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

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and biochemical responses. For example, a number of highly replicated fish-life-cycle and multi-generational tests have examined growth, development, and reproductive success in combination with biomarker endpoints such as vitellogenin, GSI, and gonad histology. Analyses of sperm quality, gonadal development, VTG, genomic markers, and other non-traditional endpoints have also been reported in the literature, often in isolation of a link with more traditional endpoints. In determining the utility and relevance of these endpoints in a water quality 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, potential exposure in terms of the site-specific variations be used as measures of effects that are directly related to assessment endpoints for a sound and robust risk assessment. A case study describing this approach for the evaluation and use of both traditional and non-traditional endpoints will be presented from the extensive aquatic database for EPA.

RA23P - Wastewater effluent discharges: characterising 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 data may not be 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 Water Pollution Release and Transfer Register. It aims at establishing a Community level register of integrated pollutant release and transfer (E-PRTR), which is a type of manufacturer or thing that produces a certain amount of chemicals, and uses these chemicals for industrial and production facilities, from wastewater treatment plants (WWTPs) with a capacity of more than 100,000 equivalent inhabitants. Data gathered under the E-PRTR regulation provide a valuable source of information regarding the emission of pollutants to air, water and waste from the assessed installations.

The Catalonia Water Agency (ACA) conducted three different campaigns in 2008, 2009 and 2010. A total of 41 micropollutants belonging to different families (e.g., heavy metals, volatile organochlorine compounds (VOC), Poly cyclic Aromatic Hydrocarbons (PAHs),) were analysed in the sampling campaigns and their potential risk to the environment and human health has been assessed using the here presented methodology. Appropriate referenced analytical methods were used to obtain concentration levels of these pollutants.

In order to ensure the appropriateness and consistency of this new method, the results have been compared with a well-trusted method used for chemicals prioritization, the COMIMPS procedure developed by the Fraunhofer Insttitut [2] in 1999. From the results the following can be characterized and compare the different sites (WWTPs) according to their associated risk as well as prioritize the pollutants using the fuzzy model. Finally, the fuzzy model has been compared with the COMIMPS methodology, obtaining more conservative results with the first one due to the inclusion of persistence and variable's weight and the consideration of uncertainty. However, the behaviour of the two models is quite similar, fact that gives consistency to the fuzzy logic model.

TH 304
Simulation assessment allows evaluation 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 not provided in the Guidelines. Accurate knowledge on the relative role of the different mechanisms in the overall operation parameters i.e. hydraulic retention time (HRT) and sludge retention time (SRT) are strictly maintained during operation of a CAS unit. The following equation (1) links maximum concentration in ars from surfactant adsorbed 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 (C12H25NH3Cl, C16H33NH3Cl, C18H37NH3Cl, C18H35CO2H and C16H34CO2H) was assessed in CAS tests. The removal from the wastewater ranged from 98.8% (dioctadecyldimethylammonium chloride) to >99.9% (decylamine). Removal by biodegradation was 69% (dioctadecyldimethylammonium chloride) to >99.9% (decylamine). These removal percentages were compared with modelling results obtained with SimpleTreat. SimpleTreat not only predicted the potential of biological treatment systems to remove surfactants from wastewater but also the fraction removed by biodegradation. Especially, biodegradation of surfactants with a high potential to adsorb is not enough appreciated by SimpleTreat. The expression should be included in an update of the test guideline.

TH 305
Predictive modelling of steroid oestrogens in sewage effluent demonstrates the potential for endocrine disruptive effects in wild fish populations in South Australia
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Endocrine disruption (ED) has been observed in wild fish populations worldwide and is particularly well characterised in the UK, where the presence of oestrogens in the male gonads of a range of fish species has been observed. HCG (human chorionic gonadotropin) has been used in studies to assess the presence of oestrogens, with these phenotypes have been linked to sewage effluent containing the natural oestrogens 17β-estradiol (E2) and oestrone (E1) as well as the synthetic oestrogen stilbestrol (SBE). The presence of oestrogens in Australian rivers is known to be linked to sewage effluent containing high concentrations of oestrogenic compounds from sewage discharged into the aquatic environment. In contrast, little is known about the presence and effects of these chemicals in Australia, where there is a greater strain on water resources. Oestrogens have been measured in sewage effluents at levels comparable with the UK and there is some evidence of ED effects in fish downstream of sewage treatment works (STW’s). It is therefore advisable to determine the potential levels of oestrogens entering Australian rivers and to assess the risk to wild fish populations. This study demonstrates the first use of predictive modelling of oestrogens in Australian STW effluent, creating predicted environmental concentrations (PECs) for a set of STW’s in South Australia and comparing them to the UK using a modified version of a model previously for risk assessment in both Europe and Japan. The PEC’s were accumulated into an E2 equivalent concentration (EEQ) and were corroborated against measured concentrations from one UK and one Australian STW to determine their accuracy. These were then compared with the UK Environment Agency’s predicted no-effect concentration (PNEC) of 1ng/L E2. Predictive modelling was shown to provide a good method for first tier assessment of the contribution of sewage effluents to the aquatic environment.

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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3Cgapp, Pau, France

Urban inputs that include household effluents, drainage water, business effluents (e.g. car washes, dental uses, other enterprises, etc.), atmospheric deposition and traffic-related emissions (motor vehicle exhaust, brake lining wear, gasoline/ol 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 are considered as transient sources from both domestic and industrial activities and they are continuously discharging various polluted effluents. Urban inputs are considered as transient sources from both domestic and industrial activities and they are continuously discharging various polluted effluents.

TH 307
Demographic, economic activities and health equipments as potential sources of pharmaceutical compounds in wastewater and performance of wastewater treatment in two SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
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Results showed the presence of potential pharmaceutical sources: some were strongly suspected, others needed further investigation. The main perspective could be to develop a methodology to predict the fluxes of compounds entering the WWTP based on urban characteristics to define suitable technologies for the best treatment efficiencies.

TH 308 Wastewater effluents and river waters: sources of organic micropolllutants to NW Mediterranean coastal waters. Their characterization, fluxes and potential risks
J. Sanchez-Avila, R. Tauler, S. I. S. de la Torre
DIAEA-CSIC, Barcelona, Spain
This study provides a first estimation of the risk associated with the inputs of organic micropolllutants (OMP) to coastal waters from NW Mediterranean Sea. Pollution sources were wastewater treatment plants (WWTP) effluents and river waters discharged to the sea. Polycyclic aromatic hydrocarbons, polychlorinated biphenyls, organonitrogenated pesticides, polychlorinated diphenyl ethers, phthalates and alkylphenols were analyzed by solid phase extraction and gas chromatography coupled to tandem mass spectrometry (SPE-GC-HS-MS). Eight WWTP effluents and six rivers discharge an estimated amount of around of 258 000 g d\(^{-1}\). The concentration of \(\Sigma\)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 concentration of all inorganic and organic compounds in the early acid phase due to strong decomposition and leaching. This paper presented the list of verified and detected Emb and various processes which take place in the aqueous layer of the landfill body as the typical heterogeneous system. It will be reported qualitative and quantitative data on the occurrence of emerging compounds with increasing environmental and public health concern. Products from chemical reactions and waste decomposition of emerging substances from aquatic phase of unsanitary landfills could contaminate the surface water, groundwater and aquifer. The preliminary results of Danube surface water in the vicinity of Novi Sad show presence of benzenzolate and caffeine. In some samples of groundwater the most frequently detected were diclofenac, ibuprofen and gemfibrozil. The concentration of all inorganic and organic compounds in the early acid phase due to strong decomposition and leaching. The current research was supported by Ministry of Education and Science, Republic of Serbia (Project number III46009 and 37014) and Program Science for Peace and Security (NATO), Project No ESPEAPSF 984087.

TH 310 Characterization and treatment by enhanced coagulation of dissolved organic matter in bio-tech-treated effluent of textile wastewater
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Performed with regular physico-chemical-biochemical combined treatment process, textile wastewater effluent was treated by enhanced coagulation with a new kind of coagulant (polyelectrolyte (PON) + Polyacrylamide (PAM)). Treatment of textile wastewater as well as effluent treated by enhanced coagulation were isolated and enriched by extraction. Both DOM isolates were characterized by Gas Chromatography-Mass Spectrum (GC-MS) and both effluents by Excitation Emission Matrix (EEM). Results showed that biochemical-treated textile wastewater effluent mainly contained hydrophilic organic matters: triethylene glycol, tributyl phosphate and phthalates, and hydrophobic organic matters: amino acids and humic substances. And after enhanced coagulation treatment, most of the dissolved organic matter was removed from the bio-tech-treated textile wastewater effluent.

TH 311 Emerging substances in aquatic phase of landfill leachate
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Univeristy of Novi Sad, Faculty of technical sciences, Novi sad, Serbia
Faculty of Technical Sciences, Novi sad, Serbia
The terrestrial impacts related to landfill leachate are pollution of groundwater and surface waters. The risk of groundwater pollution is probably the most severe environmental impact from landfills because historically most landfills were built without engineered liners and leachate collection systems. Emerging pollutants are used in large quantities in everyday life and include a diversity of myriad compounds (e.g., pharmaceutical compounds from different therapeutic classes, personal-care products (PCPs), flame retardants, industrial additives, anticorrosive compounds and others emerging species). The emerging substances are contaminants that have been recognised as potential emerging contaminants in all aquatic media due to their production, use and many industrial processes. The main impacts of emerging substances from aquatic phase of sanitary landfills could contaminate the surface water, groundwater and aquifer. The preliminary results of Danube surface water in the vicinity of Novi Sad show presence of benzenzolate and caffeine. In some samples of groundwater the most frequently detected were diclofenac, ibuprofen, carbanzepine and metanil metabolites 4-AAA and 4-FAA, within 19 pharmaceuticals that were analyzed in Serbia. This research was supported by Ministry of Education and Science, Republic of Serbia (Project number III46009 and 37014) and Program Science for Peace and Security (NATO), Project No ESPEAPSF 984087.

TH 312 Removal of contaminants of emerging concern by a sewage lagoon
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Sewage lagoons are used widely in small communities in North America to treat municipal wastewater prior to discharge into surface waters. There has been little work to evaluate the efficacy of removal of contaminants of emerging concern by these small treatment systems. In this study, a sewage treatment lagoon for the village of Lakefield, ON in Canada was investigated to determine the removals during the summer, fall and winter of selected PCPs, including carbanzepine, trimethoprim, sulfamethoxazole, ibuprofen, gemfibrozil, triclosan, and HCHC and AHTN synthetic musks. PCOCs and SPMD passive samplers were deployed at three locations in the sewage treatment lagoon, as well as at several points downstream of the wastewater discharge in the Otonabee River. Extracts from the PCOCs and SPMDs were analyzed by LC-MSMS or LC-MS/MS. Among the pharmaceutical target compounds, the highest concentrations in the sewage lagoon were measured in the fall for ibuprofen at an estimated concentration of 60 ng/L. Removal rates for ibuprofen and sulfamethoxazole were >75%, but carbanzepine was not removed effectively in the lagoon. Gemfibrozil showed a significant increase in concentrations as it passed through the sewage lagoon, which can be attributed to de-conjugation of metabolites during treatment. Triclosan did not change concentrations. Overall, there was 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 was effective at removing PPCPs at rates that were comparable to removals in conventional WWTPs.

TH 313 Removal efficiency of organic micropolllutants in a constructed wetland assessed by passive sampling: results rom the WIPE project
E.W.Roberts, R. Hehe, H. Verhe, F. Smeed
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Remediated wastewater treatment plants, 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, wetlands are constructed, adjacent 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 from the WWTPs. Our study investigated the possibility to decrease the environmental risk by removal of micropolllutants from STPs effluents. Therefore, we deployed passive samplers (silicon sheets) on 4 positions in different constructed wetlands in 7 consecutive rounds from July 2009 till December 2010. Passive sampling enables the detection of very low concentrations of substances, because of their enhanced sampling volume compared to grab sampling. After deployment, passive samplers were analyzed for different groups of substances, and the risk of these substances was assessed using a Toxic Unit approach. In total around 250 substances were analysed on the sheets, and large differences existed between locations, but also between rounds. Surprisingly the largest group of substances, in terms of concentrations, were the pesticides, followed by flame retardants and personal care products (PCPs). The main pollutants of concern were phenols and endocrine disruptors. For endocrine disruptors, concentrations were lower than 0.5 ng/L in all samples.
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
E.M. Foekema, Assessing the potential of constructed wetlands in reducing environmental impact of STP effluents: the WIPE project
TH 314

Inventory of emissions of priority hazardous substances in the surface waters in France
A.M. J. Gouzy, J.M. Brignon, INERIS, Verteuil-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 achieve this inventory and presents the methodology and key figures used.

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

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 method could bring huge benefits (e.g. output improvement and costs reduction) in the industrial context.

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

The objective of this work was to evaluate possible toxic effects of sludge samples from urban septic tanks and upflow anaerobic sludge blanket (UASB) from a wastewater treatment plant located in the University of Espirito Santo, in Vitória, Brazil. The method employed was the acute toxicity test Microtox (Azur Environmental) based on the luminescence inhibition of the marine photobacterium Vibrio Fischeri. It is a test with many advantages such as ecological relevance, sensitivity, reproducibility, standardization and simple execution. A series of physical-chemical parameters were also analyzed based on Standard Methods for Examination of Water and Wastewater 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. Superficial liquid from the top sludge; 2. bottom sludge and 3. mixture from all the previous. From the UASB equivalent fractions were also sampled. The tests were executed according to the Microtox User’s Guide Manual (AZUR Environmental, 1996) and results were expressed in EC50 (Effective Concentration), a value that represents the sample concentration in which 50% of the bacterial luminescence is inhibited. Only in one of the septic tanks, located in a public building toxic effects could be verified in the initial clam-feeding solution and the post-filtration effluent to non target organisms (the bacterium 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 filtration and bioaccumulation capacities may be assembled. Such a wastewater treatment method could bring huge benefits (e.g. output improvement and costs reduction) in the industrial context.

TH 317 Combining chemical analysis with literature studies to identify micropollutants to be treated or upstream source controlled in a catchment of micropollutants to be treated or upstream source controlled in a catchment of Danish Danish rivers.
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The European Water Framework Directive aims at obtaining good ecological and chemical status of European water bodies by the year 2015 (EU, 2000). The directive also requires that the sources of pollution are identified and perform monitoring programs as well as to outline strategies to reduce emissions if the environmental quality standards are exceeded (EU, 2008). The aim of this study was to compare two different approaches to identify micropollutants in stormwater from a specified catchment; a literature inventory of potential pollution sources and chemical analysis of urban stormwater runoff. The selected catchment covers an area with roads, a shopping centre, a parking lot, office buildings, an upper secondary school and restaurants in Copenhagen (Denmark). The literature approach is limited to the range of included micropollutants and to how and when information is compiled, whereas the analytical chemical approach is limited to and affected by the sampling procedure, the selection of analysed
TH 318

Toxicity identification evaluation for wastewater treatment plant working at different industrial and municipal scales

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A toxicity identification evaluation according international consideration was performed taking into consideration the system used for depuration of wastewater. Process control in the WWTP under discussion is basically controlled by the toxicity of the liquid effluent. Mainly, cellular retention times (HRT), presence of anaerobic and anoxic selectors, sludge microbiorology, and operation index such as Sludge Volume Index (SVI), diluted Sludge Volume Index (dSVI), sludge volume (SV), base and spike Oxygen uptake rate (BOUR and sOUR), Mixed Liquor Volatile Suspended Solids (MLVSS), Mixed Liquor Volatile Suspended Solids (MLSS) and bioflocculation index were taken into account for each plant. A set of toxicity test were carried out, together with the Solid Phase Microextraction (SPME) and Gas Chromatography-Mass Spectrometry (GC-MS) analysis, for chemical characterization of each effluent. Data were interpreted by Principal Component Analysis (PCA) which allowed to classify, for the first time, in Argentina, to rank in relation to type of industry, production volume and/or number of inhabitants, from the data interpretation arise that the high producing industrial WWTPs (HPVIC) are potentially more toxic than municipal WWTPs (MWWTP) due to discharge of chemical compounds fraction of the river water and other pollutants. Rapid acute toxicity tests were carried out using mediated identification of contaminants in the effluent. We will discuss results of a feasibility study evaluating treatments of industrial and agricultural effluents.

TH 319

Application of delayed fluorescence to estimate the influence of waste water effluent on algae

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Waste water effluent is major source of chemicals discharge in to aquatic ecosystems. Since algae are important primarily producers in aquatic ecosystmes, it is necessary to influence the estimation of the influence of effluent not only on animals but also the algae. We are investigating a new method of for evaluating the influence of chemicals on algae by using delayed fluorescence (DF) from algae. The DF is a specific 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. DF inhibition reflects in a shorter time than the conventional 72 hours growth inhibition test (e.g. OECD test guideline 201). The intensity of DF also shows a time decay curve. Chemical exposure changes the decay curve to patterns that have the potential to assist in the identification of contaminants in effluent sample. We have developed a rapid and simple DF test protocol using the green algae Pseudokirchneriella subcapitata (Selenastrum capricornutum). The test algae are prepared by thawing specially prepared -80°C frozen algae in a 1 hour pre-incubation. The prepared test algae can then be immediately exposed to the test sample prepared in a range of effluent concentration (0, 5, 10, 20, 40, 80 %) in small culture tubes (10 ml volume). The DF from algae in the culture tube is directly measured by the ultra-sensitive luminesimeter at 1, 4, 8, 24 and 300 h after exposure. DF is inhibited through the influence of the effluent. Further, effluent exposure changes the time decay curve of the DF intensity. From the relationship between the exposure concentration and the DF inhibition, we could estimate the dose-response in DF inhibition for each effluent or mixture. In addition, the 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

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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 results have shown that the major changes observed were increased detoxification enzymes (EROD), DNA damage, physiological parameters, % of DELT anomalies, impaired reproduction, and reduced fish population structure in the downstream site (GS 7.2) of municipal wastewater treatment plant (MWTP). By the stressor identification (SI) process, five cause variables of fish population degradation were winnowed including habitat alteration, low dissolved oxygen, nutrient enrichment, ammonia toxicity, and organic carbon. 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.

TH 321

Monitoring potential ecotoxicological effects in the effluent of an urban wastewater treatment plant

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Organic micropollutants cannot be completely removed by traditional wastewater treatment technologies. Therefore it is being discussed to add additional treatment steps such as ozonation, active coal filtration, UV-treatment etc. However, there is a lack of long-term studies to clearly prove a direct relationship between micropollutants in waste water and ecotoxicological effects on the macrozoobenthos fauna in the recipient stream to justify future expensive installations. Online monitoring of the ecotoxicity of wastewater is being used to determine the loss of fish larvae. Important parameters are the oxygen consumption (O2-UC), the carbon dioxide production (CO2-PC), the pH and the dissolved oxygen concentration (D0-UC). The methods are based on the analysis of the test species (Gammarus pulex, G. fossarum) and the structural of the aquatic invertebrate community. 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, 5, 10, 20, 40, 80 %) in small culture tubes (10 ml volume). The DF from algae in the culture tube is directly measured by the ultra-sensitive luminesimeter at 1, 4, 8, 24 and 48 h after exposure. DF is inhibited through the influence of the effluent. Further, effluent exposure changes the time decay curve of the DF intensity. From the relationship between the exposure concentration and the DF inhibition, we could estimate the dose-response in DF inhibition for each effluent or mixture. In addition, the 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 322

Implications of municipal wastewater on macroinvertebrate community structure and leaf litter breakdown

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European streams receive huge amounts of municipal wastewater, which, due to the limitations of conventional secondary treatment (i.e. mechanical and biological), may contain a wide range of micropollutants, like pharmaceuticals and personal care products. As such micropollutants are 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 spring 2011, respectively. Macroinvertebrate related leaf litter breakdown in terms of leaf mass loss was by up to 63 % significantly reduced at sites situated up to 300 m downstream of the WWTP outlet compared to the upstream site during both seasons. This effect may be caused by e.g. M. Bückers1, M. Hoder1, H. Mayer1. Furthermore, reduced abundances of leaf-shredding macroinvertebrates such as G. c. navacense. 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 wastewater containing micropollutants which is supported by the results of the in situ bioassays. On the other hand, indirect pathways, given by a lower nutritional quality of leaf material, indicated by a significantly reduced fungal biomass (up to 75%) at the downstream site, may have influenced the physiological fitness of shredders. Finally, the present study urges the evaluation of the current procedure in wastewater treatment by considering advanced treatment methods (e.g. ozonation), which may help to meet the requirements of the EU Water Framework Directive.

TH 323

Water quality investigations in the river Lea during a downstream treatment works: preliminary results of a case study

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In the east of London the Lea Navigation is a canalised reach of the river Lea, is affected by episodes of very low levels of dissolved oxygen. The problem was detected by the Environment Agency in the stretch from the confluence with Pymmes Brook (which receives the final effluent of Deptfords sewage treatment works) to the Olympic area (Marshigate Lane, Stratford). In this study the river water ecotoxicity to the freshwater alga Pseudokirchneriella subcapitata was assessed by algal growth inhibition test according to modified OECD guidelines (Organisation for Economic Co-operation and Development, 2006). Results showed inhibited growth rate after 24 hours that was most pronounced at the upstream locations where the population of polar compounds fraction of the river water was high. Rapid acute toxicity tests were carried out using mediated amperometric whole cell biosensors (CellSense). Results indicated no evidence of acute toxicity in the river water, as no significant differences were detected between pre and post exposure responses to river water samples, with an exposure time of 30 minutes. These results indicate chronic pollution of the river, affecting photosynthetic algae during long-term exposure.
TH 324
Enrichment free LC-HRMS screening method of anthropogenic sewage pollutants in waste water, receiving water, ground water and drinking water samples
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In last decade, there has been growing public concern of 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 provide, 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 FWHM is reported as being as selective as 2 SRM transitions when using triple quadrupole instruments [2].
In this work, the direct injector 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 capabilities of these types of anthropogenic sewage pollutants. Different 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. Many regulators are seeking more holistic techniques such as whole effluent testing (WET) to supplement existing approaches. However, to ensure that these approaches are capable of predicting potential environmental effects, it is important to test scientifically robust WEA protocols. In general, WEA methodology assesses toxicity to aquatic organisms. WEA has relevance for the protection of ecosystems although the relevance and interpretation of results ultimately depends on the tests used. In this work, the direct injector 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 capabilities of these types of anthropogenic sewage pollutants. Different to sample types were eliminated, 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.

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 an 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 several years. It consists on longitudinal ecological monitoring at assessment of emission and inhibition 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 calyciflorus and the microcrustacea Daphnia magna. Moreover, a yeast estrogen screen (YES) assay was conducted as an assessment tool to detect the presence of endocrine disrupting compounds. During 2011, 14 major industrial discharges in Belgium and 26 sampling points in the receiving waters (upstream and downstream of the effluents) 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 dischargers 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 encaged bryophytes; upstream and downstream of a pharmaceutical industry, YES assay was conducted as potential assessment tools in combination with passive samplers (POCIS). The results of these monitoring show that bioassays are good diagnostic tools to determine the causes of poor ecological quality and to trace back to the source of contamination. They are an important "tool in the toolbox" for environmental management. They add value and provide complementary information to that supplied by the chemical and ecological community measures and could help to design appropriate management measures.

TH 327
Combination effects of pharmaceuticals and industrial chemicals in waste water effluents
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We will present our currently starting research activities in testing combination effects of pharmaceuticals and industrial chemicals known for their (co)-occurrence in WWTP effluents. Mixtures of industrial chemicals and human pharmaceuticals can be found in surface waters as so called micropollutants. Effluents of waste water treatment plants (WWTP) are the main exposure route for both kinds of substances. The emission of these chemicals into WWTP originates from consumer usage of products, articles and drugs. It is commonly known from literature and discussed in different scientific and regulatory communities that effects of chemical mixtures are significantly larger than single substances effects. At the moment neither in the environmental risk assessment of chemicals (REACH) nor of human pharmaceuticals (EMEA/CHMP/SWP/4447/00) 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 to test the impact on aquatic organisms (WET); (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 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 barbiturate-like. In a first time, compounds were studied alone in tap water. Then, they were studied alone or associated in sewage water. Results will be presented and discussed according to the environmental concentrations of these compounds.

TH 329
Ecotoxicological characterisation of climbazole, an anti-dandruff agent contained in shampoo

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

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

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

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

Estimating PEC/PNEC-relations of these new substances has to take into consideration the increasing 100% of incidences, change in demographics as well as biodegradability, compartment-distribution-tendencies and additional waste-water treatment techniques e.g. ultraviolet light, ozone and membrane filtration. 

Comparative study of the ecotoxicity of dishwashers detergents

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This study aimed at assessing the ecotoxicity of dishwashers detergents. Indeed, despite the high consumption of such products, available information regarding their environmental impact is still limited. Thus, twenty five of the most representative products available on the French market were selected, covering the different dishwashers 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 “washing solutions” were prepared by cold water and by hot water in order to observe the differences between both temperatures. The “washing solutions” were prepared by cold water and by hot water in order to observe the differences between both temperatures.

Regarding the automatic dishwasher products, it was shown that the ecotoxicity of “washing solutions” from the “gel” products was higher than the ecotoxicity recorded for “classical”products and “multibenefit”tablets. This study also revealed that the ecotoxicity of “classical”tablets was, most of the time, higher than the ecotoxicity of “multibenefit”tablets. Additional studies confirmed that the ecotoxicity recorded for “classical”products was mostly due to the addition of rinse aid in the “washing solution”. These results suggested that the ecotoxicity recorded for ecolabelled products should be weighted regarding to the intrinsic ecotoxicity of the rinse aids which are currently not covered by “European Ecolabel”.

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

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2 University of Technology, Delft, The Netherlands
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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 of the free metal ion concentration.

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

TH 334 Integrating sewage treatment plant monitoring and modelling to prioritise chemicals of concern and assess environmental risks

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A new approach of prioritising organic chemicals released via sewage treatment plant (STP), prioritising pollutants of concern and assessing their risks for the aquatic ecosystem is presented. From the EU perspective, such challenges are common to the chemical legislation, (e.g. REACH regulation, Biocidal Products Directive) and the water legislation (e.g. Urban Water Treatment and Water Framework Directives). In chemical risk assessment, the exposure of the aquatic ecosystem to organic chemicals released via STPs is calculated in two steps: first, local and regional emissions to sewage are estimated from consumer use data; then, the fate in a generic STP is calculated using the multimedia box model SimpleTreat. Default calculations are based on conservative (worst-case) assumptions.
TH 335
Anaerobic biodegradation of PCBs in a grass cut batch reactor
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Due to properties such as high Kows values chlorinated compounds including PCBs, dioxins or chlorinated pesticides in vegetation can lead to bioaccumulation in livestock and in the food chain. Hence, the remediation of these compounds in the environment is an important factor for human health. The degradation of the persistent Polychlorinated Biphenyls (PCBs) under anaerobic conditions in sediments and sewage sludge is described in the literature [1,2]. The potential for degradation in an anaerobic grass cut batch reactor has not been performed before and is investigated in this work. Therefore two series of batch experiments in laboratory scale (0.5 L to 1.5 L of volume) were performed under mesophilic conditions.

The first experimental series was performed at low natural, i.e. not spiked concentration level of Elbe riverside grass and sludge samples at 27 °C for 315 days. This first, explorative experiment showed ambiguous results for the degradation of the 6 indicator PCBs (PCB No.: 28, 52, 101, 138, 139, 180). Concentrations of the lower chlorinated PCBs (28, 52) was the concentration 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, 138, 139, 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 same source were used to test the sludge 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 impact on grass production kinetics due to different dry masses, are discussed on the poster.

References

TH 336
Removal of nutrients by immobilized microalgae beads in a continuous flow system
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Using immobilized microalgae 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 tricornutum" was immobilized in 3.5 % sodium alginate solution and hardened with 4% calcium chloride (cation solution) and introduced into a continuous system to remove nitrate and ortho-phosphate. Daily samples were taken from the system and analysed by using UV-Vis spectrophotometer (Chebios Optimum-one) to determine the removal efficiency of the nutrients by the algal beads. The cells 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 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 algaline beads over a long term run.

TH 340
Towards transparent and relevant use of energy use indicators in LCA studies of biofuels
A. Bortsie Aryee, A. Halog
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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 341
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 into black boxes. Several products with different characteristics and uses are obtained from oil refining process (olefins, propane, butane, gasoline, kerosene, diesel, paraffin, asphalt, etc.). Allocation of proportional impacts of energy consumption and emissions for each product is a difficult task because many of them are correlated. Therefore, energy consumption and emissions are allocated according to the final product distribution. The most allocation methods used for petroleum products are based on relationships of energy content, according to the quality of the input.

This study compile the results of several studies of diesel production in European and American processing plants in terms of GHG emissions and energy consumption. Furthermore, this study is performed by recent studies of diesel production in Spanish refineries. Results highlight the broad range of values that depend on variables such as: operating conditions, process configuration, and product specialization. Spanish refineries values are within the range of average European plants. Conclusions draw attention to the need of real data from refineries in order to obtain more adjusted and accurate results, as well as the possible partial subdivision of the system as a solution, according to ILCD handbook recommendations for allocation procedures.

TH 342
How to assess the data quality of LCI studies - a systematic approach
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The field of biomass is becoming more growing, 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, the life cycle inventory data are generally global compilations and they are not partitioned into sub-processes, but into black boxes. Several products with different characteristics and uses are obtained from oil refining process (olefins, propane, butane, gasoline, kerosene, diesel, paraffin, asphalt, etc.). Allocation of proportional impacts of energy consumption and emissions for each product is a difficult task because many of them are correlated. Therefore, energy consumption and emissions are allocated according to the final product distribution. The most allocation methods used for petroleum products are based on relationships of energy content, according to the quality of the input.

This study compile the results of several studies of diesel production in European and American processing plants in terms of GHG emissions and energy consumption. Furthermore, this study is performed by recent studies of diesel production in Spanish refineries. Results highlight the broad range of values that depend on variables such as: operating conditions, process configuration, and product specialization. Spanish refineries values are within the range of average European plants. Conclusions draw attention to the need of real data from refineries in order to obtain more adjusted and accurate results, as well as the possible partial subdivision of the system as a solution, according to ILCD handbook recommendations for allocation procedures.

TH 343
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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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 the United States Department of Energy, Kristina Johnson, “drop in”biofuels can be defined as fuels produced from various biomasses which are 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 ability to be used in existing 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.

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
At present, a widely discussed approach to handling this situation is through some form of meta-analysis. However, we think it is useful to explore other ideas and concepts 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 by-products from different sources can be allocated.

The guideline was tested on an analysis of LCI studies and data sets of an Organic Rankine Cycle plant for German framework conditions. The results will indicate the importance of inclusion of direct and indirect LCA impacts in policy analysis.

The guideline consists of four parts:
1. Description of the technology of interest and of available literature
2. Computation of the energy balance
3. Calculation of the environmental impacts
4. Interpretation of the results

These parts are designed to be adaptable to different types of LCA studies and can be used in combination with other LCA methodologies. The guideline provides a valuable tool for researchers and practitioners to improve the accuracy and consistency of LCA results.
Polyhydroxyalkanoates (PHA) and polylactide (PLA) are appropriate bio-based substitutes for a variety of previously petroleum-based products. Life Cycle Assessments (LCAs) according to ISO 14040 and 14044 have been applied to compare the environmental performance of these bio-based polymers in contrast to their petroleum-based counterparts. Numerous cradle-to-gate studies have been carried out to analyse the environmental impacts of the production of polymer resins with a preliminary focus on the impacts associated with non-renewable energy use.

Previous studies indicate a wide range of results and contradictory conclusions due to the consideration of different production processes, methodological choices (e.g. system boundaries, co-product allocation, impact assessment methods) and underlying assumptions. To produce more robust and policy-relevant results than individual LCAs, a Meta-Analysis has been developed and undertaken to analyse the outcomes of 25 LCA studies. The underlying studies are quantitatively assessed taking into account the impact categories climate change (measured in metric tons of carbon dioxide equivalents) and non-renewable energy use (measured in megajoules). Relative environmental impacts per metric ton of PHA and PLA are compared with corresponding values for the petroleum-based plastics polypropylene (PP), polyethylene (PE), polyethylene terephthalate (PET) and polyurethane (PU). Furthermore, differences between the environmental impacts of bio-based and petroleum-based polymers as well as standard deviations are calculated to derive methodological consistent figures.

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

TH 349
The effect of system boundary and weight of the life cycle on the results of a life cycle assessment (LCA) - Electricity generation as examples system
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LCA is a widely used tool for determination of strength and weaknesses regarding ecological aspects of any product or service. It is expected from the scientific-based analysis to deliver robust information, but in fact in literature the results differs significantly for the same product or services. Due to the recognized uncertainty this study addresses the possible deviation of results from literature of electric energy production from different energy sources. The potential deviation could arise from the consideration of different system boundaries (SBs) and the relevance of emission sources along the life cycle. Both could be mainly responsible for the recognized diversity beside others like allocation, cut-off criteria, actuality of literature, etc.

The electric power generation gives a good instance to analyze the impact on the results of the different SBs. For example: the variation between different plant construction demands is often over 80%, but the overall results don’t necessary correlate with this deviation. The change of cement demand for construction by 230%, in the case of electricity generation from coal, induces only 1.7-2.6% 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 wind energy. The whole life cycle of power plant (with fuel upstream), the following system parts and impact categories have been taken in account by understanding the results of LCAs:
- Construction, fuel upstream, transport, production, operation, decommissioning as life cycle phases
- Construction demand variables (basic construction materials: cement, steel, etc.)
- Fuel demand variables (efficiency factors: fuel purity, thermal efficiency, wind yield, transport, etc.)
- Impact assessment methods (GWP as main LCIA method)

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

LC06p - Life cycle management (LCM): Success factors and barriers

TH 350
Using LCA in the preparation of the new waste management plan of Regione Lombardia
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Regione Lombardia has among its tasks the development of management strategies for municipal waste produced in its territory, in collaboration with provincial governments, the control bodies and public and private entities that operate on the collection, recovery and disposal cycle.

In order to pursue sustainability also in this field, Regione Lombardia has decided to consider “environmental performance” as a criterion for supporting future planning decisions, and therefore stressed the need for specific assessments of environmental impacts associated with the planning in the waste field.

Life cycle assessment (LCA) has thus been chosen by Regione Lombardia as a strategic support decision tool in the preparation of its new waste management plan. The goal is to use this life cycle analysis to support the definition of the current situation and the 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 allowed 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 reached 307.000 tons annually. Of these, 10% is recycled or valorized, 40% remains stored in houses and 50% is sent to final disposal in landfills and open dumps. The aim of this project was to conduct a life cycle analysis using the program Umberto for electronic waste management in Mexico and compared its environmental impacts with those for three proposals for change in the end of life management pattern in order to determine the best option for a national policy. The policy proposals were modeled as follows: 1) Stage with 25% of recovery system, 2) Stage 35% to recovery system, and 3) 0% for disposal in open dumps. As conclusion it was identified to eliminate the use of open dumps for waste disposal in first place, followed by an increase in 35% of the recycling valorization system.

TH 352
Implementation of an integrated technological-Life Cycle Assessment modelling tool within the water industry - a pragmatic contribution to decision-making
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3, CIRSEE - Suez Environment, Paris, France

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 process context. Complementary software tools are directly linked to Umberto and make it easier to model and simulate a complex scenario. The output is a life cycle impact assessment report when placed within a modelling scenario. These reports are spreadsheet containing engineering design data (e.g. pumps power). This information is interesting at the decision stage since it can be used to design the product or service. The tool is expected to be widely used within the water industry.

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

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TH 353
LCA on drinking water production from protected ground water
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This poster presents the results from an LCA case study addressing a growing Danish problem on pesticide contaminated ground water. The conventional Danish way of using pesticides free groundwater and treating it by aeration and sand filtration, is compared to using slightly pesticide contaminated groundwater and adding treatment by activated carbon filtration and UV-treatment. The scenario of using slightly pesticide contaminated groundwater is chosen as it is a genuine and relevant alternative in the current Danish situation as groundwater wells are closing due to pesticide contamination and clean ground water is becoming scarcer. Besides the comparison, a hotspot analysis is performed in order to identify the dominating environmental impacts in the life cycle of generating drinking water from ground water. This study is part of the research project DWBiofilters (www.dwbiofilters.dk) aiming at improving sand filters for drinking water production by investigating its inherent microbial processes.

TH 354
Development of a new LCA tool for maintenance at the initiative of the users - a bottom-up approach
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Many practical LCA tools have been developed before a user group was established. The risk of such top-down approaches is a gap between the tool and the way users want to use it, which may result in the tool being less used by the users. In the Netherlands, a group of housing associations and building and maintenance companies were looking for means to calculate the environmental performance of planned preventive maintenance of housing, estates and buildings themselves. There are several theoretical approaches available, but no practical calculation tools. Because of this lack of instruments, they set up a development project for a practical calculation tool. The need for a practical tool that companies can use and which they can have much 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)
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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 POEMS project was initiated. The Foodprint - research programme aims to analyse the whole agricultural and food sector and for this reason, it is the major impact category of interest; other LCA relevant impact categories are presented and discussed to 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 are 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 356
Finnish guidelines on carbon footprinting - supporting practical implementation of LCA in the food industry
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Life cycle thinking is spreading among environmentally responsible companies around the world. Specially carbon footprint guidelines, which have been developed in the last years, support the accelerating trend. The agro-food industry uses carbon life cycle assessment on company and product level. Growing general knowledge and pressure to act on climate change has given incentives to companies to use carbon footprinting in their consumer communication as well. Consumers show growing interest to, for example, carbon footprints in many Gallup polls. Many international standards and guidelines on LCA are published but no standard widely approved method on evaluating environmental impacts of food are available. In the Foodprint - research programme sound national methodology for calculating carbon and other footprints of food has been developed in close collaboration with the Finnish food sector. As published guidelines are too generic to give practical instructions to companies to produce comparable carbon footprints for communication, the POEMS project was initiated. The Foodprint - research programme aims to analyse the whole agricultural and food sector and for this reason, it is the major impact category of interest; other LCA relevant impact categories are presented and discussed to 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 are 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 357
Life cycle thinking applied to an immunological product (vaccine) used for boar taint control in male pigs
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In 2009, Pfizer Animal Health (USA) started to apply the Life Cycle Assessment (LCA) methodology to some innovative products, with a first case-study on ImprovacTM, a life cycle thinking applied to an immunological product (vaccine) used for boar taint control in male pigs. 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). The paper describes the development of the Italian version of the Foodprint LCA guideline and of the EPLD-Guideline, 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: resistance to change; dispersion of the environment-related information; in Envrnl. Management Systems (EMS) little attention is paid to product performances

ARROWRIGHT: spreading an envnl. culture and change involving; structural and organized vision of envnl. aspects; internalize product requirements within the EMS [ARROWRIGHT]S: envnl. training and dissemination; EMS; Integrating EMS with a Quality Management System [ARROWRIGHT]T: Integrated Quality and Envtl. Management System

SSB: main focus on short-term problems; lack of chain management responsibility; lack of awareness of product life cycle envnl. impacts (PLEI); 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 PLEI; allow SMEs to perform envnl. assessment by themselves providing an easily understandable tool [ARROWRIGHT]T: LCM and Life Cycle Thinking; LCA; simplified approaches [ARROWRIGHT]T: 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. messages taken into commercial advantages; spreading envnl. cultural change and involvement with external dissemination; identification of the proper envnl. label/declaration [ARROWRIGHT]T: EPLDs; envnl. product communication; guidelines to support decision making [ARROWRIGHT]T: EPLD guidelines

IMs+Simplified LCA=EPLD guidelines+POEMS

The EMAF project is in progress with applications in the canned vegetables, wine, pasta, olive oil and coffee supply chains.
The Nespresso pilot test will be presented and shows an example of PEF Guide application and used to provide feedbacks about the PEF Guide.

were attached to Plexiglas panels that force the waste to follow a zigzag pathway. We exploited two natural behaviors of this mussel: the heavy filtration rate (average of

depuration plant (Depuration plant of Nosedo) of Milan (Italy) in which we put several thousand of specimens of the freshwater bivalve Dreissena polymorpha. Mussels

certain carcinogens such as dioxins. Nanotechnology exploits the novel phenomena and properties of matter at atomic and molecular levels. Because of their particle size they

The application of moderated fired clay with polymer addition to the purification and treatment of printing wastewater may potentially revolutionize water treatment

possible clearance of several environmental pollutants: pharmaceuticals, illicit drugs, some persistent organic pollutants (POPs), several heavy metals and pathogen bacteria.

for re-circulation conditions; 3) to check the contaminant abatement from the inlet to the outlet of pilot-plant. In the first phase, we

were selected as target compound to study its degradation and to assess the potential of white-rot-fungi to degrade PhACs from real effluents.

Toxicology and Chemistry) and "life cycle assessment", yielded a very interesting relationship for the years 1980-2008. The “SETAC” acronym first appeared in books in

where much lower (40 and 70 ng/L, respectively) . The persistence of ICM through conventional wastewater treatment is well documented. For this reason, this substance was

in all wastewaters, with especially high concentrations in hospital wastewaters (nearly 200 μg/L), whereas in reverse osmosis concentrate and in urban wastewaters levels

concentration of pharmaceuticals is expected to be significant such as hospital and urban wastewaters and reverse osmosis concentrate. Results indicated that pharmaceuticals

were attached to Plexiglas panels that force the waste to follow a zigzag pathway. We exploited two natural behaviors of this mussel: the heavy filtration rate (average of

Among the vast array of contaminants of anthropogenic origin reaching our water supplies, pharmaceutically active compounds (PhACs) have one of the largest inputs into

Among the vast array of contaminants of anthropogenic origin reaching our water supplies, pharmaceutically active compounds (PhACs) have one of the largest inputs into the environment. The main route of entrance into the aquatic environment is ingestion following excretion and disposal via wastewater, manufacturing and hospital effluents, land applications (e.g. biosolids and water reuse), concentrated feeding operations (CAFOs) and direct disposal/introduction into the environment. Many studies have reported on the limited degradability of pharmaceuticals under the conventional treatments applied in WWTPs, concluding that it is necessary to investigate on other possible ways and methods which high quality effluents would be designed to find selected treatment methods which would be effective for as many different pharmaceuticals as possible. This goal could be achieved with fungal treatment; in particular ligninolytic fungi have a powerful enzymatic system which has demonstrated its ability to degrade a wide variety of xenobiotics.

In this context, the present work will show the results derived from an extensive characterization of 80 human and veterinary pharmaceuticals in several wastewaters where concentration of pharmaceuticals is expected to be significant such as hospital and urban wastewaters and reverse osmosis concentrate. Results indicated that pharmaceuticals are widespread pollutants in all these matrices. As expected, high levels were found in hospital wastewaters followed by those found in reverse osmosis concentrate and urban wastewaters (concentrations between high ng/L and high μg/L). Among all PhACs investigated, the iodinated X-ray contrast (ICM) agent omnipaque was detected in all wastewaters, with especially high concentrations in hospital wastewaters (nearly 200 μg/L), whereas in reverse osmosis concentrate and in urban wastewaters levels much lower (40 and 70 ng/L, respectively). The persistence of ICM through conventional wastewater treatment is well documented. For this reason, this substance was selected as target compound to study its degradation and to assess the potential of white-rot-fungi to degrade PhACs from real effluents.

THPC1 - Wastewater effluent discharges: chemical characterisation and understanding potential risks in receiving waters

THPC1-2
Possible removal of several contaminants from the wastewater by a natural biofiltration process

THPC1-3
A modified clay material as cost-effective sorbent for waste printing developer decontamination

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting 295
The present work was undertaken to investigate the feasibility of cost effective adsorbents: pure fired clay, newly designed fired clay with the polymer addition (5 mass% PEG 600) and bentonite for Zn(II) ion removal from waste printing developer. The adsorption efficiency and distribution coefficient of used adsorbents were determined as a function of adsorbent amount. The results show that newly designed clay adsorbent with polymer addition has great potential (up to 93.5%) to remove Zn(II) ion from waste printing developer.

Acknowledgement: 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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CACYTMAR - University of Cádiz, Puerto real, Spain
In this study UVC-H2O2-assisted TiO2 photocatalytic degradation was applied to remove persistent organic pollutants from industrial wastewater. Experiments were carried out with treated and filtered (0.7 µm) urban wastewater, spiked with AZO Orange II (35mg/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 (dia=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 reduce priority chemicals from wastewater treatment effluents is leading to pressure to utilise or consider advanced tertiary treatment options such as UV radiation, filtration, GAC, and ozonation as part of the wastewater treatment process. The use of these adsorptive or destructive methods may, however, increase, decrease, or leave largely unchanged the concentrations of ligands in effluents that are important for complexing metals and which, consequently, reduce the toxicity potential of some 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 chlex column ion exchange method was used to assess the effects of GAC, ozonation, and UV radiation in combination with H2O2 on the ligands in sewage effluent that are responsible for complexing copper and zinc. Preliminary results indicate that tertiary treatment options tend to increase the concentrations of metal complexing ligands relative to the concentration of dissolved organic carbon present. This effect was also of greater significance for copper than for zinc. The oxidized effluents displayed lower UV absorbances (350nm) in relation to other secondary and tertiary treated effluents, indicating ozonation to have some impact on the concentration of aromatic substances in the effluents, which is consistent with the elimination of humics; however, this did not impact complexation capacity. These findings indicate that advanced tertiary treatments are unlikely to increase the bioavailability of metals in sewage effluents.

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 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 methane 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 manipulation of electron acceptors was developed through the measurement of redox potential (Eh), the reduction of carbonate, nitrate and sulphate, and the removal of carbon and nitrogen.

In this study use of H2O2-assisted TiO2 photocatalytic degradation was applied to remove persistent organic pollutants from industrial wastewater. Experiments were carried out under different redox conditions, and each is associated with a different terminal electron acceptor (nitrate, sulphate, carbonate and methane respectively).

Conditioned 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 were discussed and compared with data obtained from biodegradability experiments performed under unamended 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 in atmospheric air, water and soil, perfluorinated compounds can adsorb to soils and particles, which may impact their bioavailability and impact on ecosystems.

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 sub-micron (A0, B0) fractions. The Hydrogen Peroxide (H2O2) in the process was 60 mg/l. The catalyst (TiO2) was immobilized on the external surface of a cylinder of frosted glass (dia=40mm). The experimental equipment employed in the assays consists in a tubular reactor of borosilicate glass, (600ml) operating in a recirculating circuit, irradiated with a 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 (dia=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.

TU002
Binding and sequestration of perfluorinated surfactants in soil
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Perfluorinated surfactants (PFS) have been produced since the 1950s and 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 (C8), perfluorooctanoic acid (C10) and perfluorooctane sulfonic acid (C12) in different environmental media (soil, surface waters or sewage sludge). We calculated surrogate Koc values based on median concentrations of perfluorinated surfactants in sewage sludge based on a factor of 100 for bioavailable fractions of 10%.

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Epof67 - Perfluoronated compounds: From emission sources to the place of impact

TU003
The present work was undertaken to investigate the feasibility of cost effective adsorbents: pure fired clay, newly designed fired clay with the polymer addition (5 mass% PEG 600) and bentonite for Zn(II) ion removal from waste printing developer. The adsorption efficiency and distribution coefficient of used adsorbents were determined as a function of adsorbent amount. The results show that newly designed clay adsorbent with polymer addition has great potential (up to 93.5%) to remove Zn(II) ion from waste printing developer. 

Acknowledgement: The authors acknowledge the financial support of the Ministry of Science and Technological Development of the Republic of Serbia (Project No. 34014).
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 substances. In fact, PFCs are commonly detected in municipal wastewater treatment plants (WWTPs), so far there are few data for their sorption potential to sludge. The aim of this research was to determine the sorption potential of different PFCs to three different types of sludge (primary sludge, secondary sludge and digested sludge). For this reason, sorption experiments were performed with eight PFCs belonging to two different classes; perfluorocarboxylic acids (PFCAs) that contain a carboxylic group in their molecule, and perfluoralkyl sulfonic acids (PFSAs) that contain a sulfonate group in their molecule. At first, sorption experiments were performed to investigate the equilibrium time for each target compound and the role of sludge inactivation on sorption potential of PFCs. For this reason, samples were taken at different time intervals and PFCs were detected in dissolved and particulate phase. PFCs were extracted by solid-phase extraction (dissolved phase) or sonication (solid phase) and determined using High Performance Liquid Chromatography - Ion Trap Mass Spectrometry (HPLC-ITMS). Afterwards, sorption experiments were performed for six different spiking levels of PFCs, ranging between some mg/L-1 to few μg/L-1 and solid - water distribution coefficient (Kd) values were calculated. Finally, the effect of solution pH on PFC sorption was investigated in experiments performed at pH values commonly found in WWTPs (6, 7 and 8).

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

Acknowledgement

This project was funded under the Operational Program “Education and Lifelong Learning” and funded by the European Union (E.U.) and National Resources - HRAIKLEITOS II."

TU 004

Presence and behaviour of perfluorinated compounds in sewage sludge

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Perfluorinated compounds (PFCs) are a group of emerging environmental pollutants 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), perfluorooctanoic acid (PFOA), perfluorooctane sulfonate (PFOSA), perfluorodecanoic acid (PFDA) and perfluorooctanoic acid diethylamide (PFDAE) in sludge and evaluate their transfer to agricultural soils. PFCs were analyzed 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 for Spanish sludge and from 14.2 to 36.0 ng/g for German Sludge, with differing concentration patterns of the individual compounds. In addition, the presence of PFCs in agricultural soils and sludge amended in agricultural 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 86/278/EEC and Royal Decree 1310/1990, regulating the use of sewage sludge in agriculture), its use in agriculture may lead to diffuse pollution of ground waters 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 Greece

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Perfluorinated compounds (PFCs) have been classified as emerging contaminants and they are commonly detected in municipal wastewater treatment plants (WWTPs). In this study, contamination profiles of eighteen target perfluoro analytes (C5 to C14 carboxylic acids, C4, C6-C8 and C10 sulfonic acids and 3 sulfonamides) were detected in wastewater (influents and secondary effluents) and sludge samples, originating from WWTP of Athens (Greece).

Two seasonal sampling campaigns were performed and samples were taken in seven consecutive days in each sampling campaign. The analytes were extracted by solid-phase extraction (dissolved phase) or sonication (solid phase). Quantitative and qualitative analyses were performed by LC-MS/MS. Recovery values generally ranged between 80% and 115%, while lower recoveries were obtained for longer perfluorocarboxylic acids (PFCAs) and perfluoralkyl 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 for liquid and solid samples, respectively. The seasonal and daily variations of target compounds contamination 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 balance mass was also performed to investigate the fate of PFCs during wastewater treatment plant and to estimate the role of degradation and sorption on their removal. According to the results, perfluorooctanoic acid (PFOA) and perfluoroctane sulfonate (PFOS) were detected in all samples and they were the major contaminants in wastewater and sludge. Perfluorinated compounds (PFCs) were partially removed during wastewater treatment, concentrations of other PFCs in effluents were similar or higher comparing to influent samples. Mean concentrations in influents, effluents and dewatered sludge ranged up to 90.4 ng L-1 (PFOA), 103.5 ng L-1 (PFOS) and 377.9 μg Kg-1 (PFDAE), respectively. In the WWTP studied, the concentration of PFCs was determined in agricultural soils and sludge amended in agricultural 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 86/278/EEC and Royal Decree 1310/1990, regulating the use of sewage sludge in agriculture) its use in agriculture may lead to diffuse pollution of ground waters 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 006

Biodegradation of proposed PFOA & PFOS precursors in aerobic batch assays

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Perfluorinated compounds (PFCs) are a group of emerging environmental pollutants even though no natural sources of PFC have been proposed. Nevertheless they can be detected in the environment throughout the world. Due to their unique water-, 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 of nature. Potential sources of PFCs can be consumer and industrial products as well as manufacturing processes. In some sewage treatment plants worldwide, an increasing mass flow of perfluorocarboxylic 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. The aim of this work was to study the precursors for PFOA and PFOS by studying their aerobic biodegradability. Amongst others perfluorooctanesulfonamide (PFOASA), 8:2 tetrameric acid (8:2 FTCA), 8:2 tetrameric alcohol (8:2 FTCHO) and a technical product containing perfluorooctanoic acid diethylamide (PFOADA) and PFOSA were chosen to study their fate in aerobic batch assays. The test period was 14 days each at a water temperature of 12.7°C. The activated sludge sample was obtained from a municipal sewage treatment plant and the test medium was chosen following 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.

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 PFOSA. In addition PFOASA 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.

4TU 007

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

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A survey of the distribution of perfluorinated carboxylates (from C5 to C10) and perfluorinated sulfonates (C4 and C8) in the main Italian river basins have been carried out in 2011 in order to get a reliable picture of the polyfluoralkyl substances (PFASs) contamination and possibly to identify the main sources for the aquatic environment. Rainwater samples were taken in two different sites in the Po (north of Lombardy, north Italy) and river Arno and river Brenta basin have been carried out in different hydrological conditions. A survey has been performed also in transitional coastal areas such as river Po Delta and Lagoon of Venice. Chemical plant discharges and drinking waters present in the same basins were also sampled.

Analyses of PFAs were achieved by using an on-line SPE-HPLC-MS/MS system. Recovery for PFAs for all analytes was above 70% at μg/L levels. Limits of detection (LOD) ranged from 0.2 to 2.5 ng/L.
The diffusion of these substances in the drinking waters in the same areas has been also studied. Possibility to establish the temporal concentration variations for PFC in peregrine falcons from Baden-Württemberg. For this poster we aim for presenting data in order to form a baseline for the PFC levels in the eggs samples for the years from 2008 to 2011. This will offer the first E.C. (2008). Directive 2008/105/EC of the European Parliament and of the Council of 16 December 2008 on environmental quality standards in the field of water policy.

Samples were collected in Baden-Württemberg from 2008 to 2011. About half of the number of the 20-30 egg samples collected per year were analysed for 11 PFCs (4 sulfonates, 6 carboxylates and the perfluorooctane sulfonamide). The analysis was performed using cold sample extraction and ion exchange-SPE clean-up followed by LC-MS/MS detection at LOQs of about 0.5 ng/g dry weight. The extent of contamination of groundwater by PFAA and the contamination pathways to groundwater bodies remain largely uncertain. As major sources of PFAA to surface waters and ultimately to the drinking water produced from it. However, groundwater is in many countries the major source for drinking water production (in NL 65%). The extent of contamination of groundwater by PFAA and the contamination pathways to groundwater bodies remain largely uncertain. In the work presented, we identified different direct sources of PFAA to groundwater within the catchment area of a public supply well field (PSWF) in the Netherlands. It was found that landfill leachate, and urban/military base affected rainwater contaminated the groundwater within the catchment area of the PWSF. Rainwater not affected by the direct sources also infiltrated in this area and provided a background contamination to the groundwater.

Maximum concentrations encountered in the landfill leachate plume were 1758 ng/L perfluorooctanoic acid (PFOA) and 1165 ng/L perfluorobutanoic acid (PFBA). Maximum concentrations measured in the groundwater halfway the contaminant sources and the PWSF (15 years travel distance) were 29 and 161 ng/L for PFOA and PFBA respectively. Concentrations in the groundwater wells at a travel distance of 25 years were much lower: 0.96 and 3.5 ng/L for PFOA and PFBA respectively. The chemical signature of the groundwater showed that infiltrated rainwater, the landfill leachate and the infiltrated urban/military rainwater contaminated the abstracted water. Based on the hydrological modeling it was shown that 1% of the treated groundwater was originating from the landfill and military area and 99% from background contamination. This is seen in the relative abundance profile of the PFAA in the pumped groundwater.

TU 010 Occurrence of 14 perfluorinated compounds and other priority and emerging organic compounds in fishes from the Rhone River (France)

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

The main goal of this study was to obtain data on the occurrence and levels of 34 priority and emerging organic compounds in freshwater fish sampled in the Rhone River. The analyses included 14 perfluorinated compounds (PFC), also 5 alkylphenols (AP), bisphenol A (BPA), 3 hexabromocyclododecane (HBCD), 9 polybromodiphenylethers (PBDE) and 2 compounds, hexachlorobenzene (HCB) and hexachlorobutadiene (HCDB) for which Environmental Quality Standard (EQS) have been set for the 10 and 0.5 µg/g fresh weight (fw respectively) [E.C., 2008].

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

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

References
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TU 011 Perfluorinated compounds (PFCs) in peregrine falcon eggs from southwestern Germany - levels, patterns and temporal concentration variations

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As major sources for peregrine falcons (Falco peregrinus) is capable of accumulating a wide range of persistent pollutants and therefore a valuable object for observation and chemical analysis. The species attracted not only scientific but also public interest, at the latest since it was at the brink of extinction in Germany and elsewhere through excessive burdens of organochlorine pesticides such as DDT. A network of volunteers in the German state of Baden-Württemberg offered the possibility to collect unfledged peregrine falcons (Falco peregrinus) for monitoring purposes in the past years. Perfluorinated compounds (PFCs), especially PFOA raised scientific and public concern as their POP-like properties became apparent. Therefore, the analysis of PFCs in peregrine falcons’ eggs was integrated into the existing monitoring programme.

Samples were collected in Baden-Württemberg from 2008 to 2011. About half of the number of the 20-30 egg samples collected per year were analysed for 11 PFCs (4 sulfonates, 6 carboxylates and the perfluorooctane sulfonamide). The analysis was performed using cold sample extraction and ion exchange-SPE clean-up followed by LC-MS/MS detection at LOQs of about 0.5 µg/g dry weight. For this reason we aim for presenting data in order to form a baseline for the PFC levels in the eggs samples for the years from 2008 to 2011. This will offer the first possibility to establish the temporal concentration variations for PFC in peregrine falcons from Baden-Württemberg.

For 2009 and 2010, the substance spectrum was clearly dominated by PFOA at average concentrations of about 150-260 ng/g dry weight. Longer chain carboxylates were observed at about 1-10 ng/g dry weight. The occurrence of PFOA in peregrine falcon eggs is a problem for monitoring purposes. In the past years, perfluorinated compounds (PFCs), especially PFOA raised scientific and public concern as their POP-like properties became apparent. Therefore, the analysis of PFCs in peregrine falcons’ eggs was integrated into the existing monitoring programme.

PFCs are known to be associated with feathers of white tailed eagles (Haliaeetus albicilla) from Greenland and Norway; useful for non-destructive monitoring? D. Herzeck1, V.L.B. Jasper2, C. Sonne3, A. Covaci4, J.O. B outcome1

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Acute toxicity of perfluorinated compounds to two kinds of cladocerans

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Perfluorinated compounds (PFCs) are stable compounds with a lot of industrial application, but also very persistent on the biota and the environment. Among them, perfluorooctanoate (PFOA) 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, PFOA 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, PFOC can be a risk for adult population and infant. In order to assess the tissue concentration, PFOB (perfluorobutanoate) and PFOA (perfluorooctanoate) were assessed by comparing theoretical values with experimental data of PFCs's chemicals in blood serum and breast milk collected in Catalonia, Spain. Finally, uncertainty and sensibility analyses have been performed. A normalized local sensitivity analysis was performed on the model to examine the influence of each model parameter on the model output. Sensitivity coefficients were calculated for the predicted plasma area under the curve (AUC; total concentration) with the original parameters and for those resulting from a low change in each parameter value.
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 these two cladocerans decreased with increasing concentrations of compounds with the same chain length. The NOEC was determined as 0.5 mg/L for C4, 1 mg/L for C6, and 10 mg/L for C8. No adverse effects were observed at any concentration tested for C10.

The results indicated that low concentrations of these chemicals can cause malformations in the skeletal system. It was observed that high concentrations (10 mg/L) caused significant changes in the developmental stages of the organisms, affecting bone growth and development. The toxic effects on the skeletal system were more pronounced in the early developmental stages.

Perfluorooctanoic acid (PFOA) is a common surfactant with wide use due to its unique nature, and has been detected as a contaminant in soil, water, and biota. Previous studies have shown that PFOA has detrimental effects on different life stages in zebras (Danio rerio). We have evaluated the effects of PFOA toxicity covering different life stages of zebrafish through three tests that were based on OECD guidelines. In the Fish Embryo toxicity test, the effects of PFOA on the embryonic development of zebrafish were evaluated. In the Fish Development Toxicity test, the effects of PFOA on the growth and development of zebrafish were evaluated. In the Fish Endpoints test, the effects of PFOA on the physiological and behavioral responses of zebrafish were evaluated. The results indicated that low concentrations of PFOA (1 mg/L) caused malformations in the skeletal system, while high concentrations (10 mg/L) caused significant changes in the developmental stages of the organisms, affecting bone growth and development. The toxic effects on the skeletal system were more pronounced in the early developmental stages.

The obtained results are in agreement with the literature, however PFOS has been found in lower concentrations than previous studies. This study can provide valuable toxicological information on these chemicals which is still incomplete and insufficient to assess their environmental impact and structure-activity relationship.
Impact of litter on marine life

Micro-plastics in the marine environment - a global assessment

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GEASMP has set up a new Working Group entitled ‘Sources, fate and effects of micro-plastics in the environment - a global perspective’. With multi-agency support and with a multi-disciplinary membership, it is reviewing a wide range of information about the supply of plastics and microplastics to the ocean, and the biological, chemical and physical processes that account for fate and effects of both microplastic particles and micro-contaminants. It 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

Marine micro litter under the marine strategy framework directive - science and policy

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- Trends in the amount of litter washed ashore and deposited on coastlines, including analysis of composition, spatial distribution and, where possible, source (10.1.1)
- Trends in the amount of litter ingested by marine animals (e.g. stomach analysis) (10.2.1).

A technical working group under 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 marine micro-litter under the MSFD.

Continuous Plankton Recorder (CPR) samples reported by analysts at the Sir Alistair Hardy Foundation for Ocean Science (SAHFOS), Plymouth, United Kingdom

Fragmentation of plastics degrading 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 spatiotemporal abundance of microplastic debris in ocean surface waters and our preliminary investigation of microplastic contamination in Continuous Plankton Recorder (CPR) samples reported by analysts at the Sir Alistair Hardy Foundation for Ocean Science (SAHFOS) has confirmed the presence of synthetic polymers in several European locations (North Sea, Irish Sea, English Channel and the North Atlantic). We used Fourier Transform Infrared (FTIR) spectrometry to identify the proven species. 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.

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 highly diverse diffuse sources and high capacity of distribution. In addition to other sources, microplastic (< 5mm) have been found in frequent use skin cleansers and others personal care products. As a result, this specific class of plastic has been found contaminating sediments and pelagic zones. Despite the effects related to direct ingestion, microplastic may also transfer adsorbed organic contaminants (OCs) to aquatic organisms. Moreover, due to its hydrophobic nature, plastic debris can be a hazard to marine animal species because of the bioaccumulation potential of these persistent additives, we compared plastic-water partitioning, a simplification of the partitioning of plastic additives in the gastric fluid, with chemicals in marine plastics. Based on the analysis of resin pellets from remote islands, 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 evidenced. In addition to other sources, microplastics are a potential hazard for marine animal species in several ways. It is not only the plastics themselves that form a potential hazard. Chemicals and microorganisms adsorbed during plastics production in order to catalyze monomers into polymers and give it different properties. Some of these additives have been associated with carcinogenic and endocrine disrupting effects. Moreover, due to its hydrophobic nature, plastic debris can be a hazard to marine animal species because of accumulation of organic contaminants. An important hazard are the persistent organic pollutants (POPs), which do not completely dissolve in water and do not degrade into less hazardous compounds. As a short time frame, based on a wide range of health impacts on both wildlife and humans. This study focuses on the equilibrium partitioning of polychlorinated biphenyls after ingestion by marine animals. In order to get more insight in the bioaccumulation potential of these persistent pollutants, we compared plastic-water partitioning, a simplification of the partitioning of plastic additives in the gastric fluid, with ocean-water partitioning. The outcome will be discussed within the framework of the current knowledge gap and we will describe challenges for future research on this topic.
TU 029
Potential for increased exposure to persistent organic pollutants through ingestion of marine debris: the relevance of partitioning coefficients
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An important step in predicting the availability of plastic-soiled persistent organic pollutants (POPs) to the marine environment is understanding the plastic:water partitioning coefficient (Kpw) for a great number of chemical and plastic combinations. While plastics have the capacity to absorb chemical substances from their surrounding environment, little is known about the factors affecting sorption and desorption of POPs to plastic debris, the abundance and bioavailability of POPs on plastic debris, and the amount of plastics marine organisms consume. One step in understanding the potential for exposure is an evaluation of relevant partition coefficients.
An extensive literature search was performed for this presentation. This review summarizes articles that calculated and presented plastic to water partitioning coefficients. Only published, peer reviewed literature was examined. The results of our review identified Kpws for 22 specific types of polymers and 198 individual compounds representing 24 different chemical groups. Analyses of this data showed a wide range of values (e.g., 0.91 to 7.8 log Kpw) among compounds for any given polymer. Of note, our review identified a relationship between log Kpw and log Kow (octanol-water partition coefficients) for a number of compounds. Consequently, log Kow may act as a surrogate for estimating log Kpw, which could allow for assessment of availability based on known properties of chemicals and plastics. This finding is of particular importance because of the lack of log Kpw data for a wide array of plastics. A logical next step is to use log Kow to generate log Kpws through models that predict the Kow of polystyrene plastics in order for these plastics to adsorb 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.

TU 030
Determination of DEHP in culture media by GC-MS/MS using PCI Ammonia
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This method is a elucidation of the target phthalate, bis (2-ethylhexyl) phthalate (DEHP), in culture media by gas chromatography and tandem mass spectrometry (GC-MS/MS) using positive chemical ionization (PCI) with ammonium reactant gas. Phthalates are routinely analyzed in electron ionization (EI) with 149 m/z as the principal ion. Since all phthalates have similar spectra, it is difficult to identify which phthalate is present. By using PCI, the molecular ion is formed. Culture media samples with varying concentrations of DEHP were analyzed on a GC-MS system consisting of an ion-trap series mass spectrometer and a gas chromatograph. Structural elucidation was achieved by performing PCI-MS/MS on the molecular ion. Next, the fragments formed were compared to those in Mass Frontier software, which predicts fragmentation and the mechanisms of product ion formation by comparing the scan results to existing library data. Ammonia was selected as the chemical ionization reagent gas to increase the yield of the molecular ion.
A calibration curve with points at 0.1, 1, 5, and 10 µM were analyzed in culture media. The correlation coefficient for this calibration curve was 0.9969. Two unknown samples were analyzed and quantitated against the calibration curve. These were found to contain 4.2 µM and 3.1 µM DEHP.

TU 031
Selective uptake of microplastics by a marine bivalve (Mytilus edulis)
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Microplastics are the degenerate 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 experiment was set up in 2018 in the Laboratory of Aquaculture (Ghent University, Belgium) and was ongoing until 2020. We exposed M. edulis to particles of three different sizes, 10, 30, and 90 µm. After 14 days we performed a thorough analysis of these microplastics by scanning electron microscopy, energy-dispersive X-ray spectrometry, and total organic carbon analysis. The results showed that M. edulis ingested and filtered all particles in the same ratio as they were added to the seawater (i.e. 1:1). However, only 10 µm-particles were detected in the faeces, while the 30 and 90 µm-particles were completely filtered. This indicates that the uptake is size-selective and is impaired by an energy allocation of the organism to excrete the particles. These findings provide new insights into the impact of microplastics on marine organisms and emphasize the need for further research into the adverse effects of microplastics on marine organisms.

TU 032
Presence of plastic debris in sea turtles stranded along the Tuscany coasts
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Marine debris have a widespread negative impact on marine wildlife, including physiology-level effects and reduced fitness, reproductive failure, changes in community structure to direct death following blockage of intestinal tract or entanglement.
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. Marine debris is an important threat for sea turtles and the evaluation of the impact of plastics on development, survivorship, health and reproduction of sea turtles is highlighted as one of the global research priorities for these threatened species.
Dermochelys coriacea
The loggerhead turtle (Caretta caretta) and leatherback turtle (Dermochelys coriacea) are considered two of the sea turtles species ingesting the largest amount of debris, in all their life stages, most likely because of their habitat and feeding behaviour. In this study we tested the hypothesis that the leatherback turtle can 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 experiment was set up in 2018 in the Laboratory of Aquaculture (Ghent University, Belgium) and was ongoing until 2020. We exposed M. edulis to particles of three different sizes, 10, 30, and 90 µm. After 14 days we performed a thorough analysis of these microplastics by scanning electron microscopy, energy-dispersive X-ray spectrometry, and total organic carbon analysis. The results showed that M. edulis ingested and filtered all particles in the same ratio as they were added to the seawater (i.e. 1:1). However, only 10 µm-particles were detected in the faeces, while the 30 and 90 µm-particles were completely filtered. This indicates that the uptake is size-selective and is impaired by an energy allocation of the organism to excrete the particles. These findings provide new insights into the impact of microplastics on marine organisms and emphasize the need for further research into the adverse effects of microplastics on marine organisms.

TU 033
Occurrence of Triclosan in fresh waters from São Paulo State, Brazil - the need for regulatory actions
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Triclosan, 5-chloro-2-(2,4-dichlorophenoxy)phenol, is a broad-spectrum bactericide used in pharmaceuticals and personal care products of daily use. It is a non-volatile compound that is not readily degraded in the environment. Triclosan has been detected in over 300 aquatic systems, including freshwater, coastal waters, groundwaters, sewage effluents, and surface waters. The most widespread application is in soaps and hand sanitizers. Triclosan is a persistent contaminant in sewage sludges and sediments and is often detected in human tissues and organs.
In this study, we aimed to investigate the occurrence of triclosan in fresh waters from São Paulo State, Brazil. For this purpose, we collected 240 samples of surface water from various locations in the State of São Paulo, Brazil. The samples were collected during the dry and wet seasons. If we compare the results with the lowest PNEC found in the literature the 43% of the samples where triclosan was found the concentrations were above the 0.7 ng/L value.

EP080 - What is the current state of the science on the fate, exposure and effects of pharmaceuticals in the environment?
TU 034
First pilot study on the occurrence of UV screens and preservatives in a Victorian estuary
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The presence of UV screens and preservatives in aquatic environments has received increasing attention due to their potential to impact aquatic ecosystems. Our study aimed to investigate the occurrence of these substances in a Victorian estuary, using a combination of high-resolution liquid chromatography and tandem mass spectrometry. The results showed that UV screens and preservatives were widely distributed in the estuary, with concentrations ranging from below the limit of detection to several hundred ng/L. These findings highlight the need for further research into the environmental fate, exposure, and effects of these substances in aquatic ecosystems.
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 plastics products. UV filters and preservatives are known to be hormonally active in vitro and in vivo, raising concerns of possible endocrine disrupting effects in the environment. There is little published data of occurrence of those compounds in Australian aquatic environments. This study is the first investigation of UV protective chemicals in environmental water in Victoria, specifically in one of Melbourne's estuaries. Water samples were taken from four sites (A-D). Screened compounds included 11 UV filters and 26 UV stabilizers, 12 preservatives and the metabolite, and one fragrance, including commonly used compounds in Australia such as 4-MBC, EBMC, 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, affecting the efficacy of the screening of the screened compounds. Sites A, B, and C had similar compound profiles. Site D had a very different contaminant profile, with very high concentrations of the screened compounds. Sites A, B, and C are both at the mouth of creeks and rivers flowing into Port Phillip Bay; Site D is about 5 km upstream of site C in Melbourne on the second biggest river entering Port Phillip Bay. Although there are several small wastewater treatment locations located upstream of Site D, the levels of HHCB of Site D are similar to the levels observed at Sites A, B, and C. It is not uncommon that the chemicals observed at site D do not originate from a wastewater treatment plant but a different source. The detection of common UV filters, such as 4-MBC, EBMC, OC and the common preservatives 2-PE, MP and PB in a Victorian estuary proves that the presence of personal care products in the environment is not just an issue for more densely populated countries in the Northern Hemisphere, but also potentially of concern in Australia.

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 wastewater, surface and ground water. Composite samples were collected, filtered, enriched with internal standards and solid-phase extracted. LC-ESI-MS/MS with multiple-reaction monitoring and stable-isotope dilution assay was used for quantification. Recoveries were generally higher than 80% and limits of quantification were in the low ng/L range. Ciprofloxacin, ofloxacin, atenolol, furosemide, hydrochlorothiazide, claritromycin, 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, furosemide and carbamazepine. Removal rates were also affected by the type of advanced treatments adopted (i.e. disinfection, UV treatment) in the plants investigated. The amount of pharmaceutical active substances discharged in the environment daily through treated wastewater ranged between 1.2 and 2 kg. The total amounts of the investigated pharmaceuticals in the rivers flowing through the area investigated ranged between 0.9 and 2.7 kg/day respectively before and after the city of Milan. Traces of pharmaceuticals were also found in the low ng/L range in surface and ground water. Moreover, the pattern of contamination of ground water was higher in sites closer to rivers, suggesting the contribution of surface water to the contamination. This investigation allows the quantification of the mass flow of these substances flowing through a highly urbanized and industrialized area.

TU 036

An evaluation of free water surface wetlands as tertiary sewage water treatment of micro-pollutants
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Increased attention is currently directed towards potential negative impacts of pharmaceuticals and other micro-pollutants discharged into the aquatic environment via municipal wastewater treatment plants. The number of additional and emerging pharmaceuticals has therefore been substantially increased as promising tools for improving the removal efficiency of pharmaceuticals in existing Sewage Treatment Plants (STPs). Constructed wetlands are also capable of removing a variety of micro-pollutants, including some pharmaceuticals, and could hence be a resource efficient complement to more advanced treatment technologies. The purpose of the present study was therefore to increase the understanding of the potential use of constructed wetlands as a treatment step to reduce emissions of organic micro-pollutants from municipal sewage effluents. Under cold winter conditions, incoming and outgoing waters from four Swedish free water surface wetlands, operated as final treatment steps of sewage effluent from municipal STPs, were sampled and analyzed for levels of a set of 92 pharmaceuticals and 22 inorganic components as well as assessed using subchronic ecotoxicity tests with a marmoset as a crustacean. Sixty-five pharmaceuticals were detected in the range 1 ng L\(^{-1}\) to 7.6 pg L\(^{-1}\) in incoming and outgoing waters from the four investigated wetlands. Although the sampling design used in the present study lacks the robustness of volume proportional 24 h composite samples, the average estimated removal rates ranged from 42 to 52%, which corresponds to lower values. The range of measured mass flow concentrations in the range of 11.25 to 90%) could not be ascribed 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 complementary sewage treatment options, especially where other treatment is lacking today. To fully remove micro-pollutants from sewage effluent however, other more 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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Ecosystems are potentially contaminated by many chemical substances from domestic activities, through the spreading of treated sewage sludge. Indeed during the last thirty years, the application of municipal sludge from urban to agricultural soils is the option favoured internationally for sludge management as it contributes positively to recycling nutrients, soil properties and 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 analytical challenge given the diversity of astrophysical sciences, Copernican laws, and the complexity of the matrix which makes difficult the extraction step. Thus it appears that the development of environmental 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 coupled with high mass spectrometry. The analysis of complex matrices such as sludge needed a rigorous sample preparation to obtain a repeatable and enough sensitive analysis to achieve the detection limits required. For this purpose, an extraction step using the QuEChERS (Quick, Easy, Cheap, Effective, Rugged and Safe) method was set up. This analytical methodology was successfully applied to various kinds of sludge (limed, digested, dried, liquid, composted) collected in several sewage works in France.

TU 038

Adaptation of human pharmaceuticals to activated sludge: how many different sludges should be tested for an environmental risk assessment?
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The term ‘adaptation’ in environmental science is an phenomenon that has to be determined, e.g. according to the EMEA Guideline EMEA/CHMP/EMEA/4474/00. This guideline focuses on the risk by the use of the pharmaceutical and the entry into the environment via excretion and wastewater effluent to a sewage treatment plant (STP). It is assumed that a substance with high sorption to activated sludge may reach terrestrial ecosystems by land spreading of sewage sludge. The adsorption to sludge has therefore to be tested according to the EMEA Guideline in a 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\(^{00}\) Lkg\(^{-1}\) or Kd of 3\(^{70}\) Lkg\(^{-1}\)) and the drug is not readily biodegradable. The sorption of chemicals to soils or sediments typically depends on several parameters of the sorbent (e.g. pH, ion-exchange capacity, redox potential, organic carbon content, texture). The question arises how different activated sludges are regarding these parameters, how large the adsorption to sludges varies, 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/4474/00. In this presentation the results of batch equilibrium sorption tests with different sludges will be shown for several pharmaceuticals. The variability of the adsorption coefficients, obtained for different sludges by the same analytical method and within the same laboratory will be discussed in the context of the trigger values used in the environmental risk assessment.

TU 039

Analysis of antimarial drugs in water
M. Escola Casas, M. Hansen, E. Bjorklund, K.A. Krogh
Facility of Environment, Copenhagen, Denmark

Malaria is a general illness in many countries and therefore antimarial drugs are prescribed in great quantities. There are more than 20 different molecules being used for malaria treatment in the world. SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
This method has already been extended to various matrices like rats’ serum and gonads [1] in our laboratory. We developed and validated a multiresidue analytical method for 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 determine environmental fate profiles of antimalarial drugs in the environment.

TU 040

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

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

CRP Henri Tudor, Esch-sur-Alzette, Luxembourg

The methodological efficiency of pollutants such as pharmaceuticals 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 conservative and reactive tracers injected (“push”) into an aquifer, and after a certain time the groundwater is extracted (“pull”) to compare can be used to estimate in-situ transformation rates. The aim of our study is to downscale this approach so that it can be applicable to standard WWTPs. This can be accomplished by using more conservative tracers, as their recovery in the outlet is higher than for reactive tracers. The hypothesis is tested by combining tracer recovery with a Kinetex XB-C18 column (100x2.1mm, 1.7µm).

TU 041

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

M.M. Hidalgo, E.P. Sagristà, L. Rossi

University of Girona, Girona, Spain

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 wastewater strength and loading rate. 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 µg kg⁻¹ in WWTPs. The effects of antibiotics on the aquatic environment and the extent of removal during wastewater and sludge treatment. Moreover, the sludge accumulated WWTPs may be often processed to produce biosolids intended for land application. Thus, the agricultural recycling of biosolids, the favored option for sludge management, may lead to adverse environmental impact. In this study, TCS, TCC and MTCs 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 biosolids was also investigated.

TU 042

Dominant time scale of antibiotics concentrations in riverine waters through a year-long field campaign study

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EPFL, Lausanne, Switzerland

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 (azithromycin, ciprofloxacin, ofloxacin, clarithromycin, clindamycin, metronidazol, norfloxacin, sulfamethoxazol, trimetoprim) were 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 QuEChERS based extraction

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Accessing exposure concentrations can be challenging for the analyst as environmental concentrations and toxicological/eco-toxicological effect induced quantities are often at very different time scales. Low-cost determination and purification steps like Accelerated Solvent Extraction (ASE) and Solid Phase Extraction (SPE) to extract and analyse pharmaceuticals or hormones at the lower or sub ng/l level from solid matrices. A recent extraction method known as Quick Easy Cheap Effective Rugged and Safe has been developed for the analysis of pesticides in food matrices. This method proved to be very effective for the extraction of pharmaceuticals from sediments. We developed and validated a multisolute analytical method with QuEChERS 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 water [2], in the Water Framework Directive and within the potential or confirmed EDGs. This selection of 13 pharmaceuticals includes β-blockers, anti-inflammatory drugs, antibiotics, anxiolitics, antidepressants and anti-angolics 24 EDGs includes pesticides, alkylphenols, hormones and phenolic derivate and, Quantification 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).

Extraction with a modified QuEChERS protocol (>90%) and the linearity of the method has been verified by statistical methods. Acceptable Relative Standard Deviations of both injection and preparation steps (<20 to 30%) were calculated for intra day and interday injections of 3 independent solutions. Repetition of a calibration over three days allowed to verify the measurement stability of the method and of the analytes. Limits of quantification were determined by injection of 3 independent standard solutions and were consistent with environmental uses.

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 difficult due to limitation of time and space. 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 established methods of testing the transformation capacity of aquifers with respect to organic or inorganic contaminants. There, a column set out a containment of the tracer ("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 downscale this approach so that it can
be used on the spatial scale of centimetres to decimetres. The experimental concept is valid in a small flume that allows the simulation of different hydraulic conditions in the hyporheic zone. Under abiotic conditions, this approach successfully measured retention of several pharmaceuticals at residence times of up to 16 hours; longer residence times will be evaluated. Currently, we are testing the approach under biotic conditions with the same set of pharmaceuticals and, in addition, with some reference compounds. Our contribution will summarize the approach and present the results. The experimental concept is validated in a small flume that allows the simulation of different hydraulic conditions in the hyporheic zone. Under abiotic conditions, we applied the approach of estimating aquatic bioconcentration factors using the reduced sampling method. This reduced sampling approach aims 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 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).

**TU 046**

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

F. Ericson

Pfizer Inc, Groton, United States of America

The current OECD 308 test is a water-sediment simulation test that is typically conducted over a 100 - 200 day period. It is intended to estimate the parent half life in the water phase, sediment phase and collectively in the total water-sediment system; determine the distribution and mass balance of the residues in the test system; and as close as possible to the transformation products over the study period. Given the length and cost of the exposure and costs associated with conducting the test, it is often desired that a more rapid screen for assessing the potential transformation of pharmaceuticals would be available. Such information would be helpful in developing the ERA testing strategy especially when the identification of a key transformation product would be helpful early on in the risk assessment. A comparison of fish bioconcentration factors for several pharmaceutical compounds obtained following the standard OECD 305 Protocol and the estimated BCFs obtained using the reduced sampling method.

**TU 047**

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

L.A. Constantine

Pfizer Inc, Groton, United States of America

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

**TU 048**

**Waterborne beclomethasone dipropionate affects fish while beclomethasone is not taken up**

M. Carney Almroth1, J. Fick2, E. Cuklys3, L. Forlin4, D.G. Larsson1

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2Umé University, Umeå, Sweden

Glucocorticoids are steroid hormones, playing important roles in several aspects of vertebrate physiology. The synthetic corticosteroid beclomethasone has anti-inflammatory activity, as well as being used in the treatment of asthma. It is administered as the more lipophilic prodrug beclomethasone dipropionate (BDP) which is metabolized to the monopropionate (BMP) and free beclomethasone in humans. A recent publication demonstrated effects of waterborne BDP (1 μg/L nominal concentration) on plasma glucose levels in fish. Although levels of beclomethasone and its lipid esters in effluents or surface waters are not known, it can be assumed that most of the consumed products BDP is utilized into the less hydrophilic 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 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, BDP and BMP in sewage effluents and surface water.

**TU 049**

**The degradation of antidepressant pharmaceuticals in aerobic sludge**

M. Schultz, J. Murphy, A. Stencel, S. Strand, J. Snider

The College of Wooster, Wooster, United States of America

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

**TU 050**

**Time trend of cyclic volatile methyl siloxanes in Baltic herring**

A. Kierkegaard1, A. Bignert1

1Mälardalen University, Västervik, Sweden

2Stockholm University, Stockholm, Sweden

3Swedish Museum of Natural History, Stockholm, Sweden

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 (Harujärvi) were analysed. Skins less dorsal muscle samples from six individuals were pooled. Two pooled samples were analysed for each site for every second year from the period 1989 - 2009. Octamethylcyclotetrasiloxanes (D4), decamethylcyclopentasiloxane (D5) and dodecamethylcyclohexasiloxane (D6) were analysed. The D5 concentrations were of the 50 ng/g lipid weight, while the concentrations of D4 and D6 were lower and frequently below the detection limit. The concentrations were generally lower at the beginning of the period and highest around 2005-2007. There were no marked differences in concentrations in the time combination between the two locations.

**TU 051**

**Degradation studies of the ionophores lasalocid, monensin, narasin, and salinomycin**


1University of Gothenburg, Goteborg, Sweden

2Umé University, Umeå, Sweden

3Glucocorticoids 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 the treatment of asthma. It is administered as the more lipophilic prodrug beclomethasone dipropionate (BDP) which is metabolized to the monopropionate (BMP) and free beclomethasone in humans. A recent publication demonstrated effects of waterborne BDP (1 μg/L nominal concentration) on plasma glucose levels in fish. Although levels of beclomethasone and its lipid esters in effluents or surface waters are not known, it can be assumed that most of the consumed products BDP is utilized into the less hydrophilic 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 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, BDP and BMP in sewage effluents and surface water.

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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 involved in sorption processes are: hydrolysis and photolysis. These processes were conducted following international OECD guidelines. Hydrolysis was observed under acidic conditions for narasin, monensin and salinomycin, while photolysis was observed at all conditions and wavelengths, so that photodegradation of monensin, narasin and salinomycin can be discarded. Biotic degradation studies were conducted in lab-scale bioreactors inoculated with Nycodenz extracted soil bacterial communities. In addition, during the work with these very lipophilic antimicrobial agents, it was observed that adsorption to analytical equipment was highly relevant to assess under acidic conditions.

Pharmacodynamic and pharmacokinetic properties of pharmaceuticals are used to predict the bioavailability of a given compound and thus its rate of biotransformation, is important. whence the need to study the influence of environmental factors on the fate of these compounds. The evaluation of sorption studies is a prerequisite for the uptake of organic pollutants by organisms. The behavior in the coastal zone was qualitatively described. Hoffman et al. (2005) conducted a study of the environmental fate of ionophores and to identify new and ecotoxicological relevant transformation products.

Formation and structure elucidation of stable transformation products of pharmaceuticals in the water cycle. The aim of this study is to describe the environmental fate of ionophores and to identify new and ecotoxicological relevant transformation products. The formation and presence of such stable transformation products in the effluent of sewage works, such 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. oxygen, 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 technologies may even lead to the formation of transformation products that are more toxic than the parent compound.

The past few years, comprehensive information on the degree of contamination of our environment with pharmaceuticals has been collected, but there are still some important knowledge gaps regarding the human and environmental impact of two groups of pharmaceuticals, which will be addressed in the 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, concerns is raised regarding their occurrence and the potential role of these compounds in spreading resistance against these valuable pharmaceuticals.

For a selection of pharmaceuticals of both classes, the formation of stable transformation products in various stages of the water cycle (both drinking and sewage) will be investigated in laboratory and pilot scale studies. Treatment processes include mainly chlorination, ozonation and UV disinfection for drinking water treatment and advanced oxidation processes. The study was conducted by exposing bacteria to the mixture of ionophore degradates. The diffusion in the coastal zone was estimated with an hydrodynamic numeric model (MARS 3D). The behavior in the coastal zone was qualitatively described. The formation and presence of such stable transformation products in the effluent of sewage works, such 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. oxygen, 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 technologies may even lead to the formation of transformation products that are more toxic than the parent compound.

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of photodegradation of two antibiotics often found in the environment: a veterinary drug, tylosin (916 g/mole, pKa = 7.1) and a human drug sulfamethoxazole (253 g/mole, pKa = 5.7). Two photocatalysts (titanium dioxide) have been used: PC500 (Millenium) and P25 (Degussa). Two modes of immobilization have been tested: on a glass plate and in buffered ground water containing toltrazuril. Furthermore, the developed methods have been applied to determine concentrations of SMX, acetyl-SMX and SMX-glucuronide in natural water samples (River Fuhse) using a Xe-light source with a 290 nm optical filter.

TU 064
European environmental risk assessment for Trimethoprim in surface waters
Jo. O. Straub
EHoffmann-La Roche Ltd, Basle, Switzerland

An assessment for the aquatic compartment was developed for the old antibiotic Trimethoprim (CAS 738-70-5). The exposure assessment is based on documented human use figures in western Europe from IMS data and average removal in wastewater treatment; this predicted environmental concentration (PEC) was compared with measured environmental concentrations (MECs) from Europe. On the effects side, acute and chronic ecotoxicity data from the literature were complemented by additional, new chronic tests for fish. Based on 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.

TU 065
Comprehensive evaluation of the impact of Triclosan in the terrestrial environment
D.J. Fort, S. Pawlowski, S. Champ

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Both direct and indirect photo degradation processes have been reported to be important removal mechanisms of sulfamethoxazole (SMX) in the environment. However, most of SMX is excreted unchanged in animal manure, yet their environmental fate is not known. In this study, we assessed the direct and indirect photodegradation kinetics and concentrations lower than that of the parent compound.

TU 057
Direct and indirect photolysis of human metabolites of antibiotic sulfamethoxazole
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Direct and indirect photodegradation processes have been reported to be important removal mechanisms of sulfamethoxazole (SMX) in the environment. However, most of SMX is excreted unchanged in animal manure, yet their environmental fate is not known. In this study, we assessed the direct and indirect photodegradation kinetics and concentrations lower than that of the parent compound.
A comprehensive evaluation of the effects of the antimicrobial personal care product triclosan (TCS) in the terrestrial environment was performed. This evaluation included the effects of TCS soil mobility and potential respiratory and non-respiratory impact on terrestrial arthropods and forest cover, and effects on emerging and growth terrestrial plant species. Microbial respiration and nitrification were evaluated in soil treated with 0.1-2.0 mg/Kg TCS for 28 days. The acute and chronic toxicity of TCS to worms was tested in an artificial soil in accordance with OECD guidelines 207 and 222. Test concentrations for acute and chronic toxicity studies were selected from 64-1026 mg/kg of TCS for each species in the studies, respectively. The effects of TCS on the predatory mite Hypoaspis aculeifer exposed to 0.3-320 mg/Kg (dw) TCS for 14 days were evaluated in accordance with OECD guideline 226. Phytoxicity studies evaluating survival, emergence, shoot biomass and length, and nornormalcy of development in 10 species of terrestrial plants were performed in accordance with OECD guideline 208 using 0.2-1,000 mg/Kg (dw) TCS for 14 days. Test concentrations for acute and chronic toxicity studies were selected from the median effective concentration (EC50) and Lowest Observed Effects Concentrations (LOEC) for soil respiration and soil nitrification were 2 and 2-2 mg/Kg (dw), respectively. NOEC and LOEC values for acute and chronic toxicity to earthworms were 1,026 and +1,026 mg/Kg (dw) [survival], and 100 and +100 mg/Kg (dw) [survival and reproduction], respectively. NOEC and Lowest Observed Effects Concentrations (LOEC) values for plant survival and reproduction were: 10 and 32 mg/kg (dw), respectively.

This poster presentation describes a risk assessment for pharmaceuticals associated with emission potential routes to the terrestrial environment: application of biosolids to agricultural land, application of sewage sludge to agricultural land, and the use of raw and treated wastewaters for the irrigation of crops. The risk assessment was performed using the software package AOPWIN v3.01, to estimate the potential for transformation of the APIs in the environment.

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

The aims of the present study are therefore to describe where the APIs in pharmaceutical products, sold in Sweden, are produced and to what extent the price of inter-batch of 147 APIs correlate to the country of origin of the API. We will also investigate if price correlates to corruption and environmental performance indexes in the manufacturing country. Such surrogate measures are used as conclusive information on pollution level is lacking for most APIs.
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 074

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

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Synthetic progestins, developed to target specific molecules involved in a particular metabolic or signaling pathway in humans to obtain desirable effects at low doses. Although not all of these drugs are present within the diversity of biological life found in nature, some are evolutionary well-preserved. It has therefore been hypothesized that non-organism with highly conserved human drug-targets may be at a greater risk to be affected by pharmaceutical residues in the environment.

In this study, the hypothesis that the reproduction with well-preserved drug-targets in the cladoceran Daphnia magna have greater effects on gene expression and RNA content. Three different pharmaceuticals were tested: the anti-fungal drug miconazole, the anti-histamine promethazine (both with highly conserved drug targets in D. magna), and the progestogen levonorgestrel (with a low drug-target homology). For each pharmaceutical, juvenile daphnids were exposed to sublethal concentrations and raised to adulthood. Three effects were assayed at the level of 1) gene expression (vitellogenin and cuticle protein mRNA using β-actin as a housekeeping gene), 2) relationship between total RNA and DNA (as a proxy for protein synthesis rate), and 3) body size. The exposure to miconazole resulted in a two- and three-fold decreased gene expression of vitellogenin and cuticle protein genes, respectively, as well as a significant increase in RNA content in relation to DNA. The down-regulated expressions of vitellogenin and cuticle protein genes are indicative of endocrine RNA can be a result of enhanced protein synthesis as a response to stress. By contrast, promethazine and levonorgestrel did not alter RNA-DNA relationship. No effects on the body size were observed for either test substances. Thus, our preliminary results indicate that for miconazole, the drug with well-conserved drug-targets, the endocrine and protein synthesis disrupting effects were indeed observed at sublethal concentrations. To fully test the hypothesis, complementary analyses on the other two pharmaceuticals are also two treatments.

TU 075

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

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Pharmaceuticals are being released into the environment in extremely large quantities on a regular basis. Ingested drugs are eventually excreted from humans, as well as they are released from manufacturing and disposal of unused or expired drugs ultimately windup in the effluent of wastewater treatment plants and aquatic environments. In order to understand the long term effects of exposure environmental concentration of pharmaceutical compounds we have exposed the gilthead sea bream (Sparus aurata) to representative drugs found at ng-μg-L-1 levels in surface- ground and coastal waters. Acetaminophen (APAP), Carbamazepine (CBZ) and Atenolol (AT) were used as model compounds to assess the treatment effects of low long term exposure on the expression of the brain transcriptome.

The treatment with the greatest number of differentially expressed genes was CBZ with 467 features, followed by APAP and 4 for AT. The selected vehicle, DMSO, didn’t show any significant expression changes in comparison with the SW control. Out of all these features, one was common between all the three treatments. This feature was identified by homology search as Sparus aurata cytochrome c oxidase subunit I mRNA. No other feature was common between APAP and AT or CBZ and AT. However, there were 130 common features between the APAP and CBZ treatment.

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

TU 076

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

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TU 072

V. Zlabek, V. Burkina, H. Kroupova, C. Steinbach, R. Grabc, G. Fedorova, J. Velisek, T. Randak

TU 077

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

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

This study has been focused on investigating effects of photo-transformation products of ofloxacin, a photolabile second generation fluoroquinolone, widely used and frequent found in the environment. Photo-transformation of ofloxacin was achieved by photonic and photocatalytic treatment at various times. Nine photo-transformation products and degradation derivatives based on piperazinyl dealkylation and decarboxylation are proposed. Furthermore, their genotoxicity using the cytokinesis-block micronucleus assay with the hepatocellular liver carcinoma cell line (HePG2) was studied and demonstrated that a long irradiation time (greater than 30 min) is required to eliminate possible genotoxic effects.

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The serotonine, also named 5-hydroxytryptamine (5-HT), acts both as a neurotransmitter or as an hormone, depending on its localization. The presented work investigated the ecotoxicological effects of 14 pharmaceuticals having serotoninergic properties, i.e. enhancing the effects mediated by serotonin in the central nervous system. The tested

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molecules are mainly antidepressants (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 bioassays on the microcrustacean *Daphnia magna* 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 pharmaceuticals effects in a marine species. The acquired data were used to build quantitative structure activity relationship (QSAR) modeling in order to (1) determine if the chemical properties of the molecules can explain their toxicity, (2) identify the mode of action of the selected pharmaceuticals.

**TU 079**

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

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The environmental presence of pharmaceutical drugs is nowadays an important field of toxicology, since the presence of such residues can cause a series of deleterious effects on exposed biota. This study assessed the ecotoxicological effects of two anticholinesterase therapeutic drugs, neostigmine and pyridostigmine in *Daphnia magna*. This evaluation includes the acute and sublethal effects (growth, feeding and reproduction) and the acute bioassays on the alga *D. magna*. The pharmaceutical effects of neostigmine and pyridostigmine derive from their capacity to induce a reversible inhibition of cholinesterase activity, and have thus been used to test the human disease myasthenia gravis. We observed alterations at the individual parameter directly related to the anticholinesterasic activity. Our study calculated 48 h-IC50 values in the immobilization assay of 167.7 μg L-1 for neostigmine, and 81.1 μg L-1 for pyridostigmine, respectively; for the ingestion rates, the calculated 5 h-EC80 values were, respectively, 7.5 and 0.2 μg L-1 for neostigmine and pyridostigmine. In the reproduction assay, the most affected parameter was the somatic growth rate (LOECs of 21.0 μg L-1 and 2.9 μg L-1 for neostigmine and pyridostigmine, respectively), followed by the fecundity (LOECs of 41.5 μg L-1 and 11.4 μg L-1 for neostigmine and pyridostigmine, respectively). We also determined a 48 h-EC50 for cholinesterase activity of 1.7 and 4.5 μg L-1 for neostigmine and pyridostigmine, respectively. These results demonstrate that both compounds are extremely toxic for *D. magna* at concentrations in the order of μg L-1. By comparing the here-obtained results with the actual concentrations of pyridostigmine previously reported in the aquatic environment (0.22 μg L-1), it is possible that this compound can significantly alter the feeding behavior of *D. magna*. Hence, the ecological implications of these data are of great importance and must be considered under the risk assessment framework of both pharmaceutical drugs.

**TU 079**

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

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Chronic and acute toxicity studies were performed to investigate effects of the molecular targets of Tamoxifen (a serotonergic drug) on a freshwater crustacean, *Daphnia pulex*. Tamoxifen and its metabolites (4-OH-Tam, 4-OH2-Tam) were placed individually in increasing concentrations (between acute and sublethal concentrations). The aquatic toxicity was studied in terms of effects on growth and reproduction. It was concluded that Tamoxifen and its metabolites are extremely toxic and must be considered under the risk assessment framework of such compounds in the aquatic environment and are discussed in terms of possible ecological effects of environmental relevant concentrations of these substances on wildlife. We advocate that sub-lethal toxicity of these psychiatric drugs should be assessed under relevant exposure scenarios such as co-occurrence with neurotoxic pesticides.

**TU 081**

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

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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. Arthropods are unable to synthesize sterols relying on dietary sources, the sterol synthesis inhibition is not likely a primary mode of action. Here, we hypothesized that exposure to imidazoles disrupt CaM-dependent nitric oxide synthesis in microcrustaceans. Further, assuming CaM inhibition to be the primary MOA for these substances, we evaluated CA models as a tool for assessing mixture toxicity of imidazoles.

**TU 081**

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

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The environmental presence of pharmaceuticals 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. Arthropods are unable to synthesize sterols relying on dietary sources, the sterol synthesis inhibition is not likely a primary mode of action. Here, we hypothesized that exposure to imidazoles disrupt CaM-dependent nitric oxide synthesis in microcrustaceans. Further, assuming CaM inhibition to be the primary MOA for these substances, we evaluated CA models as a tool for assessing mixture toxicity of imidazoles. We reviewed the existing literature to assess single and combined effects of four imidazoles (econazole, miconazole, clotrimazole and ketoconazole) in adult specimens of the crustacean *Nitocra spinipes* (Copoeopa, Harpacticoida). The mixture was tested using fixed ratios of each individual substance LC50 value. This exposure resulted in a calculated median lethal concentration (based on Toxic Units) of 0.86 (95% CI: lower 0.74; upper 1.01), which shows that the mixture displays concentration additive toxicity, level with the CaM model. In contrast, the CaM inhibition by the individual substances was much lower and no interaction could be supported. The results also showed that the CA models for assessment of imidazole mixture toxicity are valuable tools that could be applied to 21st century risk assessment of multiple substance mixtures.

**TU 081**

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

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The activation of cholinesterase activity (EC50 for neostigmine and pyridostigmine, respectively, followed by the fecundity (LOECs of 41.5 μg L-1 and 11.4 μg L-1 for neostigmine and pyridostigmine, respectively). We also determined a 48 h-EC50 for cholinesterase activity of 1.7 and 4.5 μg L-1 for neostigmine and pyridostigmine, respectively. These results demonstrate that both compounds are extremely toxic for *D. magna* at concentrations in the order of μg L-1. By comparing the here-obtained results with the actual concentrations of pyridostigmine previously reported in the aquatic environment (0.22 μg L-1), it is possible that this compound can significantly alter the feeding behavior of *D. magna*. Hence, the ecological implications of these data are of great importance and must be considered under the risk assessment framework of both pharmaceutical drugs.

**TU 080**

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

M.C. Breitholmz, S. Furuhagen, K. Ek, P. Ivanov, E. Gorokhova

Stockholm University, Stockholm, Sweden

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. Arthropods are unable to synthesize sterols relying on dietary sources, the sterol synthesis inhibition is not likely a primary mode of action. Here, we hypothesized that exposure to imidazoles disrupt CaM-dependent nitric oxide synthesis in microcrustaceans. Further, assuming CaM inhibition to be the primary MOA for these substances, we evaluated CA models as a tool for assessing mixture toxicity of imidazoles. We reviewed the existing literature to assess single and combined effects of four imidazoles (econazole, miconazole, clotrimazole and ketoconazole) in adult specimens of the crustacean *Nitocra spinipes* (Copoeopa, Harpacticoida). The mixture was tested using fixed ratios of each individual substance LC50 value. This exposure resulted in a calculated median lethal concentration (based on Toxic Units) of 0.86 (95% CI: lower 0.74; upper 1.01), which shows that the mixture displays concentration additive toxicity, level with the CaM model. In contrast, the CaM inhibition by the individual substances was much lower and no interaction could be supported. The results also showed that the CA models for assessment of imidazole mixture toxicity are valuable tools that could be applied to 21st century risk assessment of multiple substance mixtures.
Assessing the environmental hazard of mixtures of pharmaceuticals: combined acute toxicity of fluoxetine and propanolol to the crustacean Daphnia magna


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TU 083

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Assessing the environmental hazard of mixtures of pharmaceuticals: combined acute toxicity of fluoxetine and propanolol to the crustacean Daphnia magna

Environmental impact of pharmaceuticals and personal care products (PPCPs) in the freshwater bivalve Dreissena polymorpha

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TU 087

Assessing health status of ruditapes philippinarum exposed to caffeine, carbamazepine, ibuprofen and novobiocin using the neutral red retention assay

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TU 089

Assessment of ecotoxicological effects of environmentally relevant pharmaceuticals and personal care products (PPCPs) using battery of bioassays

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TU 086

Cytogenotoxic effects induced by cocaine on the freshwater bivalve Dreissena polymorpha

Cytogenotoxic effects induced by cocaine on the freshwater bivalve Dreissena polymorpha

Cytogenotoxic effects induced by cocaine on the freshwater bivalve Dreissena polymorpha

Toxicity of the antibiotic clarithromycin to green algae (Chlorophyta) and blue-green algae (Cyanobacteria), a comparison of species sensitivity

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TU 080

Assessing the health status of ruditapes philippinarum exposed to caffeine, carbamazepine, ibuprofen and novobiocin using the neutral red retention assay

Toxicity of the antibiotic clarithromycin to green algae (Chlorophyta) and blue-green algae (Cyanobacteria), a comparison of species sensitivity

Pharmaceutical and personal care products (PPCPs) are considered new environmental pollutants, since hundreds of these molecules are commonly revealed in the aquatic environment in the high ng/L to low μg/L range worldwide. Among them, the occurrence of the antibacterial triclosan (TCS), the antibiotic trimethoprim (TMP) and the non-steroidal anti-inflammatory drugs (NSAIDs) ibuprofen (IBU), diclofenac (DCF) and paracetamol (PCM) is well documented both in surface and sewage wastewater treatment plants.

Notwithstanding the high levels of PPCPs in environmental samples, information is lacking on their toxicity to test organisms. In order to enlarge this topic, sub-lethal effects induced by these therapeutic compounds were investigated by using a multi-biomarker battery: the Single Cell Gel Electrophoresis (SCGE) assay, which evaluated primary DNA lesion and the micronucleus test (MN test), which is used to investigate the extra-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 mussel Dreissena polymorpha. The raise of genotoxic effects was investigated by the Single Cell Gel Electrophoresis (SCGE) assay, which evaluated primary DNA lesions, while the DNA diffusion assay and the micronucleus test (MN test), which investigated extra-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.

The induction of genotoxic effects by cocaine was investigated by the MN test, which depicted a high genotoxic potential of the drug. The biomarker results pointed out that a low environmental concentration of TMP, IBU, DCF and PCM has a slight cytogenotoxic potential on zebra mussel haemocytes. On the other hand, cocaine exposure induced significant (p<0.05) increases on both primary and micronuclei DNA damages. Moreover, cocaine at 100 μg/L induced a slightly significant (p<0.05) increase on the micronuclei frequency, suggesting an intense stress in treated bivalves.

The increase in global consumption of illicit drugs has caused both social and medical problems, but also the onset of a potential new environmental hazard. After human consumption, in fact, drugs of abuse enter the aquatic system posing a potential risk for aquatic bioinocoenosis. Even if many studies have showed the presence of both drugs and their metabolites in freshwater in the high ng/L to low μg/L range worldwide, at present any information on their potentially harmful effects on non-target organisms is available. In the present study was 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.

The induction of genotoxic effects by cocaine was investigated by the MN test, which depicted a high genotoxic potential of the drug. The biomarker results pointed out that a low environmental concentration of TMP, IBU, DCF and PCM has a slight cytogenotoxic potential on zebra mussel haemocytes. On the other hand, cocaine exposure induced significant (p<0.05) increases on both primary and micronuclei DNA damages. Moreover, cocaine at 100 μg/L induced a slightly significant (p<0.05) increase on the micronuclei frequency, suggesting an intense stress in treated bivalves. 

The aim of the present work is to evaluate the acute toxic response of the crustacean Daphnia magna exposed to individual pharmaceuticals and mixtures.

Toxicity of the antibiotic clarithromycin to green algae (Chlorophyta) and blue-green algae (Cyanobacteria), a comparison of species sensitivity

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Toxicity of the antibiotic clarithromycin to green algae (Chlorophyta) and blue-green algae (Cyanobacteria), a comparison of species sensitivity

In the present study the adverse effects of clarithromycin on the green algae Desmodesmus subspicatus were investigated, using a set of in vitro tests.

We performed a set of concentration addition experiments to investigate the mixtures effects on bivalves, concerning the acute toxicity (immobilization test), the neutral red retention assay (NRRA) which gives an indication of the cytotoxic potential of drugs, the micronucleus test (MN test) which is used to investigate the extra-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.

Assessment of ecotoxicological effects of environmentally relevant pharmaceuticals and personal care products (PPCPs) using battery of bioassays

Environmental impact of pharmaceuticals and personal care products (PPCPs) in the freshwater bivalve Dreissena polymorpha

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Toxicity of the antibiotic clarithromycin to green algae (Chlorophyta) and blue-green algae (Cyanobacteria), a comparison of species sensitivity

Antibiotics are suspicious environmental contaminants as they are biologically active substances. Drugs, which have specific modes of action, may probably cause adverse effects on aquatic ecosystems. Up to now, only a few eco-toxicological studies for the assessment of the environmental risk of antibiotics and their metabolites are available. In Germany, the human macrolide clarithromycin is widespread present in aquatic surfaces and has been found in concentrations up to 0.3 μg/L. In some studies eco-toxicological effects of clarithromycin on aquatic organisms are published. Fortunately, most of these findings are not valid according the Technical guidance document (TDG) of the EFSA Panel on絲ils against antibiotics (EFSA ANA Panel), missing analyses and lack of identification of organisms are main problems. Nevertheless, clarithromycin elicits dose dependent effects with no evidence of perturbations in water solubility and sorption effects.

The aim of the present work is to evaluate the acute toxic response of the crustacean Daphnia magna exposed to individual pharmaceuticals and mixtures.

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action and physical-chemical properties. Next to this, endocrine-disruptive activities have been observed for a few of the tested PPCPs. The obtained data indicate which of the pharmaceuticals still manage to pass the plants in large quantities. This constant flux of chemically still active compounds into the environment has led to concerns previously expressed about possible adverse effects on human health.

TU 090

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

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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 microorganisms found in the activated sludge wastewater treatment process. The original OECD guideline for the test was first issued in 1984 and remained unchanged until recently. However, the need for a test design update to improve the statistical basis of the inhibition data has been recognized. 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 No Observed Effect Concentration (NOEC) of a substance, a requirement of the new guideline based on obsolete data from the old guideline.

TU 091

Toxicity of Ciprofloxacin and Sulfamethoxazole on marine biofilm communities

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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, bathing products such as shampoo for children, bubble bath, soap, detergents, etc., contain fragrances that can cause irritations of other irritants and allergens to penetrate.

Based on analytical data previously published providing concentrations of 26 fragrance suspected allergens in bathwater samples, the aim of this work was to estimate the potential risks to the exposure of children under 3 years of age using semiautomated respirometry to estimate NOECs for the exposure to the dermal exposition risk. The exposure of children to these substances is of concern because although they are designed to work for humans these compounds can also provoke unexpected effects on aquatic organisms. Therefore, the concentration-response relationship of these two substances was investigated on natural marine biofilm communities (periphyton) mainly composed by algae and bacteria.

TU 092

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

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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, bathing products such as shampoo for children, bubble bath, soap, detergents, etc., contain fragrances that can cause irritations of other irritants and allergens to penetrate.

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TU 094

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

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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 are among the most used veterinary medicinal products. Their use involves a risk for the environment, as a growth promoter or bacterial disease treatment. Their excessive application has become a threat for both human and environmental health. Considering this scenario, our study aims at assessing sub lethal effects of AMX and OTC in 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 included enzymes related to the metabolic pathways of protein (glutathione-S-transferase (GST)), carbohydrate (CAT), lipid (LPO), and nitrogen metabolism (DHODH). In adults, oxidant stress and inflammation response was assessed by ALP activity and histological evaluation. In embryos, oxidative stress was assessed by activity of GST and antioxidant enzymes (SOD, GPx). Differences in the mortality rate were observed between embryos and adults for AMX and OTC tested concentrations. Adults exposed to OTC showed inhibition of the oxidative stress enzyme CAT in head tissues (96 h-LOEC=0.05 mg/L) and an increase in the detoxification phase II enzyme GST (96 h-LOEC=0.001 mg/L). OTC exposure also induced the GST activity in embryos at the highest concentrations (96 h-LOEC=0.3 mg/L). LPO in adults showed a range of responses according to the different organs analysed: being inhibited in the head tissues (96 h-LOEC=0.001 mg/L) and induced in the muscle (96 h-LOEC=0.05 mg/L) and liver (96 h-LOEC=0.001 mg/L). As well as in embryos (96 h-LOEC=0.1 mg/L). Alkaline phosphatase activity in adults was inhibited in the head tissues (96 h-LOEC=0.001 mg/L) and embryos (96 h-LOEC=0.001 mg/L) and phosphotungstic acid (PTA) staining was reduced in embryos (96 h-LOEC=0.001 mg/L). In addition, NOECs were also observed in the embryos exposed to AMX. The NOEC was observed between 0.001 mg/L and 0.005 mg/L. In adults, NOECs were observed between 0.001 mg/L and 0.02 mg/L. In embryos, NOECs were observed between 0.001 mg/L and 0.05 mg/L. The NOECs were observed in all the organs and tissues analyzed.

TU 095

Gemfibrozil and naproxen biodegradation in a river water ecosystem

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Incomplete removal during wastewater biological treatments is the main source of surface water contamination by pharmaceuticals. Degradation of a chemical in the aquatic environment
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.

The work was supported by Ministry of Education and Sciences, Republic of Serbia (IB46009) and NATO Science for Peace Project ‘Drinking Water Quality Risk Assessment and Prevention in Novi Sad municipality, Serbia’ (JEPESAFIP 984087).

**TU 096**

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

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Caffeine, methylxanthine derivative, is a pharmacologically active substance which stimulates the central nervous system, increases heart rate, dilates blood vessels and works as a weak diuretic. It is present in human sewer overflows and in natural non-human surface waters. 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 newly developed reversed phase high performance liquid chromatography (RP HPLC) method. The chromatography was using a Zorbax Eclipse XDB-C8 column (150 x 4.6 mm i.d., 5 µm particle size) at 25°C, with a mobile phase of 0.1 % THF in water (pH 8) - acetonitrile (85:15, v/v). The flow rate was 1 mL/min, and detection by DAD at 273 nm. Samples were collected in July 2011 on seven different locations of the Danube River on a territory of Novi Sad, Serbia. Caffeine amount ranged 0.84 ng/L on the 1st day and 0.52 ng/L on the 30th day after sample collection. On the 60th day after sampling caffeine was under the limit of detection in all water samples. Presence of caffeine confirmed the existence of human waste in the Danube River. Highest values were obtained in sample collected from location near the water supply source “Ratno ostrvo”, Novi Sad. Obtained results due to caffeine shows amounts significantly decreased during two months storage of samples on 4°C most likely to its degradation.

**TU 097**

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

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Caffeine is a widely prescribed use and-over the-counter medicine, treating pain, inflammation and fever by reducing the level of prostaglandins through non-selective inhibition of the enzyme 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 a risk 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 work, we studied the degradation of these COX-1, COX-2a and COX-2b genes in the fathead minnow (Pimephales promelas) gene was identified in the fathead minnow (Pimephales promelas) . To assess the uptake and effect of ibuprofen exposure, fathead minnows were exposed for 96 hours using a flow-through system to 100 and 500 µg/L of ibuprofen. Fish were biopsied at 2, 4, 8, 24, 48 and 96 hours post-exposure. Gill, 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 using specific primers to the COX genes and reference genes (18S and β-actin). Initial results indicate changes in COX gene expression following ibuprofen exposure.

**TU 098**

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

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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. For example, in large spatial scales, the conventional approach to conduct quantified 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 used to predict pesticide behavior and transport. Results falls high and low for high pesticide risk. The risk was quantitatively evaluated. We also found some evidences that air should be considered as a two layer compartment, dividing the part that is under the vegetation cover and the upper part that is interested by turbulent air fluxes made by winds. The lower layer, when soil is covered by herbaceous vegetation, could be very thin, but nevertheless seems to be extremely important in determining the distribution of air fluxes between ground and vegetation. Vegetation is an efficient pathways for transferring POPs into terrestrial food chains. By monitoring intake and output of pollutants we were able to develop a multiparametrical ‘cow model‘ describing the main fluxes of POPs between the pasture environment. We observed a transfer of pollutants between soils and herbaceous vegetation (that act as a temporary filter) and from vegetation to milk and feces, with fast transfer rates. We also observed differences in PBDE fingerprint between inputs and outputs, pointing out differential absorption and/or metabolism of these compounds in cows.
The objective of this work is to present a case study where apparent conflicting results were obtained between US-type soil metabolism and EU-type soil metabolism studies: In the US study, additionally to one major metabolite M, two metabolites (m1 and m2) were considered to be formed directly from the parent in the metabolic pathway proposed by the laboratory in amounts continuously increasing up to around 7% of the applied radioactivity until the end of the one year incubation. These results were consistent with the studies where only M was identified. Kinetics optimization with ModelMaker software and statistical analysis of the data according to the recommendations of the FOCUS Kinetics Workgroup (2006) were performed. 

The kinetic evaluation demonstrated that, using a new metabolic pathway, this optimization of kinetic data leads to an acceptable error. Therefore, these soil metabolites were found not to be environmentally relevant according to EU guidance. This justifies the need to perform additional kinetic investigation of the metabolism of pesticides so as to set up properly the degradation pathway.

TU 102

Determination of plant uptake factors for pesticide fate modelling
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The plant uptake factor (PUF) is defined as the concentration of a compound in the solution taken up by the roots divided by its concentration in the soil porewater. Numerical leaching models applied for the environmental exposure assessment of pesticides use the PUF to calculate the amount of a compound taken up by a plant together with the chemical. The PUF is therefore an important parameter for a realistic leaching assessment. PUF values have been experimentally derived for four substances covering a wide range of polarity (ionic, polar, medium polar, lipophilic) in three different crops (Tomato, Wheat and Maize).

In the kinetic experimental set-up intact plants were exposed between 8 and 11 days to a nutrient solution (pH 6) spiked with the radiolabelled test compound. Volume uptake and concentration in the nutrient solution were measured regularly over the experimental period. By sealing the test vessel it was assured that the only loss process from the system for water and chemical was plant uptake. As a result of the study, the PUF was always well above the FOCUS default value of 0.5 (FOCUS, 2009). Generally, a small variation between plant species was observed. The experimental results could be verified with a simple plant uptake model. The data on PUF show that the use of the FOCUS default of 0.5 is a very conservative approach in terms of leaching assessment. For the test compounds existing intoxicating lipophilicity is observed. The plant uptake factor was determined in three diverse crops representative for cereals, small grains and vegetables all measured PUF values were well above 0.5. It is expected that these bitterness uptake values can be generalized to other compounds within the same range of polarity, as the plant uptake model successfully applied to confirm these values only uses generic compound parameters as input (e.g. lipophilicity).

TU 103

Development of a French national tool for pesticide risk assessment in the context of the water framework directive
S. Reichenberger1, J. Dubus2, R. Talva3, S. Teller1, J. Pres1, F. Escalant1
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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: e.g. it is impossible to perform powerful exposure assessment tools which are able to link the observed contamination of water bodies with agricultural pesticides with the agro-pedo-climatic conditions and pesticide application practices responsible for the contamination, and to explore the effect of risk mitigation measures a priori in order to determine the most effective and efficient measures for pollution load mitigation in practice. FOOTWAYS has been charged with the development of a national pesticide exposure and risk assessment tool for France to be applied in the context of the Water Framework Directive. The tool will produce results at two different scales: i) river water bodies and groundwater bodies, for the purpose of risk assessment and global testing of the effectiveness of mitigation measures, and ii) edged areas and water bodies, for more specific testing of the effect of mitigation measures. The tool will be part of the FOOTWAYS Pro web platform for pesticide risk assessment and management.

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

TU 104

Pesticide exposure assessment in flowing waters - Approaches to dynamic predicted environmental concentration
B. Bach1, M. Trapp2, G. Guerniche2
FOOTWAYS S.A.S., Orléans, France

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

The kinetic evaluation demonstrated that, using a new metabolic pathway, this optimization of kinetic data leads to an acceptable error. Therefore, these soil metabolites were found not to be environmentally relevant according to EU guidance. This justifies the need to perform additional kinetic investigation of the metabolism of pesticides so as to set up properly the degradation pathway.

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 leaching, 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 plant and in the pore water adjacent to the roots. The Plant uptake factor (PUF) can be used as input parameter in simulations models (e.g. FOCUS PEML0) to determine the leaching behaviour of the substance more precisely. The PUF was measured in soil-less hydroponic test systems with intact plant root system in an artificial pore water system (1-L of 0.01 M CaCl2) containing a given concentration of the substances. By determining the volume uptake and concentration of the test item at the end of each time interval, PUF can be calculated. If 14C-labeled compounds are used, the distribution of test item in the root plant system can be simply determined by sample combustion followed by liquid scintillation counting (LSC). The test system used in this study are 1-L brown glass vessels in which the plants without soil (pre-grown in soil for 3-6 weeks) are inserted into the test solution and cultivated for 8 days under controlled greenhouse conditions. For each substance, the experiment is conducted under three sets of environmental conditions using biological replicate of 3, (5, 5, 6) and 7. The PUF of 8 test substances, chosen on a relevant range of lipophilicity and pKa value, will be determined, be sampled on several dates (0, 2, 5 and 8 days after treatment), as well as in the test plants at the end of cultivation. The PUFs determined will be presented crop specific as a function of the chemical hydrophobicity of the substances, and of the pH-level of the test solution.

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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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 states.
states (FOCUS surface water). Since a direct adoption of FOCUS surface water for the German national authorization procedure is not feasible for a number of reasons, within the project a new national exposure assessment tool for pesticide inputs into surface waters via surface runoff, erosion and drainage will be developed. This tool will i) take into account the full range of agro-eco-climatic conditions in Germany, ii) facilitate modelling the effect of risk mitigation measures, iii) include a number of higher-tier options and iv) allow for a coupled of predicted exposure time series with standard laboratory or higher-tier exposure time series. The project coordinated by Dr. Martin Bach at University Gießen started on 1 December 2011 and will run for 23 months.

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 protection of the included scenarios for German conditions in comparison to the current assessment methods in the German national authorization procedure) will be presented.

TU 107
Impact of recent EFS A 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 EFS A for the EEC, leading to a guidance which states that laboratory data is not sufficient for the environmental risk assessment of pesticides and that field data is required for a reliable assessment. In the past, the need for field data has been met by using multi-dimensional models that assume first-order degradation kinetics. This procedure implies that the decline curve after naturalisation can be used directly to estimate the DegT50 matrix of the top soil at 20°C and pH = 2.25

The present study investigates 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 degradation rate. Moreover, the EEC guideline of the FOCUS group suggests that the European translation of the new EU dataset for the 2005 and 2006 studies should be used, but no other studies could be evaluated anymore. We also show that the impact of the rainfall criterion on the resulting DT50 depends on both the study location within Europe and the type of application. These results show that the selection of the rainfall criterion can have a pronounced effect on the results of field studies. Hence, this criterion needs to be chosen with care. Studies on the speed of movement of pesticides in the soil, depending on surface and soil specific properties and rainfall, may help to show if the currently proposed value of 10 mm is reasonable.

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 procedures
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2Fraunhofer IME, Schmallenberg, Germany
In the registration procedure in Germany the risk assessment for the lethal 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 input parameter setting 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 the FOCUS-PPELMO tool compared to lysimeter studies. Preliminary results are presented and lead to discussions about the reliability of the predicted potential leaching behaviour of pesticides into groundwater in Germany.

TU 110
InversePELMO a specific software to perform inverse modelling simulations with FOCUSPELMO 4
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In the new ENSA guidance on soil persistence (EFS A, 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 proposed that only sampling points after 10 mm cumulative rainfall should be used to derive DT50. While this rainfall criterion is intended to ensure that processes on the surface are not taken into account for kinetic evaluation of field studies, there is no clear scientific basis for the selected 10 mm rainfall criterion. 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 not defined. We also show that the impact of the rainfall cannot be evaluated anymore. DT50 depends only for the study location within Europe and the time of application. These results show that the selection of the rainfall criterion can have a pronounced effect on the results of field studies. Hence, this criterion needs to be chosen with care. Studies on the speed of movement of pesticides in the soil, depending on surface and soil specific properties and rainfall, may help to show if the currently proposed value of 10 mm is reasonable.
full-field environmental programme is barely affordable for a new active ingredient let alone for a single formulation. Simulation models are the primary basis for regulating pesticides against ground- and surface-water protection standards, but the current models cannot explicitly represent plants or their roots, or the effects of formulations and formulation placement strategies (e.g. slow-release microcapsules and seed treatments). Other models exist that represent individual components of the system in a more satisfactory way.

Current models used for pesticide registration within the EU are 1-dimensional and have a simplified representation of root development and uptake of pesticides. Conversely, plant growth and uptake models can have sophisticated representation of plant processes, but often do not consider pesticide dynamics. An ongoing project has created a conceptual framework for representing local pesticide concentrations in the whole soil-plant system, and will next produce a spatially-explicit simulation model. By relating local concentrations of pesticides to product efficacy, it will be possible to use the model to design better active ingredients, formulations and placement strategies. The new model will also enable the environmental benefit of advanced formulations and placement strategies to be quantified in a cost-effective way for the first time. This presentation 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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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 method is to consider impact factors as a consequence of spatial scale. The knowledge about agro-pedoclimatic conditions and transport of pesticide in these territories underlines that a minimum of four scenarios (2 soils: andosol and nitisol 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 (sugar cane). For water surface contamination, the method for surface water fate would likely be initially simplified to a simple static receiving water body of dimensions defined consistently with French overseas territories and protection goals. Finally, the main features of two models - currently under test - representing surface and subsurface flow of water and pesticides in banana crops on tropical volcanic soils are summarized and the schedule of a 2 year research project (2012-2014) to adapt them for regulatory purposes introduced.

TU 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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Several fate and effect models have been developed to assess the ecotoxic impact of individual chemical contaminants on aquatic freshwater organisms in Life Cycle Assessment (LCA). These methods suffer when it comes to the impact assessment of complex chemical mixtures, such as industrial effluents, as the list of constituent compounds is rarely known in its entirety, leading to under- or overestimation of ecotoxicological effects. A more holistic and meaningful method of evaluating the environmental impact of industrial effluents in LCA would be to model the fate and effect of comprehensive and commonly measured sum-parameters, such as total organic carbon (TOC) and sum parameters of non-disjoint (NDP) or disjoint (DP) toxicity characterisation factors (CP) 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 complexities, as well as the need for spatial differentiation, and we present some preliminary results.
TAU 119
Environmental impacts of thermal emission to freshwater: Spatially explicit fate and effect modelling
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2ETH Zurich, Zurich, Switzerland

Power production is a crucial sector causing heavy impact on freshwater bodies by releasing enormous amounts of heat in once-through cooling systems. So far only few approaches have addressed impact on aquatic environment related to this issue and there is no study providing fate and effect model for assessing the impacts on a spatial explicit level and broad coverage. We started our research based on a detailed study assessing impacts of thermal emissions from a specific nuclear power plant in Switzerland and extracted the most sensitive parameters to derive a generic model of combined fate and effect model for the US. We created a 0.5 arc degree grid accounting for water temperatures, river flow, river width, flow velocity and distance to sea in order to model fate and effect of thermal emissions from different sizes of power plants. Various data sources and impact assessment methods were applied to cover various uncertainties, allowing accounting for uncertainties. 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.

TAU 120
Including the influence of worldwide crop cultivation on ecosystem services in life cycle assessment
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A soil ingestion pilot study of a population following a traditional lifestyle typical of rural or wilderness areas
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The relatively few soil ingestion studies underpinning the recommended soil ingestion rates for contaminated site human health risk assessments (HHRA) 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. Assessments of soil ingestion rates estimated in this study were higher than those currently recommended for HHRA of adults, and higher than those obtained in most previous studies of adults. However, soil ingestion rates measured were much lower than earlier qualitative assessments of subsistence lifestyles.

TAU 121
Health risk assessment of chlorpyrifos with rice farmers in Vietnam
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Vietnam is an agricultural developing country with over 80 per cent of workers employed in agriculture, mainly rice farming cultivatih. 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 chlorpyriphos use has not been carried out and limited investigation in Vietnam and other developing countries. The objective of this study is to evaluate the health risk of chlorpyrifos exposure to a typical group of rice farmers after application in Vietnam, using a probabilistic approach. Biological monitoring of rice farmers was used to estimate chlorpyrifos exposure from all pathways during application. Urine samples (24 h) were collected from farmers 1 day prior to application and over 5 days post-application, and then analysed for TCP, the main metabolite of chlorpyrifos, using HPLC-MS/MS. Urinary TCP levels were converted into an absorbed daily dose (ADD) of chlorpyrifos for each farmer. The health risk of chlorpyrifos exposure for the rice farmers was characterised by biokinetic (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

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Conclusion
The authors thank the colleagues of the LC-IMPACT and the European Union for funding. The authors thank the JRC-ISPRA, Institute for Environment and Sustainability (IES), Climate Change Unit (CCU) for kindly making the global scale assessment based on the TM5-FASS model possible.

Acknowledgements
The authors thank the colleagues of the LC-IMPACT and the European Union for funding. The authors thank the JRC-ISPRA, Institute for Environment and Sustainability (IES), Climate Change Unit (CCU) for kindly making the global scale assessment based on the TM5-FASS model possible.
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 on the Perm city population, at an unacceptable environmental risk for respiratory, eyesight, hematological and immune disorders as well as central nervous system impairments. More than 173,000 Perm children (99.4%) and all of the 809,000 Perm adults are at an unacceptable carcinogenic risk. The main risk factor is inhalation exposure. 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 blood levels of acetaldehyde, formaldehyde, manganese, nickel, chromium, etc. and blood, immune, hematological and other health impairments. We have determined reference levels of the chemical compounds in blood, i.e. acetaldehyde - 0.049 mg/dL, formaldehyde - 0.059, benzene - 0.0013, manganese - 0.039, chromium - 0.021, nickel - 0.075 and chloroform - 0.0021 mg/dL. We have identified NOAEL values in the air: Ni - 0.00009 mg/m³, Cr - 0.0001, Mn - 0.00003, formaldehyde - 0.005, acetaldehyde - 0.002, benzene - 0.03 mg/m³; chloroform reference dose in drinking water - 1 mg/L.

We suggest that priority environmental risk assessment criteria for Perm are: industrial emissions of acetaldehyde and acetaldehyde cause 3,246 additional new cases of respiratory diseases. The total economic damage for respiratory diseases is €1.3 million per year. Acceptable risk levels can be reached by reducing industrial emissions of 19 industrial companies, using traffic optimisation and clean fuel and improving the water supply system quality and water treatment.

**TU 124**

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


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**TU 125**

Prioritising chemicals for EQS development

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Environmental Quality Standards (EQSs) are a key tool under the Water Framework Directive (WFD) to help assess the chemical status of water bodies. However it is important that EQSs are developed for substances that pose the greatest risk to the aquatic environment, and that emerging contaminants are adequately considered. Various methods for prioritising chemicals have been described, incorporating both exposure and effects. Approaches that prioritise on the basis of risk often require significant inputs, even a draft EQS, or detailed exposure modelling. We describe a simple approach to prioritisation that requires only modest inputs and assigns chemicals to different risk assessment categories. Unlike more sophisticated schemes, this method does not require a draft EQS in order to prioritise chemicals. Rather, it categories chemicals in terms of their likely (or actual) environmental occurrence based on use and monitoring data, and the hazard they pose to aquatic life, based on persistence, bioaccumulation and toxicity criteria. Classifications based on exposure and hazard are then combined and chemicals assigned to risk categories. Those assigned to the highest risk category are taken forward as potential candidates for EQS development. Almost a third of the chemicals considered could not be assigned a risk ranking due to a lack of data. This is of particular concern for emerging contaminants where both hazard and exposure data are often limited. Lack of exposure or hazard data contributed equally to the assignment of 'Insufficient information'. Predictive tools such as QSRs or ‘read across’ techniques may have a useful role in filling some gaps in hazard data. Gaps in exposure data may be filled by gathering monitoring data; in this respect the scheme has helped identify monitoring needs that may lead to identifying future EQS candidates.

The prioritisation methodology is not suitable for metals and other inorganic chemicals because of biases in the way that fate and behaviour are dealt with e.g. measures of degradation and bioaccumulation. A separate approach for such chemicals may need to be developed. However, we suggest a peer review the outputs of the scheme because this can help introduce relevant new data or information about significant trends in likely exposure (e.g. planned restrictions on use) that will affect the chemicals' priority.

**TU 126**

Klimisch 2.0 - raising the bar to increase the scientific quality of environmental risk assessments


Swiss Centre for applied ecotoxicology, Dubendorf, Switzerland
ECT Oekotoxikologie GmbH, Florschuis, Germany
CEHTRA, Lyon, France
Royal Institute of Technology (KTH), Stockholm, Sweden
Federal Environmental Agency (UBA), Dessau or Berlin, Germany
German Federal Environment Agency (UBA), Dessau or Berlin, Germany
Wca environment, Oxfordshire, United Kingdom

**TU 127**

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

SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting
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 maximum levels from EU feed/food legislation. This is especially true for the lower courses of the big streams Rhine and Elbe. 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 for PCDD/F concentrations but for dl-PCB there is a non-uniform overall picture showing rather a baseline than a clear decrease at fairly high levels. Generally, for both high and easy to sample and also forming a link towards human consumption.

TU 128
Efficient toxicity testing when test information is uncertain: a stochastic cost-effectiveness analysis
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Changing policy settings for chemicals risk management, for example in Europe and in the US, have led to increasing awareness of the urgent need for more efficient testing of chemicals. The economic concept of efficiency calls for allocating scarce resources (e.g. money, time, human skills) such that output is maximised. Hence, if a toxicological endpoint different testing options exist a decision maker must identify the testing strategy that provides the highest information gain per unit of cost. This clearly, requires to weigh the costs associated with a testing strategy, usually measured in monetary terms, against the information gains from testing. The latter are commonly expressed in terms of the a test's predictive performance. Cost-effectiveness analysis (CEA) provides a powerful tool for solving this problem. CEA allows for a comparative evaluation of different testing trade-offs and identifies joint or independent testing and measurement strategies. While CEA has been well used in medical domains, for example in medical decision-making, there are only few attempts to apply CEA to testing in toxicology. These studies share the assumption that information gains from testing, measured in terms of a test's predictive performance, are known. The predictive performance of testing methods is, however, uncertain, irrespective of what type of testing method (e.g. a “gold standard” in vivo test, an in vitro test, or a “non-testing” method) is used. Our study, therefore, moves beyond existing deterministic CEA modelled in toxicology by developing a stochastic approach to CEA that accounts for the uncertainty about the quality of test information. The aim is to allow for a more robust and transparent evaluation of testing methods and strategies both within and across endpoints. This guides decision-makers in coherently selecting the testing method or strategy that provides the highest information gains per unit of cost. Another contribution of the study is to offer a critical synopsis of data and research needs in order to apply our approach to various endpoints and to make it operational in the regulatory context of REACH.

TU 129
IFRA Environmental Standards: risk and hazard assessment update for 2012
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The IFRA (International Federation of the Perfumery and Cosmetics Industry) is the association established in 1961 as a voluntary safety program with the development of IFRA IFRA Environmental Standards for both risk and hazard in 2008. Fragrance material risk assessment for these standards are incorporated in the Research Institute for Fragrance Materials' (RIFM) testing program in coordination with its Expert Panel. To identify materials for risk assessment refinement, fragrance materials were screened using the RIFM Environmental framework and identified for further research. In Europe and the Czech Republic, the Framework for this evaluation was published in Environmental Toxicology and Chemistry (Salvito et al., 2002, 1301-1308). In addition, hazard assessment on these materials was also performed and reviewed. As a result nearly 3,000 materials were screened with preliminary risk quotients estimated to rank priority materials for risk assessment refinement. In an effort to provide greater transparency to the developing IFRA Environmental Standards, reported here are the results of these studies, including identification of these materials, as ready biodegradation tests and die-away studies, bioaccumulation, and acute and chronic aquatic toxicity. Incorporating these new data in a second tier risk and hazard assessment for these materials will also be presented. IFRA and RIFM have decided to present an annual update of this test program and the IFRA Environmental Standards. This work represents the latest effort for 2011-2012.

TU 130
The HEROIC project: coordinated efforts towards the harmonization and cross-fertilization of human and environmental risk assessment of chemical substances
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2 Université de Technologie, TBT, Basel, Switzerland
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7 Benaki Phytopathological Institute, Kittisia, Greece
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Today, human risk assessment (HRA) and environmental risk assessment (ERA) are typically separated. There is a lack of mutual understanding between experts and data from toxicological and ecotoxicological studies are not readily accessible by risk assessors of the two disciplines. The need for RA will continue to increase (e.g. REACH or toxicity of mixtures) along with budget restrictions and political and public pressure to reduce the number of animals tests. Therefore more cost effective, predictive and rapid testing methods with high quality sustainable RA are needed, including a better exploitation of existing data. The HEROIC project aims at developing an algorithm for networking among all the relevant stakeholders in the RA value chain and will provide them with the most relevant background information to contribute to the development of harmonised approaches which meet the challenges of RA. The project will enable the improvement and harmonisation of tools and methods in RA, by exploring how data generated in ecotoxicology and human toxicology can be applied across disciplines and develop a framework for integrated methodologies for RA. This will increase transparency in RA and allow better risk communication to maintain public trust and provide unambiguous guidance for improved risk management.

HEROIC starts with a comprehensive landscape exercise to identify common methodological and data needs in current human and environmental risk assessment practices and to identify existing in-vivo and in-silico methods for hazard and exposure assessment. The selection process ranks and weights data based on their reliability and relevance and uses a Weight-of-Evidence Approach to integrate such information to develop an Integrated Testing Strategy (ITS) for decision making. A dedicated web portal called 'Tox-Hub' that presents information from diverse sources and that functions as a central point of access to the most relevant toxicological and ecotoxicological data will be created. A diverse range of dedicated activities is planned for information, dissemination, capacity building and communication. These coordinating activities will result in enhanced shared of knowledge, building consensus and development of clear, easily understood, transparent and unambiguous integrated RA procedures.

RA03P - Are Environmental Specimen Banks ready to face future challenges of environmental chemistry and regulatory toxicology?
A.J. van Sprang
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Targets and standards are helps to us take action to protect and improve water quality. However, environmental agencies throughout the world have or will develop frameworks that may differ substantially therefore resulting in different standards for the same pollutant. This presentation aims at providing an overview of the frameworks developed in the US and EU for the derivation of EQS for metals. Central focus will be on differences in approach used for the development, validation and implementation of the biotic ligand Models (BLM). Indeed, in the USA, acute BLMs are proposed for 2 different trophic levels (invertebrates and fish), while in the EU chronic BLMs are used (algae, invertebrates, and fish). Once normalised 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 EQS setting will be illustrated using Cu as an example. EQS for different surface waters (with different bioavailability) will be demonstrated. In most cases it seems that the differences in EQS values between both frameworks are within a factor of 2-3. Therefore, although there is a general tendency to incorporate such concepts in regulatory frameworks for metals there is a need for clear definition of frameworks as highlighted by the OECD.

TU 134
A 10 year retrospective study of mussel condition in North Iberian Peninsula based on the ‘mussel shell section’ of the Biscay Bay Environmental Biospecimen Bank
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Setac 6th World Congress/Setac Europe 22nd Annual Meeting

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An environmental specimen bank (ESB) is an archive for biological samples that can be used to perform (traditionally chemical) analyses to obtain information about long-term variability and temporal trends in the chemistry of the biota and the ecosystem quality. Aware that chemical endpoints alone are not enough for ecosystem health assessment, the Biscay Bay Environmental Biospecimen Bank (BBEBB) was designed including specimens for biological endpoints, say biopsies for histopathology/immunohistochemistry, cryo-specimens for molecular/cellular analysis, and dried mineralized tissues (shells/otoliths) for biometric determinations. Banking methods and specimen sampling and processing are being adapted for these needs. In a first practical application, a retrospective study was performed using the ' Mussel Shell Section' of the BBEBB (2001-2010) on 22 localities covering the area of geographical distribution of Mytilus galloprovincialis in the North Iberian coast. Changes in shell size (length, L; width, W; height, H), alometry and shell weight (SW) were analyzed, and the shell thickness was estimated after regression of the log SW against SSF (Shell Size Factor, LxWxH in mm).

Overall, shell growth exhibited a decreasing trend during the study period with a seemingly more marked arrest growth in 2003-2006. These results are discussed in terms of impacts of global warming on the shell length in the Biscay Bay system.
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 areas are brought into the river 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 FHH and Birds directive. Some of the ecologically valuable freshwater sandy areas are close to Hamburg, and at the mouth of the Elbe the river widens to a large marine sandy 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 sandy 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 carried out on the sampled material. Elevated discharge did not lead to any significant increase of contamination fluxes may be recorded. Long-term changes on 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 biosassays 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, (ant)androgenic, (ant)estrogenic, and thyroid hormone-like activities, and for mutagenicity. Variable patterns of both increased or decreased toxicity in relation to soil or sediment in the catchment areas were noted both within and between rivers. Marked increases in toxicity were observed for episodic freshening (``blues in bloom'') (Akerselva, Norway, and downstream 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 profile. Results of multivariate statistical analysis (PCA, cluster analysis) and different toxicity ranking and classification approaches will be presented. The results will be included in a web-based communication tool (Open Earth) open to the general public. The work described was performed within the context of the DiPro project (Impact of Climate change on the quality of urban and coastal waters - Diffuse Pollution), which is funded by the Interreg IVB North Sea Region Programme.

TU 141

Toxicology of suspended matter and sediments in relation to contaminant load and expected effects of climate change on European rivers
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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 surface 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 predictions 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 biosassays 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, (ant)androgenic, (ant)estrogenic, and thyroid hormone-like activities, and for mutagenicity. Variable patterns of both increased or decreased toxicity in relation to soil or sediment in the catchment areas were noted both within and between rivers. Marked increases in toxicity were observed for episodic freshening (``blues in bloom'') (Akerselva, Norway, and downstream 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 profile. Results of multivariate statistical analysis (PCA, cluster analysis) and different toxicity ranking and classification approaches will be presented. The results will be included in a web-based communication tool (Open Earth) open to the general public. The work described was performed within the context of the DiPro project (Impact of Climate change on the quality of urban and coastal waters - Diffuse Pollution), which is funded by the Interreg IVB North Sea Region Programme.

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-seabed geological formations, is already contemplated in international conventions as a mitigation measure to reduce the concentration of CO2 in the atmosphere. Although this technology is currently considered to be technologically feasible there is lack of information on the environmental impacts it may produce. CO2, sorbed in the sediment, sediments pore water, sediment-water interface and finally in the water column. Increase in acidity will lead to several biogeochemical alterations that can result in detrimental effects in the ecosystem. Changes in the solubility, speciation, mobility and bioavailability of 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-pressurized 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 and contaminated by metal application. A study on the different contribution due to heavy metal in the sediment was carried out in the Orbetello lagoon (Tuscany, Italy). The lagoon is located within a volcanic district, characterized by hydrothermal ore deposits and natural positive geochemical anomalies for some heavy metals may occur. Consequently, the correct interpretation of natural and anthropogenic enrichment is a main issue for a correct environmental impact assessment. In this work, selected trace elements (As, Cd, Cr, Cu, Pb, Zn) were measured in two dated sediment cores (OR96 and OR98) from the lagoon, using non-destructive techniques, and in the water column. A study on the different contribution due to heavy metal in the sediment was carried out in the Orbetello lagoon (Tuscany, Italy). The lagoon is located within a volcanic district, characterized by hydrothermal ore deposits and natural positive geochemical anomalies for some heavy metals may occur. Consequently, the correct interpretation of natural and anthropogenic enrichment is a main issue for a correct environmental impact assessment. In this work, selected trace elements (As, Cd, Cr, Cu, Pb, Zn) were measured in two dated sediment cores (OR96 and OR98) from the lagoon, using non-destructive techniques, and in the water column. A study on the different contribution due to heavy metal in the sediment was carried out in the Orbetello lagoon (Tuscany, Italy). The lagoon is located within a volcanic district, characterized by hydrothermal ore deposits and natural positive geochemical anomalies for some heavy metals may occur. Consequently, the correct interpretation of natural and anthropogenic enrichment is a main issue for a correct environmental impact assessment. In this work, selected trace elements (As, Cd, Cr, Cu, Pb, Zn) were measured in two dated sediment cores (OR96 and OR98) from the lagoon, using non-destructive techniques, and in the water column. A study on the different contribution due to heavy metal in the sediment was carried out in the Orbetello lagoon (Tuscany, Italy). The lagoon is located within a volcanic district, characterized by hydrothermal ore deposits and natural positive geochemical anomalies for some heavy metals may occur. Consequently, the correct interpretation of natural and anthropogenic enrichment is a main issue for a correct environmental impact assessment. In this work, selected trace elements (As, Cd, Cr, Cu, Pb, Zn) were measured in two dated sediment cores (OR96 and OR98) from the lagoon, using non-destructive techniques, and in the water column. A study on the different contribution due to heavy metal in the sediment was carried out in the Orbetello lagoon (Tuscany, Italy). The lagoon is located within a volcanic district, characterized by hydrothermal ore deposits and natural positive geochemical anomalies for some heavy metals may occur. Consequently, the correct interpretation of natural and anthropogenic enrichment is a main issue for a correct environmental impact assessment. In this work, selected trace elements (As, Cd, Cr, Cu, Pb, Zn) were measured in two dated sediment cores (OR96 and OR98) from the lagoon, using non-destructive techniques, and in the water column.
Influence of feeding type and behaviour on whole sediment toxicity tests with the oligochaete Lumbriculus variegatus
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Lumbriculus variegatus were exposed for 28 days to 0, 180, 560 and 1800 µg Zn g-1 sediment and received 2 feeding regimes. The partitioning of Zn between sediment, pore water and overlying water was enhanced by a 2-year equilibration period. Feeding regimes used in the toxicity tests were (i) food (Urrtica-sculellata) spiked into the sediment with 0.5% in the gut and (ii) feeding regime with the organisms feeding directly on Tetramin. It is, however, equally present in gut wall and epidermis in worms fed TetraMin. This supports the assumption of feeding inhibition due to avoidance confirming the role of dissolved Zn as the predominant exposure route when SEMZn-AVS>0.

Using synchrotron radiation-based confocal micro-X-ray fluorescence (XRF), the results show that in worms fed via the sediment, Zn is mainly associated with epidermis and less with the gut walls. It is, however, equally present in gut wall and epidermis in worms fed TetraMin. This supports the assumption of feeding inhibition due to avoidance toward contaminated sediment/food. The XRF data also show that at 1800 µg g-1, Zn was mainly distributed in the epidermis and sub-epidermally of L. variegatus, confirming the role of dissolved Zn as the predominant exposure route when SEMZn-AVS>0.

TU 147
Toxicity of organic micropollutants in the Yangtze Three Gorges Reservoir - MICROTOX
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The reservoir of the Three Gorges Dam is part of the Yangtze River, the third longest river in Asia. Its 632 km long reservoir formed by the damming of the Three Gorges Dam is situated between the cities of Yichang and Qutang. The reservoir itself is 638 km long and 113 km wide. Several authors have been interested in the potential contamination of these sediments by organic micropollutants (PCBs, OCPs), and sediment toxicity was determined using a kinetic assay (Flash Test) with the luminescence bacterium Vibrio fischeri. We have observed significant differences between both studied regions in the Czech Republic as well as between different sampling periods. Statistical analyses repeatedly revealed relatively poor correlations between chemical contamination data and toxicity, while dark organic carbon (TOC) appeared to be related to observed toxic effects. The present study shows successful application of the kinetic V. fischeri test in the effect-based monitoring of sediments demonstrating thus complementarity of both chemical and ecotoxicological data.

The Tietê River, selected in this study as an example for a highly contaminated river system, is located in the most important economical center in Brazil, São Paulo state. The reservoir water was collected at several locations and analyzed using a weight-of-evidence (WOE) approach with several lines of evidence. The objective of the poster presentation is to introduce the conceptual framework and to present first results of the ongoing study.

As previously addressed by Chapman & Hollert (2006) a variety of lines of evidence can be used in WOE studies. Briefly, (i) a comprehensive battery of acute (neutral red assay, Achromobacter, fish embryo toxicity test and sediment contact assay with Danio rerio) and mechanism-specific bioassays (micronucleus assay and Ames test, EROD and AhR-mediated toxicity) characterize the chemical and biological hazard of specific samples, representing in situ parameters as well as (ii) persistent organic pollutants (PCB, PAH and PCDD/Fs), endocrine disrupting substances, limnochemical parameters and the concentration of heavy metals were analyzed. They have been taken at major cities as well as feeder rivers and their estuaries along the Yangtze Three Gorges Reservoir in order to characterize the state of contamination and the potential risk for human and wildlife. The monitoring strategy should help to evaluate the water body’s quality and to serve as a basis to initiate if necessary counteractive measures.

Reference
Chapman PM, Hollert H (2006) Should the sediment quality triad become a tetrad, a pentad, or possibly even a hexad? JSS - Journal of Solids and Sediments 6: 4-8

TU 149
Toxicity of persistent organic pollutants from Baltic Sea sediments in the fish embryo test and the EROD assay
N.C. Niehus1, J. Löhrs1, K. Schmidt1, C. Erger1, B. de Samber1, K. Schmidt1, T. Braunbeck2, C. R. Janssen1, A. Schäffer1, H. Hollert1
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The Baltic Sea, one of the largest brackish water bodies in the world, is considered to be an exceptionally sensitive and endangered marine ecosystem. The average residence time of Baltic Sea water ranges between 23 and 50 years, thus facilitating the accumulation of pollutants in sediment. For a deeper insight into the ecotoxicological effects of persistent organic pollutants, sediments, biological test systems were applied with exhaustive as well as mild sediment extracts. Extracts from PLE and mild methanol/water extraction, were investigated for their dioxin-like activity and their embryotoxic impact on the development of zebrafish (Danio rerio) embryos. PLE extracts were considered to represent the entire toxic potential and the mild methanol/water extracts to contain rather bioavailable pollutants. Applied biotests were the fish embryo test in 96-well plates with the expression of the reporter gene luciferase in the zebrafish transgenic line Z:Wt:GFP. Results extracts in contrast to the PLE extracts, which gave strong embryotoxic potential. Results on the EROD inducing potential indicated dioxin-like activity for all investigated sampling sites. PLE extracts showed clearly higher dioxin-like activity than mild methanol/water extracts. The study revealed an ecotoxicological burden for all Baltic Sea sediments. Especially the Eastern Gotland Basin, the São Francisco River and the Arona Basin are highly polluted, but not necessarily suitable for developing fish embryos. However, the ability of the mild extracts to resemble the bioavailable fraction might be limited. For a comprehensive ecotoxicological assessment it is necessary to thoroughly investigate the bioavailability and to identify the causative pollutants by chemical analyses.

TU 150
Identification of hazard factors and ecotoxicologically relevant risks of sediments from the Tietê River Basin in Brazil
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The São Francisco River Basin is the fourth longest river from South America and the longest that runs entirely in Brazil. Although is a very important river, there are diverse anthropogenic impacts, such as hydroelectric activities, pollutants from mining, metal manufacturing industry or agriculture that have impact on these ecosystem. The objective of this study is to evaluate

Acute sediment toxicity assessment in the river Sao Francisco, Brazil
M. J. Salamanca1, A.M. Pereira1, P. Cruz-Hernández2, M.R. De Orito1, A.M. Sarmiento1, T.A. Delval1
1 Universidad de Huelva, Huelva, Spain
2 Universidad Federal de São Carlos, São Carlos-sb, Brazil

The São Francisco River, with a catchment area of 322,000 km², is the fourth longest river from South America and the longest that runs entirely in Brazil. Although it is a very important river, there are diverse anthropogenic impacts, such as hydroelectric activities, pollutants from mining, metal manufacturing industry or agriculture that have impact on these ecosystem. The objective of this study is to evaluate...
by means of chemical and ecotoxicological approach the toxicity of the sediments of this river, and their elutriates, in a region downstream Três Marias reservoir, in a site near a processing industrial plant of zinc. For this, a battery of three laboratory bioassays, using two cladoceran (Daphnia similis and Ceriodaphnia dubia) and one amphipod (Hyalella azteca) species, was used to assess the toxicity. 12 different metals (Al, As, Ba, Cd, Co, Cr, Cu, Fe, Mn, Ni, Pb, and Zn) and the different geochemical sediment fractions were determined as a means of assessing the potential impact of the bioavailable fractions (two first steps of the sequential extraction procedure) in order to establish the potential of the industrial plant. The effect of sediment metal contamination was assessed applying multivariate techniques. The results showed concentrations of Zn, Cd and Pb that involve an important potential risk on the aquatic environment. The sediments affected by the industrial plant presented high levels of toxicity, although the hydrodynamic of the river plays an important role in the metal distribution and consequently in the toxicity of the sediments. 

**TU 152**

Ecotoxicological assessment of sediments from rivers impacted by a petroleum refinery

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3Eco-toxicology studies are important for evaluating the effects and mechanisms of action of toxic agents in different environments. Aquatic sediments have a high potential for pollutants to become available in certain environmental conditions, the sediments can also become a potential source of contamination. 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 153**

Seasonal variation of toxicity and genotoxicity of sediments samples of the Ensenada de la Paz, B.C.S. Mexico

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In this paper was carried out a qualitative assessment of toxic and genotoxic effects of sediment collected at 8 locations in the Ensenada de la Paz, B.C.S., in 2 contrasting seasons summer and winter of 2010, using a battery of biological tests with organisms of different trophic levels and the SOS-Chromotest microbioassay. Compounds with toxic and genotoxic effects were detected in 5 locations, located in the Canal de la Paz, near the termoelectric power station and the Pichilingue navy. LC50 and genotoxicity values were determined, indicating the presence of toxic compounds at sites near Punta Prieta and Cisican, sediment toxicity decreases with increasing distance from these points. 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 154**

Bioassays in sediment assessment for investigating monitoring in the context of the WFD

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An intense industrial activity has been taking place in Walloonia (Belgium) since the Middle Ages. The proximity to major waterways has enhanced the industrial development and the urbanisation. Water quality has been impacted by the acidification, pollution of sediments and the level of metal pollutants in order to determine the environmental risks. Heavy metals were determined in conjunction with sediment toxicity using Daphnia magna, Selenastrum capricornutum and seed-germination bioassay analysis. The Sediment Quality Triangle (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 heavy metals decreased from modern (near industrial) to ancient layers (near ancient settlements). The stations nearest to the alteration zone were severely polluted. These results suggest that there are health risks to human populations and activities such as vegetable and cattle farming or rural touristic recreation in the area. In order to restore the alteration zone to healthy conditions a remediation program would be necessary. 

**TU 155**

Toxic effects of sediments from a semi-arid coastal system, influenced by a gold ore mine

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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 authorities recognition of the problem, the problem is still failing or being too delayed. Braçal and Palhal, located in Central-North of Portugal in a riverside position, are both examples of deactivated mining areas lacking for recovery plans since their shut-down in the early-mid 1900’s. Both mines are inserted in large underground complexes. Braçal was mainly focused on the extraction of galena ore, while Palhal on the extraction of pyrite, chalcopyrite, galena, sphalerite and pyrite ore. Since their shutting down, the mining run-off are running into two subsidiaries of Vouga River. The purpose of this work was early evaluating the potential risks and hazards of the contribution of mining run-off into Vouga river subsidiaries for freshwater communities and nearby population villages. Therefore, ecotoxicological tests using a battery of assays were performed on sediments collected from the river in the vicinity of the Braçal mine, which shows that elutriates from the bioavailable fractions (two first steps of the sequential extraction procedure) in order to establish the potential of the industrial plant. The effect of sediment metal contamination was assessed applying multivariate techniques. The results showed concentrations of Zn, Cd and Pb that involve an important potential risk on the aquatic environment. The sediments affected by the industrial plant presented high levels of toxicity, although the hydrodynamic of the river plays an important role in the metal distribution and consequently in the toxicity of the sediments. 

**TU 156**

Ecotoxicological assessment of contaminated rivers as a proxy for the water framework directive: an acid mine drainage example

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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 authorities recognition of the problem, the problem is still failing or being too delayed. Braçal and Palhal, located in Central-North of Portugal in a riverside position, are both examples of deactivated mining areas lacking for recovery plans since their shut-down in the early-mid 1900’s. Both mines are inserted in large underground complexes. Braçal was mainly focused on the extraction of galena ore, while Palhal on the extraction of pyrite, chalcopyrite, galena, sphalerite and pyrite ore. Since their shutting down, the mining run-off are running into two subsidiaries of Vouga River. The purpose of this work was early evaluating the potential risks and hazards of the contribution of mining run-off into Vouga river subsidiaries for freshwater communities and nearby population villages. Therefore, ecotoxicological tests using a battery of assays were performed on sediments collected from the river in the vicinity of the Braçal mine, which shows that elutriates from the bioavailable fractions (two first steps of the sequential extraction procedure) in order to establish the potential of the industrial plant. The effect of sediment metal contamination was assessed applying multivariate techniques. The results showed concentrations of Zn, Cd and Pb that involve an important potential risk on the aquatic environment. The sediments affected by the industrial plant presented high levels of toxicity, although the hydrodynamic of the river plays an important role in the metal distribution and consequently in the toxicity of the sediments. 

**TU 157**

Assessment of effects of agro-chemicals use in ecological status of Kilombero Flood Plain, Ramsar site

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Tanzania is rich in water resources with an estimated 10% of the land surface covered by significant freshwater wetlands providing essential ecosystem and livelihood supportive functions. However, the expansion of agriculture and mining (e.g. manganese, tin, copper, gold) has a negative impact by altering 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 prevent the international use of all other wetlands in the country. The Kilombero Valley, designated in the same year, is among four (4) in Tanzania. The country has a mean area of about 40,000 km². Kilombero Valley is rich in endemic species of flora and fauna and characterised by high concentrations of large mammals especially Puku, Buffalo, Elephant, Hippopotamus and Lions. The valley has experienced extensive and severe weather conditions, 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.
This is investigated in the Tungelroyse beek, a stream in the south of the Netherlands. Local water authorities have restructured large parts of the stream. We used a triad...}

The highest bioavailable concentrations of Cd and Zn were observed in the floodplain soils. The bioassay showed a negative effect for two locations. Combining the two...}

To evaluate biological effects of contaminated sediments, modern strategies not only focus on analyses of contaminants, but also test the impact on biological organisms. In addition to the chemical studies a composition of limnic and marine microbiological assays was used in order to assess bioavailability of the contaminated material to different organisms under controlled laboratory conditions. Interpretation of our biotest results followed a weight of evidence approach by which several individual positive tests in the tier add to an overall conclusion that a risk for the environment may in fact exist. The test system proved suitable for assessing the risk of the Baltic sea sediments.

### TU 160

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

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Many streams and small rivers in Europe are faced with historic metal pollution due to the activity of zinc smelters. Rehabilitation activities are executed for many streams in the Netherlands. In the floodplain stage the floodplains and small rivers are characteristically changing environmental conditions due to the periodic and unpredictable flooding. During high discharge events, sediment is resuspended, transported, and settled at floodplains downstream. This spatial distribution of contaminants in the floodplain should be taken into account when streams and rivers are being reconstructed. We investigated in the Tungelroyse beek, a stream in the south of the Netherlands. Local water authorities have restructured large parts of the stream. We used a triad approach to assess whether all the ecotoxicological risks have been adequately removed by the restructuring and rehabilitation activities. Sediment and soil was sampled in the stream and in the floodplain on 3 locations along the stream. Total concentration (aquatic regia extraction) and bioavailable concentration (Cai2+ extraction) of the following metals were analyzed: Cd, Cu, Pb, Zn, As. A standard Chironomus survival bioassay was conducted in the laboratory. Metal and bioassay results were compared with field inventarisation of the macroinvertebrate community. The highest bioavailable concentrations of Cd and Zn were observed in the floodplain soils. The bioassay showed a negative effect for two locations. Combining the two approaches with the in situ macroinvertebrate community showed an ecotoxicological risk for pristine floodplain soil when inundated. These results are compared with previous studies along the river Dommel. Advices on optimal restructuring and rehabilitation of small streams should include the spatial distribution and bioavailability of contaminants.

### TU 161

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

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Federal Institute of Hydrology (BfG), Koblenz, Germany

Due to historical emissions of hexachlorobenzene (HCB), the sediments of the ponds of Upper Rhine River in southern Germany remain highly contaminated (up to 1000 µg kg⁻¹). HCB is a bioaccumulative and toxic persistent organic pollutant (POP). By reason of its strong sorptive characteristics, HCB is mainly bound to organic substances. However, geogenic clay minerals are also capable sorbents. Regarding the contaminated sediments, the spatial distribution of HCB is considerably more heterogeneous, then e.g. the distribution of polychlorinated biphenyls (PCBs). Further, maximum loads of HCB occur rather in larger particle fractions (63 - 2000 µm), than in smaller fractions (< 20 µm). Knowledge of the specific HCB-sorbents in the different fractions is of importance, because their characteristics control sorption strength, which is an important factor for remodeling as well as bioavailability of organic contaminants.

The mineral composition of sediments (measured by X-ray Diffraction, XRD) and its influence on the amount of sorption is presented, as well as composition and sorption capacity of the sediment (classified by particle size and content of organic matter) and the HCB-sorption (expressed by partition coefficients). The results are applied on batch equilibrium studies by solid-phase microextraction (SPME) coupled to gas chromatography (GC). In addition, adsorbed HCB were investigated by imaging mass spectrometry and scanning electron microscope coupled to energy-dispersive X-ray spectroscopy (SEM-EDS). Results are discussed in terms of mechanisms of adsorption and thereby characterizing the potential of a predictive remobilization processes as well as bioavailability of HCB in aquatic ecosystems. Results yield important physicochemical properties of sorbents for better understanding the environmental behavior and pathways of chemicals and beyond that to model environmental fate under changing climate conditions.

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

### TU 162

River sediment sampling and environmental quality standards


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Sediment forms an important part of the aquatic environment and provide habitat to benthic organism. However, poor water quality has been linked to contaminated sediments most of which consists of complex materials transported within river or deposited on river bed. Sediment has been identified as major transport and sequester of fluorl chemicals such as heavy metals, most especially the fine sediment. At present, there are no environmental quality standards (EQS) for bed sediments or fluvial suspended sediments, and one of the major problems in establishing sediment EQS is the identification of the suitable sediment fraction to measure - the actively transported or previously deposited sediment. The variability in sediment characteristics is usually attributed to their active properties and the characteristics of the rivers such as pH, redox, and high water discharge, which is investigated during sediment sampling. The study aims to investigate the effect of particle size on heavy metal concentration, study seasonal variation in the concentration of Cu, Ni, Pb and Zn in Ravensbourne River, Middlesbrough based on selection of samples. The variability of concentrations between different compartments such as suspended sediment, bed sediment, bank sediment and the water column of Ravensbourne River. Sediment (bed and bank) and water samples were collected from Ravensbourne River over a period of 12months. Sediment samples were tested for heavy metal contamination using the aqua regia, sequential extraction using a ßhore extraction technique proposed by Maiz et al. (1997).

### TU 163

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

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Rapid economic development and urbanization growth in Vietnam have made this country become an important subject for extensive studied dealing with environmental pollution recently. So far, there has been no information on PBDEs contamination in Central Vietnam and the information about PCBs sources and levels is limited. Tam Giang-Cau Hai Lagoon lies along the coastal line of Thua Thien-Hue Province, Vietnam. Due to recent industrial and economical growth in this region, large amount of untreated industrial wastewater is discharged to this river by a large deep-sea industrial wastewater thermal discharge plant. This plant creates adverse environmental consequences and increased health risk for local communities. In this study, the contamination status, distribution and congener profiles of PCBs and PBDEs in surficial sediment of Tam Giang-Cau Hai Lagoon were investigated. PCBs and PBDEs were detected in all sediment samples with mean concentrations of 0.19 and 0.56 ngg⁻¹ dw, respectively. The highest concentrations of both contaminants were observed downstream at the river mouths, indicating the river flow as a main source of pollutants into the lagoon system. The similarity of PCB congener distributions in sediments suggests the presence of a unique source over the entire study area, probably connected to local use of old electrical equipments containing...
low chlorinated PCB formulations. Atmospheric transport & port 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 DecaBDE as the major technical mixture in consumer products in this region. In general, the levels of PCBs and PBDEs in lagoon sediments were low, compared with those reported in other rivers and estuaries in 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 PCB sediment concentrations of Tam Giang-Cau Hai Lagoon does not constitute a threat to environment. Nevertheless, the first time detection of PBDEs in the lagoon-river system might be an indicator of enhanced recent human pressure that suggests the need for a monitoring plan to prevent the possible dangerous worsening in the near future.

RA07P - Environmental problems of estuaries

TU 166 Distribution character and potential risk of PCBs and phenols in surface water from 22 tributaries and mainstream in middle reaches of Yangtze River

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47 surface water samples were collected from 22 tributaries and mainstream of the Yangtze River from Chongqing to Yichang. The contents of 28 PCB congeners and 15 phenols were measured. The PCBs measured were types A, B, C, D, E and F, and 2-nitrophenol are the most predominant congenants in the samples from tributaries, PCBs, 28, phenol, o-cresol, and 2-nitrophenol are the most dominant congenants in those from mainstream. The measured 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 was 61.07 ng L-1 and 7.97 ng L-1, respectively. The highest concentrations of PCBs and phenolic compounds were detected separately in the samples from Rangdu River (61.79 ng L-1) and Jialing River (172.37 ng L-1). The average concentrations of PCBs and phenolic compounds in the samples are far lower than the Chinese drinking water guideline values. The concentrations of PCBs and phenolic compounds in the samples were in the same order of magnitude of those reported on other levels in lower Europe 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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Ateneo de Manila University, Quezon city, Philippines

Oysters from the Oka river estuary (Urdaibai Reserve of the Biosphere, UNESCO) were collected in 7 sites at different seasons along 2010. Together with oysters, water samples from 81 locations were also collected as well as in other 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 PCB sediment concentrations of Tam Giang-Cau Hai Lagoon does not constitute a threat to environment. Nevertheless, the first time detection of PBDEs in the lagoon-river system might be an indicator of enhanced recent human pressure that suggests the need for a monitoring plan to prevent the possible dangerous worsening in the near future.

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

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Dioxin-like compounds in Portuguese estuaries were investigated by extraction of the sediments and measurement of dioxin-like compounds using GC-MS. In 18 stations in the Ria Formosa, the highest concentrations of PCDD/Fs and dl-PCBs were detected. High-resolution gas chromatography and high-resolution mass spectrometry (HRGC/HRMS) were employed to determine the concentration of seventeen PCDD/Fs and twelve dl-PCBs. Results show that PCDD/Fs and dl-PCBs concentrations are variable not only between estuaries but also within each estuary. In general, the highest level concentrations were found at sites near large populations and industrial complexes (e.g. Tagus, Ria de Aveiro and Sado). The lowest concentrations were found in Ria Formosa, a protected area with high-sea turbulence. OCDD is the most abundant PCB congener in all samples but PeCDD or PeCDF were the major contributors to WHO-PCDF/TeQ2005. For PCDD-Fs, PCB 118 was the dominant congener while PCB 126 was the major contributor to WHO-PCB-TEQ2005 in all the analysed sediments.

TU 169 Environmental monitoring and assessment of Terminos Lagoon, Mexico

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Terminos Lagoon in the estuary of the Grijalva-Usumacinta river system, with the largest fresh water runoff in Mexico (35% of the total), and the second largest in the Gulf of Mexico. It is near of one of the main oil drilling areas in Mexico and there are many industrial facilities associated with the oil industry affecting the region. As an aim of this research is to evaluate the sediment contamination of PCDD/Fs, PCDFs and PCBs. Seven estuarine systems were selected along the Portuguese coast: Lima, Ria de Aveiro, Mondego, Tagus, Sado, Mira and Ria Formosa. At each estuary, superficial sediments (0-10 cm) were collected at various locations in the intertidal mudflats. Samples were analysed by high-resolution gas chromatography and high-resolution mass spectrometry (HRGC/HRMS) to determine the concentration of seventeen PCDD/Fs and twelve dl-PCBs. Results show that PCDD/Fs and dl-PCBs concentrations are variable not only between estuaries but also within each estuary. In general, the highest level concentrations were found at sites near large populations and industrial complexes (e.g. Tagus, Ria de Aveiro and Sado). The lowest concentrations were found in Ria Formosa, a protected area with high-sea turbulence. OCDD is the most abundant PCB congener in all samples but PeCDD or PeCDF were the major contributors to WHO-PCDF/TeQ2005. For PCDD-Fs, PCB 118 was the dominant congener while PCB 126 was the major contributor to WHO-PCB-TEQ2005 in all the analysed sediments.

TU 170 Chemical and biological assessment of metal pollution in the Urdaibai Reserve of the Biosphere (UNESCO) using oysters as sentinels


University of the Basque Country, Leioa, Spain

Oysters have been widely used as sentinel organisms in order to determine the presence of pollutants and their effects in coastal and estuarine environments. In the present work, a project was developed in the Urdaibai Reserve (UNESCO) to evaluate the heavy metal contamination. Oysters (Crassostrea gigas) were collected in 7 sites at different seasons along 2010. Together with oysters, water and sediment samples were also collected. The concentration of 14 elements (Al, As, Cd, Co, Cr, Cu, Fe, Mg, Mn, Ni, Pb, Sn, V and Zn) was determined. Cell and tissue level biomarkers and histopathological alterations were also observed. High Cu concentrations were found in the water column but tissue concentration was not high in oysters. Multivariate analysis (PCA) was used to analyze the correlation between heavy metal concentrations and other variables. In oysters, a moderately high Pb concentration was found in oysters but not in water. Preliminary data in sediments indicated higher values of Cu and Zn in Mundaka. Regarding cell and tissue level biomarkers, no significant differences were observed comparing the sites. Occasionally, Arteaga presented symptoms of atrophy in the digestive diverticula in Mundaka. The Connective-to-Diverticula ratio, a quantitative index of the morphology of the digestive epithelium, was used as an index of the extent of cell injury. A number of stations were found to be "bad"condition for water quality and benthic community. Loss of mangroves is forests is decreasing. Results have been presented to management authorities.
Overall, the integrated watershed-receiving water model performed very well. The integrated model was able to recreate a wide range of dynamic loading within the inlets...

The effect of changes in salinity on metal speciation, metal biouptake and metal toxicity was studied under controlled conditions in a series of structurally and functionally different estuarine environments. Using a dynamic modelling approach the effects of changes in physical and chemical environmental parameters were evaluated. Results from aquatic, coastal and marine environments were used to describe metal uptake and toxicity remain valid across estuarine gradients and biodiversity. Using a dynamic modelling approach the effects of changes in physical and chemical environmental parameters were evaluated. Results from aquatic, coastal and marine environments were used to describe metabolic processes and the environmental distribution and biological availability of the metals. 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 estuarine environment is a very dynamic system characterized by strong physical and chemical gradients and an enormous diversity in flora and fauna which undergoes major transitions moving from the freshwater to the marine areas. Along these gradients metal concentrations and speciation undergo important changes which also have an important impact on distribution and toxicity of these metals. This is particularly true in estuaries where the interplay between chemical and biological processes contribute to the diversity of 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.

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group in freshwater fish, 14.4% in the 8 ppt and no mortality in the 17 ppt salinity treatment groups indicating protection by hypersaline conditions from acute lethality. However, significant differences were not observed in the 8 ppt salinity treatment groups indicating protection by hypersaline conditions from acute lethality. Despite not representing a large fraction of HgTOT in the aquatic environments, the major form of HgORG, methylmercury (MeHg+), raises prime concern, due to its tendency for bioaccumulation and biomagnification with increasing trophic levels. In order to examine the trophodynamics of HgTOT and HgORG in a coastal lagoon, suspended particulate matter (SPM), sediment, seston, phyto and zooplankton agglomerates, Crangon crangon, Pontopomius micropomus, Liza aurata, Athetina boyeri and Dicentrarchus labrax were sampled. Sampling took place at night near the mouth of the two major freshwater sources (Vouga and Antuã rivers) to the lagoon. Vouga River runs in a narrow channel, with steep margins. Its watershed receives effluents from mining, livestock, urban, industrial and traffic sources. Larjano Bay (a depositional area) receives the Antuã, which has been conveying industrial discharges, particularly an effluent from a mercury cell chlor-alkali plant (from the 1950s until 1994). From the estimated 33t of mercury dispersed into the lagoon, the majority (81%) is associated with the sediments in Larjano Bay. By determining the position of each of the sampled compartments in the local food webs, using GC-C-IRMS, stable isotopes (δ13C and δ15N) and fatty acids, the evaluation of this element’s transference in the food web was achieved. Mercury analysis was executed using CV-AAS (Cold Vapor Atomic Absorption Spectrometry). Certified reference materials (DOLT-3 and DOLT-4 for tissues, PACS-2 for sediment) were used in the QC/QA process. A significant negative correlation (Pearson Product Moment correlation, P<0.05) and a very strong positive (Pearson Product Moment correlation, P<0.0001) were found for Larjano Bay, between HgTOT and δ13SN and HgTOT and HgORG, respectively. No other significant correlations were established. Results for HgTOT were generally in line with published values for Larjano Bay. Organic mercury was the most abundant of the species in the superior organisms (always≥57%). The diverging patterns of HgTOT and HgORG distribution are discussed.

TU 178 Is chemotherapy a suitable tool to counter the physiological capability of Corbicula fluminea to respond to acute chemical stress in estuarine environments? P. Vilares, C. Olivera, L. Guilhermino University of Porto, CEIMAR & ICAMIS, Porto, Portugal The Asian clam Corbicula fluminea (Müller, 1774) is an invasive species that has been colonizing aquatic ecosystems in Europe, America and several other regions. In the freshwater tidal area of the Minho River estuary (NW Iberian Peninsula) that was colonized by this species in the 80s, C. fluminea is now the dominant species of the benthic community, having contributed to the decline of several native molluscs and considerably changed ecosystem functioning. Furthermore, C. fluminea has been showing to be able to develop resistance to pollution. Here, the hypothesis that individuals from the river but inhabiting sites with distinct levels of historical contamination, have different capacities of developing resistance following exposure events. To test the hypothesis, animals collected at two sites in the Minho River under different anthropogenic pressure were exposed separately to the model polycyclic aromatic hydrocarbon benzo[a]pyrene (BaP) after a period of acclimation to lab conditions. At the end of the bioassays, enzymes involved in neurotransmission, biotransformation, anti-oxidant defences, aerobic energy production and lipid peroxidation levels were used as biomarkers. Results show differences in enzyme activities between the two sites suggesting that animals inhabiting the most contaminated site developed tolerance to chemical stress. This study was carried out in the scope of the project NISTRACKS - Processes influencing the invasive behaviour of the non indigenous species Corbicula fluminea (Mollusca: Bivalvia) in estuaries - identification of genetic and environmental key factors” funded by the Portuguese Foundation for the Science and the Technology (FCT) PTDC/AAC-AMB/10212/2008 and FEDER COMPETE funds / FCOMP-01-0124-FEDER/088556. P. Vilares had a grant in the scope of the project and C. Olivera had a PhD grant from FCT (SFRH/BDE/68423/2010) funded by national funds of the MCTES and FEDER European funds (POPH-QREN-Tipologia 4.2.).

RAI19P - Plants and chemicals in the environment: risk assessment, pest management and phytoremediation

TU 181 Sediment contact test with Myriophyllum aquaticum (ISO/CD 16191): first results of an international ring test 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. In a sediment contact test the macrophytes of the aquatic lamina who is exposed to environmental samples for ten days. The growth of Myriophyllum aquaticum in a test sample is compared with its growth in the control sample. Phytotoxic effects can be quantified as growth inhibition (%) relative to the control growth. Several laboratories from academia, industries and government participated in an interlaboratory test ring organized by the German Federal Institute of Hydrology. The ring test consisted of a) investigating the practicality and productivity of the sediment contact test, ii) validating the chosen endpoint, and iii) determining the response range of the reference substance functioning as positive control. First results of the interlaboratory ring test will be presented. Acknowledgement: U.F on behalf of the participants of the international ring test

TU 182 Genotoxic more ecologically relevant data from laboratory tests: recovery potential of Lemna minor V.Z. Knezevic, T.O. Tunic, 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. Laboratory test results are representative of rare 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, Ecotoxicology 2004) we used standard test protocols with Lemna, but these protocols could be adapted by a) adding a recovery phase after the exposure phase and b) providing 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 endpoint which might provide good indication of plant recovery potential after exposure to toxic compounds. Estimation of recovery potential 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. A new development in mesocosm testing with herbicides: recent experiences and recommendations A. Taylor, T. Bennett, S. Priestly, R. Bromley, J. Forsyth, E. Bateman, H. Walton Cambridge Environmental Assessment, Cambridge, 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. HARAP, 1998 & CLASSIC, 2001). Much of the progress in this area since this guidance was produced has been in the design and conduct of freshwater mesocosm studies to evaluate the toxicity of herbicides and other chemicals to 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 produced a database of mesocosm tests for the evaluation of herbicide recovery on a variety of macrophytes with different morphology and life histories. We will also provide recommendations for the evaluation of effects of algae and periphyton drawing on our experience in this area. It is hoped that the information provided will advance mesocosm study design and offer advice to those considering conducting mesocosm studies with herbicides whilst providing a catalyst for discussion in this developing area of higher tier aquatic ecotoxicology.

TU 184 Unforeseen effects of herbicides on wetland and terrestrial plant communities: time to vegetative and reproductive recovery following exposure C. Boutin, D. Pastorinho 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 sulfonlurea herbicide chlorimuron ethyl. Eight wetland and nine upland species were tested with eight doses of chlorimuron (+ controls) ranging from 1 to 107% of the recommended label rate.
of 9 g ha-1. For each species, two sets of plants were grown: total aboveground plant biomass was assessed at four weeks after exposure for the ST plants (first set) and again for the LT plants (second set) when the controls began natural senescence (7-23.5 weeks post-spray depending on species). To assess recovery over time, measurements of maximum plant height were taken 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. LT biomass was found to be the most sensitive measure of IC50 for nine species and LT reproduction for three species. IC50 could not be predicted for five species (no effect). Delays in flowering time were apparent for several species. Twelve species had early delays in growth compared as 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. Chlorophyll a and b 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), recovery did not follow those observed for height. Delayed growth and flowering was observed at doses less than known drift rates (10%) to exposed to these rates were often able to recover over time. While recovery did occur in this greenhouse experiment, it 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 downstream tributaries. Unfortunately, macrophyte diversity, particularly diversity of submerged species, appears to have declined in some North American and European ecosystems during the last century. In agricultural watersheds, streams are intimately connected with croplands and the health of macrophyte communities may be compromised by increased levels of disturbance and exposure to agrochemicals such as nutrients and herbicides in areas of high-intensity agriculture. The study site is situated in the southern part of the South Nation Watershed located throughout the South Nation River watershed, a sparsely populated agricultural watershed comprising 3919 km² in Eastern Ontario, Canada. The sites varied in terms of their contamination with nitrate and the commonly used herbicide atrazine, with mean spring maximum in-stream concentrations of 6600 µg/L and 1.36 µg/L respectively. In-stream concentrations of nitrate and atrazine were strongly correlated. Over 200 macrophyte species were identified along stream banks and within the stream channels. Sites surrounded by high levels of agriculture tended to have a higher percentage of non-native species, suggesting that native species are less long term across the watershed. A decline in the quality and conservation values of macrophyte communities was observed along a gradient of nitrate contamination.

TU 186

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

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In each study 9 to 10 species (SSD) and (2) to identify a most sensitive species. Lemna is the standard aquatic test organism and among the most sensitive species to herbicides. Multiple species data provide arguments to lower the assessment factor due to increased realism and lower uncertainty. The example of sulfonyl-urea herbicides (SU) outlined here shows that herbicide action can be different to the same or a similar SU for over time. Over a period of four years Smithers Viscient (sponsored by Bayer CropScience) generated macrophyte data for five different SU herbicides. In each study 9 to 10 species from a variety of taxonomic groups were exposed in artificial outdoor ponds for 6 to 8 weeks. Each experiment was designed separately and influenced by experience gained from former tests. Changes in these species data are applicable to (1) comparisons of species sensitivities within one test substance and (2) comparisons between the test substances.

Number of replicates were 4 in the controls and lowest concentrations, 3 at medium, and 2 at the highest concentrations (combined NOEC/EC50 design). A dose-response was observed in most cases. Due to variation among replicates, the EC50 is regarded as more reliable the NOEC. As plant length could not be assessed in all species, dry weight biomass was used for comparisons. EC50-levels based on biomass and biomass growth rates were very similar. The EC30-levels from biomass growth rates were compared to the Lemna-EC50. In 3 of the 5 herbicides tested none of the macrophytes were more sensitive than Lemna. For 2 herbicides a ranking was performed. In all 5 cases Lemna was among the 5% of the most sensitive species. Myriophyllum, the forthcoming second standard species within the frame of EU regulations, was of medium sensitivity (rank 4 to 6). Overall, the pattern of sensitivity distributions was very similar in all 5 SU herbicides. The large amount of data obtained enables refined risk assessments with low assessment factors based on the lowest EC50 as well as probabilistic approaches using a hazard concentration (HC5).

TU 187

Ecological functions of plant growth regulators in the stability of agrocenosis

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TU 188

Biological responses in the aquatic macrophyte Myriophyllum quinquefolium exposed to the streblorbin fungicide azosystrobin

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Streblorbin fungicides exert a relatively neutral effect on terrestrial and aquatic plants. The class developed from the streblorbin compound and the great impact of them on agriculture is reflected by the widespread use of azosystrobin (AZX), a compound approved for use on almost all different crops. Its mechanism of toxicity is well understood in fungi but it effects in plants are scarcely studied. Aquatic macrophytes have been used as environmental biomonitor because of its biomass accumulation capacity of xenobiotics. The main goal of this study was to estimate the effects of azosystrobin on oxidative stress response in Myriophyllum quinquefolium and the chlorophyll a and b contents were tested. The plants were exposed to 0 (negative control), 0.1, 1; 10; 50 and 100 µg l-1 of AZX for 24 hours. The average content of chlorophyll was measured spectrophotometrically. Inhibition of CAT and POD at 50 µg l-1 was observed (p<0.05), suggesting the stress condition expected for any concentration. GST activity was not significantly different to the control at any concentrations tested (p>0.05) although there was no change in the chlorophyll a/chlorophyll b ratio among treatments. An increase in the content of both pigments at 100 µg/l with respect to control was observed (p<0.05). Our results show the importance of using biomarkers of different sensitivity, in the evaluation of potential negative effects of emergent agrochemicals in the environment, being a more detailed study highly recommended.

TU 189

Impact on surface water, stream sediments and macrophytes from the Aljustrel mining area (Portugal)

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The main environmental problem in the vicinity of Aljustrel mining area, as in other massive sulphide deposits of the Iberian Pyrite Belt, comes from the tailings deposited upstream and downstream from the confluence of the Água Forte stream. Water quality was assessed considering physico-chemical characteristics and ecotoxicological parameters. Sediment samples were analyzed considering general physico-chemical characteristics and a sequential extraction procedure was used to quantitatively assess trace element pool (As, Cu, Pb and Zn). Scirpus bulbosus samples were analyzed in order to assess trace element concentrations in the aboveground plant material.
Both surface water and sediments were extremely acidic at Água Forte stream, with pH values <2.92 for surface water and <3.12 for sediment samples. Surface water at Roxo stream presented pH values >7.26, apparently not affected by the confluence of the Água Forte stream, but the same was not true when considering the pH and other characteristics of the sediments. Ecotoxicological bioassays (luminescence inhibition of *Vibrio fischeri* and 48-h immobilization/mortality assay with *Daphnia magna*) were conducted with water samples. This study concludes the water samples were 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 Lemnaea: zinc storage and impacts on photosynthesis along frond developmental gradients

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9TU 192

**TU 192**

Dose-dependent effects induced by uranium (U) at pH 4.5 in Arabidopsis thaliana

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3TU 194

**TU 194**

The effect of pharmaceutical active compounds on oxidative stress response enzymes of the macrophyte Ceratophyllum demersum

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5TU 195

**TU 195**

Metal effects in *Fraxinus angustifolia* and its endophytic communities

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2TU 196

**TU 196**

Metal effects in *Fraxinus angustifolia* and its endophytic communities

J.C. Pinheiro1, C.R. Marques1, G. Pinho1, A. Mestre1, S. Mendo1, N.G. Gomes2, F. Gonçalves2, T. Rocha-Santos2, A.C. Duarte2, J. Romble3, J.P. Sousa4, M. Kissi1, A. Hadzhiivanov1, R. Perez1

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2TU 197

**TU 197**

Removal of some vineyard soils around the world, thus posing the problems of Cu toxicity to the organisms therein. Recently, a number of studies have found that some cations, such as magnesium (Mg) and calcium, may alleviate the rhizotoxicity of Cu to plants. In this study, a horsetail experiment was conducted to determine the influence of Mg concentration on the growth inhibition effects of Cu to grapevine roots. In addition, optical microscopy was used to examine the histological changes in root tissue at the different Mg concentrations. Results indicate a significant increase in root elongation inhibition concentration of Cu for root elongation at 10 μM Mg, compared to 1 μM Mg. The uptake of Cu in *L. gibba* seedlings, as assessed by leaf analysis, showed notable changes, mainly for plants exposed to the contaminated soil. The bacterial profiles from the control and reference soils showed more similarity with each other soil than with the control plant soil. The bacterial profiles from the plants were also analyzed. This analysis was made via PCR-DGGE technique, targeted for a conserved region of the 16S rRNA gene. One of the most important physiological processes in plants is photosynthesis. Apparently, the photosynthetic efficiency of plants exposed to 25-100 μM U was increased. This increase in photosynthetic efficiency strongly influenced the effects of metals on the photosynthetic apparatus. However, there is little information on how this may affect toxicological assessment in plants. Zinc accumulation, morphological distribution and cellular storage, in either bound or soluble form, are also important for zinc sensitivity/tolerance and will be affected by increasing zinc 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 Lemnaea. The maximum quantum efficiency of photosystem II, Fv/Fm, the effective quantum efficiency, Y(II), and photochemical quenching, qP, were measured in mature and young fronds as well as a developmental gradient within the plants. Zinc accumulation in mature fronds and root elongation at 1 μM Mg showed changes in the (bound and soluble forms) in the plants were also measured after seven days. L. punctata and L. minor accumulated more zinc in their tissues than L. gibba. Partitioning of zinc in L. minor was notably different from the other two species, zinc was stored mainly in roots and the bound-fraction. Fv/Fm and Y(II) in young fronds were more severely impacted by zinc than in mature fronds in all species. However, younger proximal sections of L. punctata fronds were more impacted than older distal frond sections compared to more homogenous impact in single Lemna fronds. Single colony, time-point or leaf-zone analyses may not show the full biological picture of the impact of a toxicant, especially not in L. punctata. Therefore, selection of Lemnaea species and developmental stages of fronds should be given careful consideration when using chlorophyll-a fluorometry for assessing chemical toxicity of a Lemnaea.
The toxicities of heavy metals are known to induce non-specific damages to almost all the organs of aquatic organisms. However, the tolerance of aquatic macrophytes to heavy metal pollutants is significantly higher than that of most higher aquatic plants and animals. A number of studies have also shown that nitric acid (HNO₃) increases the metal ion uptake of aquatic macrophytes. This study examined the use of the floating macrophyte Ceratophyllum demersum as a potential accumulator of toxic metals in water, and its potential as a phytoremediation agent.

The work presented here is part of a larger on going study about the metals and metalloids accumulation in aquatic plants of uraniferous geochemical province of Central Portugal. It is oriented for the use of aquatic plants as indicators of metal contaminated waters and their potential use in phytoremediation.

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The toxicity of iron nanomaterials to aquatic and terrestrial plants

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

The aim was to provide new 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 Fe₃⁺ > Fe⁺ > Fe.

The abundance of the metal P₃ in its different forms was determined in the submerged species Ceratophyllum demersum, introduced to the Diep River, Cape Town, South Africa. The Diep River passes through the urban metropolis of Cape Town and thus ultimately for humans.

The bioaccumulation of Se in widely distributed truly water moss was studied in Notranjska region, Slovenia, with different land use in the catchment, were sampled. Samples of water and moss were taken in all four seasons through the year and thus ultimately for humans. The occurrence and fate of selected human PhACs belonging to different therapeutic classes (non-steroidal anti-inflammatory drugs, anti-epileptics, contraception's and β-blockers) have been detected in many countries in sewage treatment plant effluents, surface waters, seawaters, groundwater and some drinking waters. The biological effect of even low concentrations of PhACs on non-target organisms, such as aquatic macrophytes, has so far received little attention.

In nature aquatic organisms are constantly exposed to xenobiotic compounds that cause the overproduction of oxidants or reactive oxygen species (ROS) resulting in oxidative stress by an increase in ROS production. Due to increased ROS accumulation PhACs may be selectively toxic to some organisms leading to ecosystem alterations.

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during years 2009, 2010 and 2011. The concentration of Se in water from all locations did not exceed 0.2 µg L⁻¹. Fontinalis antipyretica took Se in the range between 343 · 3039 ng Se·g⁻¹ on dry matter base (DM). The Se content varied, depending on the location and season. The highest content of Se was measured in the stream of Zerovnišcica that flows through agricultural area with pastoral farming, the value being 3039 ± 170 ng Se·g⁻¹ (DM). The amount of insoluble Se compounds after enzymatic hydrolysis using Protease (XIV) was around 75%. In soluble Se compounds only traces of Se (IV) and Se (VI) were found. No other Se compounds (SeMeSeCys, SeMet) were detected.

TU 201

The organic matter contribution of salt marsh vegetation to coastal wetland ecosystems: a case study in Jiangsu, China

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TU 202

Can we possibly derive environmental quality benchmarks for chemical mixtures?

M.Y. Leung

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In some cases, chemicals that are not bioavailable in the aquatic environment. For example, many antifouling biocide residues are often detected as a cocktail in water and sediment samples collected from coastal environments. Based on literature reviewed of studies on the combined ecotoxicity of antifouling biocides, we found that both additive and synergic effects together account for 80% of all cases in which about 35% cases are synergic. To allow more accurate risk assessment of concurrently occurring chemicals, there is a need to develop environmental quality benchmarks (EQBs) for their mixtures. In this presentation, we will introduce and discuss several possibilities of deriving EQBs for chemical mixtures. First, if all components in a chemical mixture are known to share a similar toxic mode of action, we can assume that the combined toxicity of the mixture would follow a simple concentration addition model, and the concept of toxic equivalency quotient (TEQ) could be applied to derive the EQBs based on lethal and/or effect concentrations expressed in terms of TEQ and/or TEQ concentration. This method has been applied to polychlorinated biphenyls, dioxins and dioxin-like compounds, and chlorinated polycyclic aromatic hydrocarbons. Second, if the mixtures contain chemicals with different toxic modes of action, it is possible to explore the use of the multidimensional species sensitivity distribution (m-SSD) approach. Here, we use binary mixtures of copper (Cu) and zinc (Zn). As an example, we illustrate the m-SSD method. For the Cu-Zn mixtures, the Cu-Zn mixtures showed a strong synergistic toxic effect to all test organisms. By utilizing the toxicity data, we are able to construct a two-dimensional SSD in form of a response surface, from which we can derive any specific hazardous concentration (i.e., EQB) for the two compounds. This novel method can be potentially applicable to a more complex mixture by employing non-parametric response surface models. Third, we will highlight the field-based SSD approach, which is implemented with the quantile regression method, can be used to derive sediment quality guidelines for any target chemical with consideration of the presence of chemical mixtures and biological interaction. Finally, we discuss the pros and cons of each described method.

TU 203

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

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Pesticides are regulated in the EU by the Biocidal Product Directive (98/8/EC) (BP) and the Plant Protection Product Regulation (Regulation (EC) No 1107/2009) (PRP) Reg. A new Biocide Regulation (BP Reg) is proposed and will likely come into force during 2013. Environmental and human health risks are evaluated before a product may be authorised and sold on the European market. Exposure to several substances based on the use of biocidal products and plant protection products are to be evaluated, according the PRP Reg and the BP Reg, respectively. This is more explicitly stated in the BP Reg compared to the BPD. Guidance on how to perform mixture risk assessment on biocide or plant protection products is very limited. However, several frameworks for tiered risk assessment of the combined effect of substances within products have been suggested or are being developed by e.g. WHO-IPCS and Competent Authorities from several EU Member States, such as DE, DK, ES and SE.

In the present work several such frameworks have been evaluated for risk assessment of both environmental and human health. We have used model products which are based on actual biocide or plant protection products, and the outcomes of the evaluations are compared from a regulatory decision making perspective. The suggested frameworks are all based on tiered approaches that include various levels of precaution and conservatism in order to be sufficiently protective of human health and of the environment.
even in data poor situations. The evaluation of the frameworks provides estimates of how protective and conservative they are in realistic regulatory assessments for both human health and environmental risk assessment.

The various frameworks and decision trees are designed to apply risk refinement efforts in the product dossiers should be included in forthcoming guidance.

TU 207

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

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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 other chemical mixture management (CMM) for the substance have to be considered in the CSR. In addition, manufacturer or importer have to create a safety data sheet (SDS) for substances to communicate conditions of safe use within the supply chain. ES are attached to the SDS. The formulators must assess the risk for the mixture they produce and create a SDS for the mixture on the basis of the information they get with the SDS and ES for the single substances. Although emissions to the environment results mainly from mixtures there is no guidance to assess the risk resulting from the use of mixtures. Industry developed the DPP+-method (based on the dangerous preparation directive) to assess from risk 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 substance. The method is based on the identification of a lead substance based on the classification of the substances in the Matrix Substances. However, some 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 label the environmental risk assessment of mixtures. We propose to improve the assessment of mixtures on mixture-ES based. Further, DPP+-proposals need to be 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 law 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 only considered to exist if a certain threshold of uncertainties could be balanced on structural or de-minimus considerations, even in the absence of effect data. Originally it was applied to toxicological evaluations of substances such as flavonoids, food contact materials, and for the contact assessment of chemicals (EFSA, US FDA, WHO IPCS). Later it was adopted 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 Weger et al. 2006) because of their specific MoA pesticides have some lower NOECs and thus were not included.

The TTC concept would be helpful to focus the assessment of chemicals that occur in environmental media. Recent SCHER on Toxicity and Assessment of Chemical Mixtures recommended that no further risk assessment is needed for substances that do not exceed the TTC. Thus the TTC could serve as a filter to avoid making unnecessary investigations and improvements of a regulatory framework (OECD, 2005) for risk 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 the accuracy is on the opposite side.

An ETNCaq for pesticides is not available to facilitate the consolidation of environmental information on mixtures. Proposals for possible improvements of DPD+ are mentioned above. This proposal need to be adequately addressed in the selection of lead substances and the derivation of safe conditions of use. The above considerations question if DPD+ is a reasonable instrument to label the environmental risk assessment of mixtures on mixture-ES based. Further, DPP+-proposals need to be further elaborated and included in a method to assess the risk of mixtures. The interpretation of DPD+ (only substances with classified for environmental hazards need to be addressed in the risk assessment for the environment) is regarded as not in line with the interpretation of the law 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 209

**Relevant potency thresholds: 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 evaluated (Safe 1990), then those chemicals may be assumed to be dose additive (DA) for specific toxic endpoints. Risk assessment is based on the “prudent dose” concept (Pitman 1988) with the outbreak entitled “Prudent Dose Recommendations” (Brady and Research Triangle Institute 2005) 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 MoAs. TEQs require toxicity data upon which chemical assumptions are based. Its recommendations and a published human health risk assessment that used the DA-COAS concept were evaluated to determine how firmly the concept is supported by the data and with what level of certainty the results may be extrapolated to lower doses and to humans. The underlying assumptions of the model and the risk assessment were explored for consistency with available human data, using data from the chemicals used as test chemicals. Proposals based on the DA-COAS concept were compared with other human clinical experience to determine whether those predictions are verifiable and consistent. Based upon these 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-COAS 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-COAS 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 mixtures. This test is a conventional method to characterize ecological mixture toxicity, a method that can estimate chemical toxicity in shorter ecosystems or provide information on the mode of action of chemical substance would be advantageous. Applications for a new method including improve the evaluation efficiency for toxicity screening of a large number samples for regulatory filings, toxicity identity evaluation of chemical mixtures, and efficient toxicity screening. By investigating a new rapid estimation method of the thymine (DF) from algae. The DF is a special type of luminescence; it detects the growth of only those cells that have photosynthetic capacity. Since the DF originates from re-excitation of chlorophyll a, it 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 mixture) on algae by both the DF inhibition and analysis of the DF decay curves. We also compare the detection characteristics of DF and other rapid estimation methods, including chlorophyll fluorescence-based photosynthetic activity measurement (PAM) and Microtox®; a common rapid bioassay that uses luminescent bacteria to evaluate complementary sensitivity between photosynthetic and non-photosynthetic microbial bioassay.

TU 211

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

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Coastal zones of lakes could be contaminated by a cocktail of substances coming from urban discharges or diffuse watershed run off. This type of contamination especially concerns micro pollutants such as pesticides. Benthic diatoms, which are a major component of benthic biomass, are then exposed to several pesticides that could interact together to increase the toxicity (mixtures effect). Species Sensitivity Distribution (SSD) models are partly used to extrapolate protective concentrations for a community exposed to a single or a cocktail of contaminants. To predict the toxicity of a mixture, two concepts are used depending on the mode of action of the mixture components (Concentration Addition (CA) or Independent Action (IA)). The main objective of the study was to assess if SSD using (CA or IA models) were reliable in terms of toxicity prediction of herbicide mixture on benthic diatoms and if this SSD could be used as a management tool for aquatic ecosystems. As a first step, eleven species of benthic diatoms were exposed to 4 herbicides, separately (diuron, isoproturon, terbutryn, atrazine), in 96h monospecies growth inhibition tests.
Finally, we compared the toxicity thresholds predicted by CA and IA models to the measured toxicity thresholds. We also assessed the species ranking between the mono herbicide SSD curves and the mixture SSD curves.

TU 212
Effects of Atrazine and 2,4-D mixtures on Lemma minor
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Thailand is a country where agriculture is very important in terms of the economy. Pesticides are therefore widely used in Thailand and this usage is increasing. As a wide range of pesticides is used in Thailand, aquatic life is exposed to a mixture of compounds. In order to understand the potential toxic interactions of pesticides in use in Thailand, the aim of the present study was to test the interactive effects of two herbicides, atrazine and 2,4-D, on the growth of the freshwater green alga. The test was carried out according to the OECD guideline 211. The species ranking of the mixture was subsequently tested using the Concentration Addition Reference Model.

TU 213
Predictive mixture toxicity assessment of pesticides in Swedish surface waters
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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 (SCHEER) has recently put forth concentration addition as a conceptual basis for the determination of environmental quality standards for mixtures. In this study, we have predicted the risks from pesticide mixtures within Swedish surface waters using the concentration addition concept. Data from the national pesticide monitoring program in Sweden has been combined with experimental data from the USEPA's database for single chemical toxicity and predicted toxicity in order to determine the risks from pesticides 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 additional questions. Among these the effect on risk from season, taxa most at risk, average error factor 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 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 checking
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Environmental quality standards (EQS) are used under the EU Water Framework Directive to determine the chemical status of a water body. At present, compliance with EQS is only checked on the single substance level. In order to account for the possibility of toxic interactions which are inherent in mixture studies, a SSD curve (SSD-EC50) for each herbicide. The different individual SSD-EC50 curves were combined, using CA or IA hypothesis, in order to predict the toxicity of several mixtures. This first step allowed us to predict hazardous concentrations (HC).

EC50 values derived from dose-response curves allowed to build a SSD curve (SSD-EC50) for each herbicide. The different individual SSD-EC50 curves were combined, using CA or IA hypothesis, in order to predict the toxicity of several mixtures. This first step allowed us to predict hazardous concentrations (HC).

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

We compared the toxicity thresholds predicted by CA and IA models to the measured toxicity thresholds. We also assessed the species ranking between the mono herbicide SSD curves and the mixture SSD curves.

TU 215
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]fluoranthene (20), dibenzo[a,l]pyrene (30), and benz[a]acanthrylene (60). If this approach is adopted, it will be necessary to quantify all 26 compounds in media at contaminated sites, despite the fact that most of them are not suspected to be carcinogenic. In addition, it may be necessary to re-open and reassess sites that have already received regulatory closure. However, there are many uncertainties, as well as scientific criticisms of the proposal. Most importantly, the Weight of Evidence Evaluation was performed. Second, USEPA assumed that all PAHs act by a similar mode of action with no additional evidence. USEPA also failed to validate the derived RPFs using cancer response data from real world complex mixtures, such as coal tar. This paper summarizes the USEPA's approach to deriving PAH RPFs and the toxicologic 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 216
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

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National Institute for Public Health and the Environment, Rijswijk, Netherlands

Polyaromatic 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 (EAR). These PAHs have been selected due to their occurrence in soil particles and the potential for carcinogenicity. PAHs were measured in spiked soils, in soils from a test site, and in spiked solutions of the same PAHs. The average detection level was 0.1 mg/kg for the spiked soils and 0.01 mg/kg for the spiked solutions. The results show that PAHs are present in the soils at concentrations that are above the detection level. The detection of PAHs in the soils indicates that PAHs are a potential risk to the environment.

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TU 223  Prediction of mixture toxicity for metals in soil: a reality-check
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2Eurometaxus, Brussels, Belgium

Two factors play a role in mixture toxicity of metals in soil: (i) the concentration of metals, which is generally above toxic levels for individual metals, and (ii) the interaction among metals. Both factors need to be taken into account for realistic risk assessment of heavy metals in soil. However, it is far from obvious how these factors interact. Thus, to better understand the reality of mixture toxicity for metals in soil, the following study was performed on 12 soils that have been ranked according to their concentration levels of individual metals and their toxicity in a previous study of this group. The ranking order of the soils was compared to results of field measurements of heavy metal concentrations in soil. The results showed that the ranking order of the soils was not significantly correlated with the field measurements. This indicates that the reality of mixture toxicity of heavy metals in soil is often under-estimated. Further research is required to better understand the interaction among metals in soil and their toxicity.

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

When evaluating exposure to chemical mixtures, it is crucial to consider the potential toxic effects of the individual substances present in the mixture. However, the toxicity of a mixture may differ from the sum of its individual components. This study aimed to evaluate the toxic effects of a chemical mixture composed of cadmium (Cd), copper (Cu), and zinc (Zn) in Wistar rats (200-240 g). The rats were exposed to different concentrations of the mixture (1000, 2000, and 3000 mg/kg bw) for a period of 28 days. Control groups were exposed to saline or DMSO as vehicle. The following endpoints were examined: liver weight, morphology, and histology, as well as biochemical analyses of liver function. The results showed that the mixture caused significant liver damage, with increased liver weight and histological changes indicating hepatocellular injury. The study highlights the importance of evaluating the toxic effects of chemical mixtures, as the toxicity of the mixture may not be simply additive.

TU 225  Assessing human health risk from farmed milkfish consumption: considering toxic interaction among arsenic, copper, and zinc mixture
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1National Taiwan University, Taipei, Taiwan

Milkfish is a popular food source in Taiwan, and its consumption has been linked to health risks. This study aimed to assess the potential health risks associated with the consumption of farmed milkfish, which contains various metals, including arsenic (As), copper (Cu), and zinc (Zn). The health risks were evaluated using various models, including the risk assessment framework (RAF) and the ADAM model. The results showed that the consumption of farmed milkfish poses a significant health risk, with estimated incremental cancer risks ranging from 1.0 to 10.0 per 100,000 people. The study highlights the importance of considering toxic interactions among metals when assessing health risks.

TU 226  Whether BDE209 interacts with Cd hepatotoxicity?
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1University of Belgrade, Faculty of Pharmacy, Belgrade, Serbia
2Military Medical Academy, Belgrade, Serbia

The interaction between cadmium (Cd) and brominated diphenyl ethers (BDEs) has been a topic of interest in toxicology. This study aimed to investigate the interaction between Cd and BDE209 in Wistar rats (200-240 g). The rats were exposed to different concentrations of BDE209 (0, 100, 200, 400 mg/kg bw) for a period of 28 days. Control groups were exposed to saline or DMSO as vehicle. The following endpoints were examined: liver weight, morphology, and histology, as well as biochemical analyses of liver function. The results showed that BDE209 increased liver weight and histological changes, indicating liver injury. The study highlights the importance of considering the potential interaction between Cd and BDE209 when assessing health risks.

TU 227  Waste recovery - a special treatment under REACH
F. Vermuere, A. Vassart, P. Anthoine, N.M. Debelecq
ARCHE, Gent, Belgium

Waste recovery is an important aspect of waste management, especially under the framework of REACH. This study aimed to evaluate the potential of waste recovery as a treatment under REACH. The results showed that waste recovery can be a viable option for the treatment of waste, with significant economic benefits. The study highlights the importance of considering waste recovery as a viable treatment option under REACH.

TU 228  Toxicity evaluation of disperse red 1 textile dye using freshwater organisms from different trophic levels - a PNEC proposal
I. Vacchi, G. Honório, R. Ribeiro, G.A. Umbuzeiro
University of São Paulo, Limeira, Brazil

Disperse red 1 is a commonly used textile dye in the textile industry. This study aimed to evaluate the toxicity of disperse red 1 to freshwater organisms from different trophic levels. The results showed that disperse red 1 had significant toxicity to freshwater organisms, with NOEC values ranging from 0.01 to 1.0 mg/L. The study highlights the importance of considering the toxicity of disperse red 1 to freshwater organisms, especially in areas with high trophic diversity.

TU 229  Inhibition of liver regeneration by phosphoinositide-specific phospholipase Cgamma in vivo
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Liver regeneration is a critical process for the maintenance of liver function. This study aimed to investigate the role of phosphoinositide-specific phospholipase Cgamma (PLCgamma) in liver regeneration. The results showed that PLCgamma is involved in the inhibition of liver regeneration. The study highlights the importance of considering the role of PLCgamma in liver regeneration and its potential as a target for the development of new therapeutic strategies.
Industrial enzymes - an example of the environmental risk assessment of a UVCB (unvariable or unknown composition, complex reaction products or biological materials)

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

Industrial enzymes are general of low ecotoxicity except for proteolytic enzymes, where some exhibit acute aquatic toxicity. Based on the available ecotoxicity data industrial assessment used by a policy maker can make a difference to the quality of life and health of (animal or human) populations living at a certain location. In the context of the current Life Cycle Impact Assessment, human health impacts due to water consumption have only been addressed by two published methods so far. Both methods assess generic estimates of uncertainty, especially regarding the endpoint CFs. However, they can be used to produce maps of uncertainties and also to indicate in which regions applying proper LCA including uncertainty and sensitivity analyses. On the other hand, concepts for reporting spatial uncertainty by method developers are still under development.

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 archetypes development in impact assessment of chemicals
S. Sala, B. Cuffo
European Commission - Joint Research Centre, Ispra, Italy
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-chemical properties, may exert global impact. Variability of environmental parameters may affect the fate and the exposure up to orders of magnitude. Consideration of 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 suitable archetypes.

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 MonteCarlo 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 the result of the analysis for the pesticide Lindane. The overall variability of the removal rate from air is up to 5 orders of magnitude, mainly driven by four out of the eleven environmental parameters proposed in the model. These four parameters were then used as basis for building archetypes.

TU 235 Dealing with uncertainties in UNEP SETAC toxicity model
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In the field of LCA, the issue of uncertainty generates a growing interest. Although this issue has not yet been systematically addressed in existing databases and models, 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.

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 take into account the potential 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 the uncertainty, database documentation, substance coverage, as well as user interaction are key issues.

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

Possibilities must be given to each user to view, or edit the specific documentation of a particular parameter. Reporting an error in a parameter value also have to be easy, as well as the feasibility to validate the validity of each parameter value.

Our practical experience and ideas, related to management of these uncertainties in USEtox model will be presented.

Those approaches have been implemented in a web application prototype that allows uncertainty calculation and documentation completion.

TU 236 Standard information modules as basis for LCA reliability in the manufacturing context
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In the field of LCA, the issue of uncertainty generates a growing interest. Although this issue has not yet been systematically addressed in existing databases and models, 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.

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 take into account the potential 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 the uncertainty, database documentation, substance coverage, as well as user interaction are key issues.

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

Possibilities must be given to each user to view, or edit the specific documentation of a particular parameter. Reporting an error in a parameter value also have to be easy, as well as the feasibility to validate the validity of each parameter value.

Our practical experience and ideas, related to management of these uncertainties in USEtox model will be presented.

Those approaches have been implemented in a web application prototype that allows uncertainty calculation and documentation completion.

TU 237 Taking into account variance of primary data in decision making: a method for the building sector
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In the field of LCA, the issue of uncertainty generates a growing interest. Although this issue has not yet been systematically addressed in existing databases and models, it neither can be neglected, nor addressed too simply. Although uncertainty has partly been quantified in USEtox model, several questions remain open to date.

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Those approaches have been implemented in a web application prototype that allows uncertainty calculation and documentation completion.

TU 238 Uncertainty evaluation of LCA models input data using Monte Carlo Method
T.B. Dos Santos1, J.R.F. Arruda2, E. Evrard3, D. Brussels4
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This is a contribution to the development of methodologies in considering uncertainties in LCA studies. The main results are a solid methodology for dealing with uncertainties in LCA using stochastic LCA models that enable practitioners to validate their results. The case study consists of an acoustic panel made up of cotton fibers, polyethylene and scaps 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® code, with the model inventory table and in the CML 2 baseline 2000 impact assessment tables, all exported from SimaPro®. The same approach is followed for both models. First, a sensitivity analysis is made in the determined LCA model. Next the random parameters are chosen 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
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2Harmonisation 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 a 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
EC05P - Occurrence, fate and impact of atmospheric pollutants on environmental and human health

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

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

The generally low PCB concentrations in the soils of remote mountains may mask the phenomenon of cold-trapping.

TU 242
Urban background levels of novel brominated flame retardants in ambient air in Southern Bavaria, Germany

D.J. de Boer, C. Lindstrom, R. Sturm
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HBCD (17α, α, γ-HBCD) and the brominated flame retardants were detected in concentrations from 0.08 to 2.3 pg m⁻³, and PCBs in 31 congeners and MA had 24 congeners while only 12 and 6 congeners appeared above method detection limits in CT and BG samples, respectively. Mean total PCB concentrations in the soils of remote mountains may mask the phenomenon of cold-trapping.

TU 243
Occurrence, fate and impact of atmospheric pollutants on environmental and human health

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Air pollution data have described to produce many toxic effects including endocrine disruption. Evaluation of such types of effect cannot be based only on data from chemical analyses. That shows the importance of incorporation of specific bioassays into evaluation part of the air pollution monitoring programs. The utility of these methods in monitoring of atmospheric pollution levels has been shown previously. It is known that levels of pollutants in atmosphere are closely related to type of pollution source and a season period. In our study, we focused mainly on the latter factor. Air samples were collected for one year at a traffic-burdened urban site in Brno (Czech Republic) and a village site about 8 km from Brno city to address the influence of city agglomeration as an air pollution source on the surrounding area. The samples were analyzed for a wide range of parameters and pollutants. In this work, we show the seasonal variation of aryl hydrocarbon receptor (AhR) mediated effects, anti-/estrogenicity and anti-androgenicity. These parameters were assessed using in vitro reporter gen assays based on mammalian cell lines. This research was supported by GACR 570/10/P229 and CEETOZON (CZ.1.07/2.3.00/20.0160)

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

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D.J. de Boer, C. Lindstrom, R. Sturm
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HBCD (17α, α, γ-HBCD) and the brominated flame retardants were detected in concentrations from 0.08 to 2.3 pg m⁻³, and PCBs in 31 congeners and MA had 24 congeners while only 12 and 6 congeners appeared above method detection limits in CT and BG samples, respectively. Mean total PCB concentrations in the soils of remote mountains may mask the phenomenon of cold-trapping.
3. Results and discussion

The spatial distribution and potential sources of polycyclic aromatic hydrocarbons (PAHs) over the Asian marginal seas and the Indian and Atlantic Oceans was investigated during the expedition of the Scholar Ship from January 16th to March 26th, 2010. Two sets of air samples were taken from the East and South China Seas and the Indian and Atlantic Oceans, providing an opportunity to assess spatial trends and potential sources of atmospheric PAHs over those 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 15PAHs in the particulate phase were found at Indian Harbor and close to Guinea, due to the significant contribution of SOCs along the mountain forest and clearing (2-4). This study aimed to compare atmospheric PAH concentrations in the forest canopy and nearby clearing the Lys Valley, Aosta, Italy, on the slopes of Mont Mars.

2. Materials and methods

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

3. Results and discussion

3.1. Concentrations

The average value of the total PAHs (ΣPAHs) concentrations of gaseous and particle phase was 1860 and 176.1 pg m⁻³ for the forest, and 1230 and 123 pg m⁻³ for the clearing. Seasonality, the PAH concentrations in the mountain atmospheric decrease dramatically from R1 to R4 at a factor of 3800 for gaseous phase and 5.3 for particle phase, respectively, which indicated that the forest filter effect (FFE) was much higher for particle associate PAHs than gaseous phased PAHs.

3.2. Altitudinal Distribution

PAH concentrations in the forest canopy were lower than those in the clearing. 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 PAHs in the forest because of lower wind speed. As shown in Figure 2, log F/C and log KOA showed different correlations in the same 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 particles. K values can influence the effect of the forest canopy.

TU 248

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


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

TU 249

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

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

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

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

The 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.

Among the various sources of PAHs, both natural and anthropogenic, atmospheric transport has been identified as a major route for 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.

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.

TU 250

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

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

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

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

Another factor that has to be considered when assessing human respiratory risks is persistent chemicals that are associated with the atmospheric particles and represent additional inhalation risk when released in human bodies. Size-specific distribution of these chemicals is an important parameter to monitor the risk of exposure, health effects, and risk assessment.

Specific partitioning of organic chemicals between various fractions of the atmospheric particles has been previously studied for polycyclic aromatic 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 this study aimed to assess 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.
A significant fraction of organic pollutants can be transported through the atmosphere and can be transported far from their sources associated to particulate material or dissolved. Pesticides are widely applied for agricultural treatments and polycyclic aromatic hydrocarbons are formed as consequence of urban, transport and industrial activities. Mar Menor lagoon is the discharging point of drainages from a large agricultural area where a variety of pesticides are used. This lagoon is surrounded by several villages and that have, especially in summer, an intense touristic activity. There is also a military airport close to the lagoon and this area is influenced by a very industrialized pole, which is located at 20 km south. There were not previous data of pesticides and PAHs concentrations in air of in this area. In order to estimate the levels of organic pollutants in air and the potential atmospheric input in Mar Menor lagoon, passive samplers consisting of polyurethane foam (PUF) disks housed in chambers were deployed at six sites around the basin of this lagoon. 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 was analyzed gas chromatography with mass spectrometry. The quantification limits were lower than 10 ng/L for the majority of the considered analytes. This method has been validated for more than 80 organic pollutants, polycyclic aromatic hydrocarbons and up to 23 have been identified. PUF samples from active and passive samplers. The range of estimated air concentrations is very wide (100 pg/m3-2 ng/m3), and depends on the specific compound, as consequence of the proximity of sources and environmental variables.

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

A . Cabrerizo, J . J. Dachs

b) samples from the
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. In order to investigate the potential of these sources to challenge the ecosystems, one post-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, US. The study site is located in nearby Biscayne and Everglades National Parks (NP). 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 from the region to the overall endosulfan emission to the atmosphere. The fraction has an α fraction of approximately 0.7, whereas volatilization is predicted to have an α fraction of 0.9. The median fraction observed at Homestead during periods of high and low agricultural activity was 0.84 and 0.86, respectively, indicating that drift contributes to the atmospheric concentration. The median fraction at Everglades NP was 0.88 and 1.0 during high and low agricultural activity, respectively, and at Biscayne NP was 1.0 indicating air concentrations are primarily influenced by regional volatilization. The near-invisible isomerization after application of β-endosulfan to α-endosulfan also influences the value of the α fraction.

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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 (offices, schools, hospitals) environments. An extensive indoor 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- Sensidyne), operating at a flow of about 120 mL min⁻¹. Sampling cartridges were desorbed using the Automatic Thermal Desorber UNITY2 coupled to a GC/MS-system. Concentrations of total siloxanes ranged from 20.6 to 467 ug/m³ and from 55.7 to 424 ug/m³ in Italian and UK samples, respectively. Cyclic volatile methyl siloxanes were found in bathrooms; in particular, D₅ represented the principal compound probably due to its dominant presence in most hand and face creams, cosmetics, hair lotions and among 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 different concentrations were found in different types of indoor air environments. The daily inhalation exposure (DIE) to cyclic and linear volatile methyl siloxanes was also evaluated.

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

N.S. Jovicic, 1, J.R. Radonic, 1, M.M. Turk Sekulic, 2, M.B. Vojinovic Milarovic 3

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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 (offices, schools, hospitals) environments. An extensive indoor 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- Sensidyne), operating at a flow of about 120 mL min⁻¹. Sampling cartridges were desorbed using the Automatic Thermal Desorber UNITY2 coupled to a GC/MS-system. Concentrations of total siloxanes ranged from 20.6 to 467 ug/m³ and from 55.7 to 424 ug/m³ in Italian and UK samples, respectively. Cyclic volatile methyl siloxanes were found in bathrooms; in particular, D₅ represented the principal compound probably due to its dominant presence in most hand and face creams, cosmetics, hair lotions and among 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 different concentrations were found in different types of indoor air environments. The daily inhalation exposure (DIE) to cyclic and linear volatile methyl siloxanes was also evaluated.

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 acts as a greenhouse gas. In the atmosphere, methane seepage from surface rock layers into the atmosphere 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 through channels conduct large portions (91-95 %) of gas emitted from ground surface. The gas flow from individual through channel ranges from 0.00069 to 0.00136 cubic meter/s. The study of impact of methane seepage on human health shows that there are cases of methane poisoning of people living on the ground floor. The frequency (F) of the methane poisonings was statistically analysed. As a result, it is established that frequency F is dependent on average value of gas volumetric flow rate from individual through channel (q), number of through gas-conducting channels (k) located within a 20 m radius around each dwelling house. It is defined that value of F increases according to (q^n), where a variable exponent is the gas flow q multiplied by logarithm of the number k of gas-conducting channels.

Environmental impact of using alternative fuels in a Spanish cement plant

J. Rovira 1, M. Marín 2, M. Nadel 1, M. Schulmacher 1, J.L. Domingo 1

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Cement industry produce around 5% of the whole world anthropogenic CO2 emissions, either as direct (descarboxylation of calcium carbonate -raw material-) or indirect (fuel implementation, and the content of metals and polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) was determined . Monitoring campaigns have been conducted in the surroundings of facilities of different characteristics, in terms of used fuel (sewage sludge, refuse derived fuel, etc.) or zone of production. The results show that 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 environmental and economically beneficial. On the other hand, the population living closest to the cement plants are generally concerned about the possible effects on the environment and health. The concentrations of total siloxanes ranged from 20.6 to 467 ug/m³ and from 55.7 to 424 ug/m³ in Italian and UK samples, respectively. Cyclic volatile methyl siloxanes were found in bathrooms; in particular, D₅ represented the principal compound probably due to its dominant presence in most hand and face creams, cosmetics, hair lotions and among 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 different concentrations were found in different types of indoor air environments. The daily inhalation exposure (DIE) to cyclic and linear volatile methyl siloxanes was also evaluated.
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. Marxi, M. Nadal1, M. Schuhmacher, J.L. Domingo1

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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 by-products (such as 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 enhancement of the amount of alternative fuels 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 different soil, herbage and air samples around this facility before and after the partial fuel substitution. The potential changes on the health risks for the population living around the facility were also assessed.

In general terms, 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. Vilavert, M. Nadal, M. Schuhmacher, J.L. Domingo

I. R. Gutiérrez

TU 270

Persistent organic pollutants (POPs) in ambient air, human breast milk and edible fish - a potential for health risk for Ghana

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Centre for Marine Environmental Studies (CMES), Ehime, Japan

Levels of persistent organic pollutants (POPs) in rural and urban background air of southern Ghana were measured in 2008 using polyurethane foam (PUF) disks passive air samplers (PAF) (referred to as PUF-disks, respectively). The object 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 Bosumtwi 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

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Burning of municipal solid waste (MSW) in cement process has become an increasingly 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 cells nor for micro-organisms. Thus there is a need for established microscale toxicity screening of unknown combustion born particles.

Here, in this study, two ISO standardised bacterial contact assays and one yeast biotest were modified for the use with fine dust. Having different endpoints for 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 whole not as extracts. Particulate matter was measured electrostatically from different furnaces in the flue gas channel. Suspended in water, vortexed for 1 min, and ultrasonicated 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 globiformis 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 FA, FA-P exhibited cytotoxicity between 0.1 and 1 mg FP/mL. High contents of Zn supposedly caused cytotoxicity in B. FP A was slightly genotoxic (+59) at 1 mg/mL and potentially estrogenic. Besides PAFs, 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.
EC06P - Sorption and bioavailability in sustainable remediation of organic chemicals

TU 276
Simulating the bioavailability of mineral hydrocarbons for earthworms using different extraction methods
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In the context of assessing the habitat function of contaminated sites only the bioavailable contaminant fraction of relevance is. Information on the habitat function, therefore, can be obtained in ecotoxicological tests performed with representative soil organisms. Depending on the test organism the duration of effect measurements varies between several weeks and several months. In order to obtain results focusing on bioavailability faster, chemical methods are being developed to predict the amount of contaminant that can be taken up by a specific organism. Suitable methods have to simulate the respective exposure pathways and represent the bioavailable fraction of the contaminant. Extraction procedures for mineral hydrocarbons were regarded with respect to their suitability for simulating the bioavailable fraction for soil organisms. As effect parameter the earthworm reproduction was used 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 extraction using chloroform, (II) fraction of C10-C40 using chloroform, (III) water based extraction - shaken using shaking extraction procedure and (IV) water based extraction - use of an ultra sonic phase: HPCD.

The best relation between an increased concentration of contamination and a reduced habitat function was detected for the C10-C22 fraction of the HPCD-extraction. Relations with the C10-C40 fraction of the HPCD-extraction and with the C10-C22 fraction of the exhaustive extraction were less pronounced. No relation was observed for the C23-C40 fraction of the HPCD-extraction. For the C10-C22 fraction of the HPCD-extraction seems to be a good indicator for the available fraction. A value of 300 mg/kg may be a suitable threshold value regarding the habitat function of soils. Values exceeding this content may indicate that there is concern for a reduced habitat function.

TU 277
Impact of geosorbents on bioavailability of polycyclic aromatic hydrocarbons to humans by oral uptake
W. Male, B. reveals, A. Koons, C. Achten

University of Minnesota, Institute of Geology and Paleontology, Münster, Germany

To assess the health risk from human uptake of contaminated soil from hand-to-mouth activity, it is prerequisite to know the oral bioavailability of the contaminants. Soil-bound contaminants can be mobilized by digestion juices and hence become available for absorption through the intestinal wall [1]. With a physiologically based extraction model (PBET) that is simulating the situation in the human gastrointestinal tract, it is possible to determine the bioaccessible fraction of soil-bound contaminants.

Previous studies revealed strong variabilities of the bioaccessible fraction (23-68 %) of polycyclic aromatic hydrocarbons (PAH) in natural site samples [2]. Reasons for these variations are unknown. Apart from worldwide use of varying PBET models, we assume that quality and quantity of present geosorbents in the samples lead to variabilities. The results obtained in the earthworm studies were compared with the concentration of the mineral hydrocarbon contamination using different extraction procedures: (I) total content using extraction using chloroform, (II) fraction of C10-C40 using chloroform, (III) water based extraction - shaken using shaking extraction procedure and (IV) water based extraction - use of an ultra sonic phase: HPCD.

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TU 278
Selectivity of PCBs at low level with high precision using GC-MS/MS Triple Quadrupole
W. Phillips, D. Steiniger, T. Robarge, A. Mayer, M. Godula

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The objective of this work was to compare the toxicological value of different soil sorbents in regard to the chemical composition. In this context we investigate airborne PM from different sites in the Region of Aachen. A549 cells were exposed to increasing PM concentrations followed by analyses of cell viability, pro-inflammatory and oxidative stress response.

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

The results of the ambient PM and of the different samples show significant differences in the PM composition 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).

TU 279
Impact of geosorbents on bioavailability of polycyclic aromatic hydrocarbons to humans by oral uptake
W. Male, B. reveals, A. Koons, C. Achten

University of Minnesota, Institute of Geology and Paleontology, Münster, Germany

To assess the health risk from human uptake of contaminated soil from hand-to-mouth activity, it is prerequisite to know the oral bioavailability of the contaminants. Soil-bound contaminants can be mobilized by digestion juices and hence become available for absorption through the intestinal wall [1]. With a physiologically based extraction model (PBET) that is simulating the situation in the human gastrointestinal tract, it is possible to determine the bioaccessible fraction of soil-bound contaminants.

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The best relation between an increased concentration of contamination and a reduced habitat function was detected for the C10-C22 fraction of the HPCD-extraction. Relations with the C10-C40 fraction of the HPCD-extraction and with the C10-C22 fraction of the exhaustive extraction were less pronounced. No relation was observed for the C23-C40 fraction of the HPCD-extraction. For the C10-C22 fraction of the HPCD-extraction seems to be a good indicator for the available fraction. A value of 300 mg/kg may be a suitable threshold value regarding the habitat function of soils. Values exceeding this content may indicate that there is concern for a reduced habitat function.
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 sediment on ecosystems and human health, a risk assessment guideline tool for contaminated marine sediments was recently developed in Norway. In many legal policy standards overestimate the risk posed by these sediments as a result of much stronger partitioning to organic phases in the sediment than commonly assumed. Therefore tools to estimate contaminant bioavailability in sediments, bioaccumulation potential and risk of transfer to the overlying water phase are needed. This study aimed to assess (predict the potential for) the in vivo bioaccumulation of contaminants from historically polluted sediments using simple generic sorption models and from freely dissolved pore water concentrations measured with passive sampling. Freely dissolved pore water concentrations were measured in batch experiments in the laboratory using low density polyethylene (LDPE). In vivo exposures were carried out using Nereis virens and Hinia reticulata.

TU 281
Bringing (bio)accessibility extractions to the next level - combining mobilisation medium and infinite absorption sink

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There is sufficient ‘sink’ in current bioaccessibility determinations of organic pollutants in soils. Caco-2 and HepG2 cells, while useful, lack direct relevance to field conditions. This study assessed the impact of choosing, for bioaccessibility extraction, a method that simulates an infinite absorption sink. Soils were spiked with a mixture of priority polycyclic aromatic hydrocarbons (PAH) and activated carbon which lead to the contaminant trap method. This contaminant trap is a practical and simple approach for the isolation and quantitation of the desorption resistant contaminants in soils, its main limitation being that it is not possible to backtrack from the extraction of the contaminant trap. The next step was to find a polymer material and format that can act as infinite sink and allow simple back extraction. Silicon rods were chosen, which are already used in silicon rod extraction and passive sampling. This sampling was found to be a better and more relevant bioaccessibility extraction approach and simplified the analytical procedures. The silicone rods were applied to both cyclodextrin solutions and artificial digestive fluids, using PAHs as model compounds. Passive dosing was applied to determine the free fraction and partitioning of PAHs in cyclodextrin and digestive fluids, which in turn was used for sink dimensioning. Validation experiments with spiked cyclodextrin and digestive fluids confirmed an efficient absorption of PAHs by the silicon rod. Finally, determination of the readily desorbing PAHs from a wood wool sample with and without the absorption sink clearly showed that a sink is needed and makes a substantial difference.

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

TU 282
Bioavailability studies: 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 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 (20x) and benzo(k)acehthylene (100x). If this approach is adopted, human health risks from exposure to PAHs will increase considerably, and risk-based cleanup 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 in risk assessments. The literature, USEPA’s recent recommendation, and USEPA’s recent supported a policy of performing in vivo bioavailability studies of site-specific media impacted by complex organic compounds. The authors have designed such an in vivo study and are seeking its regulatory approval for execution in 2012. This paper will summarize literature bioavailability results for PAHs and discuss methodological issues regarding the ongoing study, which is a robust, internally consistent animal bioavailability study with site aged soils (air, soil, sludge) discussed included typical exposed organisms (fish, macroinvertebrate), target PAHs, animal species and strain, sampled biological media (blood, urine, feces, other tissues), pharmacokinetic issues (single time point versus area under the curve), and analyses of interest (parent PAHs versus PAH metabolites vs DNA or protein adducts).

TU 283
Desorption-resistant fraction in PAH-contaminated soils: aged spiked soils can not resemble historically contaminated soils

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University of Natural Resources and Life Sciences Vienna, Austria, Tulln, Austria

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

TU 284
Highways versus pipelines - modelling the contributions of two fungal transport mechanisms to efficient bioremediation

B. Trubnik, K. Jobst, L.Y. Wick, S. Foji, H. Harms, K. Frank
UFZ - Helmholtz Centre for Environmental Research, Leipzig, Germany

Based on experimental studies, two fungus-mediated transport strategies have been suggested to facilitate bacterial degradation of organic soil contaminants: bacteria may use liquid films around fungal hyphae for quick dispersal (‘fungal highways’), and fungi may take up and translocate contaminants through their mycelial network (‘fungal pipelines’). Both mechanisms promise to enhance the bioavailability of contaminants to degrading bacteria. However, a comparative study of their respective
efficiency in increasing biodegradation performance, and its dependence on environmental conditions, has hitherto not been conducted. Using a microbiological simulation model, we first 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 heterogenous bioavailability of PAHs. In turn, this. Our results of soil samples had under laboratory conditions a similar stimulatory effect on the slow degradation of PAHs in soil slurries. The stimulation of the indigenous bacterial population resulted in both situations a similar residual concentration of PAHs. We can conclude that the effects of plants on the residual concentrations of PAHs could be reproduced under laboratory conditions by slurring, shaking and the addition of root exudates.

**TU 287**

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

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

Instituto de Recursos Naturales y Agrobiología de Sevilla, Sevilla, Spain

**Abstract:** We conclude that the effects of plants on the residual concentrations of PAHs could be reproduced under laboratory conditions by slurring, shaking and the addition of root exudates.

**TU 288**

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

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

Instituto de Recursos Naturales y Agrobiología de Sevilla, Sevilla, Spain

**Abstract:** The success of the rhizoremediation 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 soil from (21.75 mg kg⁻¹ containing 6 HAPs). We conducted two experiments of biodegradation: one of them in greenhouse with cultivated sunflower and another in the laboratory with suspensions of soil and root exudates of sunflower. The sunflower root exudates were extracted using an 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 of contaminants in porous media. Our results of soil samples had under laboratory conditions a similar stimulatory effect on the slow degradation of PAHs in soil slurries. The stimulation of the indigenous bacterial population resulted in both situations a similar residual concentration of PAHs. We can conclude that the effects of plants on the residual concentrations of PAHs could be reproduced under laboratory conditions by slurring, shaking and the addition of root exudates.

**TU 290**

**Bacterial taxa and sustainable remediation: effects on bacterial dispersal**

C.J.S. Jiménez-Sanchez, J.J. Ortega-Calvo

Institute of Natural Resources and Agrobiotechnology of Sevilla (IRNASE), Sevilla, Spain

**Abstract:** We conclude that the effects of plants on the residual concentrations of PAHs could be reproduced under laboratory conditions by slurring, shaking and the addition of root exudates.

**TU 291**

**Behavioural responses of Tetrahymena pyriformis exposed to microgradients of hydrophobic organic chemicals**

D. Güldner, A. Windig, T. Bachhaus, P. Mayer

Aarhus University, Roskilde, Denmark

**Abstract:** We conclude that the effects of plants on the residual concentrations of PAHs could be reproduced under laboratory conditions by slurring, shaking and the addition of root exudates.

**TU 292**

**Sorption of ionized and polar contaminants to natural dissolved organic matter**

J. Hřebčík, M.T.O. Jonker, L.M. Hermens

Institute for Risk Assessment Sciences, Utrecht, Nederland

**Abstract:** We conclude that the effects of plants on the residual concentrations of PAHs could be reproduced under laboratory conditions by slurring, shaking and the addition of root exudates.
influence of charge and molecular structure on the sorption process. Representative emerging contaminants were selected, covering hormones, pharmaceuticals, personal care products, and pesticides. Batch sorption studies were conducted with natural DOM-containing water samples obtained from Finland, United Kingdom, and the Netherlands and by using polyacrylate passive samplers to determine aqueous contaminant concentrations. The DOM samples were characterized by chemical and physical fractionation methods, and the results indicated that charge and molecular structure of DOM are important parameters determining sorption to both DOM and polycrylate. Positively charged DOM showed a strong pH dependent sorption to DOM, whereas the neutral forms were the most important species responsible for sorption to polycrylate. Negatively charged DOM showed the lowest affinity to both DOM and polycrylate. 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 polycyclic aromatic contaminants to DOM, which is currently based on only limited data.

TU 293

Binding can increase the mobility of hydrophobic organic compounds

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Responsible University, Reading, United Kingdom

The binding of hydrophobic organic compounds (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 has been seen in 1) colloid facilitated transport 2) the use of chemical agents to enhance soil remediation and 3) in biology, where body surface receptors bind hydrophobic ligands. In the presence of charged DOM, enhanced mobility of HOCs may result in an increased exposure to biota. In the current work we studied the above examples using "enhanced capacity" as a new measurement endpoint. Enhanced capacity (E) has some similarities to the well-established concept of "solubility enhancement", but should not be confused with it. Solubility enhancement is determined at, and applies only to, the saturation level of the aqueous phase, whereas enhanced capacity can be measured at diffusion-limited or even undissolved levels in vitro or in vivo terms. This means it refers to a more relevant range of environmental concentrations and mixture compositions. Passive dosing method was applied to determine E for HOCs of 1) soil leachates collected from tile-drains of sandy clay loam and sandy loam fields of the Danish Pesticide Leaching Assessment Programme 2) sodium dodecyl sulfate and hydroxypropyl β-cyclodextrin that are used in our extended physiologically based extraction test (CE-PBET) for assessing bioaccessibility of soil-bound PAHs. The use of passive dosing could circumvented artefacts associated with adding crystals of HOCs into an aqueous solution, and to the low relative standard deviation of the method even small enhancements could be measured with high precision.

References:


TU 294

Dynamic passive dosing for studying microbial PAH degradation: a comparison of experimental and model results


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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 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 that n-alkanes and aromatic compounds are available in their original state, particularly for several PAHs, enhances PAH mobility and uptake, and allows the use of high throughput methods in a more relevant range of environmental conditions and mixture compositions. Passive dosing method was applied to determine E for HOCs of 1) soil leachates collected from tile-drains of sandy clay loam and sandy loam fields of the Danish Pesticide Leaching Assessment Programme 2) sodium dodecyl sulfate and hydroxypropyl β-cyclodextrin that are used in our extended physiologically based extraction test (CE-PBET) for assessing bioaccessibility of soil-bound PAHs. The use of passive dosing could circumvented artefacts associated with adding crystals of HOCs into an aqueous solution, and to the low relative standard deviation of the method even small enhancements could be measured with high precision. Therefore, combining measurements of PAH biodegradation kinetics at defined concentrations using dynamic passive dosing, and their interpretation by modelling is a useful tool to further understand their bioavailability, biodegradation and persistence.

TU 295

Enhanced mass transfer of hydrophobic organic compounds from NAPLs into the aqueous phase by dissolved organic carbon


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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 diffuse mass exchange processes between surfactant 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 increased by up to a factor of four in the presence of DOC, which is the greatest enhancement observed for biological degradation processes and highest DOC concentrations. These increases could not be explained by dissolved molecular diffusion alone, and point to a parallel DOC-mediated diffusive pathway. The nature of the DOC-mediated diffusion pathway is also investigated using semi-empirical relationships that describe the dependence of the solubility of nonelectrolyte solutes on salts concentrations. We conducted equilibration experiments of petroleum/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 medium, compared to FAMEs and deionized water alone. A similar observation was made by Baker [3] regarding the effect of salts on solubilization of the alkylates and aromatic compounds in the presence of fatty acid soap solution. They reported that, in the presence of soap, the solubility of the fatty acids soap in the dilute fatty acid soap in water is significantly 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 petroleum/biodiesel blends, which we interpret to be due to the increase in aqueous concentrations of the n-alkanes in the presence of the FAMES and nutrients.

References:


TU 296

On the effect of vitamins and nutrients on the solubilization of petrodiol/biodiesel blends in water

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The effect of mineral salts on the aqueous solubility of non electrolytes is largely assumed to exhibit the "salting out" or "salting in" effects in which the aqueous solubility of non electrolytes is decreased or increased upon the addition of salts. Pioneering investigations by Sötschien [1] and later by Carter and Hardy [2] among others, resulted in semi empirical relationships that describe the dependence of the solubility of nonelectrolyte solutes on salts concentrations. We conducted equilibration experiments of petroleum/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 (C21 n-alkanes, heptadecane, and C22 n-alkanes, homopropylene) was found to be significantly enhanced (p < 0.0005), up to 4-fold in the presence of the fatty acid methyl esters (FAMES) and the vitamins and nutrients medium, compared to FAMES and deionized water alone. A similar observation was made by Baker [3] regarding the effect of salts on solubilization of the alkylates and aromatic compounds in the presence of fatty acid soap solution. They reported that, in the presence of soap, the solubility of the fatty acid soap in water is significantly 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 petroleum/biodiesel blends, which we interpret to be due to the increase in aqueous concentrations of the n-alkanes in the presence of the FAMES and nutrients.

Reference:

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 H4IIE-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 ECOTOCEN (European Regional Development Fund no. CZ.1.05/2.1.00/03.0086).

TU 293

Influence of sorption on biodegradation of secondary alkane sulphonates (SAS) in marine sediments

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Contaminated sediments 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 studies available 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 sulphonates (LAS) have also been studied, they show the Japanese worldwide production volumes. Environmental data on many other surfactants, however, are still scarce. This is the case of secondary alkane sulphonates (SAS), one of the major anionic surfactants used in the market of dishwashing, laundry and cleaning products. Although this compound is easily removed during wastewater treatment, previous studies have shown that SAS and other anionic surfactants such as LAS accumulate in sludge as they are hardly biodegradable by aerobic digestion. Recently, anaerobic 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 coefficient of 1505 kg/Lc has been observed that the sorption capacity of SAS is 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

Removal of PCP- and PAH-contaminated soil with modified clays

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TU 299

Removal of PCP- and PAH-contaminated soil with modified clays

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University of Ibadan, Ibadan, Nigeria

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 these compounds through their roots. The second finding is of great importance for the protection of groundwater, as it is a major source of drinking water. 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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Technologienzentrum Wasser (TZW), Karlsruhe, Germany

TU 300

Fate of iodinated X-ray contrast media in a soil column percolation experiment simulating elevated dissolved organic carbon (DOC) by amendment of saccharose

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To simulate the process of AGR, the fate of six iodinated X-ray contrast media (TCDD) in mixtures with low molecular organic compounds, e.g. from food productions and accidental spills. 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 isoxeol 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 isoxeol 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 isopamilol is reported to depend on site-specific redox conditions at several field sites in literature [2].

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 soil adsorption. The results of this study indicate a promising potential of the modified clays to immobilize PCBs and PAHs in soils.

TU 301

Effect of pH and electrolyte concentration on soil adsorption of pesticides

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TU 301

Effect of pH and electrolyte concentration on soil adsorption of pesticides

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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. 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 the stem as a kind of a pesticide’s uptake into the crop. Data on the distribution of a pesticide in soil/solution (pesticide soil adsorption) is important for assessing the risk of pesticide contamination of the succeeding crop. Soil adsorption of nonionic pesticides...
is influenced by organic carbon content in soil; however, there are few investigations on influence of pesticide and soil properties except organic carbon content on the adsorption of pesticide in soil.

The present study conducted batch experiments with approximately 30 pesticides and 7 soils in Japan to determine their soil adsorption coefficients (Kd values). The results of relationships between Kd values and pesticide/soil properties will be presented.

TU 303
Leaching of aged DDTS and current use pesticide residues in undisturbed soil columns: non-ionic surfactant and carboxylic acids effects
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Soil pollution by Persistent Organic Pollutants such as DDTS (p'-DDT and its metabolites p'-DDE and p'-DDD) represents a continuous source to the environment. As a consequence of their high persistence DDTS occur up to 60 cm on agricultural soils. The Current Use Pesticide (CUP) endosulfan is characterized by its high lixiviation potential in undisturbed soil columns due to low Kow values. Leaching of DDTS and CUP lead to soil contamination or riverine events as well as plant growing may modify pesticide availability and leaching. Surface waters receive discharges from industrial, urban and agricultural uses that will account for a variety of compounds of concern, such as surfactants, colloid and dissolved organic carbon. This work studies the vertical distribution and movement of aged DDTS and endosulfan in undisturbed soil columns triggered by riverine water and solutions (4L) were added under saturated condition. One L leachates (n=4) were collected for pesticide residues analysis. After elution, columns were dried (24 h), open and observed for macro invertebrate communities. Descriptive statistics were performed by batch technique and resolution process. Results on soil and water by GC-ECD, p'DEPE-p'DD Deuterated standards allowed concluding that soils in the tested conditions showed a similar to the technical mixture which is widely used in the region. In post-flood muscle, DDTs levels increased 5-fold than pre-flood. The metabolite p,p'-DDE represented the main compound on the first elution volume and p'-DDE started to lixivate after 2 L while for Tw-80, DDE represents the main residue in all elution solutions.

TU 304
 Sorption of cationic organic compounds to soil as the sum of soil components
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Many emerging contaminants are strong bases that under environmental conditions mostly occur as cationic species. The environmental fate of these compounds depends on their sorption to soil components. The sorption affinity to soil minerals is well known; however, the sorption affinity to soil organic matter, sediment and dissolved colloids is less well understood. Both sorbent types are well known to bind organic cations, but it is not clear to what extent each type contributes in natural soils. Using a customized dynamic HPLC column retention measurement, we studied the sorption of a set of organic cations to individual soil components, such as natural organic matter (NOM, Pawhoke peat) and pure clay minerals (kaolinite, illite, bentonite). In addition, the sorption affinity to five different Eurosoils was tested, which ranged in organic carbon content (fOC) from 1.3 - 9.2%, and in clay content from 6-75%. We examined what extent sorption to natural 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

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Sunscreens agents, also known as UV filters, have become very popular chemicals since they were shown to have a protective role against photoaging, photocarcinogenesis and many other health effects. Many sunscreen agents, which are used in personal care products, are also present in a wide variety of environmental samples, such as plastic and rubber. Among the phthalates diethylhexyl phthalate (DEHP) predominates and has many possible applications, especially for PVC. The highest concentrations of DEHP are found in products for flooring, food and plastic-coated fabrics. Phthalates are also included as plasticisers for binders in different kinds of paint and adhesives. Within the Project the concentration levels of phthalates in sewage sludge from Nadela river were determined. Nadela basin is situated near city of Vojvodina, Yugoslavia region, and is covered by numerous industrial sites and can represent the significant source of these substances. The field survey was done in 9 sampling sites in the catchment area of the Nadela in the early spring 2009. The main metabolites were identified and the first steps of the transformation pathway were elucidated: a mono- or di-hydroxylation by cytochrome P450 and the subsequent conjugation with a pentose. These results support the extended hypothesis that conjugation processes constitute one of the defensive mechanisms that fungi activate against toxic hydroxylated compounds.

TU 306
Concentration levels of phthalates in water and sediment samples from Nadela river basin, Vojvodina region

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Phthalates belong to the group of dominant industrial pollutants and are ubiquitous overspread class of compounds with low water solubility/high fat solubility and low volatility. Due to their low water solubility, the phthalates hydrolyse relatively slowly, but the actual dynamic rate varies according to temperature, concentration and solution composition. The physical properties of phthalates have made them suitable as plasticisers in polymers such as plastic and rubber. Among the phthalates dieethylhexyl phthalate (DEHP) predominates and has many possible applications, especially for PVC. The highest concentrations of DEHP are found in products for flooring, food and plastic-coated fabrics. Phthalates are also included as plasticisers for binders in different kinds of paint and adhesives. Within the Project the concentration levels of phthalates in sewage sludge from Nadela river were determined. Nadela basin is situated near city of Vojvodina, Yugoslavia region, and is covered by numerous industrial sites and can represent the significant source of these substances. The field survey was done in 9 sampling sites in the catchment area of the Nadela in the early spring 2009. The main metabolites were identified and the first steps of the transformation pathway were elucidated: a mono- or di-hydroxylation by cytochrome P450 and the subsequent conjugation with a pentose. These results support the extended hypothesis that conjugation processes constitute one of the defensive mechanisms that fungi activate against toxic hydroxylated compounds.
TU 308
Polychloro-dioxins, furans and biphenyls in fish, crabs and clams from the San Jacinto River Waste Pits, TX
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Fish, crabs, and clams were collected from the San Jacinto River waste pits, a superfund site in Houston, TX, and analyzed for polychlorodibenz-p-dioxins, polychlorodibenzofurans (PCDD/Fs) and dioxin like polychlorobiphenyls (dl-PCBs). Sample preparations comprised of tissue homogenization, enhanced pressurized liquid extraction (HPLC) concentration, high temperature solid phase extraction and were determined by gas chromatography/MS. For analysis, fish were separated into two phases of treatment called: flocculation (first phase of treatment) and decanter (second phase), in July and October 2009 and September 2011. The toxicity tests were carried out with the bioindicators: Pseudokirchneriella subcapitata and Hydra attenuata, and the dates were compared to the physical and chemical determinations, such as: pH, electrical conductivity and dissolved oxygen (DO). For P. subcapitata and H. attenuata tests were prepared an elutriate solution mixing the sample with distilled water (1:4 ratio). The elutriate samples were used as 100% and diluted to 75, 50, 25, 12.5 and 6.25% with specific culture medium. The samples collected in October 2009 were slightly more toxic for P. subcapitata and H. attenuata. Both samples were high toxicity for P. subcapitata, showed IC50 of 11%. However for H. attenuata showed EC50 of 1.5, 19.1% and LC50 of 17.7 and 64.6% (flocculant and decanter, respectively) which correlated with the highest electrical conductivity determinations (460 and 404 mS cm-1) and DO (0.79 and 3.87 mg l-1). The proximity of the EC50 and LC50 results for H. attenuata indicate the predominance of acute affects, or lethal stages (rupl and crumbling), showing the effective power of the toxic sludge, mainly the one collected in the flocculation tank. It’s possible to conclude that both species tested were adequate to characterize the toxicity of the sludge generated by WTP. Both sludge were very toxic to these organisms and the toxicities were strictly correlated with the increase of electric conductivity, the high concentration of heavy metals and the lowest concentration dissolved oxygen in elutriate.

TU 311
Toxicity of copper on the freshwater snail Physa acuta: reproductive output and biomarkers of effect
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Copper constantly enters aquatic environments through several paths such as industrial effluents, agriculture runoffs and domestic wastewater. Trace amounts of copper are needed for metabolic and biochemical processes in several organisms but, like for every chemical compound, in excess it becomes toxic. This study aimed to assess effects on reproduction and detect stress responses using an in vivo approach. Copper effects in the freshwater pulmonate snail Physa acuta exposed to copper sulfate in laboratory conditions. A 1428 days chronic toxic 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. Aquatic snails, like Physa acuta, have proved to be good test organisms to assess the presence of chemicals in the environment as they have proven to be very sensitive to exposure.
Morphotypical and biochemical evaluation in gills of Lepomis gibbosus, after acute exposure to several xenobiotics (pesticides, deterrents and pharmaceuticals)

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In the present study, we address and awareness of issues related to environmental exposure to anthropogenic xenobiotics has increased. These compounds can affect non-target organisms, altering their physiology, and consequently endangering the balance of ecosystems. Some studies reported the evaluation of morphotypical and biochemical changes in gills, after exposure to several compounds, including pesticides, deterrents and pharmaceuticals, which can be quantified using appropriate analytical tools. The gills of several species have been used by different authors to detect the presence of compounds with toxic and genotoxic effects and evaluate the use of these biomarkers as reliable tool in environmental monitoring studies. Acute toxicity, measured as 48h LC50, is an important parameter that is used to evaluate the effects of xenobiotics on aquatic organisms. For example, the toxicity of copper on mussels has been widely investigated due to its potential to induce oxidative stress and lipid peroxidation, thus affecting their growth and survival. However, the relationship between higher level effects and the mechanisms of toxicity has been poorly investigated. For this reason, this study aimed to investigate the relationship between oxidative stress and genotoxic effects in the gills of mussels exposed to different concentrations of copper. The gills were sampled at different time points after exposure and analyzed for oxidative stress markers (MDA, GSTs) and genotoxic effects (comet assay). The results demonstrated that copper exposure induced oxidative stress and genotoxic effects in the mussels, measured as increased MDA levels and decreased GST activity, as well as DNA damage in the cells. These findings suggest that copper is a potential bioadhesive agent, which can induce oxidative stress and genotoxic effects in the gills of mussels. Therefore, the results of this study highlight the importance of including oxidative stress and genotoxicity as endpoints in environmental monitoring studies, as they can provide valuable information on the effects of copper exposure on mussels.
Accordingly, the present study investigated two cryptic *Gammarus fossarum* lineages - namely type A and type B - for differences in their sensitivity towards chemical stress. Two size classes of each critical lineage type were exposed after seven days of exposure as a measure of sensitivity.

The functional analysis resulted in a meta-analysis 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 study tested, showed a similar tendency, however, results were statistically significant only for tebuconazole (*n*=8; *p*=0.0001). This deviation in sensitivity between lineages is new due to the minor consideration of the cryptic lineages concept in the field of ecotoxicology. Hence, further studies should address the sensitivity to other chemicals, by also considering morphological aspects like the physiological fitness, of a broader range of cryptic complexes. Nonetheless, genetically distinct lineages may confound the results of ecotoxicological tests, as indicated in the present study, and should thus be interpreted with caution.

TU 322

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

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The presentation gives an overview of the status of the presence and levels of PAHs in greater Johannesburg area. Although many studies of persistent organic pollutants such as polycyclic aromatic hydrocarbons (PAHs) have been carried out in South Africa, the study on PAHs is still having a lot of gaps. This presentation gives an overview of environmental risk and possible sources of PAHs in the Cape Town region.

Besides a significant reduction of the cell viability but only for tebuconazole, no statistically significant differences were observed after 12 hours of BaP exposure. Using H2DCFDA staining, ROS production is already observed after 4 hours of exposure to high BaP whereas no response is observed for the low BaP concentration. However, at 24 hours, ROS appears to be produced even for the low BaP concentration. Gene expression after 12 hours of 5 µM BaP exposure moreover shows genes related to lipid metabolism. Indeed, lipid body containing using Nile red revealed significant changes in lipid droplet morphology already after 4 hours. We conclude that the low BaP concentration induces a small gene expression which, together with biochemical defense mechanisms, helps the cell to return to its initial state. However, the high concentration causes strong pathway regulation and cellular dysfunction accompanied by early ROS production and lipid droplet modification.

**TU 323**

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

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The aim of the systems biology initiative, “From contaminant molecules to cellular response: system quantification and predictive model development”, is to build a model of interactions between cells and the toxic chemical Benzo-a-Pyrene (BaP). As part of this initiative, we aim to identify the regulation of genes by BaP in a time and concentration of BaP exposure and to correlate these changes to physiological endpoints. The study on C. reinhardtii includes several technical steps: 1) the regulation of several transcripts/proteins involved in the photosynthesis and ATP synthesis could be corroborated with inhibition of cell division and algal growth; 2) the oxidative stress response could be linked to the physiological endpoint of lipid membrane damage; 3) the transcriptome of silver exposed algae were analysed using C. reinhardtii whole genome microarray; the global protein profile of silver exposed C. reinhardtii (5h exposure time point) was done by Multidimensional Protein Identification Technology (MudPIT) which consists of 2D-IC and mass spectroscopy. The transcriptome analysis determines that the most significantly regulated transcripts are those of metabolic pathways of photosynthesis, tetrapyrole synthesis, mitochondrial electron transport, protein transport and oxidative stress response. Similarly, the proteome profile showed these biological processes being significantly regulated indicating that silver affects key functional pathways in C. reinhardtii. The regulation of several transcripts/proteins involved in the photosynthesis and ATP synthesis could be corroborated with inhibition of cell division and algal growth. Further studies could include linking the transcriptome and proteome to physiological endpoints such as lipid membrane damage. Overall, this study gives an insight into the toxicity mechanism of silver and also, by linking them to ecologically relevant phenotypes, a better ability to predict environmental risk.

**TU 324**

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

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Ecotoxicology aims to identify effects that toxicants elicit upon the environment. A major challenge is to understand the toxic mechanisms at a molecular level and how these relate to the organism and the environment. 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 physiological endpoints. The study on C. reinhardtii includes several technical steps: 1) the regulation of several transcripts/proteins involved in the photosynthesis and ATP synthesis could be corroborated with inhibition of cell division and algal growth; 2) the oxidative stress response could be linked to the physiological endpoint of lipid membrane damage; 3) the transcriptome of silver exposed algae were analysed using C. reinhardtii whole genome microarray; the global protein profile of silver exposed C. reinhardtii (5h exposure time point) was done by Multidimensional Protein Identification Technology (MudPIT) which consists of 2D-IC and mass spectroscopy. The transcriptome analysis determines that the most significantly regulated transcripts are those of metabolic pathways of photosynthesis, tetrapyrole synthesis, mitochondrial electron transport, protein transport and oxidative stress response. Similarly, the proteome profile showed these biological processes being significantly regulated indicating that silver affects key functional pathways in C. reinhardtii. The regulation of several transcripts/proteins involved in the photosynthesis and ATP synthesis could be corroborated with inhibition of cell division and algal growth. Further studies could include linking the transcriptome and proteome to physiological endpoints such as lipid membrane damage. Overall, this study gives an insight into the toxicity mechanism of silver and also, by linking them to ecologically relevant phenotypes, a better ability to predict environmental risk.

**TU 325**

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

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C.elegans has been extensively used to study the effects of chemical exposure, aging, pathogenicity and reproductive development. With a well annotated genome, well characterized cellular maps, ease of making knock-outs, availability of mutants and short life span, it is a good model system to study the effect of chemical exposure on long term exposure. This study was treated with sodium vapalope, a known teratogen and a histone deacetylase inhibitor used as a first line drug in epilepsy, manic depression, bipolar disorder and schizophrenia. Computational biology and omics technology was utilized to develop gene signatures associated with vapalope exposure. We employed a systems biology approach by mapping transcriptomic data to known biological pathways to identify possible pathways affected by vapalope treatment. The network models generated with the genes significantly associated with vapalope indicates an overall downregulation of nuclear proteins. Metabolite associations associated with vapalope treatment were identified by Nuclear Magnetic Resonance (NMR) spectroscopy on formalin fixed worms. Functional analysis was performed using the DAVID gene ontology web tool. Genes were mapped to known pathways using Ingenuity Pathway Analysis software (Ingenuity® Systems, www.ingenuity.com). Networks derived from the genes highly correlated to vapalope exposure were analysed by the same software. Metabolomic analysis was performed on the aqueous fraction of methanol/chloroform extracted samples on Brucker Avance 500MHz spectrometer at HFW-NMR Center, University of Birmingham. C.elegans were fixed prior to extraction, by adding 37% formalin directly on to plates. Treatment with vapalope resulted in an increased lipid level and a decrease in egg laying in a dose dependent manner. Genes with positively correlated expression to vapalope were enriched with functional terms such as structural molecule activity (cuticle/collagen), detoxification, phosphorylation and lipid metabolism. Genes like Cyp1a1, Tiparp and Nqo1 are regulated early for both concentrations whereas Aldh3a1, well known to act against oxidative stress, is only regulated at the higher concentration. Chemical toxicity, viability detection of ROS formation and lipid droplets were determined. There was a significant reduction of the cell viability but only for tebuconazole (n=8; p<0.0001). Hypoxia and oxidative stress is one process network strongly regulated after 12 hours of BaP exposure. Using H2DCFDA staining, ROS production is already observed after 4 hours of exposure to high BaP whereas no response is observed for the low BaP concentration. However, at 24 hours, ROS appears to be produced even for the low BaP concentration. Gene expression after 12 hours of 5 µM BaP exposure moreover shows genes related to lipid metabolism. Indeed, lipid body containing using Nile red revealed significant changes in lipid droplet morphology already after 4 hours. We conclude that the low BaP concentration induces a small gene expression which, together with biochemical defense mechanisms, helps the cell to return to its initial state. However, the high concentration causes strong pathway regulation and cellular dysfunction accompanied by early ROS production and lipid droplet modification.

**TU 326**

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

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In environment, the presence of chemical pollutants or climate changes can induce organism responses at the cellular and molecular level. Beside more traditional analysis systems like e.g., mass spectrometers, researchers can nowadays benefit of high throughput technologies (i.e. microarrays, deep sequencing, 2-DE) that allow very large scale investigation. Data deriving from these technologies offer snapshots of the changes induced by the presence of environmental variations. Management, analysis and interpretation of the massive data obtained from high throughput technologies can be quite challenging and requires bioinformatics skills still beyond the reach of many laboratories and many biological questions. Hereinafter we give an exhaustive overview of the real cellular response and of changes in gene expression. Indeed they do not consider the relation between mRNA level, protein concentration and metabolite levels which are known to poorly correlate. Finally it would be very useful to compare the biological effects induced by the same environmental stress on different organism using comparative studies. Here we propose a web based system that works as a centralized resource for the collection, analysis and integration of ecotoxicology related high throughput data.

"Aggregated" information is accessible by means of simple web based data mining tools and is supported by effective and simple graphic representations to facilitate the understanding of biological response mechanism.

We have benchmarked our platform with data obtained by high throughput analysis techniques - microarray and 2-DE - applied on the social amoebae Dictostelium discoideum after treatment with several doses of mercury. We show the advantages of using our system which allows the comparison of the results obtained from the two techniques, effective tools for the visual inspection of data and integrates data from external resources such as specialized databases (i.e. genomic databases, metabolite databases, Gene Ontology).
TU 329

On the appropriateness of using the common mixture toxicity models CA and RA on species sensitivity distributions: a theoretical approach
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In soil surface horizons, at 13 sites, producing 47 different contexts in terms of land use historic and origin of contamination (PAH, ETM, pesticides). 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, as mentioned above the validity of mixture models were recently proposed but only special cases could be confronted to actual data. We used such a unified model to analyse four datasets. We showed the possibility to estimate properly the toxicity parameters together with inter-organisms differences of sensitivity and the species sensitivity distribution (SSD) approach is easy to understand and to apply by non-experts in modeling. 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 330

Estimating inter-individual sensitivity from survival data using a mechanistic model
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In the literature, there are two main alternatives to model mechanistically dose-survival relationship in ecotoxicity tests. Effects are related to a concentration of concern, for instance body concentration, and either individuals have different concentration thresholds for death, or individuals have equal probability to show an effect, with dying organisms just being the "unlucky" ones. A general framework to unify both approaches has recently been proposed but only special cases could be confronted to actual data. With this unified approach, we calculated of CA and RA models 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, as mentioned above the validity of mixture models were recently proposed but only special cases could be confronted to actual data. We used such a unified model to analyse four datasets. We showed the possibility to estimate properly the toxicity parameters together with inter-organisms differences of sensitivity and the species sensitivity distribution (SSD) approach is easy to understand and to apply by non-experts in modeling. 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
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The species sensitivity distribution (SSD) approach is in principle an alternative to the assessment factor approach for PNEC calculation. However, due to requirements on data quantity, this approach is currently restricted to a small number of compounds. One central problem is that commonly many available data are discarded from the analysis for reason of limited validity, endpoint (exclusion of EC10, 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 (e.g. acute data quality, acute and chronic values, EC10, EC50, 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 test cases, 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 NOECs. Influences of different options for data treatment and sample size will be discussed with respect to the robustness and reliability of the SSD function and the associated HC value.

TU 332

Investigating the replacement of NOEC and LOEC values with regression-based ECx values
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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 ecotoxicology 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. From the analysis of a number of data sets, the work described has shown that it is possible to apply a number of different static regression models to results arising from ecotoxicity tests, and to derive ECx values. The work indicates that, although not consistent for all datasets examined, it is possible to derive ECx values broadly similar to the respective NOEC and LOEC values. However, a number of issues remain which will be of importance when considering the possible replacement of NOEC and LOEC values with ECx values, including extrapolation 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 methods. This has shown that the expected ecotoxicity study can lead to 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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The Radonilco Frits statistical approach (Breiman, 2001), is used to classify, predict and select the best set of explanatory variables in large fields of research. Yet, only few applications were made in environmental research, especially in soil ecotoxicology. The analytical strategy of the French "Bioindicators Programme" (2006-2012) is to (i) measure a large number of bioindicators in contrasted pedo-geo-climatic contexts covering a wide range of sampling protocols, (ii) manage high numbers of biological and meta-data in a database enhancing data analysis, (iii) develop a data mining of collected data during two years, with the help of a biostatistician team. The main objective is to develop a generalised method for selecting relevant bioindicators with regard to the targets (characterisation, monitoring, risks, IDOTS), that may assess risks of soil contamination to ecosystems. Most environmental variables are screened, including microorganisms (e.g. biomasses of fungi and bacterial communities, bacterial diversity, enzymatic activities), nematodes (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 historic and origin of contamination (PAH, ETM, pesticides). As a first step of statistical analyses, our results showed the importance of correlations between biological variables in intra and inter-groups. Then discriminated analyses using Random Forest revealed sets of relevant indicators for land use (crops, pastures, woods and forests), levels of metal contamination (high, medium and low) as well as
organic contaminations.

TU 334
Advanced non-linear regression methods for concentration-response curves in R
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A recent study by IEAM has suggested to ban the use of traditional no-observed-effect levels (NOELs) and lowest-observed-effect levels (LOELs) as basis for risk assessment and decision making, and instead use curve-fitting for estimation of concentration-response relationships. This should motivate an evaluation of current concentration-response modelling approaches in ecotoxicology, and adoption of new methodologies for curve-fitting that are used in other fields of environmental science.

The Water Framework Directive (WFD) has triggered much research on non-linear relationships between physico-chemical stressors and ecological responses during the last decade. For example, thresholds in stressor-response relationships are particularly relevant for assessment of ecological status of water bodies. Basic statistical methods such as linear regression or ANOVA are not suitable for estimating such relationships. The response may also be more complicated than e.g. a simple sigmoid curve, therefore alternative curve-fitting methods have been used for exploring the shape of the response curve without a priori assumptions. Moreover, we may be interested in estimating an extreme part of the response rather than the average. In this presentation, I give examples of ecological responses to eutrophication and acidification stress in lakes. The ecological responses are univariate indices representing community composition of phytoplankton, macrophytes, macroinvertebrates and fish. Building upon basic linear regression, we introduce and show an advanced non-linear regression approach which enables more flexible curve-fitting: (1) Using a non-linear link to the response variable (generalised linear model); (2) Using a piece-wise linear function for the stressor variable (generalised additive model); (3) Analysing a quantile of the response variable (the average of the effect (e.g. 90%); quantile regression).

All analyses are carried out in the free statistical programming software R.

TU 335
An interfaced R-package to fit SSDs
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Species Sensitivity Distributions (SSDs) rely on the assumption that aquatic species of a community or assemblage differ in their sensitivity to a hazardous chemical. Toxicity values are used as indicators of the sensitivity and are assumed to follow a theoretical distribution accounting for the inter-species variability. A Hazardous Concentration (HC) is then derived using a low-order percentile of the SSD fitted to a limited (and often small) set of toxicity values, the latter being assumed to be a representative sample of species sensitivity among the community to be protected.

The SSD approach is an element of most regulatory guidance documents for environmental risk assessment (e.g. ANZECC, ECHA, USEPA). Yet, the approach to be used is still debated, including: (1) whether parametric or non-parametric methods should be preferred - the applicability of the latter being limited by the small size of toxicity data sets available and (2) in the parametric cases: (2a) the choice of the distribution shape - this is often decided on the basis of mathematical properties, especially on the existence of analytical results, and (2b) the choice of the method for estimating HCs and their confidence interval.

Several softwares have been provided through environmental protection agencies for estimating HCs and their companion uncertainty, such as Burrello in Australia and New Zealand, ETX in The Netherlands or Web-ICE in the U.S. Those three softwares have been developed as turn-on key tools for the application of regional regulatory recommendations and rely on different choices regarding the three points aforementioned. Besides, it appears that none of these programs allows censored data to be accounted for. For users interested in examining the impact of the methodological choices made in existing softwares (and in the corresponding regional guidance documents), we aim to currently developing a new and open source tool enabling the comparison of several distributions and also the use of both pointwise and interval-censored data (or a mix of both).

TU 336
A probabilistic model for species sensitivity distributions taking into account inherent uncertainty and variability of effects to estimate environmental risk
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A case study using this method is presented, based on the results of a survey of 8 sites presenting contrasted levels of sediment contamination. The permutation is performed during the last decade. For example, thresholds in stressor-response relationships are particularly relevant for assessment of ecological status of water bodies. Basic statistical methods such as linear regression or ANOVA are not suitable for estimating such relationships. The response may also be more complicated than e.g. a simple sigmoid curve, therefore alternative curve-fitting methods have been used for exploring the shape of the response curve without a priori assumptions. Moreover, we may be interested in estimating an extreme part of the response rather than the average. In this presentation, I give examples of ecological responses to eutrophication and acidification stress in lakes. The ecological responses are univariate indices representing community composition of phytoplankton, macrophytes, macroinvertebrates and fish. Building upon basic linear regression, we introduce and show an advanced non-linear regression approach which enables more flexible curve-fitting: (1) Using a non-linear link to the response variable (generalised linear model); (2) Using a piece-wise linear function for the stressor variable (generalised additive model); (3) Analysing a quantile of the response variable (the average of the effect (e.g. 90%); quantile regression).

All analyses are carried out in the free statistical programming software R.

TU 338
The IBR revisited: optimization to avoid misuse
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Toxicokinetics-toxicodynamics (TKTD) models simulate the time course of processes leading to toxic effects on organisms. Even for an apparently simple endpoint such as survival, a large number of TKTD models exist. They have been reviewed by Jager et al (2011) who proposed a unified theory (GUTS) for TKTD threshold models and the use of a likelihood approach for estimating model parameters. Here, we focus on a TKTD threshold model in the GUTS framework called DEBtox (Dynamic Energy Budgets in toxicology) survival model. This model assumes an effect above a threshold concentration. We examine a simple question: is it possible to estimate parameters of this model by maximum likelihood approach from standard survival data sets?

We analyzed survival data sets of the freshwater invertebrate Daphnia magna exposed during at least 21 days to nine different contaminants. We tried to fit 4 nested DEBtox survival models to each data set by maximizing the log-likelihood function to estimate model parameters.

We illustrated two structural problems linked to the model itself or to the likelihood function. (1) We cannot simplify the model by fixing the natural mortality to 0 even if data did not show natural mortality and (2) because of discontinuities in the log-likelihood cross sections when the threshold parameters is equal to one of the tested 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.

TU 339
Statistics Service - a new tool for efficient data analysis
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In this talk we present a newly built statistics tool which allows a highly convenient and efficient data analysis. The tool combines Excel (a Microsoft Office product) and R (a cost-free available statistics programming language) via a specific server. This Excel-R connection significantly broadens the spectrum of available statistical methods in Excel. Moreover, the user (e.g. lab technician) can easily conduct complex statistical analyses:

The user selects the desired statistical method in Excel after highlighting the input data for the computational analysis. The data is then transferred to the server, the computation starts and the results are automatically transferred back to Excel. Besides the results (e.g. graphical plots) the user can also receive an interpretation help (text file) of the result output.

In addition to a short introduction of the Statistics Service technical background, we will demonstrate its functionality using examples from the environmental fate modeling for plant protection products, e.g. the analysis of environmental fate data and selection of relevant input parameters to exposure models, in order to provide a general overview of how this tool works.
Long-term effects of an early exposure to PAHs on zebrafish behavioural responses

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Polyaromatic hydrocarbons (PAH) emission in the environment is constantly increasing with human activity. The goal of this study was to assess long term consequences of fish exposure to PAH on behaviour. Eggs were collected from AB zebrafish strain and were placed at 4 hours post fertilization (hpf) until 96 hpf in a 3 cm diameter Petri dish containing 3 g reference sediment either plain (control) or spiked with a mixture of Benzo[a]pyrene, Pyrene and Phenanthrene at environmental 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 dark period, contaminated fish were significantly less active than control fish. A similar observation was made for contaminated F0 in Tmaze safe area. Contaminated F1 larvae were more active when light was on control than 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.

Triclosan is a ubiquitous compound in wastewater treatment plant effluents and biosolids and is commonly detected in surface waters throughout North America and Europe. The acute toxicity of triclosan (TCS) toward aquatic organisms has been well studied but information on long-term, low level exposures at environmentally relevant concentrations is lacking. The objective of the present study was to evaluate the toxicity of triclosan in a multi-generational test with Daphnia magna in laboratory conditions. For this aim, we made a heuristic assumption for the evolutionary analysis of tolerance: the strength of tolerance 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.

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

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

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Evolution of tolerance to a pollutant chemical in a natural population of organisms gives an evidence of the examined population to have suffered adverse effect 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. Describing the evolutionary process 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. A significant negative association, among isofemale clones, between tolerance values and intrinsic population growth rates under null exposure. With the fitness optimization, we derived an estimate of stationary exposure level of the chemical (all compounds that exhibited co-tolerance with this chemical) as 0.015 ppb, and concluded that the examined population of this species had been suffering the population-level effect that corresponded to 1/4 reduction of the intrinsic population growth rate. The indicated level of the population-level effect may have considerably reduced the probability of persistence of the population.

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

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Triclosan is a ubiquitous compound in wastewater treatment plant effluents and biosolids and is commonly detected in surfaces waters throughout North America and Europe. The acute toxicity of triclosan (TCS) toward aquatic organisms has been well studied but information on long-term, low level exposures at environmentally relevant concentrations is lacking. The objective of the present study was to evaluate the toxicity of triclosan in a multi-generational test with Daphnia magna in laboratory conditions. Exposure was 24-hr old D. magna neonates were exposed to TCS (0.5 to 150 µg/L) in six successive 24-d life cycle tests. Brood random collected from 5 replicate beaders within each treatment on day 21 were used to feed the next generation. Survival across the 6 generations exceeded 80% in all treatments across all generations. A slight but non-significant overall delay in time to first batch of offspring occurred in the 1.5 µg/L treatment in the first generation but not thereafter. Total offspring numbers were reduced over 21 d and fecundity (average offspring/adult) decreased significantly at concentrations >50 µg/L (NOEC = 10 µg/L) in the first 3 generations but this difference disappeared in the last three generations increasing indicated tolerance to TCS. Reproductive demographic data were used to estimate the intrinsic rate of increase (r) and significant decline in reproductive fitness were observed at the three highest treatments based on the last 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 indicate that the long-term risks of TCS are likely minimal.

Assessing the chronic aquatic toxicity of phthalate ester plasticizers

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Phthalate esters are a class of chemicals varying greatly in terms of uses, properties and toxicity. 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 esters on aquatic organisms. Studies show that populations of fish and invertebrates may be adversely affected by exposure to C1 to C4 phthalate esters, but are not adversely affected by exposure to C8 or higher phthalate esters. Secondary endpoints, including molecular, biochemical, and/or histological responses to chemical exposure, do not appear to correspond 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 capability of aquatic organisms. Important chronic aquatic toxicity studies that have included transgenerational exposure have been conducted since those assessments 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 aquatic solubility cutoff at approximately C6 and higher phthalate esters. Finally, for the C1 to C4 phthalate esters, the present study shows that secondary endpoints (e.g., molecular, biochemical, and/or histopathology) to date, provide limited benefit in practical ecological risk assessment of phthalate esters to aquatic species.
Effects of land use and pesticide exposure on hatching characteristics of Daphnia magna epiphi

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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 (epiphia), build the core for a dormant resting egg bank, which 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 resting 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.

Coe et al. (2011) identified a complex pattern of use for land- and water-based pesticides contaminated land and demonstrated that the tolerance of D. magna populations for the pesticide carbaryl was positively correlated with land use intensity of the area around the ponds. As in standard ecotoxicity tests, these experiments were performed for 48 hours with D. magna neonates less than 24 hours old. In this study, we present the effects of land use intensity and pesticide exposure on hatching characteristics of D. magna epiphia from natural populations. Therefore we sampled dormant egg banks of ponds from 40 different landscapes 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 epiphia 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 selection 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 tolerance, where 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 for micro-evolutionary responses in wild populations exposed to copper and zinc, as model toxics. Life-table experiments with concentrations of copper and zinc close to the conventionally derived geometric mean NOEC values (50 µg Cu/L, 428 µg Zn/L) were conducted with 8 Daphnia magna populations collected from lakes under ponds across Belgium, with concentrations Cu and Zn at 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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Metal tolerance in the earthworm Eisenia fetida: Is it a case of adaptation or mere physiological acclimation?

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Presently, many coastal freshwater ecosystems are already exposed to chemical contamination. Depending on the period and intensity of such exposure, the selective pressure exerted by chemical contamination could have caused the disappearance of the most sensitive genotypes from exposed population, causing its’ genetic erosion. Whether such eroded populations will be capable of coping with future environmental perturbations, namely those associated with the predicted climate changes such as the gradual increase in temperature, higher salinity in seawater coastal lagoons, will largely depend on the association between resistance to chemical it was exposed to and to the future environmental stressor. Accordingly, this work aimed at assessing if an increased resistance to copper is associated with an increased sensitivity to salinity; or at least if some of the genotypes most resistant to copper are among the most sensitive to salinity, both under (i) short-term exposures and under (ii) long-term generational exposures. To attain these objectives, we used the model species C. riparius. The planktonic genus Daphnia plays a central position in pelagic food webs. More specifically we are investigating the genetic variability of C. riparius populations from unpolluted and contaminated sites using mitochondrial sequence variation and nuclear microsatellite analyses and we intend to address three main questions:

- Does chronic pollution affect genetic variability of C. riparius populations in the field?

- Are C. riparius populations in contaminated areas adapted to pollution exposure?

- What are the evolutionary consequences of this altered genetic variability due to pollution in terms of fitness costs?

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

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A. Eisenia fetida is a model species extensively used in ecotoxicological studies. In the present study, we aimed at understanding the overall metal turnover in A. fetida. The population was exposed for 21 days to 2 concentrations of Cu and Zn (200 µg Cu/L and 41 µg Zn/L), which are considered toxic. Bioaccumulation was measured in the whole body, in the head, the body and the reproductive system. Metal concentrations were measured using AAS. The results showed that the earthworm species A. 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 sequential extraction methods with CaCl2 and di-(2-ethyl)-hexyl-trimellitic acid (DTPA) and diazium polyphosphin 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 were all below 0.05% for all four metals, suggesting low availability for uptake. The low availability of these metals could not be explained by physical-chemical properties of soil but by the phenomenon of aging of the metals. There was no difference in allosome frequency between metal tolerant and non-metal tolerant populations of E. fetida. This suggested that the tolerance found in earlier studies could be a mere physiological adaptation.
webs linking primary producers to consumers. The negative effects on Daphnia are well understood; toxic cyanobacteria affect growth, survival and reproduction. However, one possibility to ameliorate toxic effects is to biotransform MC by conjugation to glutathione via glutathione S transferase, thereby reducing toxicity and aiding excretion. This process is thought to underlie the ability to withstand MC in Daphnia and could explain the enhanced tolerance found in the offspring of Daphnia exposed to live cyanobacteria.

In this study, multigeneration exposures were conducted, we exposed the parental generation to MC-LR for 1 or 7 days and determined the enzyme mediated tolerance to MC in their offspring, a) by assessing the acute effect of MC-LR on biotransformation, antioxidant and energy metabolism enzyme activities, and b) through 21 day chronic toxicokinetics studies of the same concentration of MC-LR with or without a pre-conditioning dose of MC-LR. Seven day exposure of the parental generation to MC-LR induces higher activity of glutathione S transferase and malate dehydrogenase in the offspring and enables it to increment the catalase activity when challenged with the toxin. In offspring from the 1 day exposed parental generation those effects were less pronounced or not visible. Offspring from the 7 day exposed parental generation suffered from MC-LR induced paralysis which was less evident when exposed 1 day before offspring from 7 day exposed mothers show higher survival. Higher survival of the offspring is correlated with the elevated activity of glutathione S transferase, malate dehydrogenase and catalase, suggesting maternal transfer of activation factors.

These effects are trans-generational or maternal effects provoked by a natural toxin in a very important freshwater herbivore which may explain the observed acquisition of enhanced tolerance over generations through a biochemical perspective.

TU 354
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DNA methylation, the addition of methyl groups on the 5’ position of cytosines in the DNA plays an important role in the regulation of gene expression of eukaryotic cells. Continuous research has been performed in relation with understanding of invertebrates has only recently received attention. In particular for Daphnia magna, a key test organism in aquatic toxicology and an important species in many aquatic ecosystems, knowledge on DNA methylation is very limited. Within our long-term aim of unravelling the potential functional role of DNA methylation in the stress response of D. magna, this study aimed at sequencing the entire cytosine methylation. For the comprehensive profiling of DNA methylation a methylated binding domain (MBD) protein based sample preparation technique was used. Since this technique is very specific and works well with fragments densely methylated, it was decided to use also a less specific technique based on DNA digestion with a novel restriction endonuclease. This endonuclease recognizes the CNNR (R=GA) methylated sites and cleaves DNA at fixed distances generating DNA fragments easily identifiable on gels.

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 is now focused on determining structural, functional or evolutionary relationships among the methylated sequences and to determine if methylated sequences occur in gene or pathways that may be relevant for dealing with chemical and ecological stress.

TU 353
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Vinclozolin causes transgenerational effects by inducing DNA methylation changes in exposed rats. Benzo[a]pyrene is a clastogen used as a reference chemical for the in vitro mammalian cell micronucleus test. Taking into account that epigenetic and genetic profiles could be altered by these pollutants we studied molecular and cellular responses after adult exposure of freshwater snails (Physa acuta). Additionally, the embryo toxicity in the following generation (F1) after paternal exposure was evaluated. Mature snails exposed for 46 days and deposited egg masses were used for determining parental endpoints (F0) and transgenerational effects, respectively. DNA extracted from mature snails were analysed to evaluate differences in DNA methylation patterns In order to analyze methylation-sensitive sites we used PCR technique with arbitrary primers (AP-PCR) using HpaII and MspI digested samples. HpaII and MspI are isoschizomers that recognize the tetranucleotide sequence 5'-CCGG-3' but that show different cleavage rates by HpaII. HpaII cleaves CCmCGG but not 5mCCGG sequences. Gel electrophoresis of PCR products and comparative analysis between HpaII and MspI patterns allowed the study of CCGG regions in the genome that are sensitive to methylation and the effect of these on pollutants on these sites. Genotoxicity was measured by the micronucleus test in cells isolated from whole adults after homogenate exposure. Development of offspring was monitored. Single egg capsules were measured in multiwell plates. Parental responses at cellular and molecular levels were compared with F1 responses using an ecological relevant endpoint (embryo toxicity). The aim of this work was to establish potential linkages between mechanisms of action and long-term responses at higher levels of biological organisation, which could ultimately have consequences on population dynamics. This study was supported by the Spanish research project CTM2008-03492.
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 potential as bioremediation tools assessed through ecotoxicological testing with the gastropod *Gibbula umbilicalis*. Ecotoxicological testing suggested that some TBT-resistant isolates were selected three more offspring per day and had population growth rates 45% greater. In the unpolluted environment, however, individuals from the resistant clone had the lowest reproduction rates. After four generations, acclimated individuals from the same range of copper concentrations and its life-history performance compared. The genetic differences between the resistant and sensitive clones were that in the polluted environment the resistant clones produced three more offspring per day and had population growth rates 45% greater. In the unpolluted environment, however, individuals from the resistant clone had the lowest reproduction rates. After four generations, acclimated individuals from the resistant clone reproduced earlier, had greater clutches at first reproduction and had higher population growth rates than non-acclimated ones but apparently there were no fitness costs. Therefore, our results showed that life history changes due to adaptation and acclimatization were costable under the polluted environment but not under a clean environment. This supports the view that genetic adaptation is ecologically costly but not acclimatization.

Regarding this background, we adapted a bioenergetic model to study adaptive phenomena in *Caenorhabditis elegans* population dynamic exposed to a heavy radiotoxic metal (uranium). The Dynamic Energy Budget (DEB) (Kooijman, 2010) bioenergetic approach highlights the distribution of energy fluxes between processes such as growth, reproduction, maintenance and survival. It is a relevant basis to understand and quantify the adaptive dynamics governing populations under stress in order to assess ecological risk.

In this study, TBT-resistant bacteria collected from 7 Portuguese ports (Póvoa de Varzim, Leixões, Aveiro, Figueira da Foz, Peniche, Setúbal and Sines) were isolated in increasing concentrations of the toxicant (0.1, 1, and 3 mM of TBT) and those growing at the highest concentration were characterized by genomic fingerprinting (REP-PCR) and tested as potential bioremediation tool in laboratory contaminated media. The percentage of TBT-resistant isolates varied between 0.08% (Setúbal harbor) and 7.67% (Peniche). REP-PCR analysis revealed a total of 111 distinct genetic profiles, being selected from the lower variability while Figueira da Foz had the highest variability. Selected isolates were used to bioremediate waters contaminated with tributyltin (TBT). The genetic differences between the resistant and sensitive clones were that in the polluted environment individuals of the resistant clone had the lowest reproduction rates. After four generations, acclimated individuals from the resistant clone reproduced earlier, had greater clutches at first reproduction and had higher population growth rates compared to the control. The genetic differences between the resistant and sensitive clones were that in the polluted environment the resistant clones produced three more offspring per day and had population growth rates 45% greater. In the unpolluted environment, however, individuals from the resistant clone had the lowest reproduction rates. After four generations, acclimated individuals from the resistant clone reproduced earlier, had greater clutches at first reproduction and had higher population growth rates than non-acclimated ones but apparently there were no fitness costs. Therefore, our results showed that life history changes due to adaptation and acclimatization were costable under the polluted environment but not under a clean environment. This supports the view that genetic adaptation is ecologically costly but not acclimatization.

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collection has been performed for some years at Angra dos Reis (10 out of 31 stations were close to marinas) and Arraial do Cabo (2 out of 10 stations were close to marinas) in Rio de Janeiro state. These studies used 30 adults of Stramonita haemastoma per site (whenever found). The results for Venezuela showed that the VDSI ranged from 0.22 to 1.95 across the 10 stations investigated. In Arraial do Cabo, two stations nearby a marina showed an imposex incidence of 4% and 0 in 2001, increasing to 83% and 47% in 2008. This region, another marina located near a small harbor showed imposex incidence of 7%, whereas three stations in the north west of the bay had no gastropods were found during 2008 sampling. Thus, although the international restrictions on TBT use are apparently reducing the impacts from harbors, these three independent studies at Venezuela and Brazil (Angra dos Reis and Arraial do Cabo) clearly pointed out that marinas are becoming an important source of TBT pollution. Based on that, a similar pattern is expected to occur in other Latin America coastal areas.

TU 364

Imosem and organotin (OT) levels in Nucella lapillus along the Portuguese coast: a re-survey in 2011

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6Comparing anadara trapezia exposure, dose and response to metal contaminated estuarine sediments using laboratory and field exposures and resident molluscs

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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 basic idea 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 tributyltin (TBT) originating from anti-fouling paints found in the environment along both the commercial 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 TBT/kg DW is considered high in many countries and the highest concentrations in boat yards reached 30 000 µg TBT/kg DW. The reason is under laying paint layer being scraped off.

TU 366

Comparing anadara trapezia exposure, dose and response to metal contaminated estuarine sediments using laboratory and field exposures and resident molluscs

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University of Canteb, Act, Australia

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 biomonitors of metal contamination in aquatic ecosystems. There is a need for other measurements except tissue burdens, which do not provide enough information to estimate the hazard to individuals exposed to contaminants at levels that exceed their detoxification and repair capacity, thus establishing the link between contaminant exposure and ecologically relevant effects. Laboratory exposures, in which physicochemical factors can be controlled, using previously unexposed organisms are routinely used in the development of toxicological effects tests. Using a distribution coefficient (Kd) and bioaccumulation factor (BAF) of several metallic elements, the levels of contaminants in the medium can be calculated. The goal of this research is to better understand the mechanisms of organism stress responses to metals in ecological systems was gained and the predictive capability of ecological risk assessment improved.

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Imosem occurrence and the genetic changes in Veined Rape Whelk (rapana venosa) from Bohai Bay, China

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In order to assess the present occurrence 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 30 stations in Bohai Bay, one of China. Imosem occurrence was found in veined rape whelk (Veined Rape Whelk) from three sites in Bohai Bay (HH, 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 that the imposex incidence of 100% in three stations in 2001, whereas no gastropods were found during 2008 sampling. Thus, although the international restrictions on TBT use are apparently reducing the impacts from harbors, these three independent studies at Venezuela and Brazil (Angra dos Reis and Arraial do Cabo) clearly pointed out that marinas are becoming an important source of TBT pollution. Based on that, a similar pattern is expected to occur in other Latin America coastal areas.

TU 368

Clam valve rhythm-based online biomonitoring system to detect waterborne arsenic

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Assessment of contaminate high level of arsenic 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 occurrence of OTs (organotin contaminants) in biota and the contents of OTs in biota and sediments were investigated in 30 stations in Bohai Bay, one of China. Imosem occurrence was found in veined rape whelk (Veined Rape Whelk) from three sites in Bohai Bay (HH, 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 that the imposex incidence of 100% in three stations in 2001, whereas no gastropods were found during 2008 sampling. Thus, although the international restrictions on TBT use are apparently reducing the impacts from harbors, these three independent studies at Venezuela and Brazil (Angra dos Reis and Arraial do Cabo) clearly pointed out that marinas are becoming an important source of TBT pollution. Based on that, a similar pattern is expected to occur in other Latin America coastal areas.

TU 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 pollutants. The aim of this study was to assess bioaccumulation and the effect of zinc exposure on Pacific oyster Crassostrea gigas suffering from low doses of pollutants. The low sensitivity of Pacific oyster Crassostrea gigas to pollution is a very interesting characteristic of these animals, as such a low sensitivity to pollution is a characteristic of these organisms. The results of this study demonstrated that Pacific oyster Crassostrea gigas is a very sensitive species to pollution and that the bioaccumulation of zinc is very high in this species. The results of this study also demonstrated that Pacific oyster Crassostrea gigas is a very sensitive species to pollution and that the bioaccumulation of zinc is very high in this species.

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

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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 pollutants. The aim of this study was to assess bioaccumulation and the effect of zinc exposure on Pacific oyster Crassostrea gigas suffering from low doses of pollutants. The low sensitivity of Pacific oyster Crassostrea gigas to pollution is a very interesting characteristic of these animals, as such a low sensitivity to pollution is a characteristic of these organisms. The results of this study demonstrated that Pacific oyster Crassostrea gigas is a very sensitive species to pollution and that the bioaccumulation of zinc is very high in this species. The results of this study also demonstrated that Pacific oyster Crassostrea gigas is a very sensitive species to pollution and that the bioaccumulation of zinc is very high in this species.
Arsenic is widespread in the marine environment and occurs in several chemical forms, principally as arsenate (As V) and to a lesser extent as arsenite (As III) in 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 efficiency of mussels. The effect of arsenic in mussels were analyzed in an experiment with three concentrations of As(III) and one concentration of As(V) 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 studies were not related to arsenic, but their experiments. The present study has shown that the arsenic accumulated in the body of mussels did not have adverse effects to the mussels, at least in a short period of time and for those physiological parameters measured, but after 10 days of exposure some parameters (lipid and SGP) 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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Metal exposure and associated effects in mussels: an integrated approach - hyphenated analytical techniques and biomarkers was performed to investigate the effect of metal exposure in coastal areas under direct or indirect influence of maritime activities and nautical tourism (port and marinas) using integrated and analytical approaches and indicators (Mytilus galloprovincialis).

Next to the natural sources, a large number of metals are present in the environment as a result of human activities. Since the ban of organo-tin compounds, Cu is the main source of metal pollution in coastal areas, especially in enclosed marine systems, such as harbours, marinas and estuaries, where the transport, berthing or docking of vessels is extensive.

To investigate the effect of metal exposure in coastal areas under direct or indirect influence of maritime activities and nautical tourism (port and marinas) using integrated and analytical approaches and indicators (Mytilus galloprovincialis). Mussels from the most polluted sites consistently exhibited a higher metal burden compared to mussels from less polluted sites. The present study has shown that the potential toxic effect of metals on mussels is a major environmental concern, and the assessment of metal exposure in coastal areas is crucial to understand the impact of human activities on the marine environment.

TU 377

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

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The present study aimed to develop an improved on-line clam-based behavioral monitoring system. The system included a valveometry 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 valveometric 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 unimpacted water and various Cu concentrations. In this study, a probabilistic-based approach describing the valve behavioral response of C. fluminea exposed to unimpacted water and Cu was developed. The phenomenological model was constructed by using the empirical formula to analyze the relationship between Cu concentration and valve closure rate of C. fluminea. The results showed that the valve closure rate of C. fluminea exposed to Cu was significantly higher than that of the control group. The valve closure response was positively correlated with the Cu concentration. The results of this study suggest that the valve closure response is a sensitive indicator for Cu exposure and can be used as an early warning system for Cu pollution in the marine environment.

TU 378

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

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As part of an integrative monitoring campaign involving water and sediment chemistry, in situ bioassays, and mussel bioaccumulation and biomarkers, Mytilus galloprovincialis mussels of standard size were transplanted from a clean location to five sites in two important harbours from the Atlantic coast of Spain (Vigo and Pasaia) at the end of summer 2010. Three groups of mussels were exposed to a range of Cu concentrations (0, 5, 10, 20, 40 and 80 μg L⁻¹) for 10 days, and the activities of glutathione S-transferase (GST), glutathione peroxidase (GPx) and acetylcholinesterase (AChE) 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 mussels tissues were also measured. Mussels from the most polluted sites consistently exhibited a significant increase in metal content as compared to the control site. The present study has shown that the GST and AChE activities in mussels can be used as potential biomarkers of toxicity for active monitoring in marine coastal ecosystems.

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SEAT 6th World Congress/SEAT Europe 22nd Annual Meeting
Kairomones are signs produced by the predator and that can be detected by the prey, causing stress and consequent fitness costs. In order to measure those costs and evaluate PW and algae mix at low, medium and high concentrations. The following parameters were analysed: PAHs in water, PAH concentrations in SPMD and mussel soft tissues, PW in a continuous flow-through system. The dilution was set at 0.1%, from day 6 until day 10 the flow was set to 0.2% to mimic real field conditions with varying PW concentration over time. The exposure set up included: a negative control with sea water only, a positive control with diluted PW only and three tanks containing diluted PW and algae mix at low, medium and high concentrations. The following parameters were analysed: PAHs in water; PW concentrations in SPMD and mussel soft tissues; and PAH metabolites in fish. Due to the important role of gills for absorption of waterborne PAHs, a histopathological investigation of fish gills was conducted as a support parameter. The presence of realistic densities of organic particles 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 50 000 cells/ml).

TU 382

Evaluation of environmental conditions to maximize mussels shell capability in trace metal accumulations

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The evaluation of mussels shell capability of concentrate heavy metals was performed by means of a set of laboratory experiments conducted with mussels collected in unpolluted sites exposed to sub-lethal 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 individuation 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 incorporate in the crystalline calcium carbonate lattice, his loss from the shell during mussels lifetime is considered as negligible; in other hand it is known that soft tissues are able to release contaminants in response to changes environmental conditions. The aim was to establish 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 sett physical, chemical and physiological parameters in order to maximize the shell metal content and set the implementation for bioassay strategy investigations exploiting mussels 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 environment (1 µg l−1), but enriched at coastal locations near aquaculture sites. It has been used a multiple biomarker approach to assess nickel contamination in the area of Galloprovincialis, a key biologic indicator organism. Mussels were exposed to sub-lethal concentrations of nickel (0-3600 µg l−1) for 5 days. In addition to determining tissue-specific nickel accumulation, the biomarkers analysed were DNA strand breakage (comet assay); induction of micronuclei (a biomarker of effect), histopathology and expression of specific metal accumulated in mussels at different concentrations, in the tissue-specific order byssus > digestive gland > gills > foot > adductor muscle > mantle. Significant genotoxic damage was observed by both the comet assay and micronucleus test, but only at 3600 µg l−1 nickel. Correspondingly, semi-quantitative analysis of histopathology in the gills indicated an increased rate in structural damage at concentrations ≥ 1800 µg l−1 Ni. Quantitative RT-PCR revealed increases in both the glutathione (GSH and GSSG) and metallothionein (met200) genes in gill tissue after exposure to 3600 µg l−1 nickel, compared to the controls. Expression of these genes is known to be induced following xenobiotic exposure, especially to metals. The p-glycoprotein (pgp) gene, which has been implicated in multi-drug resistance, was upregulated in nickel-exposed mussels; however, an increase was observed at 18 µg l−1 Ni. These results suggest that nickel is genotoxic to mussels at 3600 µg l−1 and that nickel is genotoxic in the mussels at concentrations ≥ 1800 µg l−1 Ni. In addition, nickel copromotes responses at the molecular (i.e. biomarker of exposure) and tissue (i.e. biomarker of effect) 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 Ni.

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), 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, were measured in situ. Significant (p < 0.05) increases of GPX enzymatic activity, pH and dissolved oxygen and negatively correlated with organic matter. The contrary, macrobenthic biodiversity was significantly (p < 0.01) correlated with pH, redox potential and dissolved oxygen and positively correlated with organic matter. On the contrary, macrobenthic biodiversity was significantly (p < 0.01) correlated with pH, redox potential and 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 toxicities to marine and marine invertebrates are still not well characterized and indeed many recent studies show the most recent information based on 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 biological and physiological biomarkers in estuarine and marine invertebrates (foraminifera, sea urchins, sea anemones, sea cucumbers, cophedes, sponges, shrimps, crabs, and hydromedusae) have been reviewed. Biomarkers associated with ionic and osmotic regulation of body fluids (ionic and osmotic activity and concentration) on the gills and the way they might affect the environment are being more and more studied. Moreover predator-prey relations have been progressively more pointed as stress sources. Environmental contamination and biotic and abiotic stress co-occur, thus it is important to assess and understand the synergistic or antagonistic effects of these changes (e.g. salinity) and/or predation combined with common environmental contaminants. Kaïromones are signs produced by the predator and that can be detected by the prey, causing stress and consequent fitness costs. In order to measure those costs and evaluate the effects of simultaneous exposure to multiple stressors, the sea snail Gibulla umbilicalis was exposed to increasing concentrations of mercury and salinity and/or predatory risk, simulated by a concentration gradient of kairomones produced by a sea snail predator - sea star. Mortality, feeding rates (indirect measure by post-feeding exposure experiment) and avoidance behaviour were assessed. In the end of the experiments, animals were sacrificed and cholinesterases’ activity and energy reserves were measured. Our results have shown that although responses could be triggered by single stressors, the combination of biotic or predation-specific compounds induces
Effects of mercury contamination on acute and chronic parameters of exposed sea snail Gibbula umbilicalis

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 TU 389

Biomonitroioring 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 muscles (Mytilus galloprovincialis Lam.) were measured along the west coast of the Cape Peninsula, Cape Town, from autumn to autumn 2010 to 2011. Sampling took place at Scarborough (considered an unpolluted site), Hout Bay, Green Point, Milnerton and Bloubergstrand. The evaluated parameters included metal content and metal accumulation by the mussel. The metal content of whole animal soft tissue was 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. Exposure to some environmental contaminants, even for short periods of time, may cause serious damage to exposed individuals. Thus, to evaluate the possible effects of mercury in the sea snail Gibbula umbilicalis, acute and chronic assays were performed by exposing the animals to increasing doses of the contaminant for 96 and 168 hours. Mortality, feeding rates (indirect measure by post-feeding exposure egestion) and avoidance behaviour were assessed. In the end of the experiment, animals were sacrificed and cholinesterases' activity and energy reserves were measured. Although evaluated at individual level, the effects observed here might be translated to the population and community level, since feeding impairment and change in energy allocation may have effects on the organisms' fitness, and reproductive performance. Moreover, modification in cholinesterases' activity and its common link to behaviour shifts might lead to severe implications in population dynamics.

Results have shown that most of the parameters evaluated tend to be impaired by this constant contaminant, showing the deleterious effects that this compound may have at the population level and on marine life.
The methodology revealed to be a sensitive and effective measure of xenobiotic toxicity and a prospective tool for environmental risk assessment.

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 water. However, the occurrence of toxic blooms in the coastal zone is increasing globally, resulting in increased levels of natural toxicants expecting to affect marine ecosystems.

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 sediment contaminants on benthic organisms as well as toxicology mechanisms to biological effects. Due to their nature as a eukaryotic cell-organism and their position in the food web, ciliated protozoa are suitable models for evaluating the biological effects of chemicals in living organisms as well as in estimating pollution levels in aquatic environments. Lethal and sub-lethal effects of exposure to inorganic and organic pollutants were tested on the cell mortality, replication rate, lysosomal membrane flux, and endocytosis rate of the marine ciliate E. crassus. Increasing concentrations of mercury, copper, and benzo[a]pyrene, individually and as mixtures, were investigated in our study as they might be bioavailable in naturally occurring polluted sites. Exposures to binary mixtures of all studied pollutants were performed coupled to gas chromatography tandem mass spectrometry (GC-MS/MS) for determining polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), organochlorine and organophosphate pesticides, triazines, plasticizers and some personal care products (triclosan, UV filters and fragrances). Briefly, 10 mm stir bars coated with a flake containing water samples (100 mL) and stirred for 24 hours at room temperature. Then, bars were sonicated during 30 min using a reduced amount of ethyl acetate (0.2 mL) to extract the analytes. This extract was analyzed by GC-MS/MS, so sub-ppb levels could be detected. Several parameters were optimized: extraction and desorption time, ionic strength, presence of organic modifiers, pH and MS/MS transitions. The second objective was applying this method to characterize the presence and distribution of micropollutants in two protected salt marsh areas from SW Spain that are adjacent to cities (Cadiz and Huelva, respectively). 20 water samples were collected at each area during summer 2011. Concentrations were often below 1 µg/L for most analytes; nevertheless some of them such as triclosan (up to 0.3 µg/L) can act as endocrine disruptors and affect marine organism populations after chronic exposure. Overall, results from this study provide an overview on the state of the two sampled marine environments with respect to chemical pollution, being useful for carrying out future toxicological assays with native species.
These results highlight that protein ubiquitination assessment represents a promising approach to evaluate and gain insight into stress response in marine ecotoxicology.

**TU 398**

Toxicological effects of three polybrominated diphenyl ethers (BDE-47, 99 and 154) on growth of marine algae Isochrysis galbana

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**TU 400**

**TU 401**

**TU 402**

**SETAC 6th World Congress/SETAC Europe 22nd Annual Meeting**
A short-term in situ sediment assay based on the postexposure feeding of the estuarine isopod Cyathura 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 of selecting single-substance test systems. In situ tests conducted under laboratory controlled conditions, which is particularly relevant for estuarine ecosystems where environmental conditions are highly variable. In this context, the objective of the present study was to develop and evaluate a short-term cost-effective in situ sediment assay based on the postexposure feeding of an estuarine species widely distributed and with an important ecological role in estuarine foodwebs. The selected species was the benthic isopod Cyathura 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. Significant correlations were found between the organohalogen compounds levels and the fish characteristics.

TU 404
Toxicity of the biotransformation products of four methylated PBDEs and one PAH produced by Nereis diversicolor and Nereis virens
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Assessment of the potential for contaminant body burden in red mullet only partly corresponded to chemical characteristics of the sediments and contaminated Portuguese estuaries. The influence of different exposure conditions (sediment particle grain size, temperature, salinity, and food availability) was also taken into account through a multiple regression model, with the ultimate goal of discriminating contaminant effects from those due to environmental factors. The in situ postexposure feeding assay with C. carinata was found to be a potential useful cost-effective tool for estuarine sediment toxicity assessments.

TU 405
Vitellogenin and Zona Radiata gene expressions in three different species of catfish from Termiños Lagoon
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The objective of the study is thereby to i) assess the toxicity of the biotransformation products of 1-methylphenanthrene, 3,6-dimethylphenanthrene, 1-methylpyrene, 3-methylchrysene and phenanthrene produced by the two benthic invertebrates Nereis diversicolor and Nereis Virens, and ii) identify the most important water soluble transformation products.

The biotransformation products from PAH exposed N. diversicolor and N. virens were collected by extracting the test water of laboratory mesocosms exposures at different times. The water soluble biotransformation products were extracted and concentrated by SPE, and their toxicity (EC50) were determined by exposing Daphnia magna to dilutions of these extracts. The water soluble biotransformation products were identified and quantified by UHPLC connected in series to a fluorescence detector and a Quadruple Time of Flight Mass Spectrometer. To aid the identification enzymatic deconjugation of the phase II products was performed, and identified by use of Gas Chromatography/Mass Spectrometry (GC-MS).

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

TU 406
Polyadenylated diphenyl ethers and their methoxylated analogs in sea bass (Dicentrarchus labrax) from Bizarre Lagoon, Tunisia
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Concentrations of polybrominated diphenyl ethers (PBDEs) and methoxylated polybrominated diphenyl ethers (MeO-PBDEs) in sea bass (Dicentrarchus labrax) collected from the Bizarre 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 2PBDEs ranged from 37.3 to 218 ng g⁻¹ lipid weight (lw) for sea bass in Bizarre 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 samples from Bizarre Lagoon and in the Mediterranean Sea, the mean concentration of these naturally produced organohalogens was 482 ng g⁻¹ lw. The total PBDEs and total MeO-PBDEs concentration in sea bass from Bizarre 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.

TU 408
Seasonal pollutant monitoring in discarded fish species: is valorisation appropriate?
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Increasing the exploitation of nutrient or by-catch products from aquaculture may come from a greater demand for fish products: the development of new markets for previously discarded species, use of low-value by-catch products for aquaculture and animal feed or the creation of value-added products from by-catch or discarded fish for food, pharmaceutical or cosmetic industries. However, the contribution to a sustainable management of this biomass through their optimal valorisation highly depends on the quality of the products to be obtained from them.

Many studies in the scientific literature, like surveys of fish and fish products in markets of different countries [1] or monitoring reports of Public Administrations and the EU [2] reported significant levels of this kind of pollutants (especially of dioxins, polychlorinated byphenyls-PCBs, organochlorinated pesticides-OCPS and heavy metals) in several cases for commercial species of different fisheries. However, if 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 co-processed 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, FAROS project, co-funded by the LIFE+ Environmental Program of the EU (LIFE08 ENV/ES/001919), aims as one of its main objectives to analyse the potential of fish discards and fishmeal to contribute to their valorisation by by-catch through their optimal valorisation recovery to and to produce valuable chemicals of interest in the food and pharmaceutical industry [4]. To properly define these adding-value processes, monitoring of metals, PCBs and dioxins are being performed on the most discarded species identified in FAROS métiers.
Characterization of selected Metals in United Arab Emirates coastal fish and locally produced food products.

Sediment-contact exposure of medaka eggs to a PAH model: combined chemical, toxicological and proteomic approaches.

Long-term incubation of adult Nereis virens (Annelida: Polychaeta) in copper-spiked sediment: the effects on adult mortality, gametogenesis, spawning and embryo development.

Preliminary investigation of COP1020 towards marine algal Dunaliella tertiolecta.

Effects of copper on gametogenesis and spawning in the polychaete Nereis virens (Annelida, Polychaeta).

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 toxicogenic ions were also investigated for comparison. A decrease in sporophyte and cell density was observed in the treated groups.

2,4-Dinitrophenylhydrazine cyanate (DNPH) and 2,4-Dinitrophenylhydrazine (DNP).

PBDEs accumulation in muscle of Whitemouth Croaker (Micropogonias furnieri) exposed to BDE 99 and BDE 153.

Phenotype changes in marine medaka (Oryzias melastigma) testis following exposure to copper: an in vitro study.

Effects of hypoxia on spermatogenesis and steroidogenesis of marine medaka (Oryzias melastigma) testis: an in vitro study.

Toxic effects of ZnO nanoparticles towards marine algae Dunaliella tertiolecta.
Albatrosses and petrels (Procellariiformes) are migratory oceanic birds of considerable conservational interest. Polychlorinated biphenyls (PCBs) and organochlorine pesticides (OCs) are ubiquitous contaminants in the environment that are used in various industrial applications. In this study, we aimed to assess the accumulation pattern of OCs in the liver and muscle tissues of Albatrosses and petrels from the Southern Ocean.

The liver and muscle tissues of 20 Albatrosses and 20 petrels were collected from the Southern Ocean. The OC concentrations were measured using gas chromatography-mass spectrometry (GC-MS). The results showed that the liver tissues contained higher OC concentrations compared to the muscle tissues. The hepatic OC concentrations were significantly higher in the liver of Albatrosses compared to that of petrels, with PCBs and DDTs being the major contributors.

The muscle OC concentrations were also higher in Albatrosses compared to petrels. The main OCs found in the muscle were the chlorinated pesticides, particularly DDTs and PCBs. There were no significant differences in the OC concentrations between the sexes in both tissues.

These findings highlight the importance of OCs as biomarkers for the assessment of environmental exposure in migratory birds. The higher OC concentrations in Albatrosses compared to petrels might be attributed to their longer migration periods and exposure to OCs during their migration routes. The results also underscore the need for further studies to understand the biological significance of OC accumulation in marine birds.