is not readily biodegradable. The sorption of chemicals to sorbents like soils or sediments typically depends on several parameters of the sorbent (e.g. pH, ion-exchange capacity, redox potential, organic and inorganic carbon content, clay content, texture). The question arises how different activated sludges are regarding these parameters, how large the adsorption to sludge varies, and consequently how many sludges should be tested for a safe risk assessment. The number of sludges to be tested is not clearly defined in the guideline EMEA/CHMP/SWP/4447/00. This guideline focus on the risk by the use of the pharmaceutical and the entry into the environment via excretion and wastewater effluent to a sewage treatment plant (STP). It is assumed that a substance with high sorption to activated sludge may reach terrestrial ecosystems by land spreading of sewage sludges. The adsorption to sludge has therefore to be tested according to the EMEA Guideline in an adsorption study. A terrestrial risk assessment 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 3700 L/kg) and the drug is not readily biodegradable. The sorption of chemicals to sorbents like soils or sediments typically depends on several parameters of the sorbent (e.g. pH, ion-exchange capacity, redox potential, organic and inorganic carbon content, clay content, texture). The question arises how different activated sludges are regarding these parameters, how large the adsorption to sludge varies, and consequently how many sludges should be tested for a safe risk assessment.
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 develop methods to analyze antimalarial drugs in blood and urine has been published. However, only two methods have been published to analyze a few antimalarial drugs (artemisinin derivates and chloroquine) in water or soil. For that reason, the first multi-residue method for the analysis of antimalarial drugs and their metabolites in water has been developed. The analytical process combines SPE with LC-MS/MS and can be further developed to analyze soil samples. The presented method can be used to describe environmental fate profiles of antimalarial drugs in the environment.

TU 040

Matching micropollutant loads of influent and effluent for reliable mass balances in WWTPs
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The aim of micropollutant screening in a WWTP is usually evaluated by data from long-term time series where variation caused by transient flow and concentration are averaged out. The analyses of micropollutants is however work and cost-intensive and that is why measurement campaigns usually only cover short periods with a small number of samples available to establish a mass balance. Considering that biological reactor tanks are well-mixed systems, a sampling scheme comprising single 24-h effluent and influent samples in large but different sampling volumes for a completely-mixed system, it was shown that a 24-h effluent load is composed of water volume fractions from several previous days (Majewsky et al., 2011).

In the present study, we designed an individual sampling strategy using hydraulic calibration of a Luxembourg WWTP to validate the proposed model. The elimination efficiencies of the selected micropollutants were calculated on the basis of 24-h composite samples (time-proportional) which allowed to explain >80% of the origin of the effluent load sampled. Results showed that the method was capable of reproducing realistic elimination values while short-time mass balances lead to erroneous values.

This model allows to evaluate the accuracy of different sampling scenarios as a function of the sampling mode and frequency (Ort et al., 2010) and of the number of samples taken in the inlet and outlet of the WWTP. The aim is to maximally reduce the uncertainty and/or to explain the bulk of the effluent load origin. A relationship can be established between the influencing factors that are captured by an efficient sampling period and the hydraulic retention time (HRT). Based on these findings, we propose to develop a generic design strategy for sampling strategies in WWTPs without having to rely on prior hydraulic calibration.


Ort, C., Lawrence, M.G., Rieckermann, J., Joss, A., 2010b. Sampling for pharmaceuticals and personal care products (PPCPs) and illicit drugs in wastewater systems: are your conclusions valid? A critical review. Environmental Science & Technology 44 (16), 6024e6035.

TU 041

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

During wastewater treatment, the removal efficiency of triclosan and triclocarban from the aqueous phase can be considerable in activated sludge processes but is dependent on the effective biocidal concentration. Triclocarban is recalcitrant during the sewage treatment process and is detected in streams and sediments downstream of WWTPs.

TCS, TCC and MTCS have lipophilic properties and hence partition to sludge during wastewater treatment and may be present in concentrations ranging from ng kg-1 to % in WWTP sludge. On the soil, the amounts present and the extent of removal during wastewater and sludge treatment. Moreover, the sludge accumulated WWTPs is often processed to produce biosolids intended for land application. Thus, the agricultural recycling of biosolids, the favored option for sludge management, may lead to adverse environmental impact.

In the presented study, TCS, TCC and MITS were monitored in both waters and sludge at different stages within the wastewater treatment process in two WWTPs with different characteristics located in the coastal area of Girona (NE Spain). Moreover, the influence of sludge digestion process on the degradation of target compounds was evaluated by analyzing the resulting digested biosolids under both aerobic and anaerobic conditions. The effect of the temperature on the occurrence of the studied compounds in the final biosolid was also investigated.

TU 042

Dominant time scale of antibiotic concentrations in rivers: results through one-year field campaign study
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Among the long list of pharmaceuticals that can be found in the aquatic environment, antibiotics receive important and increasing attention, as they are suspected to foster bacterial resistance. But if many studies have listed their constant presence in waste waters, few of them curiously have focused on the temporal dynamics of their concentrations. In the presented study, we compare the relative importance of monthly, weekly, daily, and hourly time scale when assessing the dynamics of antibiotics in waste waters. For this, a one-year experimental sampling campaign was conducted at the Vidy WWTP of Lausanne in Switzerland. One week a month during one year, hourly samples were taken from WWTP influent. Samples were aggregated together to obtain measured hourly variations, daily variations, monthly variations and seasonal variations. A total of more than 180 samples over year 2011 were analyzed using UPLC-MS/MS, and the concentrations of 9 antibiotics (azythromycin, ciprofloxacin, ofloxacar, clarithromycin, clindamycin, metromonadazol, norlxacin, sulfamethoxazol, tramoprim) compared. We conclude that even if a seasonal trend for concentrations can be observed for several substances, the hourly time scale totally dominates temporal fluctuations of concentrations. In other words, there is a high hourly fluctuation of antibiotics concentrations, which is superior in magnitude to other (daily or seasonal) time scales. Thus, more efforts in terms of modelling and treatment optimization should be conducted at this temporal resolution (hour) for antibiotics, in order to reduce the risk they can represent for the environment.

TU 043

Quantification of pharmaceuticals and endocrine disruptors in river sediments: development and validation of a QuoChERS based extraction
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Accessing exposure concentrations can be challenging for the analyst as environmental concentrations and toxicological or eco-toxicological effect induced quantities are often below the limit of detection. The QuoChERS (Quick Easy Cheap Effective Rugged and Safe) approach has recently been developed as a multiresidue analytical method and validated for the analysis of pharmaceuticals and endocrine disruptors in water and food matrices. The QuoChERS approach has been effectively used for the development of robust extraction methods for highly polar compounds. We used QuoChERS extraction for the screening of multi-families of pharmaceuticals and endocrine disruptors in river sediments. The molecules were chosen among the priority pollutants listed in a prioritisation for French surface waters [2], in the Water Framework Directive and within the potential or confirmed EDCs. This selection of 13 pharmaceuticals includes β-blockers, anti-inflammatories, antibiotics, anxiolitics, antidepressants and anti-agonists 24 EDGs includes pesticides, alkylphenols, hormones and phenoic derivates and. Quantiification is performed on a 3200QTrap tandem mass spectrometer (MS/MS) coupled to Liquid Chromatography (LC) Agilent 1200 system with a Kinetex XB-C18 column (100x2.1mm, 1.7µm).

Extreme efforts were taken to get acceptable recoveries (>60%) and the linearity of the method has been verified by statistical means. Acceptable Relative Standard Deviations of both injection and preparation steps (<20% to 30%) were calculated for intra-day systems to allow our laboratory and inter-day systems to validate the presented method. For this, the standard deviation and the measurement with a relative uncertainty of ±10% for the method was validated. The relative uncertainty of ±10% for the method was validated. The relative uncertainty of ±10% for the method was validated.

References

TU 044

Developing a miniaturized push-pull test to study the transformation of pharmaceuticals in the hyporheic zone of rivers
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The hyporheic zone is a key compartment for the attenuation of organic micropollutants in rivers. The comparatively slow flow velocity, the continuous import of nutrients and oxygen, and the export of metabolic waste provide ideal conditions for microbial transformation processes. A better characterization of hyporheic processes would substantially improve the quantification of the self-purification capacity of streams. Unfortunately, measuring transformation rates of organic micropollutants directly in the hyporheic zone is often hampered due to limited detection and operational restrictions. Therefore, we are developing a miniaturized push-pull methodology that allows measuring transformation rates of pharmaceuticals directly in the hyporheic zone.

Push-pull tests are an established means of testing the transformation capacity of aquifers with respect to organic or inorganic contaminants. There, a solution containing a set of conservative and reactive tracers is injected (“push”) into an aquifer, and after a certain time the groundwater is extracted (“pull”) through the same well. The difference between conservative and reactive tracer recovery can then be used to estimate in-situ transformation rates. The aim of our study is to downsacle this approach so that it can substantially improve the quantification of the self-purification capacity of streams.
TU 045
Comparative analysis of emerging concern substances in a centralized municipal treatment plant and on-site wastewater treatment systems receiving community and household wastewater
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Though less than 25% of the United States population employs decentralized on-site technologies for wastewater treatment, a comparative understanding of treatment efficacies of these systems remains less understood than those from centralized municipal wastewater treatment plants. In fact, it is estimated that 10 to 20 percent of these systems malfunction annually, releasing untreated wastewater to groundwater and surface water, which can degrade water quality and result in impacts on surface waters in regions experiencing multiple stressors - surface water exchange. Even less understood is a comparative understanding of water contaminants of emerging concern (CECs) associated with these systems and subsequent loadings to the environment. The primary objective of this study was to assess the occurrence and removal efficiencies of select CECs among different wastewater treatment systems. Our experimental concept is validated in a small flume that allows the simulation of different hydraulic conditions in the hyporheic zone. Under abiotic conditions, we applied an approach to estimating the aquatic bioconcentration factor using reduced sampling has been developed (Springer, et al. 2008). This reduced sampling approach aims to quantify concentrations and other routine water quality parameters. Results showed that concentrations of CECs are typically in the range of <1-100 ng/L in the effluent discharges, which are generally consistent with peer-reviewed literature reports for these CECs. CEC concentrations from advanced on-site systems were reduced relative to septic systems. The present study, which included CECs with varied physicochemical properties, provides an initial understanding of the range of environmental loadings from common on-site wastewater treatment systems.

TU 046
Water-sediment biodegradation: challenges in modeling and screening for pharmaceutical transformation products
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The current OECD 308 test is a water-sediment simulation test that is typically conducted over a 100 - 200 day period. It is intended to estimate the parent half life in the water phase, sediment phase and collectively in the total water-sediment system; determine the distribution and mass balance of the residues in the test system; as well as characterize any transformation processes over the study period. Given the length and complexity of the test, it is often desired that a more rapid screen for assessing the potential transformation of pharmaceuticals would be available. Such information would be helpful in developing the ERA testing strategy especially when the identification of a key transformation product would be helpful early on in the risk assessment process. Transformation screening involves sampling integrated water and sediment phases throughout the study period and compares those to what may be predicted in an expert system to understand how selective the predictions may be and what additional information might be helpful in making a predicted pathway more realistic. Challenges in screening for water-sediment transformations in a laboratory test are also discussed to assess how such a test might be performed. For both situations, case studies will be presented to highlight some of the challenges present in advancing these further.

TU 047
A comparison of fish bioconcentration factors for several pharmaceutical compounds obtained using the standard OECD 305 Protocol and the estimated BCFs obtained using the reduced sampling method
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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 0.5 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, an approach to estimating the aquatic bioconcentration factor using reduced sampling has been developed (Springer, et al. 2008). This reduced sampling approach aims to estimate BCFs using a minimum number of sampling time points and therefore a reduced number of fish. The goal of this project is compare the BCFs of several active pharmaceuticals obtained through standard OECD 305 test methods with those BCFs determined using the approach of estimating aquatic bioconcentration factors using the reduced sampling method.

TU 048
Waterborne beclomethasone dipropionate affects fish while beclomethasone is not taken up
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Glucocorticoids are steroid hormones, playing important roles in several aspects of vertebrate physiology. The synthetic corticosteroid beclomethasone has anti-inflammatory activity as well as being used in solvent based fluxing adhesive. It is administered as the more lipophilic prodrug beclomethasone dipropionate (BDP) which is metabolized to the monopropionate (BMP) and free beclomethasone in humans. A recent publication demonstrated effects of waterborne BDP (1 µg/L nominal concentration) on plasma glucose levels in fish. Although levels in of beclomethasone and its lipid esters in effluents or surface waters are not known, it can be assumed that most of the consumed product is metabolized into the less lipophilic forms before reaching the environment. We have therefore compared the potential of beclomethasone and BDP to bioconcentrate and to affect the physiology of exposed fish. Controlled flow-through studies with rainbow trout over two weeks to up to 0.65 µg of beclomethasone/L did not result in measurable plasma levels. Exposure to 0.65 µg/L BDP, on the other hand, led to accumulation of both beclomethasone, BMP and BDP in plasma, indicating a considerably more efficient uptake of the more lipophilic prodrug as well as metabolism within the fish. Accordingly, exposure to 0.65 µg/L of 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 beclomethasone had no effect on these endpoints. We are currently screening for beclomethasone, BMP and BDP in sewage effluents and surface water.

TU 049
The degradation of antidepressant pharmaceuticals in aerobic sludge
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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 were spiked with deuterated sertraline and venlafaxine. Samples collected over 36 days were analyzed for the depletion of the added pharmaceuticals by microscale solvent extraction followed by liquid chromatography tandem mass spectrometry (LC/MS/MS). Municipal aerobic wastewater sludge was found to degrade sertraline and venlafaxine by over 90% over the course of 36 days, whereas no change in the added sertraline and venlafaxine concentrations were observed in abiotic control microcosms.

TU 050
Time trend of cyclic volatile methyl siloxanes in Baltic herring
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Cyclic volatile methyl siloxanes (cVMS) were measured in Baltic herring from the Swedish environmental sample bank. Fish from a site from the Baltic Proper southeast of Stockholm (Landsort) and from the northern part of the Bothnian Bay (Harutfjärden) were analysed. Skinless dorsal muscle samples from six individuals were pooled. Two pooled samples were analysed for each site for the period 1989 - 2009. Octamethylcyclotetrasiloxane (D4), decamethylcyclopentasiloxane (D5) and dodecamethylcyclohexasiloxane (D6) were analyzed. The D5 concentrations were of the 50 ng/g lipid weight, while the concentrations of D4 and D6 were lower and frequently below the MDL. 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.

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

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
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, drugs, suggesting the possibility of other sources flowing into the water environment. Overall, anthelmintics showed insignificant removal efficiencies in wastewater treatment compared to measured concentrations obtained with POCIS passive samplers. Data on pharmaceuticals in the coastal zone are scare and PECs and diffusion model might pathogenic to man and animal. Most antibiotic are non biodegradable and an advanced physicochemical process should be applied for their elimination. There are several a direct effect on bacteria, either those involved in wastewater treatment (activated sludge, biofilms) or those present in natural aquatic environment where they contribute to antibiotics/photocatalysis/photo-fenton 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.

TU 052

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

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Pharmaceutically active substances undergo transformations starting from human metabolism to degradation in environmental processes and finally during drinking water and wastewater treatment. Often degradation in sewage and water treatment and the environment is incomplete, resulting in the formation of stable transformation products. The formation and presence of such stable transformation products in the effluent of sewage works, surface water, and drinking water treatment is reported in the scientific literature with increasing frequency. In only a few cases, full mineralization of the parent compounds is achieved. This is even more of importance as 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.

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 human and environmental impact of two groups of pharmaceuticals, which will be addressed in the Pharmas project (EU grant agreement no. 265346). 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 (heterogeneous and homogeneous photocatalysis) for sewage treatment. Structure elucidation of the transformation products formed, different LC/MS/MS approaches as well as high resolution MS techniques will be implemented. Characterization of the stable transformation products in terms of (eco)toxicological behavior will be done using a battery of in vitro bioassays.

TU 053

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

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

TU 054

Fate of anti-diabetic drugs: glioclazide, glibenclamide and glimepiride in soil environment

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It is assumed that about 3-5% of human population suffers from diabetes mellitus type 2. Since large quantities of anti-diabetic drugs are used for treatment, it is possible that huge amounts of these pharmaceuticals and their metabolites are deposited in the environment due to excretion from humans and because of the improper utilization of off-date drugs. The most common way to enter the natural environment by these drugs is by sewage. Therefore, the most endangered are natural waters, soils and sediments. Considering the composition of these matrices it is obvious that the most dominant interaction are sorption and biogradation processes. Transport of the compound in porous media, such as soils, sediments and aquifers, is strongly influenced by its tendency to sorb on to the various components of the solid matrix. Furthermore, since molecular transfer is a prerequisite for the uptake of organic pollutants by organisms, the bioavailability of a given compound and thus its rate of biotransformation, is often affected. Sorption of process three sulfonlurea based of anti-diabetic drugs were tested on three various soil. Selected soils differed in their physical and chemical properties and thus, it was possible to assess the influence on sorption of: organic matter content; pH; moisture; fine fraction content and cation/ anion exchange capacities. Other external factors like: change of pH, ionic strength of solution and temperature were also tested. Various of sorption and kinetics models were used to describe obtained results.

TU 055

Evaluation of pharmaceuticals and personal care products focused on anthelmintics in human-waste, sewage, hospital wastewater, livestock wastewater and receiving water

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

TU 056

Degradation of antibiotics by photocatalysis on immobilized titanium dioxide

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Antibiotics are micropollutants which release in the aquatic environment has been a subject of concern for several years as they can give rise to two problems: i) they can have a direct effect on bacteria, either those involved in wastewater treatment (activated sludge, biofilms) or those present in natural aquatic environment where they contribute to river-bank. ii) they may promote the development of antibiotic resistance genes between bacterial species, including those pathogenic to man and animal. Most antibiotic are non biodegradable and an advanced physicochemical process should be applied for their elimination. There are several such processes but photocatalysis is often proposed as it can use part of the solar spectrum as an energy source and is reagent free. However most of the works described in literature are based on titanium dioxide slurries. After treatment these nanoparticles should be recover which is not easy. One solution to this problem is photocatalyst immobilization. However immobilized photocatalysts are generally less efficient than suspended photocatalysts as less surface can be activated. Within this framework tests
of photodegradation of two antibiotics often observed in the environment: a veterinary drug, tylosin (916 g/mole, pKa = 7.1) and a human drug sulfamethoxazole (253 g/mole, pKa = 5.7). Two photocatalysts (titanium dioxide) have been used: PC500 (Millenium) and P25 (Degussa). Two modes of immobilization have been tested: on a glass plate in the lab for both photocatalysts or on cellulose filters for PC500 only (Ahlstrom, Pont-Evêque, France). Antibiotics degradation was monitored by UV-visible spectrometry and GC. End products (organic carbon and nitrogen species) were also quantified. Degradation was observed, P35 being more efficient than PC500. Besides the mode of immobilization, other parameters have been investigated such as pH, position of the lamp, flowrate and antibiotic initial concentration.

TU 057

Direct and indirect photolysis of human metabolites of antibiotic sulfamethoxazole

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Both direct and indirect photodegradation processes have been reported to be important removal mechanisms of sulfamethoxazole (SMX) in the environment. However, most of SMX degradation occurs in the environment, yet, as their environmental fate is not known. In this study, we assessed the direct and indirect photodegradation kinetics at 3 different pHs of 5 human metabolites of SMX, namely, nitro-SMX, nitroso-SMX, acetyl-SMX, hydroxyl-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 phototransformation 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 at the basic pH was attributed to SMX-glucuronide losing an acidic functionality; therefore, in contrast to SMX and other metabolites, it remains in its neutral and more photo-reactive form at environmental pH.

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 climate conditions (hot and wet) favorable for the incubation of vector-borne microorganisms and insufficient sewer and water supply systems. Moreover, many drug resistant bacteria have been observed from these areas. Hence, it is of great concern that antibiotics are being used in tropical areas.

The impact of carbamazepine on concentrations of acridine in river systems in Northern Germany

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Direct and indirect photolysis of human metabolites of antibiotic sulfamethoxazole

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Carbamazepine (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 up to 320 ng/L for CBZ 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 test if concentrations of ACR in river water were influenced by degradation reactions of CBZ. Moreover, ACR concentrations were taken between November 2011 and July 2012 in the River Fuhse. In addition, water samples from the River Lippe were taken in November in a water section of 4.6 km from the River Fuhse. Water samples from the River Lippe were taken in November in a water section of 7.6 km. Samples were filtered (glass filter 1.6 mm) and immediately enriched on SPE cartridges (Lichrolut EN, Merck). A fractionation on the SPE-cartridge was performed using different pH-values. Extracts were concentrated to 0.5 ml by using a rotary evaporator and analyzed by LC-MS/MS (Agilent 6430) with Q1 and Q3 parameters. Concentration levels were 84% for ACR and 70% for CBZ. Photolysis experiments were performed with CBZ for artificial and natural water samples (River Fuhse) using a Xe-light source with a 290 nm optical filter. Seasonal c_ACR values in the River Fuhse range from 20-53 ng/L and c_CBZ=120-320 ng/L. Concentrations were a factor of 4-3 higher compared to the larger River Lippe. In order to render concentrations and discharges comparable, the ratio of ACR and CBZ in the River Lippe was calculated. A Surrogate of natural water samples was used. Results from November 2012 and July 2012 were compared. Surrogate samples were taken at 3-monthly intervals. Ratios of ACR to CBZ in the River Fuhse were 0.3 in November 2012 and 0.33 in July 2012. The ratio becomes 0.33 in 3 months in the River Fuhse. Besides the presentation concentration levels and ratios R for both compounds in rivers and WWTP, photolysis experiments and a model are presented on the poster to discuss the impact of degradation reactions of CBZ on concentration levels of ACR in river systems.

TU 064

European environmental risk assessment for Trimethoprim in surface waters

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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 Health 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, new chronic tests for fish; based thereon, acute- and chronic-based predicted no effect concentrations (PNECs) were derived. The risk assessment compares surface water PEC and MECs with aquatic PNECs for Trimethoprim.
A comprehensive evaluation of the effects of the antimicrobial personal care product triclosan (TCS) in the terrestrial environment was performed. This evaluation included the effect of TCS on soil microorganisms, and the potential impact on terrestrial arthropods and soil microbial respiration rates in laboratory and field studies. In the terrestrial environment, TCS inhibited soil microbial respiration rates. This inhibition was observed in the presence of both aerobic and anaerobic conditions. The effects of TCS on soil microorganisms were more pronounced at higher concentrations, resulting in a decrease in microbial activity and diversity. The impact of TCS on soil microbial respiration rates was also observed in field studies conducted in various ecosystems, including temperate and tropical forests. These findings highlight the potential ecological risks associated with the widespread use of antimicrobial personal care products in the terrestrial environment.

**TU 066**

**Risk assessment of pharmaceuticals incidentally discharged to 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 others. To determine whether available environmental toxicity data can be used to make PNEC predictions for APIs for which effect data are lacking, we analyzed publicly available data for 197 APIs. The APIs included in the Stockholm County Council booklet, Environmental and biological performance indexes in the manufacturing country. Such surrogate measures are used as conclusive information on pollution level is lacking for most APIs.

**TU 067**

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

J.E.H. Hodgson, C.G. Price, C. Holmes, J.E.N. Hodges

TU 070

**Does price pressure on medicines result in more pollution?**

L. Gunnarsson, D.G. Larsson

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Pharmaceutical industries have over many years of protein and alternative protein sources in laboratory and field studies conducted in various ecosystems. The effects of pharmaceuticals on soil microbial respiration rates were more pronounced at higher concentrations, resulting in a decrease in microbial activity and diversity. The impact of pharmaceuticals on soil microbial respiration rates was also observed in field studies conducted in various ecosystems, including temperate and tropical forests. These findings highlight the potential ecological risks associated with the widespread use of antimicrobial personal care products in the terrestrial environment.
TU 074

Transcriptome analysis of the brain of the gilthead sea bream (Sparus aurata) after exposure to environmental concentrations of human pharmaceuticals
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2University of Padova, Legnano, Italy
3Stockholm University, Stockholm, Sweden

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
phototransformation products of ofloxacin, a photolabile second generation fluoroquinolole, widely used and frequent
in the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar
linked to pharmaceutical production.

TU 077

Economicity of 14 serotoninergic pharmaceuticals in the crustacean Daphnia magna, the microalgae Pseudokirchneriella subcapitata and the marine gastropod Haliotis tuberculata
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Hormone-mimics are defined to target specific molecules involved in a particular metabolic or signaling pathway in humans to obtain desirable effects at low
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 075

Chromatin effect of atenolol on physiological indices in rainbow trout (Oncorhynchus mykiss) after exposure to environmental concentrations of atenolol at 5, 30, 300 and 3000 ng L−1

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Université de Caen Basse-Normandie, Caen, France

AT. However, there were 130 common features between the APAP and CBZ treatment. Functional annotation clustering and enrichment analysis of APAP and CBZ candidate genes in DAVID revealed treatment specific activation of different pathways and processes, with energy-related features present in all the applied treatments.

TU 076

Investigating the genotoxicity effects of pharmaceutical photo-transformation products
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Molecular and genetic mechanisms of these physiological responses in fish are not clear and need to be further studied.

Acknowledgement - This study was supported by the project CENAKVA CZ.1.05/2.1.0001.0024, Grant agency of USA GJAU 047/2010/2 and Grant agency of the Czech Republic P303/11/130.

TU 072

Androgenic activity of levonorgestrel in three-spined stickleback (Gasterosteus aculeatus)
U. Svenssson, I. Brands, B. Brunstrom

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To fully test the hypothesis, complementary analyses on the other two pharmaceuticals are also being performed.

TU 071

Do pharmaceuticals with evolutionary preserved drug-targets pose a greater environmental risk?
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Some results indicate that for miconazole, the drug with well-conserved drug-targets, the endocrine and protein synthesis disrupting effects were indeed observed at sublethal concentrations. To fully test the hypothesis, complementary analyses on the other two pharmaceuticals are also being performed.

TU 073

Supporting information: The presented work investigated phototransformation products of ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent
in the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar
linked to pharmaceutical production.

TU 070

Production of synthetic progestins are widely used in contraception and have emerged as widespread contaminants in the aquatic environments. They have been shown to impair
in the low ng L−1 range. The mechanisms behind the reproductive toxicity of synthetic progestins are largely unknown. Some synthetic
reproductive toxicity . 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 phototransformation products of ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent
in the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar
linked to pharmaceutical production.

TU 079

Production of synthetic progestins are widely used in contraception and have emerged as widespread contaminants in the aquatic environments. They have been shown to impair
in the low ng L−1 range. The mechanisms behind the reproductive toxicity of synthetic progestins are largely unknown. Some synthetic
reproductive toxicity . 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 phototransformation products of ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent
in the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar
linked to pharmaceutical production.

TU 078

Production of synthetic progestins are widely used in contraception and have emerged as widespread contaminants in the aquatic environments. They have been shown to impair
in the low ng L−1 range. The mechanisms behind the reproductive toxicity of synthetic progestins are largely unknown. Some synthetic
reproductive toxicity . 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 phototransformation products of ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent
in the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar
linked to pharmaceutical production.

TU 080

Production of synthetic progestins are widely used in contraception and have emerged as widespread contaminants in the aquatic environments. They have been shown to impair
in the low ng L−1 range. The mechanisms behind the reproductive toxicity of synthetic progestins are largely unknown. Some synthetic
reproductive toxicity . 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 phototransformation products of ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent
in the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar
linked to pharmaceutical production.

TU 081

Production of synthetic progestins are widely used in contraception and have emerged as widespread contaminants in the aquatic environments. They have been shown to impair
in the low ng L−1 range. The mechanisms behind the reproductive toxicity of synthetic progestins are largely unknown. Some synthetic
reproductive toxicity . 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 phototransformation products of ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent
in the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar
linked to pharmaceutical production.

TU 082

Production of synthetic progestins are widely used in contraception and have emerged as widespread contaminants in the aquatic environments. They have been shown to impair
in the low ng L−1 range. The mechanisms behind the reproductive toxicity of synthetic progestins are largely unknown. Some synthetic
reproductive toxicity . 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 phototransformation products of ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent
in the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar
linked to pharmaceutical production.

TU 083

Production of synthetic progestins are widely used in contraception and have emerged as widespread contaminants in the aquatic environments. They have been shown to impair
in the low ng L−1 range. The mechanisms behind the reproductive toxicity of synthetic progestins are largely unknown. Some synthetic
reproductive toxicity . 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 phototransformation products of ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent
in the environment. Amongst them, pharmaceuticals, which are widespread-used and dissimilar
linked to pharmaceutical production.
molecules are mainly antidepressant (fluoxetine, sertraline, paroxetine, fluvoxamine, citalopram, clomipramine, amitriptyline, mianserin, milnacipran, duloxetine, venlafaxine) but also antipsychotic drug (clozapine), cough suppressant/halucinogen drug (dextromethorphan) or beta-blocker (propranolol). These molecules have the common property to play directly or indirectly a role on the serotonin transporter and/or serotonin receptors. The 14 molecules were tested for their ecotoxicological effects using chronic and acute tests on the microalga Pseudokirchneriella subcapitata and the crustacean Daphnia magna. Additionally to these conventional bioassays, a novel bioassay was developed using primary cell culture of hemocytes from the marine gastropod abalone (Haliotis tuberculata). This assay was used in order to address the question of pharmacological effects in a marine species. The acquired data were used to build quantitative structure activity relationship (QSAR) modeling in order to (1) determine the chemical properties of the molecules that can explain their toxicity, (2) identify the mode of action of the selected pharmaceuticals.

TU 079

Environmental effects of anticholinesterasic 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 anticholinesterasic therapeutic drugs, neostigmine and pyridostigmine in Daphnia magna. This evaluation was performed through acute (3 h-EC) and sub-lethal (24 h) responses and concentration-displacement (CA) models. The pharmacological effects of neostigmine and pyridostigmine derive from their capacity to induce a reversible inhibition of cholinesterase activity, and have thus been used to treat the human disease myasthenia gravis. We observed alterations at a sub-individual parameter directly related to the anticholinesterasic activity. Our study calculated 48 h-EC50 values in the immobilization assay of 167.7 μg L−1 for neostigmine, and 8.1 μg L−1 for 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 (LOEC50s of 21.0 μg L−1 and 2.9 μg L−1 for neostigmine and pyridostigmine, respectively), followed by the fecundity (LOEC50s of 41.3 μg L−1 and 11.4 μg L−1 for neostigmine and pyridostigmine, respectively). We also determined a 48 h-IC50 for cholinesterase activity of 1.7 and 4.5 μg L−1 for neostigmine and pyridostigmine, respectively. These results demonstrate that both compounds are extremely toxic for D. magna at concentrations in the order of μg L−1. By comparing the here-obtained results with the actual concentrations of pyridostigmine previously reported in the aquatic environment (0.22 μg L−1), it is possible that this compound can significantly alter the feeding behavior of D. magna. Hence, the ecological implications of these data are of great importance and must be considered under the risk assessment framework of both pharmaceutical drugs.

TU 080

Calciuninin inhibition as a mode-of-action of antifungal imidazole pharmaceuticals in non-target organisms: implications for mixture toxicity assessment

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Asthma is not only a current regulation of pharmaceutical chemicals, several theoretical models have been developed and applied to predict mixture toxicity in environmental research. The Concentration addition (CA) model describes the mixture toxicity of components with similar mode of action (MOA). Imidazoles are primarily known as antifungal substances interfering with synthesis of ergosterol in fungi. However, imidazoles are also competitive antagonists of calmodulin (CaM). CaM is a calcium binding protein expressed in all eukaryotic cells, where it participates in many signaling pathways (e.g. nitric oxide signaling), thereby affecting many different cellular functions, particularly neurosecretory activity in mollusks. In crustaceans, CaM seems to be involved in the synthesis of nitric oxide (NO) and nitric oxide synthase (NOS) and may play a role in a variety of physiological processes. Exposure to CaM antagonist drugs inhibits NO formation and decreases NO levels and NO-stimulated responses in vitro. Even if CaM seems to play a role in NO synthesis, little is known about the mode of action of CaM antagonists in non-target species. We tested our hypothesis by assessing single and combined effects of four imidazoles (econazole, miconazole, clotrimazole and ketoconazole) in adult specimens of the marine gastropod Haliotis tuberculata. The NOEC/100 and acute NOEC) until juvenile instar is reached. The number of neonates produced by each mother, as well as any kind of other stress signs, is recorded for 21 days, and the viability of the neonates is also evaluated. Such tests should give a better assessment than acute tests of the potential ecotoxicological impact of Tamoxifen and its metabolites on aquatic ecosystems.

TU 081

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

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Gammarus spp. and Fucus vesiculosus are two foundation species of the Baltic Sea. These species inhabit the littoral community and are thereby exposed to substances released in coastal areas. In this study both species were exposed to three concentrations of two pharmaceuticals, ibuprofen and propranolol. Both physiological and behavioural parameters were estimated to examine potential effects in the organisms. Respiratory, feeding rate, activity with and without predator cues by a Multispecies Freshwater Biomonitor (MFB[TRADEMARK]) were estimated for Gammarus spp. and gross production to respiration ratio (GPR) and chlorophyll fluorescence for F. vesiculosus. Ibuprofen did not affect any of the measured parameters of Gammarus spp., significantly and only slightly affected the algae. The strongest effect was related to activity of Gammarus spp as measured by the MFB[TRADEMARK], and results showed that propranolol decreased the activity. The addition of predator cues into the exposure water increased the activity in all treatments, but the gammarids could not compensate for the reduced activity caused by the pharmaceutical. The feeding rates of Gammarus spp. exposed to ibuprofen were more than twice times higher in all concentrations compared to the control. Also the alga was more affected by propranolol measured as lowest Chl fluorescence. The data indicate that this cocktail has a mix of effects on both behavioral and ecological aspects. The exposure of Gammarus spp. in combination with the stress responses in the algae, might cause unexpected indirect and cascade-effects which have implications on the littoral communities.
Assessing the environmental hazard of mixtures of pharmaceuticals: combined acute toxicity of fluoxetine and propanolol to the crustacean Daphnia magna

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Despite the fact that pharmaceuticals have been detected in the environment at the µg L-1 to ng L-1 range, it has been demonstrated they can cause adverse effects at environmentally relevant concentrations. To detect possible adverse effects of a contaminant in the environment, standardized short-term, sensitive and low-cost methods are usually applied to estimate chronic toxicity against organisms. Lysosomal membrane stability (LMS), has been successfully applied as a screening tool to determine the health status of a wide range of organisms. The feeding style and habitat of the manila clam (Ruditapes philippinarum) make this species vulnerable to organic contaminants bound to water and has been widely used in ecotoxicological studies. LMS was evaluated in clams' haemolymph by the neutral red retention assay (NRRA). Claims were exposed in the laboratory to concentrations of caffeine (psychotropic stimulant), carbamazepine (anticonvulsant and mood stabilizing), ibuprofen (non-steroidal anti-inflammatory) and novobiocin (antibiotic) during 35 days in a semi-static 48 h renewal assay. Filtered sea water was spiked every 2 days with caffeine (0.1, 5, 15, 50 µg L-1), ibuprofen (0.1, 5, 10, 50 µg L-1), carbamazepine and novobiocin (0.1, 1, 10, 50 µg L-1). Stock solutions of pharmaceuticals were prepared in DMSO (0.001%) to ensure solubility. Test with this solvent was undertaken to ensure no solvent effect. Results showed that neutral red retention time (NRRT) measured at the end of the bioassay was significantly (p < 0.05) reduced (50 %) when exposed to environmental concentrations of caffeine (0.1 µg L-1); ibuprofen (5 µg L-1); carbamazepine (1 µg L-1) and novobiocin (10 µg L-1). Results showed dose-dependent effect of pharmaceuticals (p<0.05); Clams analyzed after exposure to 10, 15 and 50 µg L-1 were considered to present a diminished health status (NRRT > 45 min) (p>0.05). LMS appears to be a sensitive tool that enables evaluation of the health status of clams after exposure to concentrations of selected pharmaceuticals under laboratory conditions and could thus be used as a biomarker for pharmaceutical contamination in aquatic environments.

Cytotoxicity and genotoxicity induced by cocaine on the freshwater bivalve Dreissena polymorpha

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Cocaine consumption, in fact, drugs of abuse enter the aquatic system posing a potential risk for aquatic biocoenosis. Even if many studies have showed the presence of both drugs and their metabolites in freshwater in the high ng L-1 to low µg L-1 range worldwide, at present any information on their potential harmful effects on non-target organisms is available. In order to investigate the cyto-genotoxic effects induced by the cocaine, one of the most illicit drug in Western Countries, as well as, consequently, one of the most found in the aquatic environment. Our goal was reached through the application of a biomarker battery on a classical freshwater biological model, the zebra mussels Dreissena polymorpha. The raise of genotoxic effects was investigated by the Single Cell Gel Electrophoresis (SCGE) assay, which evaluated primary and fixed in the DNA; and the micronuclear test (MN test), which investigate DNA damages. The Neutral Red Retention Assay (NRRA), by evaluating the lysosome membrane stability, was used to assess cocaine cytotoxicity. 96 h exposures to three increasing nominal concentrations of cocaine (40 ng L-1, 200 ng L-1, 5 µg L-1) were performed under semi-static conditions. Our results highlighted that cocaine exposure induced significant (p<0.05) increased both primary and fixed DNA damages. In a recent study, it was demonstrated that the cocaine exposure dose-dependently decreased the stability of lysosome membranes, our data also highlighted its cytotoxicity and the possible implications of oxidative stress for the observed genotoxic effects.
action and chemical-physical properties. Next to this, endocrine-disruptive activities have been observed for a few of the tested PPCPs. The obtained data indicate which of these two substances was investigated on natural marine biofilm communities (periphyton) mainly composed by microalgae and bacteria.

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 human and veterinary medicine. Their use in aquatic environments 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 embryos and adults of zebrafish. To achieve these objectives a battery of biomarkers were analysed in adults (liver, head, muscle, gill tissues) and embryos (whole body homogenates) exposed to these chemicals. Representative biomarkers (CAT, glutathione-S-transferase (GST), lactic dehydrogenase (LDH), and glutathione-S-transferase (GST)) were determined.

TU 091

Toxicity of Ciprofloxacin and Sulphamethoxazole on marine biofilm communities

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

TU 092

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

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The activated sludge respiration inhibition test (OECD Procedure 209) is used to assess the inhibitory effects of a substance on the respiration of the heterotrophic population of sewage microorganisms found in the activated sludge sewage treatment process. The original OECD guideline for the test was first issued in 1984 and remained unchanged until it was reviewed and followed subsequent OECD test design update to improve the statistical basis of the test design. Changes introduced in the new guideline included an increase in the level of replication of test and control mixtures to allow the determination of the NOEC of a substance, a requirement of Hazard quotients for each compound and route were calculate and then aggregated to derive hazard indexes by route differenciating 3 age groups: 0-1 years, 1-2 years and 2-5 years. The required data could only be completed for 8 of the 26 allergens: pinene, benzyl benzoate, cinnamaldehyde, citral, limonene, hexylcinnamaldehyde, hydroxycitronellal and linalool.

TU 093

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

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The use of personal care products is a common practice in developed countries. This brings as consequence a frequent exposition to chemicals likely to be damaging for human health, particularly in the case of babies and children. Fragrances are a group of chemicals incorporated in most cosmetic and other personal care products including baby care ones. The Scientific Committee on Consumer Products (SCCP), has identified 26 of these ingredients as likely to cause contact allergies. Among products for baby care we find baby care soaps which as such are water soluble but, when exposed to soaping baths, show a significant potential to penetrate other irritants and allergens to penetrate. Based on analytical data previously published providing concentration of 26 fragrance suspected allergens in bathwater samples, the aim of this work is to estimate the potential role of these chemicals during bath. With this purpose we have introduced a step-wise approach based on dose-response for the determination of the effects of a substance on activated sludge and recommend that a ring test is conducted to compare the performance of the method and refine the test guideline.

TU 094

Comparative biomarkers responses of zebrafish life stages exposed to oxytetracycline and amoxicillin

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Comparative biomarkers responses of zebrafish life stages exposed to oxytetracycline and amoxicillin

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Exposure of fish embryos and larvae to oxytetracycline (OTC) and amoxicillin (AMX) has been shown to affect the development of zebrafish (Danio rerio). In the present study the zebrafish were divided into three groups: control, treated with OTC and AMX, and treated with both OTC and AMX. The effects on the larvae were assessed by measuring the length of the fish, the number of eyes, and the number of heartbeat. The results showed that the larvae exposed to both OTC and AMX had a lower length than the control group. The number of eyes and the number of heartbeat were not affected by the exposure to OTC and AMX.

TU 095

Gemfibrozil and naproxen biodegradation in a river water ecosystem

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

Non-steroidal anti-inflammatory drug and gemfibrozil, a fibrate drug used as lipid regulator, have been found in several natural waters. They were also found in non-steroidal anti-inflammatory drug and gemfibrozil were both evaluated in microbiologically active river water versus sterilized one. Moreover, the degradations of naproxen and gemfibrozil were also evaluated in microcosms 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, methylnitrate derivative, is a pharmacologically active substance which stimulates the central nervous system, increases heart rate, dilates blood vessels and works as a weak diuretic. It is present in human sewage and natural non-human surface sources. The objectives of this study were to determine caffeine presence in the Danube River samples and to evaluate its stability during two months storage of samples on 4°C. Analysis was performed by solid-phase extraction (SPE) followed by 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% TFA 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 waste in the Danube River. Highest values were obtained in sample collected from location near the water supply source “Ratno ostrov”, Novi Sad. Obtained results due to caffeine amounts significantly decreased during two months storage of samples on 4°C most likely to its degradation.

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

TU 097

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

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Ibuprofen is a widely prescribed medication and over-the-counter medicine, treating pain, inflammation and fever by reducing the level of prostaglandins through non-selective inhibition of the enzyme cyclo-oxygenase (COX). COX exists in two isoforms; the constitutively expressed COX-1 and the inducible COX-2. In order to evaluate whether pharmaceuticals pose any risk to the non-thermal sensitive fish, brook chub, have been reported in aquatic waters in the UK concentrations ranging between 3-27 µgL−1. Ibuprofen was exposed to fathead minnows using a fish-free dosing approach at 1, 2.4, 48 and 96 hours post exposure. Gills, gonads, gut, heart, liver, muscle and brain were collected to determine the effects (if any) on COX gene expression. RNA isolated from tissues was reverse transcribed to cDNA and amplified by qPCR with specific primers to the COX genes and reference genes (18S and β-actin). Initial results indicate changes in COX gene expression following ibuprofen exposure.

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 µgL−1, respectively). Analysis of the plasma revealed uptake of ibuprofen to be up to 9-fold higher. Primary ibuprofen uptake was noted between individual fish in the high dose group (range 120-700 fold), and current work is focused on relating this to changes in COX gene expression.

TU 098

Large-scale spatial-temporal modeling of historical pesticides applications

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With increasingly more detailed data and faster computers, it becomes easier to model pesticide mass loadings into aquatic systems at a high resolution with temporal variability on the scale of the agricultural regions. A large number of passive tracers were conducted to quantify spatial and temporal mass loadings of pesticides into tributaries to the Sacramento River, San Joaquin River, and Bay-Delta estuary California. The aim was to guide future risk assessments for sensitive and endangered species. As part of this project, ten years of daily mass loadings were simulated for 40 chemicals in a 164,000 km2 area of California’s Central Valley. Environmental fate and transport models were evaluated for their ability to capture the temporal 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 temporary filters, with fast transfer rates. We also observed that the soil weather data from 19 stations in the California Irrigation Management Information System, detailed soils information (SSURGO) from the NRCS, and high resolution land use data were needed. The results showed that DDT and its isomers and metabolites follow 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 temporary filters, with fast transfer rates.
The objective of this work is to present a case study where apparent conflicting results were obtained between US-type soil metabolism and EU-type soil metabolism studies: In the US study, additionally to one major metabolite M, two metabolites (m1 and m2) were considered to be formed directly from the parent in the metabolic pathway proposed by the laboratory in amounts continuously increasing up to around 7% of the applied radioactivity until the end of the one year incubation. These results were contested in the UK studies where only M was identified. Kinetics optimization with ModelMaker software and statistical analysis of the data according to the recommendations of the FOCUS Kinetics Workgroup (2006) were performed.

The experimental data 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
R. Sure1, V. Gourlay, U. Hommen, T. G. Preuss, M. Trapp

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

from the system for water and chemical was plant uptake.

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

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, in particular the limited effectiveness of the existing tools for the predictive assessment of pesticide impacts on water bodies and the insufficient knowledge of the fate and effects of the pesticides applied. This is the main reason why FOOTWAYS (FOOtprint tools for pesticide risk assessment in Europe) project was set up, with the objective of developing a comprehensive approach to the assessment of pesticide impacts on water bodies.

The aim of FOOTWAYS is to develop effective tools for the assessment of pesticide impacts on water bodies. The developed tool should be able to:

- Identify the pesticide sources and the processes responsible for their transport to water bodies.
- Estimate the potential risk of pesticide impacts on water bodies.
- Support the implementation of effective risk reduction measures.

The tool will be applied in the context of the Water Framework Directive (WFD) and will be used to support the implementation of the WFD in France.

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 FOCUSss 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 FOCUSss standard scenarios reflect the "realistic worst case" appropriate.

Given the fact, that the vast majority of water bodies 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 longitudinal extension of an initial substance pulse.

(ii) Pesticide applications on fields along a river stretch affect the whole stretch, in contrast to a static contamination of a water body surface, in case of a contamination of a water body surface, in case of a contamination of the river by agricultural runoff.

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

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

The experimental data 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 105

Plant uptake of eight pesticides / metabolites as a function of log Kow and of pH in a hydroponic test system
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Plant uptake of environmentally relevant chemicals like pesticides is an important process limiting their availability for reaching, run-off and volatilisation. Chemical 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 hydrophobic component (e.g. in the pore water adjacent to the roots) and the concentration in the nutrient solution. The Plant uptake factor (PUF) can be used as input parameter for a realistic leaching assessment.

TU 106

Exposure and risk assessment for pesticide inputs into surface waters via surface runoff, erosion and drainage: developing a new concept for German national pesticide authorization
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The new EU regulation 1107/2009 concerning the placing of plant protection products on the market requires a harmonization of the various national pesticide exposure and risk assessment approaches with each other. As a first step towards harmonization among member states, the German Federal Environment Agency (UBA) launched a project to harmonize the German national exposure and risk assessment procedure for surface waters with the procedure used at the EU level and in various other member
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 protectedness 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 EFSA guidance on soil degradation rates and environmental exposure modelling
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Registration of agrochemicals under the EU Regulation 1107/2009 requires a lot of challenges and numerous guidance documents have been recently issued, thanks to EFSA for a good glacialing of a previous case of the year-by-year assessment, the methodology of the derivation of kinetic parameters linked to the leaching potential in the environment is probably the most advanced in the Regulatory arena world-wide. This poster is dealing with the estimate of DegT50 which has to be used not only for the soil exposure assessment but also for the assessment of potential leaching to groundwaters and surface waters. The question about the calculation of DegT50 is a well-known but frequently misunderstood. Mainly during this process can appreciably affect the results. Usually a minimum of four laboratory studies are required to estimate the dissipation pattern in soils. If the degradation half-life (DegT50) in top soil at 20°C at pH = 2.25 exceeds 60 days additional field dissipation studies need to be conducted.

In the presented work, the degradation of pesticides is affected by the variable factors, i.e. soil moisture and temperature having an significant effect on the bioavailability of the microflora. Normalisation of field degradation data may need to be performed to obtain reliable degradation data parameters and to be used for modelling purposes.

FOCUS (2005 & 2006 & further to FOCUS, 1997) developed general guidance on estimating degradation rate parameters from laboratory and field studies.

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

However, according to EFSA panel, this decline is expected to show a rapid initial phase in the period when surface loss processes play an important role followed by a slower phase that is dominated by degradation rates within the soil matrix.

In the proposed poster, we will show for an existing substance how the methodology is being used (according to the new EFSA (2010) guidance) to derive DegT50 and we will discuss the impact of this new guidance on the results and on exposure estimation.

TU 108
How reliable is the predicted leaching of pesticides into groundwater? - Validation of the FOCUS groundwater model PELMO 4 for use in the German national registration process
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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 simulated leaching concentrations of the FOCUS Hamburg scenario from the latest version of the FOCUS PELMO model (tier 1, 2). Dependencies of pesticide sorption and degradation data from different soil properties as well as the parameter variability are considered in the endpoint selection for modelling, which is in line with the FOCUS recommendations. The measured leachate concentrations for active substances and/or metabolites from outdoor lysimeter studies are accepted as higher tier endpoints in the risk assessment and overwrite predicted concentrations from simulation runs (tier 3). This is generally justified by comparable soil and climate conditions in the Hamburg scenario and compared for substances for which such data exist. Preliminary results are presented and lead to discussions about the reliability of the predicted potential leaching behaviour of pesticides into groundwater in Germany.

Further investigation is planned on the critical points, how the short duration of lysimeter studies in combination with a single application finally affects the prediction of the leaching potential. Methodology of tier 1 and tier 2 simulations with FOCUS PELMO was chosen to derive degradation and sorption values for selected substances and allow a model based extrapolation of the lysimeter results to different conditions, e.g. longer investigation period, multiple application, different application rates and crops. The outcome of the analysis shall indicate under which conditions lysimeter studies can be evaluated as endpoint or as process studies. A proposal, how inverse modelling of lysimeter results can be adequately considered for future regulatory decision making, is thought to be useful with respect to further harmonisation between member states in the EU.

The impact of the rainfall criterion in the new EFSA soil persistence guideline on the results of field degradation trials
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In the new EFSA guidance on soil persistence (EFSA, 2010) it is intended to exclude loss processes on the soil surface (photolysis, volatilisation) for the derivation of field half-lives of pesticides. As a pragmatic approach, it is only sampling points after 10 mm cumulative rainfall should be used to derive DT50. While this rainfall criterion is meant to ensure that processes on the surface are not taken into account for kinetic evaluation of field studies, there is no clear scientific basis for the selected 10 mm rainfall amount. We therefore evaluated which impact the selection of this criterion has on the kinetic analysis based on field studies from different locations across Europe and for different substances. Of those studies which could be evaluated according to the new guidance, a substantial fraction showed different results (DT50) depending on the selected rainfall criterion (e.g. 5 mm, 10 mm, 15 mm, etc). While in some cases only the resulting DT50 varied according to the applied rainfall criterion, in other cases the DT50 was even completely different. We therefore also show the impact of the rainfall criterion on the results of field studies. Hence, this criterion needs to be chosen with care. Studies on the speed of movement of pesticides in the soil, depending on substrate and soil specific properties and rainfall, may help to show how the criteria proposed value of 10 mm is reasonable.

TU 110
InversePELMO: a specific software to perform inverse modelling simulations with FOCUSPELMO 4
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In the assessment for authorisation of a plant protection product its leaching behaviour is an important factor to protect the groundwater. In this context the sorption to soil (Parameter: Koc) and the degradation (Parameter: DT50) are processes that must be taken into account. Recently, the new FOCUS groundwater group suggested a third methodology called the inverse modelling setting (FOCUS 2009). 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 study results. This results in the recorded dissipation patterns (e.g. rainfall, temperatures, percolation, and subsurface fluxes). Therefore all data of a lysimeter study are used to vary the input parameters Koc and DT50 until the leaching model shows the same results as the experiment. Generally, 2 steps have to be conducted when performing inverse modelling simulations. Firstly, the hydrology in soil is optimised, followed by the optimisation of pesticide fate. The software InversePELMO is able to provide both processes and is an open source tool and the simulation model with the necessary input files in the correct format. InversePELMO has also a built-in module to perform standard statistical tests to check the quality of the optimisation such as the determination of the ‘FOCUS error’ at which the chi² error pass as described in FOCUS (2006). It was also tested that PEST works under all relevant windows systems (XP, VISTA and 7) in a 32 bit as well as 64 bit version. The results of InversePELMO can be used to make predictions about the likely behaviour of the substance if it had been evaluated over a longer period, translating the lysimeter results to a different situation with respect to the environmental conditions (e.g. different climate), translations of the lysimeter result to a different situation with respect to the application pattern of the substance (e.g. change of the range), translations of parameter settings for a refined reduced tier 1 simulation.

TU 111
Multi-dimensional modelling of pesticide placement and fate in the soil-root-plant system
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The modelled substance is field applied, including residual herbicides, soil insecticides and seed treatments incorporating fungicides and/or insecticides. They are under intense regulatory pressure with regard to water contamination. The pressure of regulation of pesticides within the EU is such that registrants are examining the option of using application strategies such as seed treatments and slow release formulations as a means of reducing environmental impacts due to off-site movement of pesticides. Experimental approaches for demonstrating environmental benefits of formulation are impractical; each active ingredient is sold in many formulations and the cost of a
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 microparticles and seed treatments). Other models exist that represent individual components of the system in a more satisfactory way. Current models used for pesticide registration within the EU are 1-dimensional and have a simplified representation of root development and uptake of pesticides. Conversely, plant growth and uptake models can have sophisticated representation of plant processes, but often do not consider pesticide dynamics. An ongoing project has created a conceptual framework for representing local pesticide concentrations in the whole soil-plant system, and will next produce a spatially-explicit simulation model. By relating local concentrations of pesticides to product efficacy, it will be possible to use the model to design better active ingredients, formulations and placement strategies. The new model will also enable the environmental benefit of advanced formulations and placement strategies to be quantified in a cost-effective way for the first time. This presentation will introduce the project to the scientific community, overview results from the first year of work, and discuss anticipated outcomes and the potential benefits to the scientific and regulatory communities.

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

TU 112

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 and transport of pesticide in these territories underlines that (1) a minimum of four scenarios (2 soils: arable and nitosol and 2 crops: banana and sugar cane) would be necessary for the risk assessment of the main uses of the French overseas territories and (2) the models to be used for predicting transport of pesticide have to account for preferential flow and specific redistribution of rainfall by crops canopy for banana. For water surface contamination, the module for surface water fate would likely 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 used under test: representing surface and subsurface flow of water and pesticides in banana crops on tropical volcanic soils are summarized and the schedule of a 2 year research project (2012-2014) to adapt them for regulatory purposes introduced.

TU 113

Simulation of the herbicides flufenacet and metazachlor in a lowland catchment with the model SWAT - A sensitivity analysis

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TU 115

Spatial differentiated impact assessment of chemicals in freshwater ecosystem at multiple scales

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

TU 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 flow of obsoles electric and electronic devices is constantly growing, according to a prediction of Zooketman et al. (2010) by 3 to 5 % each year. It is suspected to add up to a volume of 20 to 50 million tons every year (Brigden et al. 2003). A large amount of waste electronic and electric equipment (WEEE) containing a variety of hazardous substances such as Pb, Cd and Pb is shipped overseas to China, India and Western Africa for recycling. In these countries, WEEE is often processed by “informal recycling” without proper equipment for metal extraction, and labor safety. Thus it heavily affects the health of workers and people living in the vicinity, as well as the environment.

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

In the frame of the SFA the following information was gained: a) Global transportation routes and mass flows of WEEE b) Data on the composition of typical e-wastes exports with regard to the European WEEE-Directive categories c) Chemical composition of the single categories with a special focus on lead and brominated flame retardants (PBDEs and TBBPAs) d) Estimated emissions of Pb and PB to the environment as a consequence of different informal recycling techniques. In a second step, results from the SFA were used to a field multimedia fate model that was applied to assess the environmental distribution of the selected hazardous substances and to perform an estimation of human and environmental risk. For this, Guiyu region in China was chosen as a local case site as it is one of the largest informal recycling areas.

References:
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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). Those 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 content. We present first results of a method that uses single-point (CP) or aquatic ecotoxicity characterization factors (CF) for waterborne organic bulk emissions from different industries, based on whole effluent assessment (WEA) and the principles of mixture toxicity. We discuss the advantages of the methodology, its complexity, as well as the need for spatial differentiation, and we present some preliminary results.

TU 118

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

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was over 2 times higher than the acute MRL of chlorpyrifos recommended by ATSDR (3 µg/kg/d) and 1.5 times higher than that recommended by US EPA (5 µg/kg/d), baseline exposure level (0.11 µg/kg/d) (see Figure 1). In comparison with acute guideline doses, the 50th value of post-application exposure among the rice farmers in Vietnam 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 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 (18), from 1 day prior to application and over 5 days post-application, and then analysed for TCP, the main metabolite of chlorpyrifos, using HPLC-MS/MS. Urinary TCP within the TM5-FASST modelling framework, the world is divided into 56 regions. Each region serves as a source region and each grid cell (resolution 1°x1°) of the whole explicit, LCIA methods and characterization factors. 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. The project illustrates how fate and effect model can be integrated to improve the assessment of spatially differentiated impact assessment considerably. 3. Results A detailed comparison will be made between iFs derived by the TM5-FASST model and by 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. 

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TU 119 Environmental impacts of thermal emission to freshwater: Spatially explicit fate and effect modelling S. Pfister1, S. Suh2

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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 emission to freshwater bodies 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 A.N. Muchada1, R. Van Zelm1, M. van der Velde1, E. Schmid1, M. Obersteiner3, M.A.J. Huijbregts3

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Land use is increasing worldwide leading to changes in the ecosystem. To measure these changes allows 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. The aim of our research is to focus on ecosystem service assessment. 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 homogeneous response units characterized by altitude, slope and soil class. Inputs 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.

RA02P - Approaches for comparative hazard and risk assessment of chemicals

TU 121 Health risk assessment of chlorpyrifos with rice farmers in Vietnam T. Phung, D. Connell, M. Chu, G.M. Miller

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Vietnam is an agricultural developing country with over 80 per cent of workers employed in agriculture, mainly rice farming cultivation. Farmers use back-pack reservoirs with hand pumps to apply pesticides, but their knowledge of safety in pesticide application is low. Chlorpyrifos is the most common organophosphate insecticide registered for agricultural use in Vietnam, but health risk assessment of chlorpyrifos use has not been carried out and limited investigation in Vietnam and other developing countries. The relatively few soil ingestion studies underpinning the recommended soil ingestion rates for contaminated site human health risk assessments (HHRAs) that have been conducted to date assessed soil ingestion in children living in urban or suburban areas of the United States, and to a lesser extent, Europe. However, the lifestyle of populations living in North American urban and suburban environments is expected to involve limited direct contact with soil. Conversely, many populations, such as indigenous and Aboriginal peoples residing in rural and wilderness areas of North America and worldwide, practice traditional land use, and participate in activities that increase the frequency of direct contact with soil. Qualitative soil exposure assessments to estimate ingestion rates for Aboriginal populations inhabiting wilderness areas suggest that high levels of soil ingestion (i.e., 400 mg d-1 quantities) may occur, and these levels are many times greater than those recommended by regulatory agencies for use in HHRAs. Accurate estimation of soil ingestion rates is of critical importance for developing effective pest management practices. To date, few studies have assessed soil ingestion rates in the present work follow-up study and previous work included in this study were higher than those currently recommended for HHRAs of adults, and higher than those obtained in most previous studies of adults. However, the soil ingestion rates measured were much lower than earlier qualitative assessments of subsistence lifestyles.

TU 123 Health risk assessment and economic damage due to environmental pollution in a large industrial centre S.V. Klein, N.V. Zaitseva, I.V. May

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A health assessment in Perm, an industrial city in European Russia, has been performed using the WHO methodology. The findings indicate spatially differentiated chronic health impacts. The presence of the above mentioned risks has been proven by the identification of contaminants in the blood of the exposed subjects and the deterioration of laboratory, clinical and functional health parameters. We have revealed a true relationship between elevated levels of acetaldehyde, formaldelyde, manganese, nickel, chromium, etc. and blood, immune, hepatic and other health endpoints.

We have determined reference levels of the chemical compounds in blood, i.e. acetaldehyde - 0.049 mg/dl, formaldelyde - 0.059, benzene - 0.0013, manganese - 0.039, chromium - 0.021, nickel - 0.075 and chloroform - 0.0021 mg/ml. We have identified NOAEL values in the air: Ni - 0.0009 mg/m³, Cr - 0.0011, Mn - 0.0005, formaldelyde - 0.003, acetaldehyde - 0.002, benzene - 0.03 mg/m³; chloroform reference dose in drinking water is 2 mg/l.

We suggest that priority environmental factors (Ni, Cr, Mn, formaldehyde and acetaldehyde) cause 3,246 additional new cases of respiratory diseases. The total economic damage for respiratory disorders is € 1.3 million per year. Acceptable economic risks can be reached by reducing industrial emissions of 19 industrial companies, using traffic optimisation and clean fuel and improving the water supply system quality and water treatment.

TU 124

Snail watch: a tool to assess the risk of metal transfer taking into account their bioavailability


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Current evaluation of soil quality, generally based on physico-chemical characteristics, does not integrate the biological aspect and so the risk of metal transfer to organisms. The assessment of biological soil quality assessment allows evaluating the bioavailability of metals and then their risk of transfer.

The aim of this study is to firstly determine the internal concentrations of reference (CIRef) of metallic contaminants (Cd, Pb, As, Cu, Cr and Zn) in Cantareus aspersus snails. Then, CIRef are used to identify abnormal metal transfer to snails. Secondly, to estimate the soil characteristics influence on metal accumulation using multivariate equation. The last objective is to establish a simple procedure to Evaluate the Risk of Transfer of Metals (ERITME) to snails to determine management priorities that take into account physico-chemical and biological parameters of metal bioavailability.

CIRef have been established on the basis of concentrations in the snails exposed on polluted sites for 28 days i.e. snail watch. In snails exposed on other sites, when the values did not fit, the concentrations of the same element were fitted in the equation. For the objective to establish a simple procedure to evaluated the Risk of Transfer of Metals (ERITME), we propose that critical information distributed across different studies should be evaluated with a weight of evidence approach, e.g. Gross et al. (2011). This should increase the scientific quality of environmental risk assessments of substances, e.g. in Environmental Quality Standard (EQS) derivation for metals in EU and USA: a comparison using copper.
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 parameter groups concentrations are at a level which is of long-term concern for environmental safety as well as human health perspective, e.g. compared against actual communication to maintain public trust and to give unambiguous guidance for improved risk management.

Once normalized for bioavailability safe threshold concentrations are calculated as the lower 5th percentile of 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 ESS setting will be illustrated using Cu as an example. EQS for different surface waters (with different bioavailabilities) will be illustrated.

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 need for clear assurance of harmonization of frameworks as highlighted by the OECD.
Sampling site Elbe/Blankenese near Hamburg harbor which represents the passage of the Elbe into the North Sea and is tidal influenced. Here, lowest concentrations for all. Therefore, the most important task concerning D. polymorpha as a biomonitoring tool is to:
- find out the differences in how substances accumulate in D. polymorpha and D. bugensis;
- develop a method to differentiate unequivocally between both species for large samples.

Within the observation period significant reductions of B[α]A, B[ε]P and B[α]P concentrations in the river Rhine could be observed.

Of interactions between the global environment trends and the 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 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 established 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 elements in marine regions
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Sealium 2nd and arsenic occur naturally in the environment but they are also known to be toxic in excess of trace levels. During the 1990s, elevated concentrations of arsenic were reported in liver tissue of ringed seals taken by Alaska Native hunters in Norton Sound, Alaska. To determine whether eggs of colonial seabirds might be good monitoring matrices for both arsenic and selenium in marine regions, Alaska, total arsenic (As) and selenium (Se) mass fractions were measured in 78 seabird egg samples collected in 2006 and banked at the US Marine Environmental Specimen Bank (Marine ESB). These eggs were collected from several colonies located within Norton Sound as well as long-term monitoring sites in two other major Alaska marine regions, St. Lazaria Island in the Gulf of Alaska and St. George Island in the Bering Sea and were from three species: common murre (Uria aalge), thick-billed murre (U. lomvia) and glaucous gulls (Larus hyperboreus). Egg samples were analyzed using collision cell kinetic energy discrimination inductively coupled plasma atomic emission spectrometry (ICP-MS). Total arsenic mass fractions ranged from 0.015 µg/kg to 0.330 µg/kg while the levels of Se were generally lower than 0.001 µg/kg to 1.017 µg/kg. As and Se levels were higher in most of the samples collected from the Norton Sound colonies compared to other colonies. Norton Sound is located in a highly mineralized region of Alaska and is an area of historical gold-mining that continues today and could be a contributing factor to the bioaccumulation of arsenic and selenium in this region. In addition, As mass fractions were also measured in 43 common murre and glaucous gull eggs collected in 1999, 2000, and 2005 from colonies located throughout the Bering Sea, including 4 of the same sites as those depicted in 2006. The As mass fractions ranged from 0.065 µg/kg to 0.349 µg/kg and were also more elevated in the Norton Sound colonies than other colonies in the Bering Sea. The data reported here illustrates that seabird eggs can be a useful monitoring tool to help determine geographic patterns of trace elements in marine regions, specifically the sub-Arctic regions of Alaska.

TU 136
Specimen security in long term specimen banking - zebra mussel example in the German ESB
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In the past few years many areas have seen a dramatic drop in zebra mussel numbers. Now, out of nowhere, what was once a successful model for monitoring waters is endangered because of a sufficient number of specimens for large samples. A possible cause is the reeding eutrophication level of the waters and the resulting lack of food. Another invasive species, the quagga mussel (Dreissena bugensis), which has a stronger presence in many areas, is increasing the pressure on the zebra mussel populations too. Recent research has also shown that fertile hybrids between D. polymorpha and D. bugensis are possible in the wild, making biomonitoring even more difficult. It has however been observed that accumulation in both species is also different, which is why D. bugensis and hybrids of both species have to be excluded from the results of monitoring studies using D. polymorpha for them to be comparable.

Investigations into the current significance of the zebra mussel in long-term monitoring projects and environmental specimen banking programs in the German ESB show that the hybridized mussel gives: This makes clear that, although there is no component of the limnic sample set. Loss of this sample type would result in a huge loss of information.

Therefore, the most important task concerning D. polymorpha as a biomonitoring tool is to:
- find out how substances accumulate in D. polymorpha and D. bugensis;
- discover whether there are wild hybrids; and
- develop a method to differentiate unequivocally between both species for large samples.

TU 137
Organic compounds in suspended particulate matter - results from the German environmental specimen bank
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Since 2003 suspended particulate matter (SPM) in the river systems of Rhine and Elbe has been sampled, processed and archived in the frame of the German Environmental Specimen Bank (ESB). Sampling is carried out with sedimentation boxes which are emptied monthly. At the end of the year monthly samples are lyophilized and pooled to a homogenate. From every homogenate about 200 subsamples are produced and stored in the ESB. The whole processing is conducted under deep frozen conditions. Some sub-samples are chemical characterized for inorganic substances, CHC's and PAH's.

The results of the five years period 2003-2009 show considerable differences between the two river systems. The concentrations of PAH's as well as of PCB's and Dioxins increase downstream the river Rhine whereas in the Elbe system only few differences of concentration are observed between the single sampling sites. One exception is the sampling site Elbe/Blankenese near Hamburg harbor which represents the passage of the Elbe into the North Sea and is tidal influenced. Here, lowest concentrations for all substances are observed. For the most substances the concentrations at Blankenese are less than 20 % of the concentrations at the other sampling sites. This is probably caused by dilution of the Elbe water with salt water of the North Sea.

With exception of Elbe/Blankenese concentrations for most substances are significantly higher in the river Elbe compared to the river Rhine. Especially the concentrations of Dioxins and HCH's are much higher in SPM from the Elbe than in SPM from the Rhine.

Within the observation period significant reductions of B[a]A, B[e]P and B[a]P concentrations in the river Rhine could be observed.

TU 138
Standardized freshwater mussel watch for monitoring of aquatic environments: implications and possibilities
J. Yang
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Mussel Watch is one of the most effective approaches to study the dynamics of aquatic pollution. Unfortunately, it is usually limited to the depending on collection sites. Based on our pilot research, we propose the concept of “standardized” biological indicator mussel (e.g., Anodonta woodiana) is first established by artificial propagation techniques, which possesses the similar biomimetic characteristics, genetic quality, and low background of environmental pollution. Subsequently, the standardized mussels with the same size will be transplanted to some typical regions as the “critical groups’, and the rest as the ‘control groups’, respectively. Consequently, a comparative assessment on temporal and spatial dynamics of pollution and bioaccumulation of persistent toxic substances (e.g., heavy metals, organic pollutants, natural toxicants) can be investigated with system error at a much smaller level and without destroying the wild mussel population. At the same time, a living individual pool of glochidia, juvenile, and adults can be established for exposure and toxicological studies, in order to assess the reliability of the field works and understand the corresponding impact degree, tolerance mechanism, and stress threshold.

Present the study will make it possible to setup the world’s first ‘Freshwater Mussel Watch’ system, the standardized living individual pool and environmental specimen bank of Anodonta woodiana, for special use on conservation and investigation of freshwater fishery environments.

TU 140
The impact of high discharge on sediment quality in the Elbe estuary
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2SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting

TU A06P - 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, DDT 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 is resuspended and carried downstream. For some compounds, 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 characterized by the Hamburg Port, the second largest port in Hamburg, about 100 km upstream of the mouth of the river. Even though the river 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 applied to determine the sampling site. Elevated discharge did not lead to any significant increase of contamination fluxes may be recorded. Long term projections of regional climate models are variable and tend to predict more extreme rainfall and dry episodes but with a limited overall increase in river discharges and suspended particulate matter (SPM) loads to the North Sea. To study the possible impact of climate change on the quality of urban and coastal waters, a battery of in vitro bioassays was applied to determine the toxicity profiles of environmental samples collected during climate change related events. SPM and sediment samples were collected in rivers from Norway, Sweden, Denmark, Germany, and The Netherlands during periods of dryness, flooding and extreme run-off. In addition, passive sampling was performed using silicone rubber sheets to evaluate the effects on dissolved contaminants. Extracts from SPM and passive samples were tested for respiratory toxicity (Microtox), dioxin-like activities, (anti)androgenic, (anti) estrogenic, and thyroid hormone-like activities, and for mutagenicity. Variable patterns of both increased or decreased toxicity in relation to discharge conditions were noted between rivers and different years within rivers. Marked increases of toxicity were noted for episodes of melting of "black snow" (Akerselva river, Oslo) and overflaw 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 methods 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 DiPol 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.

TU 141
toxicity of suspended matter and sediments in relation to contaminant load and expected effects of climate change on European rivers
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Deltas, Delta, Nederland

Climate change may not only affect river water discharges in terms of water quantity, but also in terms of water quality. During flooding periods, for instance, higher water discharges may cause a dilution of normal pollution levels, while on the other hand, higher discharges may also result in an increased mobilization of polluted sediments and in run-off from possibly polluted flood plains and inundated urban areas. During high water episodes huge increases of contaminant fluxes may be recorded. Long term projections of regional climate models are variable and tend to predict more extreme rainfall and dry episodes but with a limited overall increase in river discharges and suspended particulate matter (SPM) loads to the North Sea. To study the possible impact of climate change on the quality of urban and coastal waters, a battery of in vitro bioassays was applied to determine the toxicity profiles of environmental samples collected during climate change related events. SPM and sediment samples were collected in rivers from Norway, Sweden, Denmark, Germany, and The Netherlands during periods of dryness, flooding and extreme run-off. In addition, passive sampling was performed using silicone rubber sheets to evaluate the effects on dissolved contaminants. Extracts from SPM and passive samples were tested for respiratory toxicity (Microtox), dioxin-like activities, (anti)androgenic, (anti) estrogenic, and thyroid hormone-like activities, and for mutagenicity. Variable patterns of both increased or decreased toxicity in relation to discharge conditions were noted between rivers and different years within rivers. Marked increases of toxicity were noted for episodes of melting of "black snow" (Akerselva river, Oslo) and overflaw 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 methods 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 DiPol 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.

TU 142
the effects of CO2 leakages from marine stable geological formations on the mobility and availability of metals
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Carbon dioxide capture and storage (CCS) in marine sub-sea geologic formations, is already contemplated in international conventions as a mitigation measure to reduce the concentration of CO2 in atmosphere. Although this technology is currently considered to be technically feasible there is lack of information on the environmental impacts. CO2, Sorpape is highly soluble in the sediment, sediporp core, pore water, sediment-wa eating interface and finally in the water column. Increase in acidity will lead to several biogeochemical alterations that can result in detriments effects in the ecosystems. Changes in the solubility, speciation, mobility and bioavailability of trace metals is expected as a direct result of pH decrease.

Laboratory-scale experiments were performed, involving direct release of carbon dioxide into sediment, inside non-pressurised chambers, in order to provide data on the possible effects of CO2 leakage from geological storage sites on the fate of several metals. Marine sediments from two contaminated sites located in the south of Spain were collected to allow discrimination by means of different sampling techniques. The test lasted 14 days and samples were collected on the beginning and end of the experiment for metal analysis. The results revealed that mobility of metals from sediment to water column depends on the site, metal and time. Metals concentrations generally increased with time of exposure to CO2 injection. Within the metals tested zinc, copper, cobalt, lead and iron were most greatly influenced by acidification.

TU 143
Changes on the biogeochemistry of synthetic surfactants from river to marine sediments
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Aquatic systems are subjected to the influence of both urban and industrial wastewater discharges, which are among the main sources of organic contaminants. Due to their extensive use in a wide variety of applications, significantly high concentrations of surfactants can be found in wastewater. Once they reach water bodies, a significant fraction of these compounds 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 millimetres to centimetres depending on the aquatic system. In this work we have studied the diagenetic fate of the most commonly used surfactants: alcohol polyethoxylates (AEOs) and nonylphenol polyethoxylates (NPEOs), both non-ionics, and linear alkylbenzen sulfonates (LAS) and alkyl ethoxysulfates (AES), both anionics. Their concentrations in sediment and pore water were determined along the sedimentary column by sampling cores in three different aquatic systems from SW France: the salt-marsh environment of the Bay of Cadiz, the middle stretch and the estuary of the Guadalete River, and the Borrón water area. The non-limiting 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 18 mg/kg). The most remarkable result was that sulphonated 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 sulphate-reducing 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 AEO and NPEO ethoxylated chains were observed along sediment cores from any type of aquatic system, suggesting that their biodegradation is very limited in anoxic conditions. This may be directly related to the lower bioavailability of these surfactants as their calculated sediment pore water distribution coefficients showed much higher values when compared to those for most polari surfactants anionic (e.g., 553 ± 98 for NPEOs vs. 11 ± 7 for AES).
Influence of feeding type and behaviour on whole sediment toxicity tests with the oligochaete Lumbriculus variegatus


'Ghent University, Ghent, Belgium
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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 no additional feeding during the exposure (SED+) and (ii) daily feeding with TetraMin (TetraMin). This 4x2 design experiment was set up to test the hypothesis that feeding characteristics can affect the performance, response to toxicants and internal toxicant distribution of L. variegatus.

No adverse effects were noted in the TetraMin treatment, while in the SED+ treatment the total number of worms and biomass was significantly reduced at 560 µg g-1 and 1800 µg g-1 Zn and both feeding regimes were burdens for the organisms. The number of worms increased only at 1800 µg g-1 (SEM+Zn-AVS50). Overall, the results show that despite similarity in Zn bioaccumulation between two 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 not accompanied with Zn bioaccumulation were observed at 180 and 560 µg g-1. Feeding inhibition resulting from an avoidance reaction to contaminated food material 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 micro-X-ray fluorescence (XRF). The results show that in worms fed via the sediment, Zn is mostly associated with epithelium 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 epidermis and sub-epidermis of L. variegatus, confirming the role of dissolved Zn as the predominant exposure route when SEMZn-AVS>0.

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by means of chemical and ecotoxicological approach the toxicity of the sediments of this river, and their elutriates, in a region downstream Três Marias reservoir, in a site near a processing industrial plant for this, a battery of three laboratory bioassays, using two cladoceran (Daphnia similis and Ceriodaphnia dubia) and one amphipod (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 fractionation methods (by means of assessment of sediments from 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 present high levels of toxicity, although the hydrodynamic of the river plays an important role in the metal distribution and consequently in the toxicity of the sediments.

TU 152

Ecotoxicological assessment of sediments from rivers impacted by a petroleum refinery
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2Centro Interdisciplinario de ciencias marinas IPN, La paz, b.c.s., Mexico

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 microtoxicity bioassay. 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 observed, indicating the presence of toxic compounds at sites near Punta Prieta and Cacimbat, sediment toxicity decreases with increasing distance from these points. This fact possibly indicates a contribution of harmful compounds probably from Punta Prieta and La Paz city to the Bay of La Paz. This type of analysis is essential to identify areas of risk in studies of environmental analysis.

TU 154

Seasonal variation of toxicity and genotoxicity of sediments samples of the Ensenada de la Paz, B.C.S. Mexico
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More than 400,000 tonnes of pure arsenite are scattered in the area of the El Triunfo gold ore mine, in the southern most Baja California peninsula, Mexico. The drainage basin, from which sediments were collected for this study, discharges into the Pacific Ocean, however, the river is dry most of the year, only occasionally filled during tropical hurricanes in summer. This coastal system receives a continuous contribution of toxic compounds due to mineral extraction in the area. The purpose of this study was to evaluate the toxicity of the sediments and the level of metal pollutants in order to determine the environmental risks. Heavy metals were determined in conjunction with sediment toxicity testing using Daphnia magna, Selenatum capricornatum and seed-germination bioassay analysis. The Sediment Quality TRIAD (SQT) was used to identify areas in the system where sediment contamination may be linked to ecosystem degradation. A multivariate analysis was carried out and indicated that the results showed clear separation from the material that is not more polluted. The results of the centres nearest to the alteration zone were severely polluted. These results suggest that there are health risks to human populations and activities such as vegetable and cattle farming or rural touristic recreation in the area. In order to restore the alteration zone to healthy conditions a remediation program would be necessary.

TU 155

Bioassays in sediment assessment for investigative monitoring in the context of the WFD
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An intense industrial activity has been taking place in Wallonie (Belgium) since the Middle Ages. The proximity to major waterways has enhanced the industrial development and is the source of aquatic environment. Sediments are known for their ability to trap pollutants and release these substances years or even decades after their 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 failing to achieve the environmental objectives. They integrate all contaminants effects including additive and synergistic effects of unknown substances and breakdown products.

A sediment quality current monitoring throughout the Wallon 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, Heterocercys 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 the way of exposure (ingestion, tegumentary contact) and because they represent different trophic levels (decomposer, producer or consumer).

Among the sediments of 10 studied stations in 2010, four showed a relatively low toxicity toward several organisms of the bioassays battery (the Wiltrz, the Sure, the Geuelle and the Rhônes), 3 showed low toxicity toward one of the organisms (the Oise, the Maligne and the Eau d’Heure) and 3 showed no signs of toxicity (the Bièvres the Marne and the Eure). Even 2 non-toxicities exceed the maximum acceptable values as defined by decree of the Wallon Government. Results of the 2011 monitoring program will also be presented.

TU 156

Ecotoxicological assessment of contaminated rivers as a proxy for the water framework directive: an ecoindication drainage sample
D.S. Vidal1, J.L. Pereira1, N. Abantes1, A.M.V.M. Soares2, F. Gonçalves2
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Metal contamination of freshwater water bodies resulting from mining activities or deactivated mines is a common environmental problem in Portugal. Despite authors recognize the importance of the problem, the establishment of specific criteria to define the ecotoxicological impact of the contamination and the magnitude of the environmental risk is still under development. The present study evaluated the ecotoxicological and genotoxic effects of sediments from the river course of the Vouga River. Some results are presented with the aim of contributing to the establishment of specific criteria for the assessment of the environmental impact of contaminated rivers. The results showed that the sediments from the Vouga River contained metals at levels that may have the potential to impact the environment.

The objectives of this study were to evaluate 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 and chemicals, and chemical analyses, among these results were 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.

TU 157

Assessment of effects of agro-chemicals use in ecological status of Kilombero Flood Plain, Ramsar site
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2Hamburg University of Applied Sciences, Hamburg, Germany

Tanzania is rich in waterfowl resources with an estimated 10% of the land surface covered by significant freshwater wetlands providing essential ecosystem and livelihood supports to the surrounding people. These wetlands include some of the most important for water-birds, flora and fauna, the Kilombero flood plain. The Kilombero flood plain is severely affected by agriculture and agro-chemicals, and is also affected by the mining activities in the area, thus destroying the ecological functions of wetlands. Tanzania ratified to the Ramsar Convention on 2002, as a commitment to maintain the ecological character of its wetlands and to plan for the sustainable use of all other wetlands in the country. The Kilombero Valley, designated in the same year, is among four (together with Terra Nostra, Ilha de Santiago and Zambujeiro) of the 18 Ramsar wetlands in the country. The Kilombero Flood Plain 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 human settlement in the valley has increased, parallel with the socio-economic activities such as livestock keeping, fishing, cultivation, and bee keeping. The agro-pastoralism, large and small scale cultivation of rice and sugar cane with an intensive application of diverse arrays of pesticides, is a major threat to this valley ecosystem. However, little is known about sediment chemical contamination and pesticide load of Kilombero wetlands. This is the first study to investigate the potential impact of toxic chemicals, especially agrochemicals, on the sediment-water quality of this flood plain. During a first survey, screening of the region for hot spots will be done by applying selected bioassays that are sensitive to pesticides contaminated sediment and water samples. In a second tier, chemical analysis of those samples identified as 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.

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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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1, 2, 3Department of Environmental and Life Sciences, Istanbul Technical University, Istanbul, Turkey

Sediment samples were collected from the Nemrut Bay. The metal concentrations were analyzed by atomic absorption spectrophotometry. The results showed that the most abundant metal was Cu followed by Zn, Pb, Cd, and Cr. The heavy metal concentrations were higher in the surface sediments than in the deeper ones. The enrichment factor (EF) was calculated to assess the pollution level. The EF values were found to be greater than 5 for Cu, Zn, and Pb, indicating that these metals are of anthropogenic origin. The EF values for Cd and Cr were lower than 5, suggesting a natural source of these metals. The pollution load index (PLI) was also calculated, and the results showed that the sediments of the Nemrut Bay are moderately polluted by heavy metals.

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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2Baltic Sea Research Institute, 18119 Rostock, Germany

The study aimed to determine the ecotoxicological effects of persistent organic pollutants (POPs) from sediment cores of the Baltic Sea. The POPs investigated were polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), and hexachlorobenzene (HCB). The POP concentrations were measured using a combination of chemical measurements and aquatic toxicity testing. The chemical analysis was performed using gas chromatography-mass spectrometry (GC-MS). The aquatic toxicity testing was done using the Daphnia magna assay. The results showed that the POP concentrations were highest in the sediment from the southern part of the Baltic Sea. The POP concentrations were found to be higher in the sediments from the deeper parts of the sea. The aquatic toxicity testing showed that the POPs had toxic effects on the Daphnia magna, with the highest effects observed for the PCBs.

TU 160
Triad approach for risk assessment of sediment and floodplain soil of a metal-polluted stream
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1Alterra, Wageningen UR, Wageningen, Nederland
2University of Applied Sciences Hamburg, Hamburg, Germany

The study aimed to assess the risk of heavy metal pollution in a metal-polluted stream using a triad approach. The triad approach consists of chemical analysis, biological effects, and physicochemical properties. The chemical analysis was performed using inductively coupled plasma mass spectrometry (ICP-MS). The biological effects were studied using Chironomus tentans. The physicochemical properties were studied using scanning electron microscopy (SEM). The results showed that the metal concentrations in the sediment were high, and the sediment was toxic to the Chironomus tentans. The SEM showed that the sediment contained fine particles, which could affect the metal bioavailability.

TU 161
Hexachlorobenzene-contamination of sediments of the Upper Rhine River - identification of sorbents to assess bioavailability
E. Boekh1, T. Pohler1, R.A. Duing2

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2Federal Institute of Hydrology (BfG), Koblenz, Germany

The study aimed to identify the sorbents responsible for the bioavailability of hexachlorobenzene (HCB) in sediments of the Upper Rhine River. The sorbents were identified using scanning electron microscopy coupled to energy-dispersive X-ray spectroscopy (SEM-EDS). The results showed that the HCB concentrations were highest in the fine sediment fractions. The identification of sorbents is important for assessing the bioavailability of HCB.

TU 162
River sediment sampling and environmental quality standards
U. Mokwe Oronzedi1, S.H.A.R.R Mceldowney1, I. Foster1, E.V.A. Valsami-Jones2

1University of Westminster, London, United Kingdom
2Natural History Museum, London, United Kingdom

Sediment sampling is important for assessing the environmental quality of rivers. The study aimed to evaluate the environmental quality standards (EQS) for sediments of the River Thames, London, UK. The EQS were calculated using the chemical composition of the sediments. The results showed that the sediments met the EQS for most of the contaminants.

TU 163
The first sight into contamination of Polychlorinated biphenyls and Polybrominated diphenyl ethers in sediments of Tam Giang-Cau Hai Lagoon, Central Vietnam
T.H. Pham1, 2, N.M. Tieu1, G. Suzuki1, S. Takahashi1, S. Tanabe2

1Center for Marine Environmental Studies (CMES), Ehime University, Ehime, Japan
2National Institute for Environmental Studies, Tsukuba, Japan

The study aimed to assess the contamination of polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs) in sediments of Tam Giang-Cau Hai Lagoon, Vietnam. The sediments were sampled using a grab sampler. The PCB and PBDE concentrations were analyzed using gas chromatography-mass spectrometry (GC-MS). The results showed that the PCB and PBDE concentrations were highest in the sediments from the southern part of the lagoon. The contamination was found to be higher in the sediments from the deeper parts of the lagoon. The contamination was found to be higher in the sediments from the deeper parts of the lagoon.
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 congeners, followed by nona- and octaBDEs, indicating DecBDE as the major technical mixture in consumer products in this region. In general, the levels of PCBs and PBDEs in lagoon sediments were comparable with those reported in other rivers and 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 DecBDE in the lagoon system might not be an indicator of long-term resource risk to the environment.

RA0A7P - 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

G.F. Wang, H. Zeng, L. Zhang

China Institute of Water Resources and Hydro-power Research, Beijing, China

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 results showed that the major PCB congeners were PCB153, 28, 52, 118, 156, 180, 209, 232, 238 and 283. In the mainstream, PCB 28, phenol, o-cresol, and 2-nitrophenol are the most predominant compounds in the samples from tributaries, PCBs, 28, phenol, o-cresol, and 2-nitrophenol are the most dominant compounds in those from mainstream. The detected level of PCBs in the samples from the tributaries and the mainstream were 20.71 ng L-1 and 13.25 ng L-1, and the measured level of phenols from the tributaries and the mainstream were 246.40 ng L-1 and 117.53 ng L-1, respectively. The highest concentration of PCBs and phenolic compounds were detected separately in the samples from Rangdu River (61.79 ng L-1) and Jialing River (172.37 ng L-1). The average concentrations of PCBs and phenolic compounds were in the same order of magnitude of those 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 a 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 between a bay (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 target the labile trace metals (Cu, 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 conducted with Principal Component Analysis (PCA) and Factor Analysis (FA) were employed. This is to be able to identify the patterns 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 achieved as well. Percent concentration of each element 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 contributions were found near mid to upstream. While for Period 3, highest rank is near at the downstream. From this analysis, local sites to locate that can be given more priority and attention. Fluxes (in kg d-1) were provided as well. Period 2 having the highest flux gave the highest fluxes per site.

TU 168 Dioxin-like compounds in Portuguese estuaries: levels and patterns in superficial sediments

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

G.F. Wang, H. Zeng, L. Zhang

China Institute of Water Resources and Hydro-power Research, Beijing, China

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 results showed that the major PCB congeners were PCB153, 28, 52, 118, 156, 180, 209, 232, 238 and 283. In the mainstream, PCB 28, phenol, o-cresol, and 2-nitrophenol are the most predominant compounds in the samples from tributaries, PCBs, 28, phenol, o-cresol, and 2-nitrophenol are the most dominant compounds in those from mainstream. The detected level of PCBs in the samples from the tributaries and the mainstream were 20.71 ng L-1 and 13.25 ng L-1, and the measured level of phenols from the tributaries and the mainstream were 246.40 ng L-1 and 117.53 ng L-1, respectively. The highest concentration of PCBs and phenolic compounds were detected separately in the samples from Rangdu River (61.79 ng L-1) and Jialing River (172.37 ng L-1). The average concentrations of PCBs and phenolic compounds were in the same order of magnitude of those 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 169 Environmental monitoring and assessment of Terminos Lagoon, Mexico

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Terminos lagoon is an estuary in the Gejiglia-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 an additional activity, such as urban waste water, and agriculture, are also important inputs of pollutants to the Gulf. All these activities introduce hazardous compounds such as metals, hydrocarbons, pesticides, etc.

As one of the components of the Sustainable Management of the Gulf of Mexico Large Marine Ecosystem, the pilot project on monitoring and environmental assessment selected Terminos as the site to study. The project consists of five modules: water quality, sediment quality, contaminants and biomarkers in fish, benthic community, and habitat degradation. The results are categorized as good 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 organic contaminants no significant differences were observed comparing the sites. PCBs and PBDEs concentrations are variable not only between estuaries but also within each estuary. In general, the highest values were found at sites near large populations and industrial complexes (e.g. Lagos, Tagus, de Aveiro and Sado). The lowest PCBs and DL-PCBs volumes were detected in Ria Formosa, a protected area with strong tidal effects. OCDD is the most abundant PCDD/F congener in all the samples but PeCDD or PeCDF were the major contributors to WHO-PCDD/F-TEQ2005. For PCBs and DL-PCBs concentrations are variable not only between estuaries but also within each estuary. In general, the highest values were found at sites near large populations and industrial complexes (e.g. Lagos, Tagus, de Aveiro and Sado). The lowest PCBs and DL-PCBs volumes were detected in Ria Formosa, a protected area with strong tidal effects. OCDD is the most abundant PCDD/F congener in all the samples but PeCDD or PeCDF were the major contributors to WHO-PCDD/F-TEQ2005. For PCBs and DL-PCBs concentrations are variable not only between estuaries but also within each estuary. In general, the highest values were found at sites near large populations and industrial complexes (e.g. Lagos, Tagus, de Aveiro and Sado). The lowest PCBs and DL-PCBs volumes were detected in Ria Formosa, a protected area with strong tidal effects. OCDD is the most abundant PCDD/F congener in all the samples but PeCDD or PeCDF were the major contributors to WHO-PCDD/F-TEQ2005. For PCBs and DL-PCBs concentrations are variable not only between estuaries but also within each estuary. In general, the highest values were found at sites near large populations and industrial complexes (e.g. Lagos, Tagus, de Aveiro and Sado). The lowest PCBs and DL-PCBs volumes were detected in Ria Formosa, a protected area with strong tidal effects. OCDD is the most abundant PCDD/F congener in all the samples but PeCDD or PeCDF were the major contributors to WHO-PCDD/F-TEQ2005.
Monitoring of sediments genotoxicity of the Yucatco, lagoon Tab, Mexico
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University of Sydney, Sydney, Australia

Metal availability and toxicity in estuarine systems in relation to chemical speciation and biological diversity
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University of Antwerp, Antwerp, Belgium

Risk assessment is currently underway for a contaminated site in Northern Ireland with a wide variety of compounds of potential concern. In accordance with the UK CLR11 framework for management of contaminated sites, risk assessment is integral in leading the site from investigation to remediation, with the aim of protecting human health and the environment and obtaining a “suitable for intended use” outcome. An important feature of this site is its close proximity to an Area of Special Scientific Interest (ASSI), a Special Protection Area (SPA) and a Ramsar site. Being adjacent to such sensitive receptors, the ecological risk management approach for this site is a high priority.

This work aims to present some of the lessons learned in ecological risk management at the site, including:

- 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.
- There was a need for developing changes in ecological parameters. Parallel to this are changes in the physiological organisation of the biological 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 biotransport and metal toxicity was studied under controlled conditions in a series of structurally and functionally different ecosystems. The results were used to feed a numerical model to simulate across species diversity. For some metals, such as cadmium, where a strong inorganic metal speciation effect is observed a species sensitivity distribution analysis shows a decrease in metal toxicity moving from freshwater to higher trophic levels. On the other hand, for metals showing a strong affinity for organic ligands such as humic substances, metal toxicity increases from freshwater to higher salinity environments. However, this is not the case for a metal such as copper and in any case the effect is considerably less than what would be expected on the basis of the changes in free metal ion activity. The results of these observations are further discussed in relation to the ion and osmoregulatory constraints of the different species and whether or not normalization of metal availability and toxicity on a free metal ion activity scale is warranted for risk assessment purposes in estuarine gradients.

Integrated estuarine modeling to support watershed management for salmon and dyes inlets, Puget Sound, WA, USA
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The effect of integrated watershed management plans on the abundance and distribution of salmon and dyes inlets in Puget Sound, WA, USA was assessed using a physically-based water quality model. The model was applied to the study of the relationships between watershed management practices and potential impacts on salmon and dyes inlets. The model was calibrated using observed data from the study area and was validated using independent data sets. The results showed that the model was able to accurately simulate the effects of watershed management practices on salmon and dyes inlets. The model was able to predict the response of the system to changes in land use, climate, and other factors. The results of this study demonstrate the potential of integrated watershed management to improve the health of salmon and dyes inlets.
group in freshwater fish, 14.4% in the 8 ppt and no mortality in the 17 ppt salinity treatment groups indicating protection by hypersaline conditions from acute lethality. However, significant differences were not observed in the 8 ppt and 17 ppt salinity treatment groups indicating protection by hypersaline conditions from acute lethality. 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.

TA 181 Sediment contact test with Myriophyllum aquaticum (ISO/CD 16191): first results of an international ring test U. Feiler Federal Institute of Hydrology, Koblenz, Germany 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. 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). 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

TA 182 Germoplasm more ecologically relevant data from laboratory tests: recovery potential of Lemna minor V.Z. Knezevic, T.O. Tonic, P.L. Marjan, M.S. Kezunovic, I.S. Teodorovic Faculty of Sciences, Novi sad, Serbia 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 one of the representatives of a range of standardized 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. 2008) the standard test protocol with Lemna could be adapted by a) adding a recovery phase after the exposure phase and b) allowing observations and measurements (in 3 days long intervals) during the whole study. The suitability of adapted protocol has been tested on three substances with different mode of action: standard reference substance for Lemna (3, 5 DCP in concentration range 0.625-10 mg/l), and two herbicides - isoproturon and trifluralin (in concentration range 0.01 - 1 mg/l). The results indicate that adding the 7 days long recovery phase after the exposure phase is suitable adaptation of the standard test protocol. Frequent observations and measurements during the whole study, particularly during the recovery phase, can provide a better understanding of response and recovery patterns. Relative growth rate calculated for the last 3 day long interval of the study (Last interval RGR) proved to be a suitable and sensitive end point which might provide good indication of plant recovery potential after exposure to toxic compounds. Estimation of recovery potential of directly from suitable laboratory tests will add more ecological realism into worst case scenario typically obtained by single species laboratory toxicity test but also provide valuable data for population - level models. TA 183 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 Camborne School of Mines, Camborne, United Kingdom A number of new developments in mesocosm testing have taken place since the most recent revisions to guidance for these complex studies (e.g. HARP, 1998 & CLASSIC, 1998). Much of this progress in the past 3 years since this guidance was produced has been in the design and conduct of freshwater mesocosm studies to evaluate the toxicity of herbicides to fish, algae, periphyton and macrophytes. This presentation 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 herbicide exposure on a variety of macrophytes with different morphology and life histories. We will also provide recommendations for the evaluation of effects of algal 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 more tier aquatic ecotoxicology.

TA 184 Unforeseen effects of herbicides on wetland and terrestrial plant communities: time to vegetative and reproductive recovery following exposure D. W. Wood, DMIT, Ottawa, Canada Environment Canada, Ottawa, Canada 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 sulfonylurea herbicide chlorimuron ethyl. Eight wetland and nine upland species were tested with eight doses of chlorimuron (± controls) ranging from 1 to 100% of the recommended label rate range 0.625-10 mg/l), and two herbicides - isoproturon and trifluralin (in concentration range 0.01 - 1 mg/l). The results indicate that adding the 7 days long recovery phase after the exposure phase is suitable adaptation of the standard test protocol. Frequent observations and measurements during the whole study, particularly during the recovery phase, can provide a better understanding of response and recovery patterns. Relative growth rate calculated for the last 3 day long interval of the study (Last interval RGR) proved to be a suitable and sensitive end point which might provide good indication of plant recovery potential after exposure to toxic compounds. Estimation of recovery potential of directly from suitable laboratory tests will add more ecological realism into worst case scenario typically obtained by single species laboratory toxicity test but also provide valuable data for population - level models. The suitability of adapted protocol has been tested on three substances with different mode of action: standard reference substance for Lemna (3, 5 DCP in concentration range 0.625-10 mg/l), and two herbicides - isoproturon and trifluralin (in concentration range 0.01 - 1 mg/l). The results indicate that adding the 7 days long recovery phase after the exposure phase is suitable adaptation of the standard test protocol. Frequent observations and measurements during the whole study, particularly during the recovery phase, can provide a better understanding of response and recovery patterns. Relative growth rate calculated for the last 3 day long interval of the study (Last interval RGR) proved to be a suitable and sensitive end point which might provide good indication of plant recovery potential after exposure to toxic compounds. Estimation of recovery potential of directly from suitable laboratory tests will add more ecological realism into worst case scenario typically obtained by single species laboratory toxicity test but also provide valuable data for population - level models.
of 9 ha-1. For each species, two sets of plants were grown: total aboveground plant biomass was assessed at four weeks after exposure for the ST plants (first set) and again for the LT plants (second set) when the controls began natural senescence (7-23.5 weeks post-spray depending on species). To assess recovery over time, measurements of maximum plant height were taken weekly for all species using the LT plants. Reproductive parameters were also recorded for 13 species. Inhibition concentrations (IC50) were 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 (no effect). Plants were affected at doses of 7.4% or less, three fully recovered within an avg. 6.7 weeks post-spray, six recovered up to doses of 14.5% (avg. 6.5 weeks) and three up to doses of 28.2% (avg. 12.3 weeks). Though an overall trend towards recovery was also noted for reproductive parameters (4 spp. recovered, 3 remained the same, 3 unaffected at any dose), rates of recovery did not follow those observed for height. Delayed growth and flowering was observed at doses less than known drift rates (10% of an application rate exposed to these same sites were often above 50% for over seven weeks). While recovery did occur in this greenhouse experiment, it may not be representative of sites in natural communities where more resistant species (e.g. grasses) may grow faster and out-compete susceptible ones for light or resources. Such events may alter the natural species composition in exposed areas. This community approach is not considered in risk assessment.

TU 185

Effects of agrochemicals on macrophyte community structure and quality in a Canadian agricultural watershed

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Macrophyte communities in healthy rivers and streams have unique features. Unfortunately, macrophyte diversity, particularly diversity of submerged species, appears to have declined in some North American and European ecosystems during the last century. In agricultural watersheds, streams are intimately connected with croplands and the health of macrophyte communities may be compromised by increased levels of disturbance and exposure to agrochemicals such as nutrients and herbicides in areas of high-intensity agriculture. The objective of this study was to identify species diversity and biomass responses of macrophytes to herbicide applications at five different sulfurylurea (SU) herbicides (broad range of application rates) and at the stream sites, a sparsely populated agricultural watershed comprising 39.19 km² in Eastern Ontario, Canada. The species varied in terms of their contamination with nitrate and the commonly used herbicide atrazine, with mean maximum spring in-stream concentrations of 6600 µg L⁻¹ and 1.56 µg L⁻¹ respectively. In-stream concentrations of nitrate and atrazine were strongly correlated. Over 200 macrophyte species were identified along stream banks and through the stream channels. Sites surrounded by high levels of agriculture tended to have a higher percentage of non-native species, suggesting that native species are losing ground across the watershed. A decline in the quality and conservation values of the communities was observed along a gradient of nitrate contamination.

TU 186

The effect of five sulfonil-urea herbicides to aquatic macrophytes - implications of results from outdoor growth inhibition studies for the risk assessment

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The objective of this study was to establish an inhibition concentration at 50% (IC50) for five different SU herbicides. In each study 9 to 10 species of 3 different taxonomic groups were exposed in artificial outdoor ponds for 6 to 8 weeks. Each year the design was slightly adjusted based on experiences gained from former tests. Despite these changes, the data obtained are applicable to (1) comparisons of species sensitivities within one test substance and (2) comparisons between the test substances. Numbers of replicates were 4 in the controls and lowest concentrations, 3 at medium, and 2 at the highest concentrations (combined NOEC-ECx-design). A dose-response curve was observed in most species. Due to variation among replicates, the EC50 is regarded as more reliable than the NOEC. As plant length could not be assessed in all species, dry weight biomass was used for comparisons. EC50-levels based on biomass and biomass growth rates were very similar. In most species, no mortality was observed (p<0.05), showing the stress condition exerted by this fungicide. GST activity was not significantly different to the control at any concentrations tested (p>0.05). However, a significant increase 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 (no effect). Plants were affected at doses of 7.4% or less, three fully recovered within an avg. 6.7 weeks post-spray, six recovered up to doses of 14.5% (avg. 6.5 weeks) and three up to doses of 28.2% (avg. 12.3 weeks). Though an overall trend towards recovery was also noted for reproductive parameters (4 spp. recovered, 3 remained the same, 3 unaffected at any dose), rates of recovery did not follow those observed for height. Delayed growth and flowering was observed at doses less than known drift rates (10% of an application rate exposed to these same sites were often above 50% for over seven weeks). While recovery did occur in this greenhouse experiment, it may not be representative of sites in natural communities where more resistant species (e.g. grasses) may grow faster and out-compete susceptible ones for light or resources. Such events may alter the natural species composition in exposed areas. This community approach is not considered in risk assessment.

TU 187

Ecological functions of plant growth regulators in the stability of agroecosystem

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Tolerance of the system “soil-plant” in agroecosystem is the key condition of high yield. These functions in soil are accomplished mainly by humus component, and in the plant - by complex of biologically active compounds. Regulatory role in the resistance and protection of agroecosystem is studied in the example of chloroform-containing (COC) and pyrethromes: 2-epibrassinolide (EBilS), gibberellins (A3). Their functioning and efficiency in “soil - plant” system is connected with a series of abiotic (temperature, nutrient elements, etc.) and anthropogenic (organic pollutants, etc.) variable factors. The complexity of agro-chemical and ecological studies presupposes the widening of metered approaches. The wide use of bio-testing methods for summary characterization of COC, EpiBS, A3, of the which are widely used in the practice of agriculture. The ecological effect predictability of COC is studied at a high load of agroecosystem by chemical means of plant protection. It with the reduction of toxicity in soil, plant system, in plant and reproductive organs were revealed during using COC. Correlation of biological activity by bioassay used in agricultural lands, was found, depending on the plant nutrition system. Therefore, foliar effect of CCC influences on the plant, changes the activity of root system functioning (growth, absorption and root excretion), that actively effects on the dynamics of microbial association. The important ecological role of of EpiBS-phytomorphology was proved experimentally. The optimum created in agroecosystem artificially (providing plants with elements of mineral nutrition) is shown, based on the fungicide biocatalysis experiments (ebilS, EpiBS). Based on the reduction of medium concentration (from 50 to 10 µg L⁻¹), the activities of antioxidant enzymes were observed in a wide range of plants. By using oxidative stress enzyme activities and chlorophyll content. Particularly,
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. Ecototoxicological bioassays (luminescence inhibition of Vibrio fischeri and 48-h immobilization/mortality assay with Daphnia magna) were conducted in this stream, which was 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 Lemnaceae: zinc storage and impacts on photosynthesis along frond developmental gradients
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10Ghent University, Belgium
11Università di Udine, Italy
12Universidad de Sevilla, Spain

Zinc accumulation, morphological distribution and cellular storage, in either bound or soluble form, are also important for zinc sensitivity/tolerance and will be affected by increasing concentrations. Differential metal sensitivity of plant species has been linked with differences in accumulation and distribution. This study investigates how the frond age and developmental stage, as well as zinc accumulation and storage, determine the impact of zinc on Lemnaceae. The maximum quantum efficiency of photosystem II, Fv/Fm, the effective quantum efficiency, Y(II), and photochemical quenching, qP, were measured in mature and young fronds as well as along a developmental gradient within mature fronds. Zinc accumulation and storage in the soluble and bound forms in the plants were also measured after seven days. L. punctata and L. minor accumulating more zinc in their tissues than L. gibba. Partitioning of zinc in L. minor was notably different from the other two species, zinc was stored mainly in roots and the bound fraction. Fv/Fm and Y(II) in young fronds were more severely impacted by zinc than in mature fronds in all species. However, younger proximal sections of L. punctata fronds were more impacted than older distal frond sections compared to more homogenous impact in single Lemna fronds. Single colony, time-point or leaf-zone analyses may not show the full biological picture of the impact of a toxicant, especially not in L. punctata. Therefore, selection of Lemnaceae species and developmental stages of fronds should be given careful consideration when using chlorophyll-a fluorometry for assessing chemical impact of a toxicant in Lemnaceae.

TU 192
Alleviative effects of magnesium on copper rhizotoxicity to grapevine: macroscopic and microscopic point of view
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The study, a hydroponic experiment was conducted to determine the influence of Mg concentration on the growth inhibition effects of Cu to grapevine roots. In addition, optical microscopy was used to examine the histological changes in root tissue at the cellular level. Results indicated increased significant with increasing solution Mg concentration. On the other hand, the Cu concentration in roots was negatively correlated with the solution Mg concentration. From the light micrographs of root tip cells, the Cu concentration that caused histological changes in rhizodermal cells (i.e., increased vacuolization and plasmolysis) ranged from 10 μM to the 0.2 mM Mg treatment, to 25 μM to the 4 mM Mg treatment. In the 8 mM Mg treatment, no histological change was observed even at an exposure concentration of 25 μM Cu. In conclusion, this study demonstrates that Mg can alleviate Cu rhizotoxicity to grapevines effectively.

TU 193
Metal effects in Fraxinus angustifolia and its endophytic communities
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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 a reduced antioxidative defense system. 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-angustifolia to tolerate the contamination and its physiological performance, a set of parameters (above-ground growth, leaf area, relative water content, maximum efficiency of photosynthesis, chlorophyll content and leaf photosynthetic rate) was measured during the test. Furthermore, the specific 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. The genotypic diversity, assessed as the number of different bands in the DGGE profiles, decreased significantly with increasing concentration of U. Results indicate that U-regulation decreased significantly with increasing solution U-concentration. On the other hand, the Cu concentration in roots was negatively correlated with the solution Mg concentration. From the light micrographs of root tip cells, the Cu concentration that caused histological changes in rhizodermal cells (i.e., increased vacuolization and plasmolysis) ranged from 10 μM to the 0.2 mM Mg treatment, to 25 μM to the 4 mM Mg treatment. In the 8 mM Mg treatment, no histological change was observed even at an exposure concentration of 25 μM Cu. In conclusion, this study demonstrates that Mg can alleviate Cu rhizotoxicity to grapevines effectively.
The toxicity of iron nanomaterials to aquatic and terrestrial plants
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Zero-valent iron (Fe0) as well as ferrate (Fe(VI)) 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 get more 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 Fe²⁺ > Fe⁰ > Fe(VI). We used the frond numbers, root length and dry weight after 7 days of incubation as endpoints of the inhibition tests.

TU 197
Selection of suitable aquatic plants for phytoremediation of arsenic-contaminated water
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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 unarified geochemical province of Central Portugal. It is oriented for the use of these 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 municipal plants, with the exception of Oenanthe crocata. The highest concentrations of As were found in the submerged species Callitrichis bronta (436.92 mg/kg DW), Callitrichis stagnalis (354.03 mg/kg DW), Callitrichis homalota (160.37 mg/kg DW), Ranunculus triochophyllus (268.53 mg/kg DW), Ranunculus pelatus (103.98 mg/kg DW), in the free-floating Lemna minor (279.42 mg/kg DW), and in emergent plant Oenanthe 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/root. Other metals, such as Cu and Zn, are also accumulated by plants from the Callitrichis species family, namely, Cu by Callitrichis vertus and Cu and Zn by Callitrichis stagnalis with maximum concentration values of 132 mg/kg and 1395 mg/kg in dry biomass, respectively. The abundance of Callitrichis stagnalis and several heavy metals at the same time made this plant our first choice for phytoremediation methodologies development.

TU 198
Genetic variation in metal-tolerant Silene vulgaris clones
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Silene vulgaris is a facultative co-tolerant 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. Analytical tools based on the identification of useful genetic diversity are needed for plant genotype selection aimed at enhancement of metal tolerance 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 long polymorphisms. The intergenic spacer between the trnH and psbA genes was amplifiy with the primers trnH (GUG) and psbA. All PCRs produced a major robust band per primer pair in all samples studied. Two size variants were detected for cpmp1 (120 and 121pb), two for cpmp4 (113 and 114pb), five for cpmp2 (190, 191, 192,193 and 198pb) and six for trnH-psbA (332, 338, 339, 354, 355 and 357pb). Regardless of clone 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
Bioassorption of Pb by Chlorella vulgaris (Chlorophyceae) at laboratory scale
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In this study we evaluated the bioaccumulation of metalloids with multiplicity 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. Analytical tools based on the identification of useful genetic diversity are needed for plant genotype selection aimed at enhancement of metal tolerance 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 long polymorphisms. The intergenic spacer between the trnH and psbA genes was amplifiy with the primers trnH (GUG) and psbA. All PCRs produced a major robust band per primer pair in all samples studied. Two size variants were detected for cpmp1 (120 and 121pb), two for cpmp4 (113 and 114pb), five for cpmp2 (190, 191, 192,193 and 198pb) and six for trnH-psbA (332, 338, 339, 354, 355 and 357pb). Regardless of clone 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 200
Bioaccumulation and distribution of selected metals in the macrophyte Ceratophyllum demersum, in a polluted South African river
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Selected macrophytes 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. Additionally, water samples from the same sites, possibly as a result of having a greater surface area for uptake. Additionally, metal-laden leaves may be shed as a detoxification method. 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 bio-monitoring 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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Selenium pathway in water moss Fontinalis antipyretica
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The abundance of toxicological and heavy metal effects on aquatic organisms are constantly exposed to xenobiotic compounds that cause the overproduction of oxidants or reactive oxygen species (ROS) resulting in oxidative stress. Therefore, we have investigated the detoxification enzyme glutathione S-transferases (GST) in the plant extract to metabolize PbHg in vitro and the results showed the inhibition of GST activity under the influence of the used PhACs. The data of the peroxidase (POD) and catalase (CAT) suggests that PhACs do not directly cause oxidative stress by an increase in ROS production. Due to increased ROS accumulation PhACs may be selectively toxic to some organisms leading to ecosystem alterations.
Acute and chronic in vitro bioassays vs. autochthonous plants used as sentinel: comparing genetic biomarkers as tools in ecological risk assessment in Del Plata basin S.O. Demichelis1, C. Meneghini2, M. Biffignandi1, M. Spotorno1, G. Mainero1, M. Ansaldo1, L.P. Dompoch2

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In reality, many chemical pollutants are indeed coexisting in the aquatic environment. For example, many antifouling biocide residues are often detected as a cocktail in the aquatic environment. In this case, the combined toxicity of the mixture would follow a simple concentration addition model, and the concept of toxic equivalency quotient (TEQ) could be applied. However, in many cases, the combined toxicity of the mixture may not follow a simple concentration addition model, and the concept of toxic equivalency quotient (TEQ) may not be applicable. In these cases, more sophisticated models, such as non-parametric response surface models, may be required to assess the combined toxicity of the mixture.

RA20P - Risk assessment of chemical mixtures: where do we stand? what are the next steps?

RA20P - Risk assessment of chemical mixtures: where do we stand? what are the next steps?

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In this study, the effects of different mixtures on the survival and growth of the water hyacinth Eichhornia crassipes were investigated. The results showed that the combined toxicity of the mixture was greater than the sum of the individual toxicities of the components. The study also demonstrated that the combined toxicity of the mixture was dependent on the relative concentrations of the components. The results of this study provide a useful tool for risk assessment of chemical mixtures in the aquatic environment. The results also have important implications for the development of risk assessment models for chemical mixtures in the aquatic environment. The results of this study can be used to inform the development of risk assessment models for chemical mixtures in the aquatic environment. The results of this study can be used to inform the development of risk assessment models for chemical mixtures in the aquatic environment.
TU 207

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

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According to REACH chemical substances need to be registered at the European Chemical Agency in Helsinki. For hazardous substance produced in amounts above 10 t/y the manufacturer or importer of the substance has to conduct a risk assessment and document the assessment in a chemical safety report (CSR). Operational conditions (OC) and detailed usage conditions (DUCM) for the substance for the intended use (EU) or for the conditions under which the substance may be produced or imported have to create a safety data sheet (SDS) for substances to communicate conditional uses of safe use within the supply chain. ES are attached to the SDS. The formulators must address the risk for the mixture they produce and create a SDS for the mixture on the basis of the information they get with the SDS and ES for the single substances. Although emissions to the environment results mainly from mixtures there is no guidance to assess the risk resulting from the use of mixtures. Industry developed the DPP+-method (based on the dangerous preparation directive) to assess the risk from mixtures. Aim of the method is to consolidate the information in the SDS and ES of the single substances to derive conditions of safe use for the mixture. The method is derived on the identification of a lead substance based on the classification of the substances in the mixture. Substances whose classification are not considered in the derivation of OC and RMM for the mixture. The Federal Environment Agency, Germany (UBA) conducted a study to analyse the DPP+-method. The analysis tried to identify which potential risks of a substance could be overlooked by DPP+ and would hence not be adequately addressed in the selection of lead substances and the derivation of safe conditions of use. The above considerations question if DPP+ is a reasonable instrument to identify environmental concerns and improvements of REACH as mentioned above. Pesticide proposals need further elaborated and included in a method to assess the risk of mixtures. The interpretation of DPP+ (only substances with classified for environmental hazards need to be addressed in the risk assessment for the environment) is regarded as not in line with the interpretation of the legal text by Commission, ECHA and MS. Beyond that the possibility of an integration of scientific methods for the assessment of mixtures in the regulatory framework should be investigated.

TU 208

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

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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 to screen chemicals for those that are sufficiently protective at the screen level and could be based simply on structural or de-minimus considerations, even in the absence of effect data. Originally it was applied to toxicological evaluations of substances such as pharmaceuticals, food contact materials, and for the risk assessment of chemicals (ESFA, US FDA, WHO IPCS). Later it was adapted for ecotoxicology, and an “environmental threshold of no concern” (ETNCaq) of 0.1 µg/L was proposed for polar narcotics, non-polar narcotics and also reactive chemicals (de Wolf et al., 2007). Because of their specific MoA and LC50 to add some showed lower NOEC and thus were not included.

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

An analysis of the Bayer CropScience portfolio suggests that regulatory acceptable concentrations (RACs) for most pesticides are well above the ETNCaq of 0.1 µg/L suggested for chemicals other than pesticides. However, the original application of the ETNCaq was to derive safe thresholds in the absence of effect data, whereas for pesticides we have mechanisms and endpoints that are sensitive to chemicals that have been shown to be toxic to human health (e.g. carcinogenicity). Therefore, the concentration of pesticides used in this analysis had to be determined using different metrics such as median NBE or highest NOEC for the specific exposure scenario.

Another concern of the TTC concept is that the concentration of a specific chemical can be identified and should then be included separately in a mixture toxicity assessment, even if present at concentrations below the ETNCaq. The application of the ETNCaq as a generic TTC in the field of mixture toxicity assessment in environmental media would primarily serve to filter out irrelevant contributors, not to substitute meaningful data.

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

TU 209

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

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Relative approaches, i.e., toxic equivalent (TEQ)-like approaches, for mixtures risk assessment have been established for some time. TEQ-like approaches assume that if 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 effects for chemicals being evaluated (Safe 1990), then those chemicals may be assumed to be dose additive (DA) for screening purposes. Recently the U.S. EPA Research Advisory Panel (RAPP) on the Endocrine Disruptor Screening and Testing Act (EDSTA) recommended “containing recommendations 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 or mechanisms of action. Using different combination metrics like RAC or BAF based on the DA-CASOS concept were compared to the 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-CASOS 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-CASOS 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

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Algae are important primary producers in aquatic ecosystems. The OECD Test Guidelines 201 (TG201), alga growth inhibition test, is a conventional method that evaluates chemical toxicity on alga. In conventional methods of evaluating chemical mixtures, a method that can estimate chemical toxicity in shorter time or provide information on the mode of action of chemical substance would be advantageous. Applications for a new method include improving the evaluation efficiency for toxicity screening of a large number samples for regulatory filings, toxicity identity evaluation of chemical mixtures, and identification of potential toxic substances in effluents. By investigating a new rapid estimation method of the growth inhibition using delayed fluorescence (DF) from algae. The DF is a special type of luminescence; it detects the growth of only those cells that has photodynamic capability. Since the DF originates from re-activation of chlorophyll by a reverse of photoreaction of electron transfer, the DF inhibition reflects inhibition of photosynthetic activity that is necessary for growth. Therefore the DF is a potential tool for the determination of the influence of chemical substance of algal growth in a shorter time that the conventional 72 hours growth inhibition test (e.g. TG201). In addition, the intensity of DF shows a time delay curve. Chemical exposure changes the dye change to patterns that provide insight into the mechanisms of action, and also has potential for application to the identification of contaminants in mixtures. We discuss characteristics of the evaluation of the influence of chemicals (herbicide, other chemicals and its mixtures) on alga by both the DF inhibition and analysis of the DF decay curve. We also compare the detection characteristics of DF and other rapid estimation methods, including chlorophyll fluorescence-based photosynthetic activity measurement (PAM) and Microtox®, a common rapid bioassay that uses luminescent bacteria to evaluate chemical sensitivity between photosynthetic and non-photosynthetic microbial bioassay.
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 and mixture SSD curves and the mixture SSD curves.

TU 212

Effects of Atrazine and 2,4-D mixtures on lemmin minor
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Thalassic agriculture is very important in terms of the economy. Pesticides are therefore widely used in Thailand and this usage is increasing. As a wide range of pesticides is used in Thailand, aquatic will be exposed to a mixture of compounds. In order to understand pesticide impacts, it is therefore important to understand the potential toxic interactions of pesticides in use in Thailand. The aim of the present study was therefore to test the interactive effects of two herbicides, atrazine and 2,4-D.

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 concentration thresholds were 0.05 , 0.1, 0.2, 0.4 and 0.8 mg·L·1 and 2,4-D were 5, 10, 20, 40 and 100 mg·L·1. A minor colony of L. minor was exposed to these test concentrations for 7 d. The design of the mixture study was used seven mixture ratios and seven chemical dilutions. Dose response curves were obtained and fitted in logistic regression by using sigma plot. Isobole analysis was used to interpret the mixture toxicity results.

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

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

TU 213

Predictive mixture toxicity assessment of pesticides in Swedish 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 toxicities in QASAR 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 geographical distribution of ecological risk.

Among the results is the average risk fractions under the assumption that the acute risk fraction is zero 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 different six 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.

TU 214

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 the EQS is only checked on the single substance level. 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. To 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 ‘mult-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 the so-called troublesome taxonomic group and can be combined with the mixture cumulative ratio [MCR] approach recently presented 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.

TU 215

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 is 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 lowest 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.

TU 216

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 benzo[c]fluorine (20), dibenz[a,j]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 chemical and the step size between two subsequent concentrations vary.

However, there are many 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 arguments against the USEPA RPFs and RPFs for acute carcinogenic risk observed when the interactions between compounds 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.

TU 217

Derivation of environmental risk limits for polycyclic aromatic hydrocarbons (PAHs) based on internal residues
E.M.J. Verbruggen

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

Polycyclic aromatic hydrocarbons (PAHs) are substances that have both natural and anthropogenic origins. They can be formed as a result of combustion, and are constituents of many petroleum products as well. Environmental risk limits (ERLs) were derived for 16 PAHs that were also considered in the European Risk Assessment Report (2008). While high temperatures and substances are considered the main contributors.

It can be assumed that toxicity of all PAHs is similar and possibly caused by narcosis. The toxicity of different PAHs differs only as a consequence of different environmental factors. This has been successfully applied before for total petroleum hydrocarbons (TPH) and will be investigated here for PAHs.

All ecotoxicity data were collected and carefully evaluated for their usefulness and reliability. To calculate the total internal residues, pore water concentrations were calculated. The sum of the internal concentrations of different compounds gives rise to the same effect as that of a similar concentration of an individual compound. This is referred to as concentration additivity. This concept has been successfully applied before for total petroleum hydrocarbons (TPH) and will be investigated here for PAHs.

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

Validation of the predicted mixture models to differentiate P-gp and MRP type efflux transporter activities in zebra mussel (Dreissena polymorpha) and its environmental implications

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

TU 219 Hazard evaluation of shale oil to the environment

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Validation of the simulated earthworm gut (SEG) for widespread use in soil invertebrate toxicity testing

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TU 223  Prediction of mixture toxicity for metals in soil: a reality-check
K. Oerts1, V. Verschuere1, I. Schoeters1,2
1ARCHE, Ghent University, Ghent, Belgium
2Euromettuxs, Brussels, Belgium
Roodman et al. (2008) created a regulatory framework for assessing the ecological effects of naturally occurring elements, such as metals, in soil. However, mixture toxicity is an ongoing 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 regulatory purposes. Testing at higher concentrations in such mode of action studies may be better suited for the assessment of mixture toxicity, but this may require a bigger number of testing points.

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

TU 225  Assessing human health risk from farmed milkfish consumption: considering toxic interaction among arsenic, copper, and zinc mixture
Y.J. Lim1, M.P. Linge2, C.M. Liao1
1National Taiwan University, Taipei, Taiwan
2Chung Shan Medical University, Taichung city, Taiwan
Several 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 consuming milkfish (Chanos chanos) consumption in blackfooted blenny (I. jenkinsii)-endemic area in Taiwan. The interaction risk assessment model proposed by the U.S. Environmental Protection Agency (EPA) and Agency for Toxic Substances and Diseases Registry (ATSDR) was used to estimate the interaction-based hazard index (HBMI) of non-carcinogenic mixture toxicity. The mixture toxic interactions of As/Cu and As/Zn were both antagonistic, whereas Cu/Zn was an additive effect. Generally, the highest percentage of HBMIs was 78%, 0.37 to 3.7, and 0.73 to 2.13, respectively. Our study indicates that As, Cu, and Zn mixture exposure may pose potential non-carcinogenic risk to 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?
M. Gmičić1, S.A. A. Stanković1, S.A.A. Janković1, V.E.S.N.A. Jacevic1, S.A.L.A. Vucic2, K. Durgo1, B. Antonijević1
1University of Belgrade, Faculty of Pharmacy, Belgrade, Serbia
2Military Medical Academy, Belgrade, Serbia
This work illustrates 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 227  Waste recovery - a special treatment under REACH
P. Vermeulen, A. Vassart, P. Anthoine, N.M. Debelecq
ARCO5, Antwerp, Belgium
According to a manufacturing process is considered any production or extraction of substances in the natural state. This includes chemical modification as well as mechanistical 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 an 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 and the mixture has to be treated as either substance (mono-constituent, multi-constituent or UVCB), or impurity.

TU 228  Toxicity evaluation of disperse red 1 textile dye using freshwater organisms from different trophic levels - a PNEC proposal
I. Vazquez, G. Honorio, R. Ribeiro, G.A. Umebuze
University of Lus, Lisbon, Brazil
Azo dyes have been found in surface waters and treated wastewaters; however data about ecotoxicity of dyes are scarce in the literature. Commercial azo dyes are mixtures of a main dye, surfactants and other synthesis impurities. The commercial dye Disperse Red 1 containing 60% of the main dye N-Ethyl-N-(2-hydroxyethyl)-4-(4-nitroanilino) azine, CAS number 2872-52-8, was obtained by PCIIL industries Ltda, Brazil. This product is used for dying synthetic fibers. Previous data showed that the main dye was responsible for the dye toxicity at least for Daphnia. This same dye was found in a effluent and a receiving water sample collected in Americana region, Sao Paulo Brazil. The aim of this study was to compare the results of ecotoxicity of the commercial dye Disperse Red 1 obtained for organisms from different trophic levels: Daphnia magna (a PhaeoDaphnia) for acute life and chronic tests, the NOEC (72h) for Pseudokirchneriella subcapitata was 0.1 ppm and the NOEC obtained for Ceriodaphnia dubia in a reproduction inhibition test (7 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 new borns 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 an Aniva horn assay. Based on the EC50 (N-Ethyl-N-(2-hydroxyethyl)-4-(4-nitroanilino) azine of 0.6 gpp, 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). This study provides a 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 considered to verify the mutagenic effect of this product in microruscatae as well as monitoring studies in river waters that receive textile discharges to determine exposure concentrations.

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Enzymes can with regard to their ecotoxicological profile be grouped in proteolytic and non-proteolytic enzymes. Within these two groups read-across can be applied. Industrial enzymes are general of low ecotoxicity except for proteolytic enzymes, where some exhibit acute aquatic toxicity. Based on the available ecotoxicity data industrial leading to additional uncertainty due to aggregation of spatial explicit characterization factors (CF) on regional or global levels. This lack is a main challenge for practitioners exposed to chemical mixtures rather than single substances.

We proposed a new approach [4] that allows for the characterization of any noise-emitting source and its impact on humans, creating the necessary theoretical structure in inability of environmental model makers to consider all possible sources of uncertainties in their models or due to their unrealistic or even false assumptions.

Pilkey and Pilkey-Jarvis [1] claim the “virtual impossibility of accurate quantitative modelling to predict the outcome of natural processes on the Earth’s surface”, due to the data waiving approach. The objectives of this study are to develop and evaluate a partial least squares-based integrated addition model (PLS-IAM) for not only to overcome the multicollinearity problem which can be occurred between the two independent variables, CA and IA, but also to combine them into the integrated addition model by using the latent variable. In this study, the PLS-IAM was validated by different datasets on mixture toxicity. The results showed that the prediction capability of the PLS-IAM outperformed reference models, the CA, IA, and IAM based on ordinary least squares.
country level data might not considerably add to uncertainty. Such information helps to improve efficiency when dealing with regionalized LCA. Overall spatial aggregation added considerable uncertainties.

TU 234
Sensitivity analysis for archetype development in impact assessment of chemicals
S. Sala, B. Cuffo
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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 the 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 intense and high spatial resolution model). Trade-off between complexity of high detailed models and global applicability requires the development of suitablearchetypes.

In the present 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 Monte carlo framework, we 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 results of the analyses 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
C. Rousseau1, J. Payet1
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Cyclicce, 01500 ambergue, France
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, it neither can be neglected, nor addressed too simply. Although uncertainty has partly been 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 only 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 estimate 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 determination 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 the 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 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 modules approach is presented as methodology to reduce uncertainty in the Life Cycle Assessment. In particular such approach aims to obtain a common barriers in the modelling of complex systems within the manufacturing context. An application is illustrated with reference to the uncertainty characterization of environmental profiles referred to energy flows. The use of standard modules for environmental profile characterization seems to improve the comparison of different studies by polarizing the improvement 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 without using building team proper analysis. 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 those parameters. Then standard deviation is propagated using tailor series. This method has been implemented in a real case where decision needed to be made between three building projects. The case study shows the method presented in this paper is easily to implement and suitable for complex products which are tough to describe completely. In some case, it is possible to identify the best building solution even with up to 50% standard deviation on some primary data.

TU 238
Uncertainty evaluation of LCA models input data using Monte Carlo Method
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2G-SCOP, Grenoble, France
This is a contribution to the development of methodologies in considering uncertainties in LCA studies. The main results are a solid methodology for dealing with uncertainties in the standard information modules approach. The case study consists of an acoustic panel made up of cotton fibers, polyethylene and scraps of jeans. Its LCA model is developed with SimaPro® software. The Monte Carlo tool available in this software is used in order to develop the Monte Carlo Process model. 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 steps are followed for both models. First, a sensitivity analysis is made in the deterministic LCA model.

Next the random parameters are chosen and modeled as 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 method 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
J. Potting, E. van der Harst
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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 assumption 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
first compared whether they arrived at similar rankings for similar cups, and next compared and evaluated the studies on a large number of methodological issues that are the source for different types of uncertainties. This presentation will present the main results and the surprising conclusions from our study.

TU 245

Contamination of the marine biological reserve of atol das Rocos (Brazil) by persistent organic pollutants

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The Biological Reserve of Atol das Rocos 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 those organic contaminants in respective avifauna. One expedition was performed in February, 2010, where 16 liver samples from two species: Anous stolidus (n=14) and Onychoprion fuscatus (n=2) were collected. Samples were analyzed for organochlorine pesticides (OCPs), PCBs and PBDEs. Briefly, samples were extracted in a Soxhlet, clean-up, samples were analysed by GC-ECNI-MS/MS. PBDEs were determined as tetra- to octabrominated congeners from 0.08 to 5 pg/m³ with BDE-47 and BDE-209 being the predominating congeners. Among the alternative BFRs, pentabromobenzene (PBBs), pentabromomethylbenzene (PBT), 2,3-dibromomethyl-2,4,6-tetramethylphenyl ether (DPE), hexabromobenzene (HBB), 2-ethylhexyl 2,3,4,5-tetrabromobenzene (EHTBB) and bis-(2-ethylhexyl)-tetrabromophthalate (TBBP) were detected. HBB showed the highest concentration ranging from 0.12 to 26 pg/m³, and PBT and PBDEs ranged from not detected (n.d.) to 2.8 pg/m³ and from n.d. to 4.3 pg/m³, respectively. Dechlorane Plus (DP) ranged 0.23 to 11 pg/m³ while other Dechloranes remained <0.3 pg/m³. On a spatial scale, the highest concentrations, especially for HBB, PBT and PBDEs, were observed at the East Indian Archipelago showing South East Asia to be an important source of alternative BFRs. The approach of Clausius-Clapeyron Plots clearly indicates that the distribution and transport of PBDEs is dominated by long-range transport with little influence of fresh emissions whereas alternative BFRs, especially HBB, are subject to local sources. We present the first data on occurrence, distribution and transport of alternative BFRs and DP over the Indian Ocean.

TU 246

Seasonal variation of specific toxic effects of organic air pollutants from year-long sampling campaign


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Air pollutants were 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-estrogenticity and anti-androgenticity. These parameters were assessed using in vitro reporter gen assays based on mammalian cell lines. This research was supported by GACR 573/09/0024 and CETIOTEEN (CZ.1.07/2.3.00/30.0001).
TU 246
Recommendations for the use of airsheds for interpreting semi-volatile organic compounds in passively sampled air
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To aid in the interpretation of measurements of Semi-Volatile Organic Compounds (SVOCs) it is common to use Back-Trajectories (BTs), a calculated approximation of the spatial and temporal history of the air sampled. The endpoints of the BTs can be binned into a grid of cells to create an airshed, which indicates the fraction of the sampled air that passed through each cell. Here, to avoid the so-called ‘pole-problem’, a ‘geodesic’ grid of nearly equidistant cells was employed. The variability of airsheds in time, both year-to-year and season-to-season was calculated as the sum of absolute differences in endpoint counts in each cell from one time to another. For 24 locations for which BTs were available for 2 or more years inter-annual differences ranged from 9% to 21%, and season-to-season differences ranged from 17% to 33%. For one location for which 13 years of differences were on hand the differences between the first year and subsequent years was seen to increase with time (p = 0.69, p < 0.01).

To determine a suitable constraint on departure height of endpoints when assigning potential sources a 7 cell departure area was defined as the ‘emitting’ cell and the six cells adjacent to it. Using forward trajectories it was determined that after four time steps ~87% of trajectory endpoints were outside of the departure area - this includes points from trajectories that double-back into the departure area. At the fourth time step the 95% percentile of height was ~700m. Thus endpoints that are within the departure area but are on the very top of the very few mountainous areas that exceed 700m do not represent air flows emitted from these endpoints.

Lastly a significance criterion was derived by assuming that when assigning potential source regions to a measurement only departures from a perfectly ‘round’ airshed - one in which air arrives at the sampler in equal amounts from all directions - are of interest. Based on this a test criterion is proposed, specific to the temporal resolution of the BT endpoints, to determine the significance of any cells in an airshed. It is recommended that airsheds be generated specifically for the deployment time and location of a sampler, that endpoints with heights greater than 700m be removed from the set and that cells failing to meet the test criterion for significance be ignored when assigning potential source areas.

TU 247
The spatial distribution and potential sources of polycyclic aromatic hydrocarbons (PAHs) over the Asian marginal Seas and the Indian and Atlantic Oceans
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In the present study, PAHs were analyzed in air samples taken from the East and South China Seas and the Indian and Atlantic Oceans, providing an opportunity to assess spatial trends and potential sources of atmospheric PAHs over those oceans. Continental sources were still the major reason for the high concentrations of PAHs measured over the oceans. The 215PAHs in the gaseous phase were elevated on the approach to China and India, while the highest 215PAHs in the particulate phase were found at Chennai Harbor and close to Guianan River. The marine sources over South China Sea and the Indian Ocean could be a marker of coal and coke related combustion emission from Mainland China. The elevated high-molecular-weight PAHs in particles close to Guinea might be related to biomass burning in Africa. These results are consistent with previous PAH emission inventories and highlight the potential impact of continental PAH sources in China, India and Africa and the global marine atmosphere.

TU 248
PAHs along a mountain forest and clearing: the effect of canopy
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1Introduction
Forest can be regarded as a global sink of semi-volatile organic contaminants (SOCs). The so-called “Forest filter effect (FFE)” may be an important driver that transfers SOCs from the atmosphere into the forest system (1). Previous study has focused on the atmospheric deposition and atmospheric-surface exchange of SOCs alone the mountain forest and clearing (2-4). This study aimed to compare the temporal variability along the slopes of Mont Mars.

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

3. Results and discussion
3.1. Concentrations
The average values of the total PAHs (27PAHs) concentrations of gaseous and particle phase was 1860 and 1761.6 pg m^-2 for the forest, and 1230 and 123 pg m^-2 for the clearing. Seasonality, the PAH concentrations in the mountain atmospheric decrease dramatically from R1 to R4 at a rate of 3800 for gaseous phase and 5.3 for particle phase, respectively, which indicated that the forest filter effect (FFE) was much higher for forest 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 along the slopes of Mont Mars. The declining rate for the forest was much lower than that at the clearing, taking R1 for example, the rate was 0.003 for forest and 0.006 ng PAS^-1 m^-1 for clearing, respectively. This may due to strong forest filter effect at lower sites where corresponding to high PAH concentrations in the atmosphere.

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 PAS in the forest because of lower wind speed. As shown in Figure 2, log F/C and log KOA showed different correlations in the green line (green line) and particle phases (black line).

4. Conclusion
The filter effect of canopy was observed along the Mont Mars and higher factors was related to low altitudinal sites and atmospheric particle. Koa 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 μm, 0.95-1.5 μm, 1.5-3.0 μm, 3.0-7.2 μm, 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 gas and particulate fractions were extracted using 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 finest fraction of atmospheric particles, however, seasonal variability of this size-specific distribution is presented for the first time here.

TU 250
Size-specific particle-gas distribution of the atmospheric polyaromatic hydrocarbons (PAHs) on the spatial and temporal scales
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A presence of the particulate matter in ambient air (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 persistent 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 to study 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.
concentrations is very wide (10 pg/m^3 - 2 ng/m^3), and depends on the specific compound, as consequence of the proximity of sources and environmental variables. Pollutants (pesticides and polycyclic aromatic hydrocarbons) and up to 23 have been identified in PUF samples from active and passive samplers. The range of estimated air concentrations of VOCs is very wide (10 pg/m^3 - 2 ng/m^3), and depends on the specific compound, as consequence of the proximity of sources and environmental variables. Seasonal and spatial patterns have been found for different groups of organic pollutants associated to the main local sources in each case. The larger air levels of anthracene, fluroene and phenanthrene were detected in the proximity to the airport, while pesticides have a more homogenous spatial pattern, with larger air concentrations by the sea. A clear seasonal pattern has been detected in the case of some specific pesticides, such as chlorpyrifos, with higher concentrations in spring and autumn.

TU 252

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

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The monitoring of pollutants is a crucial step to assess their environmental exposure to organisms. In general, this task is performed in their own habitat (sediments, soil, water or air), but biomonitoring offers the possibility to estimate the multi-route uptake of contaminants. Given its worldwide presence, adequate characteristics and low availability of values, vegetation has been chosen as a passive sampler since the 1960s, allowing the passive sampling of a wide range of compounds (especially of atmospheric origin). These characteristics make them particularly suitable for assessing the atmospheric input in the different sites.

PAHs are widespread carcinogenic and mutagenic contaminants with natural and anthropogenic sources mainly associated to combustion processes. The sampling devices makes the selection of the target compounds from their lipidic structure a hard task and led to the development of multisite extraction methods in the last 20 years. This means that biomonitoring studies using these extraction methods demand for reliable extraction and clean-up procedures, which have been suffering continuous development to reach increasingly lower limits of detection associated with sharper chromatographic resolution.

The results of this study support the use of several extraction methods (ultrasound assisted extraction, ultrasound-assisted extraction, microwave-assisted extraction, accelerated solvent extraction, solid-phase microextraction and hollow fibre liquid-phase microextraction) prior to a complementary clean-up step when needed were studied for 16 PAHs in pine needles. In concomitance, the patterns and sources of contamination were assessed and compared in sampling sites from Portugal, Spain and Greece.

TU 253

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

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The concentrations of cyclic and linear volatile methyl siloxanes (IVMS) and cyclic dimethylsiloxanes (CIVMS) were determined in air samples collected from the Mar Menor lagoon. All these compounds have been identified in air samples from the United States, but not in European sites. Significant levels were found in the Mar Menor lagoon, suggesting a contamination of the aerosols. The atmospheric input in Mar Menor lagoon, passive samplers consisting of polyurethane foam (PUF) disks housed in chambers were deployed at six sites around the basin of this lagoon. Replicates at each point and calibration with a DIGITEL active sampler (at one point) equipped with a PUF module are used to improve the confidence of the determinations and to estimate the sampling ratios for the different detected species.

PUF samples have been extracted with hexane using a pressurized liquid extractor. The extract was concentrated and analyzed gas chromatography with mass spectrometry. The quantification limits were lower than 10 ng/L for the majority of the considered analytes. This method has been validated for more than 80 organic pollutants, polycyclic aromatic hydrocarbons and up to 23 have been identified in PUF samples from active and passive samplers. The range of estimated air concentrations is very wide (10 pg/m^3 - 2 ng/m^3), and depends on the specific compound, as consequence of the proximity of sources and environmental variables. The quantification limits were lower than 10 ng/L for the majority of the considered analytes. This method has been validated for more than 80 organic pollutants, polycyclic aromatic hydrocarbons and up to 23 have been identified in PUF samples from active and passive samplers. The range of estimated air concentrations is very wide (10 pg/m^3 - 2 ng/m^3), and depends on the specific compound, as consequence of the proximity of sources and environmental variables. The quantification limits were lower than 10 ng/L for the majority of the considered analytes. This method has been validated for more than 80 organic pollutants, polycyclic aromatic hydrocarbons and up to 23 have been identified in PUF samples from active and passive samplers. The range of estimated air concentrations is very wide (10 pg/m^3 - 2 ng/m^3), and depends on the specific compound, as consequence of the proximity of sources and environmental variables.
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. Anthropogenic pesticide use may also challenge these 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, and characterized in nearby Biscayne and Everglades National Parks (NPs). Endosulfan emissions from agricultural areas around Homestead appeared to influence air concentration observations at the NP sites. During an intensive sampling campaign, the highest total endosulfan concentrations at the NP sites were observed on days when air parcels were predicted to move from Homestead towards the sampling locations. The α-endosulfan fraction (α/(α+β)) was used to examine the contribution of pesticide emissions to the atmospheric degradations to the overall mass fraction. The finding that the test has an α fraction of approximately 0.7, whereas volatilization is predicted to have an α fraction of 0.9. The median fraction observed at Homestead during periods of high and agricultural activity was 0.84 and 0.86, respectively, indicating that drift contributes to the atmospheric concentrations. The median fraction at Everglades NP was 0.88 and 1.0 during high and low agricultural activity, respectively, and at Biscayne NP was 1.0 year indicating air concentrations are primarily influenced by regional volatilization. The near-inversial isomerization after application of β-endosulfan to α-endosulfan also influences the value of the α fraction.

The data illustrates that drift and volatilization are the most significant processes, contributing to the atmospheric concentrations. The median fraction at Everglades NP was 0.88 and 1.0 during high and low agricultural activity, respectively, and at Biscayne NP was 1.0 year indicating air concentrations are primarily influenced by regional volatilization. The near-inversial isomerization after application of β-endosulfan to α-endosulfan also influences the value of the α fraction.
The findings showed no significant differences between campaigns regardless of the use of alternative fuels. In conclusion, the current results support and encourage the use of alternative fuels in the cement industry.

The sum of the PBDEs analysed showed a wide range (10.4 - 8191 ng g⁻¹ wet weight (ww)) of concentrations, with a mean of 961 ng g⁻¹ ww. Males had on average twice the concentration of PBDEs compared to females. The dominant PBDE congeners were BDEs 47, 99, 100, 153, 154 and 183 in both M and F, which are the same dominant congeners present in the penta technical mixtures. However, bats have a lower proportion of PBDE 47 than the technical mixtures, suggesting degradation of this compound. Total BDEs were dominated by penta-BDEs (65% of the total), followed by hexa-BDEs (with just over 20%) for both males and females.

The highest siloxanes concentrations were found in bathrooms; in particular, D5 represented the principal compound probably due to its dominant presence in most of household products, perfumes, cosmetics, home decoration products and cleaning agents. Personal lifestyles and everyday life behaviours (e.g., selection of products, frequency of application, amount applied) had a determinant effect on the amount of total siloxanes found in both Italian and UK adult and living rooms. No significantly differences in concentration were observed between campaigns. The daily inhalation exposure (DIE) to cyclic and linear volatile methyl siloxanes was also evaluated.

The purpose of this study was to investigate their occurrence and distribution in indoor air environments, including domestic (i.e., bathrooms, living rooms, boy's/girl's rooms) and non-domestic areas (offices, schools, etc.) of several urban locations. An extensive air 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- Sensydine), operating at a flow of about 120 mL min⁻¹. Sampling cartridges were desorbed using the Automatic Thermal Desorber UNITY2 coupled to a GC/TCD, which determined the total siloxanes content. The samples were run at 280°C for 20 minutes. The second site was located near 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 TCR Tecora 1B06/9901/ECHO HVol with quartz fibre 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 36.81 ng/m³ in the heating period. Various techniques, including diagnostic ratio (DR) and principal component analysis (PCA), have been used to elucidate the main emission sources of PAHs. Diagnostic ratios were used to analyse indicator that vehicles, diesel and/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 dominant 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.

Methane emission contributes to the growing background concentration of ozone, an air pollutant that impacts on air quality and, hence, human health. In particular, methane emissions from the building sector into indoor environments is a problem in many parts of the world. The ground surface is the zone where the processes of weathering are very active. In the presence of gas-bearing rock layers (gas sources) located at a shallow depth below the ground surface, weathering-induced fractures in surface rocks can conduct gas from gas sources into the atmosphere. In the southern part of Donetsk city (Ukraine), weathering-induced fractures in very weak rock (sandstone) are important, as there is a short distance between cement plant and homes. This short distance is sometimes due to poor (or inexistent) urban planning, illegal construction and the lack of legislation in the past, the distance between populated centres and industrial facilities have been notably shortened. Methane concentrations in indoor air samples from residential areas were determined using a high volume air sampler TCR Tecora 1B06/9901/ECHO HVol with quartz fibre 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 36.81 ng/m³ in the heating period. Various techniques, including diagnostic ratio (DR) and principal component analysis (PCA), have been used to elucidate the main emission sources of PAHs. Diagnostic ratios were used to analyse indicator that vehicles, diesel and/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 dominant 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.

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option of using alternative fuels in cement plants working with the Best Available Technologies (BAT).

**TU 267**

Should the neighbourhood of cement plants be concerned when alternative fuels are used? J. Rovira¹, M. Mari², M. Nadal³, M. Schuhmacher⁴, J.L. Domingo⁵

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In recent years, co-combustion of alternative fuels in cement plants has become an increasing practice in many countries. The benefits associated to the replacement of fossil fuels by alternative fuels (mainly sewage sludge or RDF) are environmental (e.g., reduction of CO2 emissions, reuse of by-products) evident. These benefits are more important taking into account that cement production is one of the main CO2 emitting manufacture industries, but also due to the important rising of fossil fuel prices. Furthermore, considering the notable consumption of fossil fuels by the cement industries, the European Union is encouraging the enhanced contribution of the amount of alternative fuels or raw materials 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 several sediment, 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.

**TU 268**

Environmental impact of mechanical-biological treatment systems. Human health risks of chemical and microbiological pollution L. Vilvert⁴, M. Nadal⁵, M. Schuhmacher⁶, J.L. Domingo⁷

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Due to legislative, environmental, economic, and social limitations, the identification of sustainable disposal pathways for the management of municipal solid waste (MSW) is a very important issue. The mechanical-biological treatment (MBT) approach presents many advantages in comparison to other waste management possibilities. However, adverse health effects related to this practice are not negligible. Such as dust, dust, and chemical pollutants, as volatile organic compounds (VOCs), are 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 harmful and hazardous properties. In 2010, a program was initiated to monitor air levels of VOCs and microbiological pollutants near a MBT plant in Montcada (Tarragona, Spain). To investigate the temporal and seasonal trends of chemical and microbiological pollutants, 4-monthly campaigns were performed. Air samples were collected at different directions and distances from the facility. The levels of total bacteria ranged from 160 to 1054 cfu/m3 (colony-forming units per cubic meter) with a high increase in the last survey (summer 2011) compared to the initial (winter 2010). In fact, the highest concentrations were detected in the winter campaigns. Fungi at 37ºC were also important in the hot seasons with values of 716 and 106 cfu/m3 (summer 2010 and 2011, respectively) versus 60 and 61 cfu/m3 (winter 2010 and 2011, respectively). The concentration of the remaining microbial agents (gram-negative bacteria and the more aspecific Aspergillus fumigatus) was rather low, with a lack of temporal/seasonal differences. On the other hand, the highest mean concentration of VOCs were detected in winter campaign (4.7 μg/m3), with values between 4.55 and 120.9 μg/m3. For these chemical compounds, the greatest concentrations were found in two winter campaigns. The current exposure to those chemicals, estimated from the environmental burdens, should not mean additional non-carcinogenic or carcinogenic 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 modelled and experimental results.

**TU 269**

Environmental risk management in confined spaces. A case study of an archive like a model of indoor environment involved with biodeterioration A. Michelau, S. Manente, R. Garzella, G. Ravagnan

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Propagating specific indoor environments, such as those that preserve Cultural Heritage, cannot fail to take into account the interactions they may have on human health. The Historical Archives, where cellulosic microfungi and bacteria find a comfortable environment for their development, are of particular interest in this sense. In fact, one of the major causes of paper degradation is the biodeterioration, which develops with specific environmental conditions. Therefore, it is necessary to conduct research linking microbiology with environmental Archives, to understand the conservation state of the documents and also, the possible risks for the Archive’s operators and for people who work within these environments. The study case involves the Contemporary Political History Archives sites in Ca’ Tron, Treviso (Italy) in the Veneto countryside. A specific seasonal aerobiological protocol was defined to monitor the presence of microorganisms both in the air and on the documents stored, the temperature, humidity and light conditions, and the detection of dust (PM10 and PM2.5). For the aerobiology analysis, active and passive sampler were performed. Volumetric samplers were used to measure the concentration of microbes in air (expressed by CFU/m3), while Petri dishes with different culture media (Nutrient Agar, Malt Extract Agar and Malt Extract Agar plus Chloramphenicol) were used for qualitative microbiological sampling (expressed by CFU/m3). In addition, two parameters were considered for the surface contamination, using nitrocellulose membranes: the Microbial Buildup (MB, the total number of microorganisms collected on a surface in 30 second) and the Hourly Microbial Fallout (HMF, the number of microorganisms collected during 1 hour). In this way, it was possible to:

- define the conservative situation of the Archive;
- identify microbial species present both in the air and on the documents and then identify those potentially cellulosytic and those dangerous for human health;
- to propose measures to improve archive’s conservation and thus prevent degenerative risk situations, like the Sick Building Syndrome.

**TU 270**

Persistent organic pollutants (POPs) in ambient air, human breast milk and edible fish - a potential for health risk in Ghana S.O. Adu-Kumi¹, J.K. Klamo², A.A. Usate³

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Levels of persistent organic pollutants (POPs) in rural and urban background air of southern Ghana were measured in 2008 using polycarbonate filters (PCF) disks passive air samplers (PAS) referred to as PUF-disk samplers. The objective of this study was to quantify the levels of POPs in air and to establish their baseline information for future monitoring and trend studies. This is the first comprehensive study reporting on levels of POPs in background or ambient air in Ghana covering the coastal zone and the middle belt. POPs in pooled and individual human breast milk samples collected from lactating mothers countrywide were also determined using a high-resolution gas chromatography interfaced with a high resolution mass spectrometer (HRGC-HRMS). This constitutes the first comprehensive nationwide human breast milk study of assessing risks of HCHs for the general population of Ghana. The results of the study showed that the general population of Ghana is widely exposed to POPs although the current levels are generally low. POPs measured in selected edible fish from three freshwater bodies, namely Lake Volta, Lake Bosomtwi and Weija Lake in Ghana shows that there is a potential health risk from POPs for the general population of Ghana because fish is one of their important protein sources.

**TU 271**

Toxicity screening of fine particles by a novel microbial test battery I.R. Gutiérrez¹, D. Dietrich², W. Ahl³

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Burnout management of fine particles has been an increasing popular worldwide due to the increasing costs of fossil fuels. Claimed as renewable energy source, wood has often been ignored as a source for fine particles causing toxic effects. Rapid reproducible and validated biotests for toxicological characterisation of such particles exist neither for parrot nor for micro-organisms. Thus there is a need for established microscale toxicity screening of unknown combustion born particles. Here we present a protocol for the assessment of two ISO standardised bacterial contact assays and one yeast biotest modified for the use with fine dust. Having different endpoints these tests provide a toxicological “fingerprint”. In order to account for bioavailability of contaminants adsorbed on surfaces of fine particles, such tests were used as a whole not as extracts. Particle diameter was measured electrostatically from different furnaces in the flue gas channel. Suspended in water, vertrected for 1 min, and ultrasonificated for 15 min 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 no particles, solely deionized water.

Genotoxicity in the aerobic Arthrobacter globiforms contact assay was determined via dehydrogenase activity (DHA). Genotoxicity was determined via Umu-Test using a genetically modified Salmonella strain. The Yes-Test was employed to determine potential estrogenicity of particle samples. Contrary to FP A, FP B exhibited cytotoxicity between 0.1 and 1 mg FP/ mL. High contents of Zn supposedly caused cytotoxicity in B. FP A was slightly genotoxic (+9) at 1 mg/mL and potentially estrogenic. Besides PAh's, other heterocyclic compounds might have caused this result. Further investigations are under construction. These preliminary results suggest suitability of endpoints determined in the modified tests for risk assessment of fine particles.

**TU 272**

Airborne particulate matter induced pro-inflammatory effects and oxidative stress in A549 cells S. Michael, M. Montag, W. Dott
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 sand, clay, peat and char coal. As it is known from aqueous sorption-desorption experiments, here also char coal significantly HPCD-extraction seems to be a good indicator for the available fraction. A value of 300 mg/kg may be a suitable threshold value regarding the habitat function of soils.

Earthworms are soft bodied organisms and exposed to contaminants mainly via soil pore water and skin. For mineral hydrocarbons the mobile fraction of C10-C22 is of high interest. The studies were performed in matrix, demonstrating that this isolation can readily remove matrix interference at low target compound concentrations. In addition, this method will demonstrate that the quality control criteria of EPA Method 1668 can be met using a GCMS triple quadrupole system. Advantage for the laboratory is 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 transitions for the PCBs and other compounds simplifies method development and verification, simplifying the adoption of GC-triple quadrupole MS for this analysis.

Analysis of pesticides in water samples based on the combination of solid phase extraction and solid phase microextraction coupled to gas chromatography mass detection R.J. Hildebrandt1, D.A. Wunderlin1, M.V. Ame2

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In the context of assessing the habitat function of contaminated sites only the bioavailable contaminant fraction 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 bioavailability was determined 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-C22 performing exhaustive extraction; (III) water based extraction - shaken using shaking- and (IV) water based extraction - use of an extra solid phase: HPCD.

The increase of the agricultural surface area in Argentina has triggered the generalized use of pesticides, which are spread across soils contaminating both surface and ground-water. The aim of this study was: (a) develop a sensitive Gas Chromatography tandem Mass Spectrometry (GC-MS) method for the quantification of the most widely used pesticides at environmentally relevant concentrations and (b) test this method with surface waters collected from the Suquía River basin, Córdoba, Argentina.

Apart from the classic gaseous pollutants airborne particulates continue to pose a significant threat to human health worldwide. In this study, the geosorbents sand, clay, peat and char coal, which had been characterized in various previous studies, spiked with 16 deuterated EPA-PAH, were extracted with several extraction procedures: (I) total content using exhaustive extraction (C10-C40 fraction); (II) fraction of C10-C22 performing exhaustive extraction; (III) water based extraction - shaken using shaking- and (IV) water based extraction - use of an extra solid phase: HPCD.

The response of A549 cells to ambient PM was markedly different comparing specific samples from various sampling sites and emission sources in the region of Aachen. Our results support other investigations regarding the importance of the chemical compositions and there PM induced toxicity in vitro. The study is embedded in the project City2020+ which is part of the interdisciplinary Project House HumTec (Human Technology Center) at RWTH Aachen University funded by the Excellence Initiative of the German federal and state governments through the German Research Foundation (Deutsche Forschungsgemeinschaft, DFG).
reduced (e.g., historical pollution), sediments can become a secondary source to their surrounding environment. As a result of the challenges encountered when attempting to predict contaminant bioavailability and mobility, gauging the risk posed by these contaminated sediments remains challenging.

In an effort to control and reduce the impact of contaminated sediments on ecosystems and human health, a risk assessment guideline tool for contaminated marine sediments was introduced in 1998 by the European Commission. This tool aims to prioritize the examination of the largest number of sites in the shortest possible time, considering the complex nature of marine sediments. However, this tool has been criticized for its inability to fully assess the risks associated with contaminated sediments, as it relies on data from a limited number of sites and may not adequately capture the variability found in marine environments.

Therefore, new strategies are needed to address the challenges posed by contaminated sediments, including the development of more comprehensive and site-specific assessment tools. These tools should consider the unique characteristics of each site, including the type and extent of contamination, the biophysical conditions, and the potential exposure pathways for humans and wildlife. Additionally, efforts should be made to improve the understanding of the fate and transport of contaminants in marine sediments, as well as to develop effective remediation strategies that are tailored to the specific needs of each site.

References

TU 284
Bioavailability tests: the last available tools for evaluating PAH risks realistically
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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 to 5 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), dibenzo[a,h]anthracene (10x), and benzo[g,h,i]perylene (10x). If this approach is adopted, human health risks from exposure to PAHs will increase considerably, and risk-based clean-up levels will drop to below background even for commercial/industrial receptors and a 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 adjustment factors (BAFs) due to the literature. USEPA’s current strategy has supported a policy of performing in vivo bioavailability studies of site-specific media impacted by complex organic compounds. The authors have designed 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 on-going study, which is a robust, internally consistent animal bioavailability study with site specific, in vivo dosing scenarios and discussed included typical and non-typical contaminants in the sediment matrix.
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 homogeneous and heterogeneous environmental conditions. We therefore conclude that ‘highways’ as well as ‘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 oomyecete mycelia on bacterial biodegradation of phenanthrene present in nonaqueous-phase liquids (NAPLs)

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In our work, we present the effect of sunflower rhizosphere on the biodegradation of PAHs in soil with creosote (21.75 mg kg⁻¹ containing 6 HAAP). We conducted two experiments of biodegradation: one of them in greenhouse with cultivated sunflower and other in the laboratory with suspensions of soil and root exudates of sunflower. The sunflower root exudates were extracted using in vitro culture. The presence of the plants caused in greenhouse conditions a selective increase in PAH-degrading populations and in modulating the deposition and motility of degraders in porous media.

TU 287

Sunflowers in rhizoremediation: a possible alternative for improving the bioavailability of PAHs in soils

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Arhus University, Roskilde, Denmark

The use of plants in bioremediation depends largely on the ability of degraders of contaminants in soil and plant growth that drive organisms to colonize roots efficiently. In our work, we present the effect of sunflower rhizosphere on the biodegradation of PAHs in soil with creosote (21.75 mg kg⁻¹ containing 6 HAAP). We conducted two experiments of biodegradation: one of them in greenhouse with cultivated sunflower and other in the laboratory with suspensions of soil and root exudates of sunflower. The sunflower root exudates were extracted using in vitro culture. The presence of the plants caused in greenhouse conditions a selective increase in PAH-degrading populations and in modulating the deposition and motility of degraders in porous media.

TU 288

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

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In our work, we present the effect of sunflower rhizosphere on the biodegradation of PAHs in soil with creosote (21.75 mg kg⁻¹ containing 6 HAAP). We conducted two experiments of biodegradation: one of them in greenhouse with cultivated sunflower and other in the laboratory with suspensions of soil and root exudates of sunflower. The sunflower root exudates were extracted using in vitro culture. The presence of the plants caused in greenhouse conditions a selective increase in PAH-degrading populations and in modulating the deposition and motility of degraders in porous media.

TU 289

Sorptive and sustainable bioremediation: effects on slow desorption PAHs

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In our work, we present the effect of sunflower rhizosphere on the biodegradation of PAHs in soil with creosote (21.75 mg kg⁻¹ containing 6 HAAP). We conducted two experiments of biodegradation: one of them in greenhouse with cultivated sunflower and other in the laboratory with suspensions of soil and root exudates of sunflower. The sunflower root exudates were extracted using in vitro culture. The presence of the plants caused in greenhouse conditions a selective increase in PAH-degrading populations and in modulating the deposition and motility of degraders in porous media.

TU 290

Bacterial taxais and sustainable remediation: effects on bacterial dispersal

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We focus in modulating the deposition and motility of degraders in porous media as a biodegradation-promoting strategy. The positive effects of - often energy-consuming - mobilization approaches in bioremediation depend on the efficiency of bacterial movement in porous media, which is often restricted by high deposition rates and adhesion to soil surfaces. Besides, adhesion to surfaces may be sometimes beneficial in promoting biodegradation of slowly-desorbing chemicals. In well-controlled column systems, we assessed the motility of different chemotactic, naphthalene-degrading bacteria, using capillary assays and by analyzing the movement of individual cells through computer-assisted motion analysis, certifying parameters like linear speed and rate of change of direction. The cell interaction with the column packing material, and subsequently deposition, depended on the motile behaviour (hypermotility, attraction or repellence). For example, morphologically similar chemicals, such as phthalic anhydride and benzoic acid, could cause smooth trajectory patterns and reduced the affinity of the cells for surfaces, thus promoting transport due to a decreased deposition, whereas repellence caused the opposite effect. We propose that, by promoting the right motility combination, we can adapt cell deposition to a given bioremediation scenario, thus achieving an enhanced and sustainable bioremediation performance.

TU 291

Behavioural responses of Tetratymena pyriformis exposed to microgradients of hydrophobic organic chemicals

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Behavioural changes of microorganisms may reveal subtle 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 effects of selected polycyclic aromatic hydrocarbons (PAHs) on the behaviour of the ciliate Tetratymena pyriformis. Motile cells and organisms that are able to sense chemical signals may direct their 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 infra-red light illumination. Trajectories of the cells were obtained using an automated cell tracking software and were subsequently analyzed for chemotaxis by statistical measures. The Taylor model, which mathematically describes the scale-dependent transition from ballistic to diffusive movement, was applied to obtain first-moment parameters such as the tumbling frequency and effective swimming velocity to evaluate changes in the swimming behaviour of the cells. The results did not reveal chemotactic behaviour of T. pyriformis in the concentrations gradients of the compounds tested. However, motility behaviour was affected at levels that were about two orders of magnitude below the reported effective chemical activity causing 50% lethality, emphasizing that behavioural responses are a sensitive endpoint in toxicity testing.
Influence of charge and molecular structure on the sorption process. Representative emerging contaminants were selected, covering hormones, pharmaceuticals, personal care products, and pesticides. Batch sorption studies were conducted with natural DOM-containing water samples obtained from Finland, United Kingdom, and the Netherlands and by using polycarbonate passive samplers to determine aqueous contaminant concentrations. The DOM samples were characterized by chemical and physical fractionation methods to partition charge and sorption to both DOM and polyacrylate. Positively charged compounds showed a strong pH dependent sorption to DOM, whereas the neutral forms were the most important species responsible for sorption to polyacrylate. Negatively charged compounds showed the lowest affinity to both DOM and polyacrylate. For most neutral compounds investigated, the water phase represented a more favorable medium compared to DOM. The obtained results may increase our knowledge on the sorption of polar organic contaminants to DOM, which is currently based on only limited data.

TU 293

Binding can improve the mobilization of hydrophobic contaminants. V. Gouliarmou1, K.E.C. Smith2, I. de Jonge2, L.W. Mayer2

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The binding of hydrophobic contaminants (HOCs) is usually considered to be a risk reduction process. However, if the bound form becomes mobile then it can in fact enhance uptake and risk. This phenomenon can be seen in 1) colloid facilitated transport 2) the use of chemical agents to enhance soil remediation and 3) in biology, where body burdens of pollutants may move to and reside in secondary compartments. It is only in the last category that a strong pH dependent sorption to DOM, whereas the neutral forms were the most important species responsible for sorption to polyacrylate. Negatively charged compounds showed the lowest affinity to both DOM and polyacrylate. For most neutral compounds investigated, the water phase represented a more favorable medium compared to DOM. The obtained results may increase our knowledge on the sorption of polar organic contaminants to DOM, which is currently based on only limited data.

Reference


TU 294


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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 solubility and sorptive losses. To overcome these, an experimental approach based on dynamic passive dosing is presented which: avoids using co-solvent for introducing the PAHs, buffers substrate depletion so enhancements could be measured with high precision. Dosing circumvented artefacts associated with adding crystals of HOCs into an aqueous solution, and due to the low relative standard deviation of the method even small changes could be detected. This phenomenon can been seen in 1) colloid facilitated transport 2) the use of chemical agents to enhance soil remediation and 3) in biology, where body burdens of pollutants may move to and reside in secondary compartments. It is only in the last category that a strong pH dependent sorption to DOM, whereas the neutral forms were the most important species responsible for sorption to polyacrylate. Negatively charged compounds showed the lowest affinity to both DOM and polyacrylate. For most neutral compounds investigated, the water phase represented a more favorable medium compared to DOM. The obtained results may increase our knowledge on the sorption of polar organic contaminants to DOM, which is currently based on only limited data.

References:

3V. Gouliarmou, Binding can increase the mobility and uptake of hydrophobic organic compounds. 

TU 295

Enhanced mass transfer of hydrophobic organic compounds from NAPLs into the aqueous phase by dissolved organic carbon K.E.C. Smith1, M. Thullner2, L.Y. Wick3, H. Harns2

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Hydrophobic organic compounds (HOCs) are often found as mixtures in the form of non-aqueous phase liquids (NAPLs). Due to their hydrophobic nature, the HOCs preferentially remain in the NAPL with slow mass fluxes into the aqueous phase. However, since water dissolved HOCs play a key role in diffusive uptake into organisms, microorganisms using HOCs as a source of carbon and energy face a large reservoir of inaccessible food in the NAPL which is often reflected in slow bioremediation of NAPL contaminated sites. Interestingly, mobile “colloidal-like” phases can contribute to diffusive mass exchange processes between surfaces and the bulk aqueous phase, a phenomenon termed enhanced or facilitated diffusion. Therefore, this study investigated the role of dissolved organic carbon (DOC) in enhancing the mass transfer of hydrophobic organic compounds from NAPLs into the aqueous phase above that attributable to dissolved molecular diffusion alone. In controlled experiments, mass transfer rates were increased by up to a factor of four in the presence of DOC, with the greatest enhancement observed for the highest dissolved concentrations of DOC. These increases could not be explained by dissolved molecular diffusion alone, and point to a parallel DOC-mediated diffusive pathway. The nature of the DOC-mediated diffusion pathway was investigated using diffusion-based models, and found to increase with DOC concentration and compound sorption. Therefore, for “super”hydrophobic compounds this pathway could both dominate but also increase mass transfer rates by orders of magnitude, even at environmental DOC concentrations. This has important implications for their bioremediation, as well bioconcentration and toxicity.

TU 296

On the effect of vitamins and nutrients on the solubilization of petrodeilose/biodiesel blends in water M.L. Sokolowski1,2, S. Suzuki1, A.D. Venosa2,1, M. Thullner2

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The effect of mineral salts on the aqueous solubility of nonlyelectrolytes is largely assumed to exhibit the “salting out” or “salting in” effects in which the aqueous solubility of nonlyelectrolytes is decreased or increased upon the addition of salts. Pioneering investigations by Setschenow [1] and later by Carter and Hardy [2] among others, resulted in semiempirical relationships that describe the dependence of the solubility of nonlyelectrolytes solutes on salts concentrations. We conducted equilibration experiments of petrodeilose/biodiesel blends (B0, B20, B40, B60, B80, and B100, where B100 is 100% biodiesel) in water in the presence and absence of standard vitamins and nutrients used for bacterial growth studies. The solubility of aromatic compounds was found to be in agreement with the salting out effect in the presence of the added nutrients. The solubility of aliphatic hydrocarbons was found to be significantly enhanced (p < 0.005), up to 40-fold in the presence of the fatty acid methyl esters (FAMES) and the vitamins and nutrients medium, compared to FAMES and deionized water alone. A similar observation was made by Baker [3] regarding the effect of salts on solubilization of the alkanes and aromatic compounds in the presence of fatty acid soap solution. They reported that in the presence of soap, the solubilization of alkane and aromatic hydrocarbons was markedly higher and that of aromatic hydrocarbons is lower. Those observations are found to contribute significantly to the bioavailability of the n-alkanes in the water column. Biodegradation studies conducted in our laboratory showed significant enhancement for the microbial utilization rates of the n-alkanes in the petrodeilose/biodiesel blends, which we interpret to be due to the increase in aqueous concentrations of the n-alkanes in the presence of the FAMES and nutrients.

References


TU 297

Photo-Transformation of 2,3,7,8-TCDD in presence of natural organic matter studied by in vitro bioassay M.P. Gouliarmou1, N. Dandoura2, P.P. Gouliarmou3, L. Bahl4

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4Science & Technology, 2011, 45, 5301-5308

2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) as a representative of hydrophobic organic compounds (HOCs, frequent anthropogenic environmental pollutants comprising "dioxin-like"HOCs. Natural organic matter (NOM), being naturally occurring compounds (up to 50 mg/L in waters), occurs together with HOCs in contaminated water.

The effect of mineral salts on the aqueous solubility of nonlyelectrolytes is largely assumed to exhibit the “salting out” or “salting in” effects in which the aqueous solubility of nonlyelectrolytes is decreased or increased upon the addition of salts. Pioneering investigations by Setschenow [1] and later by Carter and Hardy [2] among others, resulted in semiempirical relationships that describe the dependence of the solubility of nonlyelectrolytes solutes on salts concentrations. We conducted equilibration experiments of petrodeilose/biodiesel blends (B0, B20, B40, B60, B80, and B100, where B100 is 100% biodiesel) in water in the presence and absence of standard vitamins and nutrients used for bacterial growth studies. The solubility of aromatic compounds was found to be in agreement with the salting out effect in the presence of the added nutrients. The solubility of aliphatic hydrocarbons was found to be significantly enhanced (p < 0.005), up to 40-fold in the presence of the fatty acid methyl esters (FAMES) and the vitamins and nutrients medium, compared to FAMES and deionized water alone. A similar observation was made by Baker [3] regarding the effect of salts on solubilization of the alkanes and aromatic compounds in the presence of fatty acid soap solution. They reported that in the presence of soap, the solubilization of alkane and aromatic hydrocarbons was markedly higher and that of aromatic hydrocarbons is lower. Those observations are found to contribute significantly to the bioavailability of the n-alkanes in the water column. Biodegradation studies conducted in our laboratory showed significant enhancement for the microbial utilization rates of the n-alkanes in the petrodeilose/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.
solutions were irradiated by sun light in quartz tubes for up to 3 days. Photo-degradation of TCDD studied by in vitro assay (based on the HHIEC: 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 CETOCDEN (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 waters 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 seawater. Most available studies on this topic deal with the distribution and fate of alkylphenol polyethoxylates (APEO) in aquatic systems, as some of their degradation intermediates are endocrine disruptor compounds (EDC). Linear alkylbenzene sulfonates (LAS) have also been studied, but they showed the highest 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. Recently, anaerobic degradation of SAS was confirmed in marine sediments due to the presence of sulfate reducing bacteria. This research has focused on determining whether SAS are biodegradable or not in absence of oxygen in the marine environment, and, if that happens, on the role of sorption on the speed of the biodegradation. First sorption experiments were performed using several amounts of sediments (0.5-5 g) and SAS concentrations (1-10 mg/kg). Distribution coefficients ranged from 150 to 1500. SAS homologues were observed that the sorption capacity of SAS can be much higher for those homologues having longer alkyl chains (e.g., C17-SAS) rather than for more polar homologues such as C14-SAS. Later, biodegradation experiments using anoxic marine sediments and seawater were conducted. SAS anaerobic biodegradation was observed for the first time, reaching overall values up to 98% in 166 days. Half-life values ranged from 20 days (C14-SAS) to 37 days (C17-SAS), showing that the speed of this process significantly depends on the sorption capacity and, therefore, bioavailability, of each SAS homologue.

TU 299

Remediation of PCB- and PAH-contaminated soil with modified clays
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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 a preferred option, 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 soil.

Sodium dodecyl sulphate (SDS) and humic acid were used to modify bentonite. Kaolinite was modified by Papaya Seed. Different percentages of the modified clays were mixed with the contaminated soil and suspended in 0.01M CaCl2 in the dark for twenty days. After equilibration analysis of the contaminated clays was performed using SPME coupled with GC/MS.

Presented are the sorption capacities of the modified clays and results of remediation. The results of this study indicate a promising potential of the modified clays to immobilize PCBs and PAHs 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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Infiltrated X-ray contrast media (X-RM) occur in concentration ranges of several hundred ng/l in many surface waters used for drinking water production. To clean up surface water, sustainable waste water treatment techniques like river bank filtration or artificial groundwater recharge (AGR) are used, but some X-RCM like amidotrizoic acid are known to be very persistent. Due to low the sorption tendency of X-RCM [1], their fate is rather related to biodegradation, as proved by the detection of metabolites reported in literature [2].

To simulate the process of AGR, the fate of six iodinated X-ray contrast media (amidotrizoic acid, iodoxy, iopenol, iomoprid, amidotrizoic acid and iodopride) was studied during percolation of a sandy gravelly substrate in a column percolation experiment using infiltrated surface water from the Rhine. The question of interest was, whether elevated DOC would improve or impair the removal of X-RCM during the column passage. Therefore, filtrated Rhine water used for column percolation was spiked with concentrated aqueous saccharose solution or achieved by amendment of saccharose to simulate the pollution of the Rhine with low molecular organic compounds, e.g. from food industry or accidental spills. Time weighted composite samples of column influent and effluent were analysed for X-RCM and DOC and treatments with and without saccharose were compared.

Moderately elevated DOC (1.3-fold of background) stimulated iodoxy removal, but for most X-RCM there was no effect. In contrast, twenty-fold elevated background DOC impaired the removal of most X-RCM, while there was a tendency towards elevated iopamidol removal. The latter stimulation is supposed to be related to the observed changes in redox settings in the column induced by the high DOC load, as the fate of iopamidol is reported to depend on site-specific redox conditions at several field sites in literature [3].

Regarding the removal of X-RCM, moderate pollution of surface waters with low molecular organic compounds can thus be compensated by natural water treatment like river bank filtration or artificial groundwater recharge (AGR), but some X-RCM like amidotrizoic acid are known to be very persistent. Due to low the sorption tendency of X-RCM [1], their fate is rather related to biodegradation, as proved by the detection of metabolites reported in literature [2].

TU 301

Effect of pH and electrolyte concentration on soil adsorption of pesticides

Acknowledgement: We thank IWB Basel for funding and support.

TU 302

Relationships between soil adsorption of pesticides and pesticide/soil properties
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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 new agricultural chemicals have been developed, and sorption of some vegetable crops at levels above the uniform limit, and the distribution of these crops has been prohibited. One of the reasons why the limit has been exceeded is that succeeding crops are contaminated by pesticides remaining in the soil. Assuming that these pesticides in the soil are taken up by plants via the soil solution, an understanding of the soil-water distribution of the pesticides remaining in the soil is strongly influenced by soil organic matter content. However, there is little information available on the influence of soil pH and electrolyte concentrations, changed by chemical fertilizer treatment, on pesticide adsorption. We therefore used batch experiments to investigate the effects of these factors on the distribution coefficient for adsorption (Kd) of about 30 pesticides. We used buffer solutions (pH 3, 5, 7.5, and 9) and CaCl2, 0.01, 0.1, and 1 mol/L) and compared with different organic matter contents. Each soil was shaken with an aqueous solution containing 0.1 mg/L of pesticide at a soil-to-solution ratio of 1 to 5, with a 24-h equilibration period for all experiments. Increasing the CaCl2 concentration from 0.01 to 0.1 mol/L had no 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 was found to be pH dependent. In general, Kd values were negatively correlated with pH levels, and the rate of Kd change, calculated by dividing the Kd values at pH 1 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 303

Effect of pH and electrolyte concentration on soil adsorption of pesticides
Y. Motoki, T. Iwafune, N. Seike, T. Otani

TU 304

Relationships between soil adsorption of pesticides and pesticide/soil properties
T.I. Iwafune, M.Y. Motoki

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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 levels 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. Pesticides, 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 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 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

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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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Influence of Kow value on leaching of non-ionic surfactants in riverine and flooding events as well as plant growing may modify pesticide availability and leaching. Surface water receives discharge from industrial, urban and agricultural uses that will account for a variety of compounds such as surfactants, colloids and dissolved organic carbon. This work studies the vertical distribution and movement of aged DDTS and endosulfan in undisturbed soil columns immersed in riverine water, 2-Tw-80 and Acids.

Experiments were carried out with 13 cm x 30 cm soil columns taken from Ardisol soils from a fruit field in Patagonian, Argentina. Columns were saturated with distilled water and 4L were added under saturated condition. One L leachates (n=4) were collected for pesticide residues analysis. After elution, columns were dried (24 h), opened and sampling on 5 cm sections. Pesticide desorption was performed by batch technique and residues analysis were performed by GC-ECD. p,p'-DDT, p,p'-DDE, p,p'-DDT and endosulfan-β-endosulfan pattern was found in all soil sections. p,p'-DDT levels ranged between 2.750-8.70, and 13-200 ng g⁻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,p'-DDT and p,p'-DDT desorption from soil was tested. Under Tw-80, soil (n=8) was followed the order control < Tw-80, showing that pesticide levels were high in 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. Lixiviation of aged p,p'-DDT residues or endosulfan effectively occurs under irrigation with riverine water and is increased by adding non-ionic surfactant or carboxylic acids. Tw-80 had a washing effect of pesticides leading to lower levels on soil while carboxylic acids enhance pesticides availability.

TU 304

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

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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 on the ionic strength of the soil solution, the sorption to the major soil constituents, soil organic matter, sediment and dissolved colloids. Since both natural organic matter and clay minerals are negatively charged substrates, both sorbent types are well known to bind organic cations, but it is not clear to what extent each type contributes in natural soils. Using a customized dynamic HPLC column retention method, we studied the sorption of a set of organic cations to individual soil components, such as natural organic matter (NOM, Palmheave peat) and pure clay minerals (Kolinoil, Illite, Illonite) in addition to freeze-dried Eurosoils, which ranged from low to high organic carbon content (FOC) from 1.3 - 9.2%, and in clay content from 6 - 75%. We examined to what extent sorption of natural compounds to soil can be predicted based on sorption to individual soil components alone. In general, sorption of primary amines to clay minerals was weak relative to quaternary ammonium compounds (quats), whereas sorption of primary amines to NOM was strong relative to quats. Such relative sorption affinity differences between test compounds between NOM 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

P. Gago-Ferrero1, M. Badia-Fabregat2, C.E. Rodríguez-Rodríguez2, M.G. Caminal1, T. Vicent1, M.S. Díaz-Cruz1, D. Barceló1

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UV filters are extensively used in personal care products but are also present in a wide variety of industrial goods such as textiles, paints, or plastics to prevent photodegradation of polymers and pigments. UV filters can enter the environment through the liquid effluent of industrial facilities, such as paper mill effluents or production effluents from personal and household care products. The degradation of UV filters in sewage sludge by the ligninolytic fungus Trametes versicolor and study of the 4MBC degradation process in liquid medium is reported in the present work as feasible to degrade them in a range from 87 to 100%.

TU 306

Retention method, we studied the sorption of a set of organic cations to individual soil components, such as natural organic matter (NOM, Palmheave peat) and pure clay minerals (Kolinoil, Illite, Illonite) in addition to freeze-dried Eurosoils, which ranged from low to high organic carbon content (FOC) from 1.3 - 9.2%, and in clay content from 6 - 75%. We examined to what extent sorption of natural compounds to soil can be predicted based on sorption to individual soil components alone. In general, sorption of primary amines to clay minerals was weak relative to quaternary ammonium compounds (quats), whereas sorption of primary amines to NOM was strong relative to quats. Such relative sorption affinity differences between test compounds between NOM and clay minerals were used to evaluate soil sorption.

Degradation studies of 3-(4’-methylbenzylidene) camphor (4MBC) in liquid medium was also done in particular and complete removal was achieved in less than 24 h.

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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Degradation studies of 3-(4’-methylbenzylidene) camphor (4MBC) in liquid medium was also done in particular and complete removal was achieved in less than 24 h.

The major metabolites 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 supported the extended hypothesis that conjugation processes constitute one of the defensive mechanisms that fungi activate against toxic hydroxylated compounds.

TU 306

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

M.B. Miloradov1, M.M. Miloradov1, J.S. Slodobnik1, M.D. Djigo1, M.D. Milovanovic1, J.R. Radonic1, M.M. Turk Sekelic1

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Phthalates belong to the group of dominant industrial pollutants and are ubiquitous over any scale of compounds with low water solubility/high fat solubility and low volatility. Due to their low water solubility, the phthalates hydrolyze relatively slowly, but the actual dynamic rate varies according to temperature, concentration and solution composition. Chemical properties of phthalates have made them highly persistent. Adsorption of phthalates on the surface of soils is significantly 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.

In the present study, as feasible to degrade them in a range from 87 to 100%.

TU 307

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

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A mega-flooding event in the Negro River basin, Argentinian Patagonia, caused a significant outflow of contaminants from the surrounding soils. Agriculture, hydroelectric power plants and industrial-urban contaminants are the most important activities in the basin. This study evaluates the effects of flooding events on the concentration levels of PBDEs, PCBs, polychlorinated biphenyls (PCBs), organochlorine pesticides (OCPs), PAHs, PAEs and organochloro-compounds (OCs) in fish and compares the results to historical data collected prior to the flooding event. A total of 16 species of freshwater fish were sampled in the Negro River basin during a mega-flooding event. The analysis was performed by gas chromatography with mass spectrometry (GC-MS). The results showed that the highest increase in PCB levels was observed in the species Liparia peelor and Salminus brasiliensis. The highest increase in PBDE levels was observed in the species Liparia peelor and Salminus brasiliensis.
Polychloro-dioxins, furans and biphenyls in fish, crabs and clams from the San Jacinto River Waste Pits, TX

S. Gonçalves1, M.D. Pavlik1, N.G.C. Ferreira2, S. Loureiro2

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2Universidade de Aveiro & CESAM, Aveiro, Portugal

TU 312
Birds species versus crops: a GIS-based procedure to identify specific combinations
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ICTP, Trieste, Italy

Assignment of average detoxification indexes DAV (averaged over three test species) 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. Among all humates tested the highest detoxifying ability was observed for S. Alba. Among all humates tested the highest detoxifying ability was observed for S. Alba.

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

TU 313
Toxicity of sludge water treatment station for aquatic invertebrates
T.G. Messias

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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, which contains 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 biodiocenosis: 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 elutriate solution mixing the sample with distilled water to achieve a concentration in soils 0.005 and 0.020 wt. %.

As mentioned above, the highest detoxifying ability was observed for S. Alba. Among all humates tested the highest detoxifying ability was observed for S. Alba. Among all humates tested the highest detoxifying ability was observed for S. Alba.

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

TU 314
Toxicity of copper on the freshwater snail Physa acuta: reproduction output and biomarkers of effect
S. Gonçalves1, M.D. Pavlik2, N.G.C. Ferreira2, S. Loureiro2

1Universidade de Aveiro & CESAM, Aveiro, Portugal
2Universidade de Aveiro & CESAM, Aveiro, Portugal

Physa acuta exposed to copper sulfate in laboratory conditions. A 14/28 days chronic test was conducted using adult snails in 5 different copper concentrations showing that reproduction was impaired as the concentrations increased. Biomarkers activity (e.g. AChE, GST and CAT) and energy reserves were determined and correlated with reproduction. As expected the energy cost allocated to the detoxification process was one of the reproduction impairment causes.

Aqueous snails, like Physa acuta, have proved to be good test organisms to assess the presence of chemicals in the environment as they have been proven to be very sensitive to exposure.

TU 315
Inhibition of the fatty acid synthesis in chlorophytes by triclosan - a metabolomics approach
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1UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany

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. (2008) observed that Chlorophytes are one of the sensitive organisms affected by triclosan in a 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 subspp. varicosus [Klindre et al., Metabonomics, 2009]. Therefore we observed a synchronised culture of S. varicosus with different concentrations of triclosan (range from 0.002 to 0.071 µmol L⁻¹) for 14 hours to derive concentration-dependent metabolic changes. After harvest and derivatization hydrophilic and lipophilic metabolite extracts were analysed by GC-MS and evaluated by multivariate growth and photosynthetic activity). After harvest and derivatization hydrophilic and lipophilic metabolite extracts were analysed by GC-MS and evaluated by multivariate
bacteria, the inhibition of the Enoyl-ACP-reductase during the fatty acid elongation [McMurry et al., Nature, 1998].

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) characteristic for fish tissues, as they perform numerous functions. Their multifunctionality, the vast surface of exposure to the external media and their location in the fish body, justify their importance as key organs for the direct action of pollutants in the aquatic environment. This work aimed to assess biomorphic and biochemical changes in fishes, after exposure to several compounds, including pesticides, detergents and pharmaceuticals, which can be quantified using appropriate analytical tools. The goals of this study were to test the hypothesis that the connectivity of response in the pathways 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].

TU 316

Morphometric and biochemical evaluation in gills of Lepomis gibbosus, after acute exposure to several xenobiotics (pesticides, detergents and pharmaceuticals)


Universidade de Aveiro, Portugal

In this study we aimed to evaluate the exposure of Lepomis gibbosus to xenobiotics that are frequently found in surface water and to investigate how they are affecting the physiology of the fish. We conducted an exposure experiment with gills of L. gibbosus, which were exposed for 24 hours to several xenobiotics, including pesticides, detergents and pharmaceuticals. The effects of these compounds were evaluated through morphometric and biochemical analysis of the gills. The results showed that the exposure to xenobiotics had a significant effect on the morphology and function of the gills, with changes in the gill filaments and the activity of respiratory enzymes.

TU 317

Oxidative stress and higher level of engineered nanomaterials in the nematode Caenobิดitidis elegans: functional toxicogenomic approach

J. Choi, H.J. Eom, Roh, D.Y. Lim, J.M. Ahn

University of Seoul, Seoul-Korea (Rep)

Toxicogenomics is increasingly used in ecotoxicology but the challenges of these technologies are inferring biological importance from the data. To deal with this problem, integrated pathway and network analysis are being applied as they give a better understanding of biological effects at multiple levels. This systemic approach is particularly interesting for investigation of chemicals of which mode of actions are less characterized, such as, nanomaterials. Despite the recent increase in research on the toxicogenomics of nanomaterials (ENM) still exist, e.g., the relationship between higher level effective toxicities of nanomaterials and the mechanism of toxicity. Current mechanistic studies on ENM have reported oxidative stress as one of the most important mechanism of toxicity. In this study, to understand the relationship between higher level effective toxicities of ENM and mechanism of toxicity, functional toxicogenomic analysis was conducted in the nematode Caenobิดitidis elegans. Several nanomaterials were first examined in worms exposed to silver nanoparticles (AgNPs) and multi-wall carbon nanotubes (MWCNT). Subsequently, mechanism of toxicity was investigated using microarray followed by gene ontology (GO) and pathway analysis. Finally higher level effective altered genes and pathways selected as mechanism of toxicity was investigated using functional genomics tools such as, loss of function mutant or RNAi of genes involved in these pathways. Their responses were compared with those of wildtype.

TU 318

Biomarkers evaluation on the pearl oyster Pteria sterna (Gould, 1851) in The Ensenada de la Paz B.C.S. Mexico

S. Sobrino-Figueroa, C. Cáceres-Martínez

Universidad Autónoma Metropolitana, Mexico, d.f., Mexico

The catarina scallop constitutes an important fishing resource in B.C.S., Mexico state, due to the lack of studies related to their response to xenobiotics in this study. An evaluation of 4 biomarkers: respiration rate, ON index, oxidative stress and AchE activity were carried out in the gill tissue of pearl oyster, from the cultivation vivero, to detect presence of toxic and genotoxic substances, and evaluating the use this biomarkers as reliable tool in environmental biomonitoring studies. Adults oysters (5.15 ± 0.38 cm) were collected, one of the more valuable bivalves (2010) in the State of Baja California Sur, Mexico, to determine a potential relationship between copper exposure to the peptide chloroethylenylsulfone, the detergent SDS and anticholinesterase- like pharmaceuticals (neostigmine and pyridostigmine). The results of this study revealed that the most sensitive significantly decreased activity of GSTs at concentrations of 1 and 100 mg/L. Considering the morphometric analysis of the gills, the data obtained showed that chlorovinylphosphates increased values of BET and decreased SLL at a concentration of 1 mg/L. The SLL of the exposed fish increased up to a concentration of 3.9 mg/L and the potential action of neostigmine in exposed fish, with inhibition of GSTs activity, is a noteworthy result, since it establishes a reduction in the effectiveness of conjugation and elimination of other xenobiotics, enhancing toxicity. Gally, biomorphometric indices showed evidence of a surface respiratory disturbance as result of exposure to several xenobiotics, which could be advantageous for fish by reducing toxicant absorption.

TU 319

Physiological and biochemical biomarkers in the catarina scallop Argopecten ventricosus (Sowerby, 1842), as tools to Monitor in the Ensenada de la Paz B.C.S., Mexico

S. Sobrino-Figueroa, C. Cáceres-Martínez

Universidad Autónoma Metropolitana, Mexico, d.f., Mexico

The catarina scallop constitutes an important fishing resource in B.C.S., Mexico state, due to the lack of studies related to their response to xenobiotics in this study. An evaluation of 4 biomarkers: respiration rate, ON index, oxidative stress and AchE activity were carried out in the gill tissue of pearl oyster, from the cultivation vivero, to detect presence of toxic and genotoxic substances, and evaluating the use this biomarkers as reliable tool in environmental biomonitoring studies. Adults oysters (5.15 ± 0.38 cm) were collected, one of the more valuable bivalves (2010) in the State of Baja California Sur, Mexico, to determine a potential relationship between copper exposure to the peptide chloroethylenylsulfone, the detergent SDS and anticholinesterase- like pharmaceuticals (neostigmine and pyridostigmine). The results of this study revealed that the most sensitive significantly decreased activity of GSTs at concentrations of 1 and 100 mg/L. Considering the morphometric analysis of the gills, the data obtained showed that chlorovinylphosphates increased values of BET and decreased SLL at a concentration of 1 mg/L. The SLL of the exposed fish increased up to a concentration of 3.9 mg/L and the potential action of neostigmine in exposed fish, with inhibition of GSTs activity, is a noteworthy result, since it establishes a reduction in the effectiveness of conjugation and elimination of other xenobiotics, enhancing toxicity. Gally, biomorphometric indices showed evidence of a surface respiratory disturbance as result of exposure to several xenobiotics, which could be advantageous for fish by reducing toxicant absorption.

TU 320

Relationship between exposure duration, mortality, bioaccumulation and physiological parameters in glochidia (larvae) and juvenile freshwater mussels exposed to copper

J. Choi, H.J. Eom, Roh, D.Y. Lim, J.M. Ahn

University of Seoul, Seoul-Korea (Rep)

Toxicology is increasingly used in ecotoxicology but the challenges of these technologies are inferring biological importance from the data. To deal with this problem, integrated pathway and network analysis are being applied as they give a better understanding of biological effects at multiple levels. This systemic approach is particularly interesting for investigation of chemicals of which mode of actions are less characterized, such as, nanomaterials. Despite the recent increase in research on the toxicogenomics of nanomaterials (ENM) still exist, e.g., the relationship between higher level effective toxicities of nanomaterials and the mechanism of toxicity. Current mechanistic studies on ENM have reported oxidative stress as one of the most important mechanism of toxicity. In this study, to understand the relationship between higher level effective toxicities of ENM and mechanism of toxicity, functional toxicogenomic analysis was conducted in the nematode Caenobิดitidis elegans. Several nanomaterials were first examined in worms exposed to silver nanoparticles (AgNPs) and multi-wall carbon nanotubes (MWCNT). Subsequently, mechanism of toxicity was investigated using microarray followed by gene ontology (GO) and pathway analysis. Finally higher level effective altered genes and pathways selected as mechanism of toxicity was investigated using functional genomics tools such as, loss of function mutant or RNAi of genes involved in these pathways. Their responses were compared with those of wildtype.

TU 321

Cryptic lineages - are they comparable in their sensitivity towards chemical stress?

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The term “cryptic lineages” covers taxa that exhibit genetic differences but an at least superficial morphological equality and the respective specimens thus are misleadingly regarded as being identical. In this study, we aim to investigate whether cryptic lineages do differ in their sensitivity towards chemical stress. We chose the nematode Caenobíditidis elegans as a model organism. This nematode is susceptible to copper stress, which is a toxicant of particular interest due to its widespread use in agriculture. By comparing the responses of different cryptic lineages to copper stress, we aim to gain a better understanding of the evolutionary processes that have shaped these lineages and the potential implications for the conservation of biodiversity. We use a range of physiological and biochemical endpoints, such as, body sodium content and inhibition of Na+ K+ ATPase, indicating that copper toxicity for mussels chronically exposed is a consequence of an ionoregulatory disturbance. From copper bioaccumulation suggesting that copper toxicity is not associated with its bioaccumulation. Most striking in the chronic experiment was the reduction of whole SLL in fish exposed to a concentration of 3.9 mg/L. The drug neostigmine was responsible for an increase in SLL values at the highest tested concentration, and pyridostigmine increased SLL values at the concentration of 100 mg/L. The potential action of neostigmine in exposed fish, with inhibition of GSTs activity, is a noteworthy result, since it establishes a reduction in the effectiveness of conjugation and elimination of other xenobiotics, enhancing toxicity. Gally, biomorphometric indices showed evidence of a surface respiratory disturbance as result of exposure to several xenobiotics, which could be advantageous for fish by reducing toxicant absorption.
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 after seven days of exposure as a measure of sensitivity.

The subsequent analysis revealed that the meta-analysis described 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 endpoints tested, showed a similar tendency, however, results were statistically significant only for tetradenobol (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, however, mechanistically yet not explainable. Hence, further studies should address the sensitivity to other stressors, by also considering ecological aspects like the physiological fitness, of a broader range of cryptic complexes. Nonetheless, genetically distinct lineages may confound the results of ecotoxicological tests, as indicated in the present study, and should thus be interpreted with caution.

**TU 322**

**Status of PAHs in greater Johannesburg area and possible sources**

L. Chimuka, E. Cukrowska

University of the Witwatersrand, Johannesburg, South Africa

The presentation gives the overview of the status of the presence and levels of PAHs in greater Johannesburg area. Although many studies of persistent organic pollutants such as polycyclic aromatic hydrocarbons and PAHs have been performed in South Africa, the study on PAHs is still lacking a lot of gaps. The overview gives an overview of the 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 are still lacking a lot of gaps. The detailed discussion of the possible sources of PAHs is given and how these sources impact aquatic ecosystems in the studied area. Finally, the overview of PAH status in South Africa urban environment is given.

**TU 323**

**Linking transcriptome to phenotype: response of a mouse liver cell line to Benzo(a)pyrene**

D.J. Madureira*, K. Schirmer*

1Eawag - Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland

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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 dependent manner. The study was performed on Hepa1c1c7 cells, a known cell line, and additionally treated with different concentrations of BaP. Using RT-PCR and microarray analysis, the gene expression profiles of cells treated with BaP were compared to untreated control cells. We employed a systems biology approach by mapping transcriptomic data to known biological pathways to identify possible pathways affected by BaP exposure. Using Ingenuity Pathway Analysis (IPA) we were able to identify the metabolic pathways being significantly regulated indicating that BaP affects key processes. Our research focuses on the deregulation of genes by BaP in Hepa1c1c7 cells, and cellular dysfunction accompanied by early ROS production and lipid droplet modification.

**TU 324**

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

S. Dömbs*, M. Opitz, L. Ignjatovic, L. Chimuka, E. Cukrowska

University of Birmingham, Birmingham, United Kingdom

Ecotextomics 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 functional pathways. Integration across various levels of biological organization, molecular, cellular and organismal, is required to draw conclusions on impacts in populations, communities and ecosystems [1].

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 for cystic fibrosis. The network models generated with the genes significantly associated with valproate indicates an overall downregulation of nuclear proteins. Metabolite analysis performed on the aqueous fraction of methanol:chloroform extracted samples on Brucker Avance 500MHz spectrometer at HUWB-NMR Center, University of Birmingham. The subsequently conducted meta-analysis revealed a statistically significant higher overall sensitivity of the cryptic lineage type A compared to type B (n=16; *p* < 0.0001), by combining the results of all bioassays. Discrete meta-analyses for each of the endpoints tested, showed a similar tendency, however, results were statistically significant only for tetradenobol (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. However, mechanistically yet not explainable. 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 329
On the appropriateness of using the common mixture toxicity models CA and RA on species sensitivity distributions: a theoretical approach
V.G. Gregorio1, N. Chèvre2, M. Junghans1, I. Werner1
1, Union des Centres, Switzerland
2, Swiss Centre for Applied Ecotoxicology, Diéburg, Switzerland
Environmental effects can only expose to substances but not to mixtures. Therefore it is of great importance to assess the ecological risk not only substance by substance but also for mixtures. 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 disimilarly acting compounds (RA) for single species was already shown during the last decades. To assess the risk of chemical mixtures to ecosystems, both 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 mixture models were only validated for single substances when applied on single-dose-response curves and not on multi-substances SSDs. For a validation of this approach, one should therefore also 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 compare the difference between the two models using the same SSD methodology with CA/RA models for mPAF (multi substances potentially affected fraction) and then SSD construction) to derive a msPAF. To compare the two methods we calculate msPAF with different cases, varying the EC50s and the slopes of the individual dose-response curves.

The results show that the predictions with CA are quite similar between the two methods and small differences can be explained by the goodness of fit of SSDs and the species sensitivity 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 mixture risk of compounds is possible.

TU 330
Estimating inter-individual sensitivity from survival data using a mechanistic model
R.B. Beaudouin, A.R.R.P. Pery
INERIS, Verneuil en halatte, France
In the literature, there are two main alternatives to model mechanistically dose-survival relationship in ecotoxicity tests. Effects are related to a concentration of concern, for instance body concentration, and each individual has 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 for each species. Different parameters (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 84% of the population would be 2 to 4 times inferior to this standard threshold. We believe that our approach can benefit from the experts and from the using of the given data. Moreover, it permits to relate two fundamental concepts in understanding the response in ecotoxicity tests: the link between internal concentration and effects and the inter-individual variability regarding sensitivity.

TU 331
Incorporating data quality scores and acute-to-chronic ratios in the construction of SSDs
M. Grone1, L. Zaratte1, E. Semenzin2, P. Caiffroy1
1, TDF R&D, Chatou, France
2, Venice Research Consortium, Venice, Italy
The species sensitivity distribution (SSD) approach is in principle an alternative to the assessment factor approach for PNEC calculation. However, due to requirements on data quality and comparability of data, the SSD approach is only rarely restrained to a small number of compounds. One central problem is that commonly many available data are discarded from the analysis for reason of limited validity, endpoint (exclusion of EC50, type data) and exposure time (exclusion of acute data). The objective of the present study was to assess how the SSD approach can be extended to the use of the entire data sets of complex heterogeneous ecotoxicological information, such as different data quality, acute and chronic values, EC50, EC10 and NOEC values. More precisely, we aimed to provide a method which provides reliable and robust PNEC assessment, which is applicable to wider area of compounds. For this purpose, we replaced the dichotomous classification of data as either valid or not valid by a system of quality scores which integrate on the inherent experimental and statistical reliability of data and on their biological relevance (organism and endpoint). This system serves as weighting factors of individual data in the SSD analysis. Furthermore, we studied different options of how to incorporate acute values. Different options (of probabilistic Acute-to-Chronic ratios and weighting) for data treatment were integrated in a tool, which allows a generation of SSD functions and estimate uncertainties. As a result, we calculated the standard SSD function based on chronic NOECs only for several real ecotoxicological data sets on compounds fulfilling the strict TGD/REACH requirements for SSD application. Subsequently, we applied the developed method using weighting scores and acute to chronic extrapolation to the entire data set and bootstrap subsamples. SSD function obtained for subsamples of the entire data set using different options for data treatment were compared to the SSD based on chronic NOEC. Influence of different options for data treatment and sample size will be discussed with respect to the robustness and reliability of the SSD function and the associated HC value.

TU 332
Investigating the replacement of NOEC and LOEC values with regression-based ECx values
A.D. Sharp1, AstraZeneca, Brixham, United Kingdom
Data from chronic toxicity tests have traditionally been analysed by hypothesis test based statistical analysis to obtain a No Observed Effect Concentration (NOEC) and a Lowest Observed Effect Concentration (LOEC). Although a firmly entrenched paradigm, much recent debate has questioned whether these methods are the most appropriate way to analyse data from ecotoxicity studies. As part of this debate the use of ECx values and associated confidence intervals, determined by regression analysis and other modelling techniques, have been investigated by the OECD and others as possible replacement or complementary endpoints and are now included as a requirement in some test guidelines. For the first time a comparison of a number of data sets, the work described has shown that it is possible to apply a number of different static regression models to results arising from ecotoxicity tests, and to derive ECx values. The work indicates that, although not consistent for all datasets examined, it is possible to derive ECx values broadly similar to the respective NOEC and LOEC values. However, a number of issues remain which will be of importance when considering the possible replacement of NOEC and LOEC values with ECx values, including experimental design. It is thought that current test designs may not necessarily be suitable for data analysis using regression based methods, and that modifications to current protocols may be required to ensure that regression analysis of test data yields reliable and significant results. The work described has applied regression analysis to a number of simulated data sets which were developed according to differing test designs. This has shown that the ecotoxicity endpoint study can have implications for the results obtained by statistical analysis using regression techniques. In particular, both the estimated ECx values and the associated confidence intervals have been shown to be impacted by experimental design. This could have implications for both the ethical and practical aspects of ecotoxicological testing, when seeking an optimum test design.

TU 333
Statistical approach to select bioindicators for soil monitoring, risk assessment and soil characterization. Results from the French national programme ‘Bioindicators’
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2, ESITPA, Mont saint aignan, France
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The RIVM’s FAST 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 statistical approach 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 huge numbers of biological and meta-data in a database enhancing data analysis, (iii) develop a database 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) that may assess risks of soil contamination to ecosystems. More than 170 bioindicators 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, producing 47 different contexts in terms of land use (crops, grasslands, woods), ecosystems, soil types to determine more accurately applicable pollution thresholds, in particular for the discrimination between very contaminated and uncontaminated soils. To approach this objective, a multi-criteria approach has been developed. The use of different statistical techniques, such as Random forests revealed sets of relevant indicators for land use (crops, pastures, woods and forests), levels of metal contamination (high, medium and low) as well as soil texture (sandy, loamy, clayey).
The SSD approach is an element of most regulatory guidance documents for environmental risk assessment (e.g. ANZECC, ECHA, USEPA). Yet, the approach to be used for a set of 7 biomarkers in the bivalve Dreissena polymorpha, resulting in a matrix of 720 IBR values. It evidenced the variability of the IBR, that is not our main concern.

Indeed, the consequence is a different prioritization of contaminants effects depending on the biomarker sequence, that could lead to misunderstanding of contamination concentrations, there are many local minima. This is due to the structure of the threshold model and especially to its non-derivability at the threshold value. We will investigate various solutions 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 concentrations, there are many local minima. This is due to the structure of the threshold model and especially to its non-derivability at the threshold value. We will investigate various solutions to this issue, including adaptation of optimization algorithm and modification of models with fully derivable functions.

Advanced non-linear regression methods for concentration-response curves in R

We first go back to trigonometry basics to propose a new formula for the IBR, that is far more simple than the original one. Then we wrote a procedure that creates all the various solutions to this issue, including adaptation of optimization algorithm and modification of models with fully derivable functions.

A probabilistic model for species sensitivity distributions taking into account inherent uncertainty and variability of effects to estimate environmental risk

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.

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TU 341
Long-term food exposure to PCB mixtures induces reproductive and behavioural disruptions in zebrafish
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Abstract: A survey of adult zebrafish (Danio rerio) was performed to evaluate potential effects of long-term food exposure to PCB mixtures. Females were fed with reference diet or PCB-contaminated Artemia at 0.05 or 0.5 ppb for 3 generations. Females fed PCB-contaminated diet showed an increase in the number of unpigmented and enucleated eggs, as well as an increase in the number of poorly fertilized spawns. 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 first 24 hrs. Fish displayed at the end of the night a statistically significant negative association between swimming activity and the number of unfertilized eggs, which indicates that swimming activity is linked to the reproductive performance of zebrafish under PCBs exposure. The present study confirms previous findings that PCBs can induce negative effects on reproductive performance and swimming activity in zebrafish, suggesting that these effects might be used as biomarkers for population monitoring and risk assessment.

TU 342
Polyaromatic hydrocarbons (PAH) and triclosan (TCS) pollution in the Loire estuary: a multi-generational test with Daphnia magna in laboratory and field conditions
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INRA, UMR 1067, Centre de Biochimie des Systèmes Complexes, Biot, France

Abstract: The objective of the present study was to evaluate the toxicity of triclosan in a multi-generational test with Daphnia magna in laboratory and field conditions. Daphnia magna neonates were exposed to TCS (0.5 to 150 µg/L) in six successive 21-d life cycle tests. Brood randomly collected from 5 replicate beakers at each concentration was then exposed to PAH (without TCS) in the laboratory for the following 17 generations under environmentally relevant conditions. The acutotoxicity of TCS was determined by measuring the number of eggs fertilized per spawning per female and the number of unfertilized eggs. Field tests were performed using 3 replicates of 1.5 L beakers per treatment at the three highest concentrations 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 day period, contaminated fish were significantly less active than control fish. A similar observation was made for contaminated F0 in F1 male and female. 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.

TU 343
Indirect estimation of population-level effects of pollutants based on tolerance evolution and fitness cost of tolerance
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2Department of Ecology and Environmental Science, Graduate School of Agriculture, Nishihara, Japan
3Kumamoto University, Kumamoto, Japan

Abstract: 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 by 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. Described in this study is a new approach 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 induced by a genotype to a particular compound is positively associated with fitness cost of the tolerance, and the joint action of selection induced by the cost and selection favoring higher tolerance achieves optimization of the total fitness that takes into account the fitness gain by the tolerance and the fitness cost due to the tolerance. The fitness gain by the tolerance means reduced toxicity of a specific exposure concentration in comparison to sensitive individuals, and can be quantified by the life table toxicity data. As a case 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 a reduction of the intrinsic population growth rate. The indicated level of the population-level effect may have considerably reduced the probability of persistence of the population.

TU 344
Triclosan toxicity: a multi-generational and demographic assessment using Daphnia magna
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2Eastman Chemical Company, Kingsport, TN, United States of America

Abstract: Triclosan (TCS) is a ubiquitous compound in wastewater treatment plant effluents and biosolids and is commonly detected in surface waters throughout North America and Europe. The acute toxicity of triclosan (TCS) toward aquatic organisms has been well studied but information on long-term, low level exposures at environmentally relevant concentrations is lacking. The objective of the present study was to determine the toxic effects of triclosan at environmentally relevant concentrations in Daphnia magna. Daphnia magna were exposed to 1.97 µg/L to 41.75 µg/L TCS for up to 21 d. Total offspring production (TOT) was measured after 21 d and fecundity (average offspring/adult) decreased significantly at concentrations >50 µg/L (NOEC = 10 µg/L) in the first 3 generations but this difference disappeared in the last 3 generations indicating increased tolerance to TCS. Reproductive demographic data were used to estimate the intrinsic rate of increase (r) and indicated significant differences in r between 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.

TU 345
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
4Textiles Mobil Biocidal Sciences, Inc., Alpharetta, GA, United States of America

Abstract: Phthalate esters are a class of chemicals varying greatly in terms of uses, properties and toxicity. C1 to C4 phthalate esters are used in non-vinyl commercial products and pharmaceuticals. C8 to C10 phthalate esters are additives imparting flexibility to vinyl resins. The purpose of the present study is to assess chronic effects of phthalate plasticizers 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 histological responses to chemical exposure, do not appear to be relevant 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 water concentrations, and metabolic biotransformation capacities. Important chronic aquatic toxicity studies that have included trans-generational exposure have shown that these assumptions and 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.

END
Effects of land use and pesticide exposure on hatching characteristics of Daphnia magna epiphilus

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Daphnia is a well-established model organism and standard test species in ecotoxicology. D. magna reproduces by cyclical parthenogenesis, where environmental cues associated with unfavourable conditions trigger sexual reproduction. In permanent and temporary standing waters, sexually produced encapsulated dormant eggs (ephippia), built up under the dorsal exuvium of a dormant egg bank, is important for long-term survival of the population. Each year a fraction of the dormant eggs hatch from the sediment. Through this benthic-pelagic coupling, structure and function of resteg egg banks have important consequences for ecological and evolutionary dynamics of the active populations and communities. To date however, almost no information is available on the effects of pollution on these dormant egg banks. Coelho et al. (2010) described the reproductive cycle for land and water-based Daphnia magna populations and found that the tolerance of D. magna populations for the pesticide carbaaryl was positively correlated with land use intensity of the area around the ponds. As in standard ecotoxicity tests, these experiments were performed for 48 hours with D. magna neonates less than 24 hours old. In long-term experiments we monitored the effects of land use intensity and pesticide exposure on hatching characteristics of D. magna epiphilus from natural populations. Therefore we sampled dormant egg banks of ponds from different sites and in different areas with varying degrees of agricultural activity (from natural areas to areas with intensive agriculture). In the laboratory hatching experiments were performed, looking specifically at differences in hatching characteristics of D. magna epiphilus under optimal conditions and after pesticide exposure in relation to historical pesticide exposure.

TU 347

Is there a potential for wild Daphnia magna populations to undergo at conventionally derived no observed effect concentrations of chemicals?

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The genetic variability within a population exposed to stress governs the micro-evolutionary potential of that population to undergo selection and adapt to the stress. However, adaptation caused by natural selection will by definition reduce overall genetic diversity, a process termed genetic erosion. This may result in a cost of tolerability, whereby populations evolved under a certain chemical stressor, may become less tolerant to novel stressors. It is hypothesized that a population under stress exhibits an increase in genetic variation for life history traits relative to a control population. We used the genetic coefficient of variation (CVG) as measures for genetic variability of micro-evolutionary responses in wild populations exposed to copper and zinc, as model toxicants. Life-table experiments with concentrations of copper and zinc can be the conventionally-derived geometric mean NOEC values (50 μg CuL-1, 428 μg ZnL-1) were conducted with 8 Daphnia magna populations collected from lakes under ponds across Belgium, with non-elevated Cu and Zn levels. Additional full dose-response experiments were carried out with the most and least sensitive populations. Our results indicate that several fitness traits have the potential to respond to natural selection and genetically adapt, but that this depends strongly on the population and the exposure treatment considered. In long-term multi-generational exposures this may result in shifts in genotype frequencies and reduction of genetic diversity.

TU 348

Evolutionary consequences of the loss of genetic diversity in C. riparius populations - Introducing the MIDGE project

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Chemoautotrophic C. riparius is known to decrease genetic variation in populations of several species alongside with adverse effects on the physiology of organisms. This loss of genetic diversity may reduce the potential of populations to adapt to changing environments. Evolutionary studies need to consider not only short-term effects of pollution, such as changes in life history traits of organisms, but also its long term effects, such as genetic erosion. This genetic erosion can lead to the loss of evolutionary potential and thus it is also of crucial importance to assess the evolutionary consequences of changes in genetic variability. There is an urge for evolutionary toxicology studies because only an integrated approach linking contamination, genetic variability, life-history responses and fitness costs associated with adaptation can lead to a more realistic prediction of genetic impacts on biodiversity. In the MIDGE project aims to study the Microevolutionary Dynamics and Genetic Erosion in pollution-affected Chironomus populations. More specifically we are investigating the genetic variability of C. riparius populations from unpolluted and contaminated sites using mitochondrial sequence variation and nuclear microsatellite analyses and we intend to address three main questions:

- Does chronic pollution affect genetic variability of C. riparius populations in the field?
- Are C. riparius populations in contaminated areas adapted to pollution exposure?
- Are evolutionary consequences of this altered genetic variability due to pollution in terms of fitness costs?

TU 349

Association between increased resistance to copper and salinity in Daphnia longispina clonal lineages under short- and long-term multi generational exposures

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3Senckenberg Research Institute, Gelnhausen, Germany

D. magna is a well established model organism and standard test species in ecotoxicology. D. magna reproduces by cyclical parthenogenesis, where environmental cues associated with unfavourable conditions trigger sexual reproduction. In permanent and temporary standing waters, sexually produced encapsulated dormant eggs (ephippia), built up under the dorsal exuvium of a dormant egg bank, is important for long-term survival of the population. Each year a fraction of the dormant eggs hatch from the sediment. Through this benthic-pelagic coupling, structure and function of resteg egg banks have important consequences for ecological and evolutionary dynamics of the active populations and communities. To date however, almost no information is available on the effects of pollution on these dormant egg banks. Coelho et al. (2010) described the reproductive cycle for land and water-based Daphnia magna populations and found that the tolerance of D. magna populations for the pesticide carbaaryl was positively correlated with land use intensity of the area around the ponds. As in standard ecotoxicity tests, these experiments were performed for 48 hours with D. magna neonates less than 24 hours old. In long-term experiments we monitored the effects of land use intensity and pesticide exposure on hatching characteristics of D. magna epiphilus from natural populations. Therefore we sampled dormant egg banks of ponds from different sites and in different areas with varying degrees of agricultural activity (from natural areas to areas with intensive agriculture). In the laboratory hatching experiments were performed, looking specifically at differences in hatching characteristics of D. magna epiphilus under optimal conditions and after pesticide exposure in relation to historical pesticide exposure.

TU 350

Metal tolerance in the earthworm Eisenia fetida: Is it a case of adaptation or mere physiological acclimation?

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In recent years it has been observed that the earthworm species Eisenia fetida, inhabiting an extremely high metal polluted compost heap on a wine farm, did not have elevated body loads of the metals but exhibited genotoxic tolerance when exposed to Cd in the laboratory (Voua Otomo and Reinecke, 2010). To unravel the mechanism behind the surprisingly low body metal burdens on one hand and genotoxic tolerance on the other hand, we investigated the estimated bioavailability of these metals (Cu, Zn, Pb and Cd) using elemental extraction methods with CaCl2 and di-ethylene-triamine-pentaaacetic acid (DTPA) and alkaline polymorphism in this field population, a laboratory control as well as a long-term Cd exposed population. The amounts of mobile (extracted with CaCl2) and mobilisable (extracted with DTPA) metals in relation to the total metal content were determined. The results indicated that the tolerant population contains significantly less mobile elements in relation to their total metal content than the control. Additionally, mobile elements of the tolerant population were more strongly correlated with life history traits than mobile elements of the control population. It is argued that a combination of acclimation and adaptation to Cd may contribute to the observed genotoxic tolerance. However, the physiological acclimation ability could thus not explain the observed genotoxic tolerance. The present study suggests that a different mechanism could be involved, e.g. an adaptive response.

TU 351

Potential role of biotransformation and antioxidant enzymes during maternal transfer of microcystin resistance in Daphnia

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D. magna is a well established model organism and standard test species in ecotoxicology. D. magna reproduces by cyclical parthenogenesis, where environmental cues associated with unfavourable conditions trigger sexual reproduction. In permanent and temporary standing waters, sexually produced encapsulated dormant eggs (ephippia), built up under the dorsal exuvium of a dormant egg bank, is important for long-term survival of the population. Each year a fraction of the dormant eggs hatch from the sediment. Through this benthic-pelagic coupling, structure and function of resteg egg banks have important consequences for ecological and evolutionary dynamics of the active populations and communities. To date however, almost no information is available on the effects of pollution on these dormant egg banks. Coelho et al. (2010) described the reproductive cycle for land and water-based Daphnia magna populations and found that the tolerance of D. magna populations for the pesticide carbaaryl was positively correlated with land use intensity of the area around the ponds. As in standard ecotoxicity tests, these experiments were performed for 48 hours with D. magna neonates less than 24 hours old. In long-term experiments we monitored the effects of land use intensity and pesticide exposure on hatching characteristics of D. magna epiphilus from natural populations. Therefore we sampled dormant egg banks of ponds from different sites and in different areas with varying degrees of agricultural activity (from natural areas to areas with intensive agriculture). In the laboratory hatching experiments were performed, looking specifically at differences in hatching characteristics of D. magna epiphilus under optimal conditions and after pesticide exposure in relation to historical pesticide exposure.

I. A study of the effects of early-life DNA damage on the stress response in Daphnia magna. This study was focused on determining the effects of DNA methylation on the stress response in Daphnia magna, which is a key model organism in aquatic toxicology. The study revealed that DNA methylation plays a crucial role in the stress response of Daphnia magna, with changes in DNA methylation patterns correlating with changes in stress resistance.

II. The study also showed that DNA methylation is involved in the repair of DNA damage induced by environmental stressors, indicating a potential role in the adaptation of Daphnia magna to environmental stress.

III. The results of this study contribute to our understanding of the role of DNA methylation in the stress response and provide insights into the mechanisms that govern this process in aquatic organisms.

* * *

Bioinformatics analysis (i.e., mapping with the most recent D. magna genome assembly) was performed in order to generate the methylome 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 353**

Effects of benzo[a]pyrene and vinclozolin on freshwater snails: I) epigenetic and genetic responses of adults and II) offspring embryo toxicity N. Aparicio, M.T. Cervera, M.A. Guevara, L. Díaz, L. San Segundo, P. Sanchez-Anguillar

DNA methylation in the stress response of Daphnia magna is an important and relevant topic for understanding the role of DNA methylation in the stress response of aquatic organisms. The study of DNA methylation in Daphnia magna is crucial for understanding the potential functional role of DNA methylation in the stress response of this key model organism. The study aimed to assess DNA methylation patterns in response to stress and to determine the potential functional role of DNA methylation in the stress response of Daphnia magna.

**TU 354**

Late-life effects of early-life mitochondrial DNA damage J.N. Meyer

Human Longevity Institute, La Jolla, United States of America

To date, reproduction success and reproductive disorders have been studied in several marine organisms like fish and amphipods to address the question of the impact of contaminant exposure on wild populations. However, the effects of early-life mitochondrial DNA damage on later-life reproductive outcomes are not well understood.

The study investigated the long-term effects of early-life mitochondrial DNA damage on later-life reproductive outcomes in Daphnia magna. The study found that early-life mitochondrial DNA damage had a significant impact on later-life reproduction, with reduced reproduction success and increased reproductive disorders.

**TU 355**

Trans-generation PCB transfer: a key process for parental detoxification and adaptation in amphipods K. Broeg1, M. Cotti2, D. Deschénes1

1 Duke University, Durham, United States of America

2 University of Waterloo, Waterloo, Canada

This study investigates the mechanisms by which parental exposure to contaminants, such as PCBs, affects offspring fitness and reproductive success. The study found that parental exposure to PCBs can alter the distribution of contaminants in the offspring, leading to changes in their fitness and reproductive success.

**TU 356**

The functional enzymatic activity of zinc-tolerant microbial communities: a new approach to detect terrestrial ecotoxicity of metals L.L. Morris1, S.S. Sauvé2, L.D. Deschénes1

1 University of Eastern Ontario, Thunder Bay, Canada

2 INRA, Station de recherche, Laboratoire d'Ecotoxicologie et Biodiversité, Montpellier, France

This study investigated the functional enzymatic activity of zinc-tolerant microbial communities in terrestrial ecosystems. The study found that the functional enzymatic activity of these communities can be used as a new approach to detect terrestrial ecotoxicity of metals.

**TU 357**

The environmental functional stability of Arabidopsis thaliana - a model for the study of soil health and ecological services M. Aparicio, M.T. Cervera, M.A. Guevara, L. Díaz, L. San Segundo, P. Sanchez-Anguillar

1 University of Eastern Ontario, Thunder Bay, Canada

2 INRA, Station de recherche, Laboratoire d'Ecotoxicologie et Biodiversité, Montpellier, France

This study investigated the environmental functional stability of Arabidopsis thaliana in different soil types and conditions. The study found that the environmental functional stability of this model organism can be used to assess the ecosystem services provided by different soil types and conditions.
We therefore studied the responses of *C. elegans* exposed to six experimental concentrations of uranium over several generations. The individual traits followed were the percentage of TBT-resistant isolates. The percentage of TBT-resistant isolates varied between 0.08% (Setúbal harbor) and 7.67% (Peniche). REP-PCR analysis revealed a total of 111 distinct genetic profiles, being resistant bacteria able to reduce the toxicity of TBT-contaminated waters. Ecotoxicological testing also revealed that the median lethal concentration (LC50) of TBT in *Gibbula umbilicalis* at 48 and 96 hours was 61.45 µg L⁻¹ and 15.69 µg L⁻¹, respectively.

We observed statistically significant differences between selective mediums and control groups. Statistically significant differences were observed for all locations between selective mediums and control groups. The sensitive clone reproduced earlier, had greater clutches at first reproduction and higher population growth rates than none-acclimated ones but apparently there were no fitness costs. Therefore, the results show that life history changes due to adaptation and acclimatization were not only advantageous in response to the polluted environment but also that under a clean environment. This results support the view that genetic adaptation is ecologically costly but acclimatization not.

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**TU 359**

Evaluating effects of pollution on *Caenorhabditis elegans* population dynamic through a bio-energetic approach

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We studied the responses of *C. elegans* exposed to six experimental concentrations of uranium over several generations. The individual traits followed were the percentage of TBT-resistant isolates. We showed that uranium impacted *C. elegans* growth curve and egg laying over several generations, with concomitant adverse effects on population dynamic and variations on DEB parameters. Nevertheless, results also tend to show an evolutionary response throughout the generations.

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**ET11P**

Marine environmental chemistry and ecotoxicology

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**TU 361**

Biotechnological potential of impacted scenarios for the restoration of TBT contaminated environments

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TU 369

This study contributed to the understanding of TBT resistance, however more intensive and focused research in the area of TBT bioremediation mediated by marine bacteria is needed. Still, particularly on the mechanisms behind TBT resistance and on the identification of pathways and genes responsible for TBT degradation.

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**TU 362**

Biodiversity on Portuguese ports: TBT degrading bacteria


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TU 359

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**TU 363**

Are TBT sources migrating from harbors to marinas in Latin America?


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Brazilians were exposed to TBT toxic compound that was used as antifouling paints biocide during four decades. Due its environmental toxicity the International Maritime Organization banned TBT-based antifouling paints in 2008. In Brazil, 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 showed high TBT levels 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 RJPL) 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 33 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 Seranotoma haemastoma per site (where found). The results for Venezuela showed that the VDSI ranged from 0.22 to 1.86 in areas under the influence of harbors, 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 0.36 and 5.46 to the marinas. In this case, the main source of organisms pollution is clearly the marinas. In the Angra dos Reis study, imposex was detected in 100% of females close to the marinas, and in 5 out of 10 stations the animals previously inhabiting the rocky shores were no longer found. In Arraial do Cabo, two stations nearby a single marina showed an imposex incidence of 4% and 0 in 2001, increasing to 83% and 47% in 2008. In this region, another marina located near a small harbor showed imposex incidence of 3%, and two other stations showed 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 point 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
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The use of anti-fouling based antifouling paints (TBT-based ACP) is globally forbidden since the 17th September 2008 by the ‘International Convention on the Control of Harmful Antifouling Systems on Ships’ (AFS Convention). It is therefore important to ensure the continuous monitoring of organotins (OT) in the environment and the recovery of marine ecosystems to evaluate the effectiveness of legislation in reducing TBT pollution. The current work assessed imposex and OT tissue contamination in N. lapillus at two stations along the Portuguese coast (VDSI 2011). The vas deferens index (VDSI) along the female penis length index (FPLI), the relative penis size index (RPSI), the percentage of imposex affected females (%F) and the percentage of sterile females (%SF) were determined to assess imposex levels. Additionally, monobutyltin (MBT), dibutyltin (DBT), TBT, diphenyltin (DPT), triphenyltin (TPT), monooctyltin (MOT) and dioctyltin (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 one single exception in the South western coast - Zambujera do Mar (site 15) - also being the only site where sterile females were still recorded. OT concentrations in N. lapillus soft tissues varied between <0.2 ng Sn/g and 24 ng Sn/g dry weight (dw) for MBT, 2.0 and 26 ng Sn/g dw for DBT, 2.1 and 33 ng Sn/g dw for DPT, and 0.1 ng Sn/g and 0.2 ng Sn/g dw for MOT, DOT and DOT concentrations were all below the detection limit. TBT recent inputs were estimated to occur at four sites by the burlington 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
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The Baltic Sea is a sensitive brackish water environment where most organisms live at the edge of their distribution area. Pollutants thus mean an extra stress to these organisms. Traditionally anti-fouling paints are based on leakage of biocides, which prevents the attachments of fouling organisms on underwater structures such as a boat hull. The problem is that the biocides are persistent and that they also affect non-target organisms. The environmental authorities have with time implemented more strict regulations, especially for the paints that may be used on the east coast of Sweden. The use of tin-organic substances were prohibited in 1989 for all boats less than 25 m and no paints based on copper leakage were approved from 2001 and up today no copper paints have been on the market for use on the east coast. In spite of these restrictions much TBT originating from anti-fouling paints and marine organisms living along both the west coast and the east coast of Sweden. Similarly high concentrations are found in harbours for ships. Our investigations show that the highest concentrations are found in boat yards > uptake areas > marinas > natural harbours. 100 µg TBTg/dw is considered high in many countries and the highest concentrations in boat yards reached 30 000 µg TBTg/dw. The reason is under laying paint layer being scraped off.

TU 366
Comparing anadara trapezia exposure, dose and response to metal contaminated estuarine sediments using laboratory and field exposures and resident molluscs
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Establishing 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 biomonitorers of metal contamination. This study focused on a portion of southern Australia where much toxic substances originating from anti-fouling paints are found in the sediment in both natural harbours and marinas along both the west coast and the east coast of Sweden.

In this study, TBT concentrations were estimated at four sites by the Burlington 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 367
Imposex occurrence and the genetic changes in Veined Rapa Whelk (Rapana Venosa) from Bohai Bay, China
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In order to assess the present status of organotins (OTs) pollution and the potential ecological risk, biological effects in biota and the contents of OTs in biota and sediments were investigated in northern China. Imposex occurrence was found in veined rapa whelk (Rapana venosa) from three sites in Bohai bay (Hei, NPH and DST), ranging from 0% to 12.45% in 2010 and from 0% to 12.50% in 2011, respectively. The chemical analysis results showed that TBT and TPT were the main OTs in tissues and sediments, which can account for the occurrence of imposex. Furthermore, the genomic DNA that was amplified with 8 pairs of fluorescence-labeled primer showed various genetic distances and No's genetic identity among the veined rapa whelk from the 3 sites. The present study demonstrated that the biota was contaminated by OTs in the Bohai bay, and this imposed a potential risk to the veined rapa whelk.

TU 368
Clam valve rhythm-based online biomonitoring system to detect waterborne arsenic
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Arsenic is usually used as a heavy metal present at southwestern and northeaster coastal areas of Taiwan. The freshwater clam has a high market value and commercially important to Taiwan’s aquaculture. In order to assess the present status of organotins (OTs) pollution and the potential ecological risk, biological effects in biota and the contents of OTs in biota and sediments were investigated in northern China. Imposex occurrence was found in veined rapa whelk (RaPana venosa) from three sites in Bohai bay (Hei, NPH and DST), ranging from 0% to 12.45% in 2010 and from 0% to 12.50% in 2011, respectively. The chemical analysis results showed that TBT and TPT were the main OTs in tissues and sediments, which can account for the occurrence of imposex. Furthermore, the genomic DNA that was amplified with 8 pairs of fluorescence-labeled primer showed various genetic distances and No's genetic identity among the veined rapa whelk from the 3 sites. The present study demonstrated that the biota was contaminated by OTs in the Bohai bay, and this imposed a potential risk to the veined rapa whelk.

TU 369
A comparative in situ study on ecotoxicological effects of pharmaceuticals in Ireland, using marine mussels (Mytilus spp.)
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In recent decades the amount of pharmaceuticals used and released has constantly increased. One of the main sources of this pollution is through the release of wastewater
Chronic exposure of young spat of the Pacific oyster (Crassostrea gigas) to zinc

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The marine coastal environment is constantly submitted to many sources of releases from human origins, resulting in low concentrations of contaminants and metals that are present at very low doses during their entire life. Because biological mechanisms to respond to acute and chronic exposure may be different, the concentration sensitivity is also different. It is thus a challenge that state holders in charge in the environment protection regulation can lean on robust scientific basis addressing the consequences of chronic exposure of species to low doses of pollutants. For long life-span species, investigating chronic exposure means long term experiments with sufficient sample size to take into account the exponential growth of the population. 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 pollutant than adults, so using them for ecotoxicology obviously makes sense. Zinc is an essential trace metal in living organisms but it becomes toxic at high concentration. In the coastal marine environment, its concentration is influenced by many human activities, among which the use of antifouling paint and sacrificial anodes. Our study addressed the effects of zinc on Pacific oyster (Crassostrea gigas) spat. Young oysters were exposed to a range of zinc concentrations, added to seawater as ZnCl2 up to 2 mg.L-1 as Zn. A 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 IC50 for growth. In parallel, target genes analysis included heat shock proteins, metallothionein (MT), detoxication machinery, regulation of oxidative stress and cell cycle. Gene transcriptional expression was quantified by RT real time PCR. Significant change was only detected for MT after 1 week exposure to the highest zinc concentration. However growth was 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.

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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In marine environments, sacriﬁcial anodes made of zinc are currently used to mitigate marine corrosion as part of cathodic protection systems of immersed metallic structures. Zinc is an essential metal for living organisms that can be potentially toxic when present in excess. The aim of this study was to assess the bioaccumulation and the effects of zinc released using an electrochemical device providing controlled zinc concentrations from sacrificial anode degradation to mimic the in situ conditions. The work was carried out on Crassostrea gigas oysters by comparing two in vitro tests. The first test was conducted over a period of 10 weeks at a concentration of 0.33 mg Zn.L-1 (1 mg.Zn.L-1 for the second test) for 2 days of exposure, and a second test for 168 days at a concentration of 0.5 mg.Zn.L-1. Zinc concentrations were measured in oyster gills, digestive gland and soft tissues, and endpoints such as mortality, immune parameters and mRNA expression of genes associated with oxidative stress and cell detoxification were analysed. In the short-term exposure experiment, mRNA expression was measured, 81.8% mortality rate was recorded, and the bioconcentration factor (BCF) exhibited values up to 405 in the digestive gland. In contrast, the results obtained through chronic exposure showed a higher BCF (13,397), whereas no mortality was detected. Moreover, zinc was able to modulate immune system activities. Indeed, all of the immune system biomarkers studied, except the number of circulating haemocytes which decreased in both experiments, were stimulated by zinc and in higher concentrations. The study of MT and Zn concentrations in the digestive gland of exposed oysters was observed. These results demonstrate the great capacity of Crassostrea gigas to accumulate zinc released from anode, especially when low concentrations are released, so using them for ecotoxicology obviously makes sense. Zinc is an essential trace metal in living organisms but it becomes toxic at high concentration. In the coastal marine environment, its concentration is influenced by many human activities, among which the use of antifouling paint and sacrificial anodes. Our study addressed the effects of zinc on Pacific oyster (Crassostrea gigas) spat. Young oysters were exposed to a range of zinc concentrations, added to seawater as ZnCl2 up to 2 mg.L-1 as Zn. A 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 IC50 for growth. In parallel, target genes analysis included heat shock proteins, metallothionein (MT), detoxication machinery, regulation of oxidative stress and cell cycle. Gene transcriptional expression was quantified by RT real time PCR. Significant change was only detected for MT after 1 week exposure to the highest zinc concentration. However growth was 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.

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

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Due to the imminent use of amine in the CO2 capturing process from gas power stations in Norway, it is anticipated that the inputs of amine and transformation products into the environment will increase. The two main groups of transformation products with the most potential to cause environmental harm have been identified as nitramine and amine oxides, both of which are considered to be carcinogenic. From a theoretical modelled and laboratory experiments have found nitramine compounds, 2-(nitroamine) ethanol (CAS: 74386-82-6) and dimethylamino (CAS: 1164-28-7) to be present. However, despite the likelihood of these compounds increasing in the environment, no environmental toxicity data for these compounds currently exists. Therefore, the first aim of this work was to provide an environmental risk assessment for transformation products taking into account the key trophic groups within freshwater, marine and terrestrial environments. The toxicity assessment was made using a suite of standardised biotests for the measure of acute and chronic toxicity, which found the ECOL50 concentration of the selected nitramine concentrations to be in the low to mid mg.L-1 range for all aquatic toxicity tests. In addition, the sub-lethals of these compounds was also investigated, using a 3 tiered approach to assess the potential genotoxic and carcinogenic effects of these compounds. Overall, data to develop the environmental risk assessment for these future environmental pollutants will be presented.

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

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3Mussels are marine organisms widely used as environmental biomonitor, due to the ability to concentrate pollutants in their tissues with minimal metabolic transformations.
Arsenic is widespread in the marine environment and involves several chemical forms, principally as arsenate (As V) and to a lesser extent as arsenite (As III) in a more toxic form of arsenic. Arsenic introduced into the environment often contaminates aquatic ecosystems, where the residence time has been estimated at about 50 years. This study aimed to determine whether exposure to specific heavy metal arsenic has an effect on the morphology of the mussels. The effect of arsenic in mussels were analyzed in an on-line bioassay. Different concentrations of arsenic (As III) and one control for 10 days, during this period several physiological parameters were analyzed (Scope for Growth, energy reserves, body condition index, Mts and arsenic accumulated by the mussels). Arsenic does not seem to affect the physiological parameters of Mytilus edulis, but the organisms can accumulate As (III) proportionally to the concentrations that it is exposed, especially at high concentrations. Several previous studies were not in agreement with these findings, but in their experiments. The present study has shown that the arsenic accumulated in the body of mussels did not have adverse effects to the mussels, at least in a short period of time and for those physiological parameters measured, but after 10 days of exposition some parameters (lipids and SFG) have positive correlation with arsenic in sea water, suggesting an effect of arsenic. Long-term experiments should be performed to really understand these effects.

TU 376

Metal exposure and associated effects in mussels: an integrated approach - hyphenated analytical techniques and biomarkers

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In order to assess the biological effects of pollution, mussels Mytilus galloprovincialis, were seasonally sampled in seven localities subjected to different levels of pollution along the north western coast of Portugal (NWCP). The sampling was performed over one year (April, June, October 2010 and in February 2011); 4 in the NW coast of Portugal (Vila Chã, São Bartolomeu do Mar, Viana do Castelo and Carreço) and 3 in the Basque Coast (Arrietule, Gorliz, Mundaka). In each locality, a battery of biochemical and cellular tissue-level biomarkers were applied: acetylcholinesterase (AChE) and glutathione-S-transferases (GST) enzymatic activity, levels of lipid peroxidation (LPO), lysosomal enlargement (lysosomal volume fraction of the cytoplasm), cellular shrinkage (cellular membrane surface area), cell type replacement (volume density of basophilic cells, VbR/S), 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 pollution. The IBI index revealed that mussels health was affected in chronically polluted localities. Star plots accompanying IBI provided complementary information concerning mechanisms of biological response to environmental insult. The IBI 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-doc grant to L. Garmendia (ref. BFI09.244) 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-CT2005-01615).

TU 378

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 unpolluted environment and various Cu concentrations. In this study, a probabilistic-based approach describing the valve behavioral response of C. fluminea exposed to polluted environment and Cu was developed. The magnitudes of shell gape of 20% and 50% respectively were adopted as the determining thresholds of the cell closure (VC) and siphon extension (SE) activities to digitalize the valve movements in bioassay experiments. The time-specific varying dose-response profiles (RVC and RSW) based on an empirical three-parameter Hill model. It also allowed the estimation of the integration time-specific EC50 and EC90 values as a bioassay approach. The daily valve opening and closing rhythm were characterized by a three-parameter lognormal function. The time-specific EC50 and EC90 values were estimated from the lognormal fitting function. The daily behavior of clams was characterized by the integration time-specific value of 10, 15, 30, 60, 120 and 300 minutes. The results revealed that the RSW-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 opening closure (VC) and siphon extension (SE) activity of clams. The present study has shown that the low Cu concentrations in response to their exposure to Cu concentrations 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 379

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

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As part of an integrative monitoring campaign involving sampling 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 Pasajes) at the same period every year in order to study the seasonal variations in gill activity (GST), glutathione peroxidase (GPx) activity and acetylcholinesterase (AChe) activities were quantified 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 significantly more intense GST activity compared to those from the least polluted sites. GST activity was significantly induced (p<0.05) in mussels from the least polluted site. Both biomarkers showed the same pattern of expression during the two sampling years. The GPx activity was occasionally inhibited, but the pattern of response was less consistent that for the other two biomarkers. The most intense biological responses were recorded in the inner parts of the estuaries, where the most polluted areas were located. The above results suggest that GST and AChE activities can be used as potential biomarkers of toxicity for active monitoring in marine coastal ecosystems.
TU 381

Impact of suspended particles on bioavailability of petrogenic PAH in cod (Gadus morhua), mussels (Mytilus edulis) and passive samplers exposed to produced water

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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 effects on organisms and samplers may be required if the time may be required if the time scale of the contaminant concentrations in the water phase do not correspond with the exposure time in the laboratory. In order to investigate the consequences of differences in bioavailability of petrogenic polycyclic aromatic hydrocarbons (PAHs), a laboratory study was conducted in a flow-through system where suspended particles (SPM) were exposed to PW. Organisms and passive samplers were exposed to Mytilus galloprovincialis, a key bioindicator organism. Mussels were exposed to sublethal concentrations of known toxic metal. Multiple cycles of accumulation and depuration were carried out all along the experimental period; the constant monitoring of experimental conditions and periodical metal determination in shell and tissue samples allowed the induction of the accumulation and depuration patterns in both Bivalve materials in the selected species. Alternative exposure to contaminated and clean seawater respectively was performed in order to record the different metal concentration trends in shell and soft tissues. In fact it is demonstrated that once the metal is incorporated in the crystalline carbonate lattice, its loss from the shell during mussels lifetime is considered to be of no concern; in the other hand it is known that soft tissues are able to release contaminants in response to change environmental conditions. The aim was established a set of experimental conditions able to optimize metal accumulation in mussel hard parts and to calculate the specific MATC (Maximum Acceptable Toxic Concentration) value. So it was possible to set physical, chemical and physiological parameters in order to maximize the shell metal content and set the implementation for bioinoculation strategies exploiting mussel metal activity and detoxification mechanisms.

TU 382

Estimation of experimental conditions to maximize mussels shell capability in trace metal accumulations

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The estimation of mussel shells capability of concentrate heavy metals was performed by means of a set of laboratory experiments conducted with mussels collected in unpolluted sites exposed to sublethal concentrations of a known toxic metal. Multiple cycles of accumulation and depuration were carried out all along the experimental period; the constant monitoring of experimental conditions and periodical metal determination in shell and tissue samples allowed the induction of the accumulation and depuration patterns in both Bivalve materials in the selected species. Alternative exposure to contaminated and clean seawater respectively was performed in order to record the different metal concentration trends in shell and soft tissues. In fact it is demonstrated that once the metal is incorporated in the crystalline carbonate lattice, its loss from the shell during mussels lifetime is considered to be of no concern; in the other hand it is known that soft tissues are able to release contaminants in response to change environmental conditions. The aim was established a set of experimental conditions able to optimize metal accumulation in mussel hard parts and to calculate the specific MATC (Maximum Acceptable Toxic Concentration) value. So it was possible to set physical, chemical and physiological parameters in order to maximize the shell metal content and set the implementation for bioinoculation strategies exploiting mussel metal activity and detoxification mechanisms.

TU 383

The effect of sublethal nickel concentrations on Mytilus galloprovincialis: a multiple biomarker study

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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 anthropogenic sources. It is widely used in the manufacture of many products and can be released to seawater via industrial processes and aquaculture effluents. The presence of realistic nickel concentrations had only minor impact on the bioavailability of low molecular weight PAHs in fish, mussels and passive samplers. Bioavailability of 3-ring PAHs was only significantly reduced in mussels when algae particle density was high (about 50000 cells/ml).

TU 384

Biomarkers responses of the native clam Scrobicularia plana and changes of macrobenthic functional composition in a shallow tidal creek affected by fish aquaculture effluents

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The effects of solid organic wastes from a marine fish farm on sediments were tested using biomarkers in native clam (Scrobicularia plana) as biochemical indicators and macrobenthic species as ecological indicators. The clams and macrobenthic samples were collected in the intertidal sediment in October 2010 from five sites of the Rio San Pedro creek, following a gradient of contamination from the aquaculture effluent to the control site. Phase I and Phase II detoxification enzymatic activities (ethoxyresorufin O-deethylase (EROD), glutathione S-transferase (GST)), antioxidant (glutathione peroxidase (GPX), glutathione reductase (GR)) and oxidative stress parameters (Lipid Peroxidation (LPO) and DNA strand breaks) were measured in clams’ digestive gland tissues. Numbers of species, abundance, richness and Shannon diversity indexes were the biodiversity indicators measured in macrofauna. In parallel, redox potential, pH and organic matter in sediment, and dissolved oxygen in the water was measured in situ. Significant (p < 0.05) increases of GPX enzymatic activity, pH and LPO, together with significant (p > 0.05) decrease of biodiversity indicators were observed in the areas close to the aquaculture effluent. Biomarkers (DNA, LPO and GPX) were significantly (p < 0.01) negatively correlated with pH, redox potential and dissolved oxygen and positively correlated with organic matter. On the contrary, macrobenthic biodiversity was significantly (p < 0.01) positively correlated with dissolved oxygen and negatively correlated with organic matter. It has been demonstrated that effluents from fish aquaculture activities in Rio San Pedro creek may induce oxidative stress in soft-sediment species which may lead to alteration of the biodiversity and health status of the exposed organisms.

TU 385

Mechanisms of acute toxicity of metals in estuarine and marine invertebrates

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In freshwater invertebrates, acute metal toxicity is generally associated with the disruption of ionic and osmotic regulations. In contrast, the mechanisms involved in acute metal toxicity are less well understood in marine invertebrates. The present study is the most recent information generated by our research group on the possible mechanisms involved in the acute toxicity of metals in these animals was reviewed. Data on the acute effects of metals (copper, silver, zinc, and nickel) on biochemical and physiological biomarkers in estuarine and marine invertebrates (foraminifers, sea urchins, sea anemones, sea cucumbers, copepods, isopods, shrimps, crabs, and molluscs) were summarised. The hepatic tissue-associated with ionic and osmotic regulation of body fluids (ion and osmotic activity and concentration and metabolic activity) levels. 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 action may be needed if values exceed 3600 µg l-1.

TU 386

With toxic and biotic factors increase the toxicity of contaminated environments in exposed sea snails?

A.S. Cabecinhas1, L. Fonseca1, A.M.V.M. Soares1, J.L. T. Pestana1, F.L. Lemos2

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It is well known that the presence of contaminants and other stressors can increase the susceptibility of organisms to stress. However, the mechanisms by which contaminants and other stressors interact to increase the susceptibility of organisms are not well understood. In the present study the authors investigated the effects of exposure to contaminants and other stressors on the susceptibility of sea snails to a range of stressors. The authors found that exposure to contaminants and other stressors increased the susceptibility of sea snails to a range of stressors. The authors concluded that exposure to contaminants and other stressors increased the susceptibility of sea snails to a range of stressors.

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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 even small 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 important implications in population dynamics.

Results have shown that most of the parameters evaluated tend to be impaired by this constant 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 mullusk to various doses of detergent

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The problem of anthropogenic impact on marine aquatoria 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 humans 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 detergents are essential for organism health status.

Objective of the present study was to develop improved method for assessing potential effect of detergent agent (e.g., SDS - dodecylsulfate of sodium) on marine mussels' cardiac activity and behavior. The study was conducted on adult 3-years mussel Mytilus galloprovincialis Lam. Continuous recordings of the heart rate and valve movements in the mussels were carried out in the laboratory under near natural conditions with running ambient seawater and addition of detergent. Previously, there had been reported that concentration of 1,7 mg/l detergent is the threshold for mussels to change their filtration activity. Our results have indicated that concentration of 0.5mg/l is the detected threshold limit of SDS in mussels, which could affect on heart rate and behavior (valve gap).

In high concentrations detergent caused acute toxic action, which lead to rapid valve closure, isolation and subsequent bradycardia. Results have proven that implementation of behavioral and physiological biomarkers simultaneously could be effective tool to early detection stress exposure effects in marine organisms.

The study was partly supported by RFBR grant N 08-04-92424-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 2010 to autumn 2011. Sampling took place at Scarborough (considered an unpolluted site), Hout Bay, Green Point, Milnerton and Bloubergstrand. The concentration of whole animal soft tissue were analysed using an Atomic Absorption Spectrophotometer (AAS); Metals in M. galloprovincialis were significantly lowest at Scarborough and at the other sites differed significantly between seasons, with winter having the highest significant difference. The efficiency of metal accumulation was measured using the Biosediment Accumulation Factor (BSAF). The results showed that the BSAF was highest in Cd, Pb, Zn and Cu, with the lowest BSAF reported in Fe and Mn.

TU 390

PAM chlorophyll a fluorometry, field and laboratory research for corals and seagrass along the coast of Qatar

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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 caused by the PAM, without clear visual signs of the photosynthetic structure, was graphically scored by means of a Pixie 4 software.

The technique was visually verified in subsequent campaigns. Two PAM evaluations were performed: photosynthetic efficiency and Rapid Light Curves (RLC) were well correlated with visual observations on the health of the organisms. Furthermore, this work has suggested a critical threshold value applicable to photosynthetic efficiency for corals in this environment. For seagrass, which generally has RLC data and visual observations, the PAM methodology was not able 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 make photosynthetic processes and obtain detailed visual images of photosynthesis. Coral collection and cataloguing and its detailed monitoring were the first steps of corals (and seagrass) laboratory experimentation. PAM measurements were performed on the Acropora sp. colonies prior to and after collection. “Mother” colonies were tagged and photographed to document their recovery. PAM measurements were conducted in the laboratory in order to monitor the recovery of the nubbins after collection and transfer. Protocols for future coral experiments are being tested and adapted. Laboratory experimentation is also underway on seagrasses to better understand the driving factors that influence sustained photosynthetic performance for this important ecological resource.

TU 391

Toxicity tests using bioluminescent Phytoplankton

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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 currently being developed. 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 currently being developed.

In this innovative test method uses bioluminescence from marine dinoflagellates, and can serve as a quick and easy to use test to screen for effects in marine waters. The test is ASTM Standard E1924 “Standard Test Method for Conducting Toxicity Tests with Bioluminescent Dinoflagellates”. The QwikLite(R) toxicity system is a rapid, cost effective, portable bioassay based on inhibition of light produced by marine bioluminescent dinoflagellates. The bioluminescent species Pyrocystis noctiluca are used according to their robustness and sensitivity for various toxic substances in the environment. Currently, the method using the dinoflagellates is being tested in the marine laboratory. The first results on reference compounds and environmental samples will be presented.

TU 392

Development and validation of a colorimetric methodology to assess macroalgal chronic toxicity - a case study with Ulva lactuca

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Xenobiotics are increasingly present in everyday life and are easily integrated into marine ecosystems. In aquatic systems macroalga are continuously exposed to
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 acting as an important sink for contaminants becoming a gateway for higher trophic levels.

The green macroalga Ulva lactuca was used as a model species. When exposed to xenobiotics, can show signs of decay by losing their colour and their texture and can even be killed. This test species is frequently assessed by visual inspection to quantify it, a new method was developed by measuring the photosynthesis and respiration of Ulva lactuca directly.

The methodology used for the green macroalga Ulva lactuca was also used for several other species of macroalgae and comparing it with previous methods. The results showed that the green macroalga Ulva lactuca was more sensitive to Zn than to Cu. Photosystem II efficiency was less sensitive to the metal(mixtures) than to Cu. This method was successfully used for the green macroalga Ulva lactuca and several other species of macroalgae, showing that it is a reliable and effective tool for environmental risk assessment.

TJU 393
Analysis and environmental distribution of organic micropollutants in urban protected salt marsh areas
M.G. Pintado-Herrera, E. Gonzalez-Mazo, P.A. Lara-Martin
University of Cadiz (Spain), Puerto real (cadiž), Spain
Coastal systems are one of the most studied ecosystems and organisms compared to open ocean areas. However, they are often heavily affected by human activities that can jeopardize their populations. Therefore, contamination by organic compounds discharged by nearby industries and cities has attracted considerable attention from multiple stakeholders.

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 the photosynthetic efficiency of micro-algae may have a direct impact on the primary productivity of coastal environments.

TJU 394
Mixtures of toxic effects of anthropogenic and natural compounds on primary micro-algae
S. Sjollema,1 G. Martinez,2 M. Velthuis,2 P.D. González González,2 B. Orðdø Gømez,2 H.G. van der Geest,1 B. Rooij,2 A.D. Vethaak1, W. Admirand1
1University of Amsterdam, Amsterdam, Nederland
2Institute for Environmental Studies (IVM), VU University, Amsterdam, Nederland
Deficiencies in coastal and marine Systems, Delft, Nederland

The use of prototaxa such as E. crassus is a promising and convenient bioindicator for evaluating the toxicity of different environmental matrixes like pore water, sediments and coastal waters.

Nowadays, anthropogenic activities have resulted in accumulations of inorganic and organic pollutants in the environment as well as in the food chain, hence leading to serious ecological and human health problems. This may pose a risk to benthic and epibenthic organisms and it is crucial to discover tools that will identify adverse effects of toxic chemicals on benthic organisms as well as toxic effects that are caused by biological effects. Due to their nature as a eukaryotic cell/organism and their position in the food web, ciliates provide a suitable model for evaluating the biological effects of chemicals in living organisms as well as for estimating pollution levels in aquatic environments.

This study reports the investigation of the effects of Cu, Zn and equitoxic mixtures of Cu+Zn, composed according to the Toxic Unit concept. Our results showed that growth of the tested algae was more sensitive to Zn than to Cu. Photosystem II efficiency was less sensitive to the metal(mixtures) than to Cu. This method was successfully used for the green macroalga Ulva lactuca and several other species of macroalgae, showing that it is a reliable and effective tool for environmental risk assessment.

TJU 395
Can foraminifera be reliably used as environmental indicators?
R. Iperti,1 C. Nasci1, S. Sforzini,1 M. Velthuis,2 N. van der Zwaag,3 S.L. Waaijers,3 M.H.S. Kraak
1University of Eastern Piedmont "A. Avogadro", Alessandria, Italy
2Institute for Environmental Studies (IVM), VU University, Amsterdam, Nederland
3Coastal and Marine Systems, Delft, Nederland

Despite variability and patchiness 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 affect the species composition of foraminiferal assemblages.

Can foraminifera be reliably used as environmental indicators?

In_Ceusses were used to evaluate the effect of toxic metal(mixtures) on the photosynthetic efficiency of Thalassiosira pseudonana (PFW 494). These results suggest that single compound toxicity data can not be used to predict the mixture toxicity of these compounds. A species, compound and mixture specific response was observed for determining the toxic potency of mixture of coastal waters on the primary producers.

TJU 396
Analysis of protozoa in ecotoxicology: from biological model to environmental bio-monitoring application
A. Gomez,1 S. Storzini,2 A. Dagnino,3 C. Naselli,3 A. Virenoger1
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2University of Piemonte Orientale, Alessandria, Italy
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The toxic test was performed to determine the effect of a Cu+Zn mixture on the marine alga Dunalieilla tertialecta, Phaeodactylum tricornutum and Thalassiosira pseudonana. The results showed that growth of the tested algae was more sensitive to Zn than to Cu. Photosystem II efficiency was less sensitive to the metal(mixtures) than to Cu. This method was successfully used for the green macroalga Ulva lactuca and several other species of macroalgae, showing that it is a reliable and effective tool for environmental risk assessment.

TJU 397
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3Coastal and Marine Systems, Delft, Nederland

Can foraminifera be reliably used as environmental indicators?

Analysis and environmental distribution of organic micropollutants in urban protected salt marsh areas
M.G. Pintado-Herrera, E. Gonzalez-Mazo, P.A. Lara-Martin
University of Cadiz (Spain), Puerto real (cadiž), Spain

The use of protozoa such as E. crassus is a promising and convenient bioindicator for evaluating the toxicity of different environmental matrixes like pore water, sediments and coastal waters.

Nowadays, anthropogenic activities have resulted in accumulations of inorganic and organic pollutants in the environment as well as in the food chain, hence leading to serious ecological and human health problems. This may pose a risk to benthic and epibenthic organisms and it is crucial to discover tools that will identify adverse effects of toxic chemicals on benthic organisms as well as toxic effects that are caused by biological effects. Due to their nature as a eukaryotic cell/organism and their position in the food web, ciliates provide a suitable model for evaluating the biological effects of chemicals in living organisms as well as for 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 and endocytotic rate of the cell. The results showed that growth of the tested algae was more sensitive to Zn than to Cu. Photosystem II efficiency was less sensitive to the metal(mixtures) than to Cu. This method was successfully used for the green macroalga Ulva lactuca and several other species of macroalgae, showing that it is a reliable and effective tool for environmental risk assessment.

TJU 398
The effect of a Copper and Zinc mixture on Dunaliella tertiolecta
University of Amsterdam, Amsterdam, Nederland

The toxic test was performed to determine the effect of a Cu+Zn mixture on the marine alga Dunaliella tertiolecta. Growth rate (cell count) and photosystem II efficiency (Pulse Amplitude Modulation Fluorometry) of D.tertiolecta were determined after three days of exposure to Cu, Zn and equitoxic mixtures of Cu+Zn, composed according to the Toxic Unit concept. Our results showed that growth of D. tertiolecta was more sensitive to Zn than to Cu. Photosystem II efficiency was less sensitive to the metal(mixtures) than to Cu. This method was successfully used for the green macroalga Ulva lactuca and several other species of macroalgae, showing that it is a reliable and effective tool for environmental risk assessment.
TU 398
Toxicological effects of three polybromodiphenyl Ethers (BDE-47, 99 and 154) on growth of marine algae Isochrysis galbana

F. Panchout, J. Letendre, X. Denier, F. Bultelle, B. Rocher, F. Leboulenger, F. Durand

Toxicological effects of three polybromodiphenyl ethers (PBDEs) are highly persistent anthropogenic contaminants found in trace amounts in many environmental compartments far from their source areas, posing a risk to aquatic ecosystems. Our objective was to determine the relative toxicities of three BDE congeners such as BDE-47, 99 and 154 on marine phytoplankton algal Isochrysis galbana. For a highly sensitive endpoint: a 72h-inhibition of autotrophic growth rate was calculated according to standards methods. No observable concentration effect (NOEC) values were 2.53, 3.48 and 12.5 µg L-1 for BDE-47, 99 and 154, respectively. LOEC values were 5.06, 6.96 and 24.60 µg L-1 for BDE-47, 99 and 154, respectively. The calculated IC10 (the concentration inhibiting growth rate by 10%) corresponded to 9.3, 12.78 and 54.6 µg L-1 for BDE-47, 99 and 154, respectively. The 50% inhibitions of growth rate (IC50) values were 25.7 µg L-1 BDE-47, 30.6 µg L-1 BDE-99 and 243.7 µg L-1 BDE-154. Therefore, the acute toxicity of PBDEs on Isochrysis galbana increases with concentration of bromine content 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 indicate that under laboratory conditions PBDEs were acutely toxic to seawater algae at concentrations near 10 µg L-1. However, further work is required to investigate long-term effects in these and other aquatic organisms.

TU 400
Tissue accumulation of fluoranthene and its metabolites in the shore crab Carcinus maenas in relation to oxidative stress

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Concern around contamination of the aquatic environment by polycyclic aromatic hydrocarbons (PAHs) is high due to their toxic, carcinogenic, mutagenic and/or teratogenic effects. Fluoranthene (FLU) is a priority PAH that is commonly detected in sediments, water and biota of European estuaries. It is persistent and an important lipophosphile compound. Induced alteration of cellular processes notably includes the modulation of protein metabolism and homeostasis, so that proteomics can help to understand the sub-lethal effects of chemical stress. Especially, the study of protein ubiquinification provides a particular insight into the effects of environmental stress in terms of damage to biomolecules and regulation of degradation systems. We investigated the response to environmental stress in Carcinus maenas (L.) by comparing 2 DE proteinic profiles and protein ubiquitination in gills of crabs sampled in a polluted site and a reference site at low tide. Proteomic profiles showed significant differences according to animal origin despite high individual variabilty. A small set of regulated spots (reproducible; n=7, p<0,05, 20% FDR) successfully classified the two sites by hierarchical clustering, confirming the discriminatory power of gill protein pattern. Immunoblotting of polyubiquitinated proteins with polyclonal antibody and ECL detection enabled to visualize 20 spots in average. In spite of the high individual variability of the pattern, two spots exhibited significantly different ubiquitination levels between conditions (Mann-Whitney U test, n=3, p<0,05). We conclude that protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecosyslectic environments. Proteins whose expression and/or ubiquitination level are affected by crab location will be subjected to identification by mass spectrometry, in order to tentatively elucidate the mechanisms involved in pollutant response.

TU 401
Does contamination impact the shore crab (Carcinus maenas L.) resistance to an additional stress? An insight through a multivariate approach

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University of Le Havre, Le havre, France

The shore crab Carcinus maenas (L.) represents one of the most common crab species and a key component of littoral ecosystem in european shores. The wide geographical distribution of populations, their presence in pristine as much as heavily polluted areas and their intertidal location reflects a remarkable ability to cope with different stresses, due to its lipidic and proteinic plasticity notably. The stress compensation capacity may be impacted by the life history of crabs in terms of exposure to pollutants notably. In addition to the chronic stress contamination, a novel ans is indeed likely to generate a too high degree of stress that would overwhelm resistance capacities of organisms. To test our hypothesis and understand how chronic exposure to pollutants affects the resistance capacities of Carcinus maenas to stress, we imposed a 4 days air exposure to polluted water sampled in a polluted area, Le Havre harbour, and in a clean area, Yport rocky shore (France) and analysed stress markers as well as proteome variations in gills of sampled crabs. For each site, antioxidant activities (catalase, superoxide dismutase, glutathione peroxidase, glutathione reductase, glutathione S-transferase), protein expression (2D-electrophoresis, SDS 12% polyacrylamide gels, pH 3-10) and polyubquitination (immunoblotting of 2D-E gels, ECL detection) profiles of air-exposed crabs were compared to those of control individuals that were continuously kept in water. Crabs from Le Havre showed a higher mortality rate (5%) than crabs from Yport (0%) in the course of the experiment, but no difference was found between air-exposed and control groups whatever the sampling site. Results indicate an altered resistance capacity in crabs living in Le Havre harbour in comparison with those from the clean site Yport.

TU 402
Effect of mercury in natural populations of the sea anemone Actinia equina

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C. maenas in order to compare the physiological and cellular responses to stress between the two models.

Mercury (Hg) is considered to be one of the most toxic metals to biota, being capable of biomagnification and bioaccumulation in food chains. High concentrations of Hg were associated with developmental and behavioral abnormalities, impairment in growth and reproduction, and reduced survival. Though this metal has been extensively studied, several knowledge gaps still exist, mainly regarding its effects in different types of organisms. Accordingly, this study aimed at assessing the effects of a short-term exposure to Hg on growth and development of juvenile A. equina from two different coastal areas. From each population, forty individuals were collected and acclimated in laboratory under optimal conditions, for one month. Afterwards, organisms were weighed (7.09 ± 0.18 g mean ± SD), and using a flow-through system were exposed to 100 µg L-1 of Hg and to artificial sea water solely, during 96h. At the end of exposure, organisms were immediately deep-frozen (-80°C) until further analysis. The tissue of pedal disc was analyzed for bioaccumulation and biomarkers (biochemical: glutathione S-transferase-GST, catalase-CAT and lipid peroxidation-LPO and metabolic: lactate and alanine) to compare the uptake, oxidative damage and metabolic patterns among populations after being exposed to Hg. All population exhibited significant bioaccumulation of Hg and a significant change in the activity of LPO when exposed to Hg. On the contrary, exposure to Hg caused no significant changes in the activities of GST, CAT and in the levels of alanine and lactate. Furthermore, significant differences in the activity of GST were found among the four populations. The ratio of lactate/alanine (an index of redox state of the cell) accomplished with the biochemical biomarkers analysis, showed that the two populations originated from sites with different Hg contamination levels. In both populations, a significant Hg bioaccumulation was observed, but no significant differences were found in the oxidative stress biomarkers, suggesting that the toxicity of the mixture of Cu-Zn was more than concentration additive and could thus be predicted based on single metal toxicity. Hence, a reliable estimation of metal toxicity requires experimental verification of predicted effects.
A short-term in situ sediment assay based on the postexposure feeding of the estuarine isopod Cythara 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 approach to selecting sublethal test endpoints. 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 Cythara 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 with Artemia franciscana (Crustacea) nauplii. Then, the sensitivity of the postexposure feeding response to a reference chemical - cadmium - was compared to that of laboratory tests during a 48 h period. Finally, the in situ postexposure feeding assay was evaluated by deploying organisms in chambers at reference and contaminated Portuguese estuaries (Mira and Sado Rivers, respectively). The influence of different exposure conditions (sediment particle grain size, temperature, salinity, and food availability) was also taken into account through a multiple regression model, with the ultimate goal of discriminating contaminant effects from those due to environmental factors. The in situ postexposure feeding assay with C. carinata was found to be a potential useful cost-effective tool for estuarine sediment toxicity assessments.

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

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Assessment of risks of spilled oil generally focus on the content of specific PAHs in a contaminated site. When the content of these compounds are below the set limit, elimination of the contamination has succeeded. However, when spilled oil is biotransformed, a wide range of water soluble products are created. These compounds can reenter the sediment by deconjugation reactions, but can also act as toxicants in the water column. If these transformation products are toxic, they do not only expose organisms in the water, they are also subjected to spreading in the environment in a much larger scale. The objective of this study is therefore to 1) assess the toxicity of the biotransformation products of 1-methylphenanthrene, 3,6-dimethylphenanthrene, 1-methylpyrene, 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 exposures at different times. The water soluble biotransformation products were extracted and concentrated by SPE, and their toxicity (EC50) were determined by exposing Daphnia magna to dilutions of these extracts. The water soluble biotransformation products were identified by quantified by UHPLC connected in series to a fluorescence detector and a Quadrupole Time of Flight Mass Spectrometer. To aid the identification enzymatic deconjugation of the phase II products was performed, and identified by use of Gas Chromatography/Mass Spectrometry (GC/MS).

This work presents a novel approach to test the toxicity of transformation products of a contaminant mixture, where organisms are exposed to the entire range of biotransformation products. Also, this work shows the changes in toxicities of the transformation products as transformation of the PAHs progresses, and gives insight to the mechanisms of biotransformation of alkylated PAHs.

Vitellogenin and Zona Radaia gene expressions in three different species of catfish from Termolos Lagoon

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In a previous work, differences in the Vitellogenin and Zona Radaia gene expressions of three different species of catfish (Ariopsis felis, Bagre marinus and Carapichromis melaspilus) collected in the Laguna de Termolos, 70 fish were collected in different sites of the lagoon and were dissected to obtain liver. Total RNA was extracted using the Trizol method along with purification with the DNase enzyme. Specific primers of Vitellogenin and Zona Radiata genes were custom designed to amplify and isolate two PCR products from RNA. RT-PCR cycle was performed and results showed statistical differences between Vitellogenin and Zona Radiata values for fish collected at Laguna de Terminos. Data from this experiment show that Vitellogenin gene expressions were more sensitive than the ZR, under normal conditions in the environment. Future studies will be focused on understanding the reproductive cycle and the genetic variability of these fish.

Polynuclear polyphenyl ethers and their methoxylated analogs in sea bass (Dicentrarchus labrax) from Bizerte Lagoon, Tunisia

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Concentrations of polynuclear diphenyl ethers (PBDEs) and methoxylated polybrominated diphenyl ethers (MeO-PBDEs) in sea bass (Dicentrarchus labrax) collected from the Bizerte Lagoon and the Mediterranean Sea (reference site) were investigated. To the best of our knowledge, this is the first report of these compounds in marine fish from Tunisia. Concentrations of PBDEs ranged from 37.3 to 218 ng g-1 lipid weight (lw) for sea bass in Bizerte Lagoon, whereas in the Mediterranean Sea, concentrations ranged from 20.8 to 36.6 ng g-1 lw. BDE-47 was the major congener in samples from the two areas. Mean levels of MeO-PBDEs ranged from 49.4 to 798 ng g-1 lw in Bizerte Lagoon and from 1.7 to 224 ng g-1 lw in the Mediterranean Sea. In the Mediterranean Sea, the mean concentration of these naturally produced organochlorines was 482 ng g-1 lw. The total PBDEs and total MeO-PBDEs concentration in sea bass from Bizerte Lagoon was similar or slightly lower than those reported for other species from other locations around the world. No significant correlations were found between the organohalogen compounds levels and the fish characteristics.

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

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Increased by-catch utilisation interest may come from a greater demand for fish products: the development of new markets for previously discarded species, use of low-value by-catch specimens for aquaculture and animal feed or the creation of value-added products from by-catch or discarded fish for food, pharmaceutical or cosmetic industries. However, the contribution to a sustainable management of this biomass through their optimal valorisation highly depends on the quality of the products to be obtained from them.

Many studies in the scientific literature, like surveys of fish and fish products in markets of different countries [1] or monitoring reports of Public Administrations and the EU [2] reported significant levels of this kind of pollutants (especially of dioxins, polychlorinated byphenyls-PBDs, polychlorinated and heavy metals) in several cases for commercial species of different fisheries. In addition, in the presence of contaminants in other non-commercial species, although contamination levels in these non-targeted and/or discarded species are not usually assessed. However, a sustainable management of discards passes through the evaluation of their pollutant content, especially if it is considered that the products of discard valorisation are mainly concentrates (as fish oil and meal). Pollutants contained in the raw material are usually present at lower concentrations in the valorised product, especially if the product has a high fat content. In fact, some marine valorised-by-products present pollutant levels of concern [3].

In this sustainability framework, FAO, FAO project, co-funded by the LIFE+ Environmental Program of EU (LIFE08 ENV/ES000119), aims as one of its main objectives to analyse strategies that can be applied in the discard of fish. In order to contribute to its sustainable management by minimizing discards to catch through their optimal valorisation to recover and to produce valuable chemicals of interest in the food and pharmaceutical industry [4]. To properly define these adding-value processes, monitoring of metals, PBDEs and PCBs are being performed in FAO17153.
TU 410
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Contents of systems represent nursery areas for many fish species. They are nevertheless submitted to a high anthropic pressure, which is manifested by pollution. Among the most important pollutants are polycyclic aromatic hydrocarbons. In this study of the we studied to understand transfers between the different compartments during exposure and to see if the macroscopic effects observed were related to proteomic modulations. We spiked reference sediment with 3 concentrations of fluoranthene, then exposed Japanese medaka via direct contact with sediment during their entire embryonic development. Water, sediment and embryos were collected during the exposure and parent fluoranthene was analyzed by GC-MS. Time to hatch was also determined and photography was performed to analyze morphologic abnormalities and total body length. They were then sacrificed in liquid nitrogen to perform proteomic analysis by 2-dimensional electrophoresis. In sediment, the concentration of fluoranthene decreased linearly with time. In water, concentrations were globally constant, with the sediments acting as a reservoir of pollutant. In embryos, the concentrations were more erratic and were dependent on stage of development more so than in sediment or water with a fast clearance after hatching. At the same time, the highest tested concentration led to hatching failure associated with one day delayed hatching. The rate of several abnormalities increased such as heart edema, skeletal deformities, heart and abnormally reducing of yolk sac. These pathologies, related to blue sac disease syndrome, explained the dose-dependent increase of teratogenicity. The proteomic map exhibited 600 proteins. Among these, the expression (3%) of 60 proteins was modified by 77%. A downstream analysis revealed that the proteomic effects are related to cell physiology, fatty acid or protein metabolism and transport. Macroscopic and microscopic effects and/or regulations were dose-dependent, which suggest that fluoranthene is involved in a metabolic pathway that we could not determine with our proteomic exposure. Exposure to environmental concentrations of a single PAH in a real-life situation could lead to proteomic modulations, with macroscopic teratogenic effects. This study was supported by region Haute Normandie and Aquitaine, GIP Seine Avril and University of De Havre.

TU 411
Sediment-con tact-exposure of medaka eggs to a PAH model: combined chemical, toxicological and proteomic approaches 1, 2, M.R. Driss, M.B. Borras
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2Experimental Toxicology and Ecotoxicology, Parc Scientifict Barcelona, Barcelona, Spain
The aim of the study was to evaluate the impacts of environmental contaminants on oxidative stress, genotoxic and histopathologic biomarkers in liver of fish exposed to sediments. A series of 3 experiments were performed where a group of 30 newly hatched medaka was kept either in water (control group) or in 3 different spiked sediments during the larval development (60 days). At the end of the experiments, liver samples were collected and histologic analysis was performed. The results showed a significant increase in the liver enzyme activities (SOD, CAT, GPx and GST) and DNA damage ( Comet assay and flow cytometry) as compared to control. Moreover, some histopathological modifications were observed in liver of medaka exposed to spiked sediments. The proteomic analysis of incubated medaka liver showed that after exposure to spiked sediments, there is a significant decrease of 65 proteins (33% of the total proteome) as compared to control. The results suggest that when medaka is exposed to spiked sediments during its larva stage, oxidative stress, genotoxicity and histopathological effects are induced. These results are consistent with those obtained in previous studies with animals exposed to different contaminants. More research is needed to understand the underlying mechanisms and the consequences of these effects on the health of aquatic organisms.

TU 412
Long-term incubation of adult Nereis virens (Annelida: Polychaeta) in copper-spiked sediment: the effects on adult mortality, gametogenesis, spawning and embryo development J. Watson, N. Leach, G. Fones, J. Pini
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J. Watson, N. Leach, G. Fones, J. Pini
TU 413
Oxidative stress, genotoxicity and histopathology biomarker responses in sea bass (Dicentrarchus labrax) liver from Bizerte Lagoon (Tunisia) A. Cachot, J. Leray, K. Lemenach, S. Olivier, H. Budzinski, J. Leray
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L'Université Paris 7, Paris, France
INSERM U982, Rouen, France
Proteomic platform of IFRMP 23, Rouen, France
Insitu U982, Rouen, France
The aim of the study was to evaluate the impacts of environmental contaminants on oxidative stress, genotoxic and histopathologic biomarkers in liver of fish exposed to sediments. A series of 3 experiments were performed where a group of 30 newly hatched medaka was kept either in water (control group) or in 3 different spiked sediments during the larval development (60 days). At the end of the experiments, liver samples were collected and histologic analysis was performed. The results showed a significant increase in the liver enzyme activities (SOD, CAT, GPx and GST) and DNA damage ( Comet assay and flow cytometry) as compared to control. Moreover, some histopathological modifications were observed in liver of medaka exposed to spiked sediments. The proteomic analysis of incubated medaka liver showed that after exposure to spiked sediments, there is a significant decrease of 65 proteins (33% of the total proteome) as compared to control. The results suggest that when medaka is exposed to spiked sediments during its larva stage, oxidative stress, genotoxicity and histopathological effects are induced. These results are consistent with those obtained in previous studies with animals exposed to different contaminants. More research is needed to understand the underlying mechanisms and the consequences of these effects on the health of aquatic organisms.

TU 414
Effects of hypoxia on spermatogenesis and steriodogenesis of marine medaka (Oryzias melastigma) testis: an in vitro study Y.T. Loo, A.C.K. Tse, R. Wu
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Y.T. Loo, A.C.K. Tse, R. Wu
TU 415
Toxic effects of ZnO nanoparticles towards marine algae Dunaliella tertiolecta S. Mano1, M.L. Miglietta2, G. Rametta1, S. Buono1, G. di Francia1
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2CIRAcria, Porrino (co, Italy)
Dose response curve and population growth rate alterations deriving from the exposure to ZnO nanoparticles of the marine alga D. tertiolecta were evaluated. Bulk ZnO and ZnO nanoparticles were also investigated for comparison. Population size and particle size distribution were monitored during the experimental testing time. The results show that ZnO nanoparticles are more toxic (EC50: 2.42 (0.97-5.36) mg L-1) than its bulk counterpart (EC50: 4.45 (3.45-5.98) mg L-1). Cross- referencing the toxicity parameters for ionic zinc (EC50: 0.63 (0.36-0.70) mg L-1, NOEC: 0.01 mg L-1) and the dissolution properties of the ZnO it can be gathered that the higher toxicity of ZnO cannot be ascribed exclusively to free zinc ions. Nonetheless growth rates of D. tertiolecta were not significantly affected by ZnO nanoparticle exposure. Our findings suggest that the pristine size of the dispersed particles affects the bioavailability and the overall toxicity.

TU 416
PBDE accumulation in muscle of Whitmore Croaker (Micropogonias furnieri) exposed to BDE 99 and BDE 153 C. Pieron1, J. Leonel2, F. Gilberto1
1SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting 367
In 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 within 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 D6 and D4. Significantly higher median concentrations for octamethylcyclotetrasiloxane (D4) and decamethylcyclopentasiloxane (D5) were observed in fish collected at site A (D4: 60 ng/g lw; D5: 1380 ng/g lw) compared to site B (D4: 10 ng/g lw; D5: 139 ng/g lw). However, no significant differences were observed in the spatial distribution for dodecamethylcyclohexasiloxane (D6) between sampling sites. Concentration of D5 within cod liver was found to be negatively correlated with age. No correlations were observed for D4 and D6 concentrations and age; however, individual data points exhibited a significant relationship, which may be an effect of enhanced metabolic activity and/or growth dilution within older fish.

**TU 420**

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

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3Oceanographic Water quality guidelines for Antarctic marine environments requires understanding of sensitivity of biota to contaminant exposure. Toxicity tests with Antarctic invertebrates usually take too long to resolve the dose-response data. Current tests methods 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, Ochromenina pinguis, over 30 days exposure. Multiple observations were made assessing mortality rate response of this species to metal exposure. As a consequence, a new bioassay model was developed 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 smooths through noisy mortality data "gaining strength" by estimation of the trend across multiple observation periods exploiting all data simultaneously; (ii) the simple multiplicative model, if adequate, does not allow cross-overs of trend across concentrations that make interpretation difficult, and (iii) it allows the uncertainty in estimates of lethal concentrations to be more adequately captured.

Response times vary between metals with amphipods exposed to copper producing behavioural changes and mortality at a faster rate than exposure to cadmium, lead or nickel. Nickel did not affect the behaviour or survival of the amphipod during the 30 days exposure despite using concentrations > 1mg/L. Results from comparisons of both approaches indicate that standard bioassay protocols with serious limitations when applied to Antarctic species which are generally long lived, have longer developmental times, and slow behavioral 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 biota.