IIES

International Institute for Environmental Studies

国际环境科学中心

2nd Annual IIES Scientific Workshop

August 21 – 24, 2016

University of Eastern Finland, Kuopio

UNIVERSITY OF
EASTERN FINLAND

2nd Annual IIES Scientific Workshop
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PROGRAM

Saturday, 20.8.2016

18.00	Bus transfer from Kuopio Airport – Hotel Scandic

Sunday, 21.8.2016

17.30 – 18.30	Pre-Registration possibility at Hotel Scandic
18.30 – 21.30	**Get-together evening at Hotel Scandic**

Monday, 22.8.2016

08.00	Bus transfer Hotel Scandic – University / Tietoteknia
08.00 – 08.40	Registration
08.40 – 08.50	**Opening of the Meeting** *Academic rector Professor Jaakko Puhakka*
08.50 – 09.15	**Introduction to IIES** *Professor Douglas Evans, School of the Environment, Trent University, Canada*
09.15 – 09.30	**Workshop practical information** *Karin Koivisto, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*

Session 1

Environmental Health — **Chair: Professor Yu Zhao, Nanjing University, P. R. China**

09.35 – 09.55	**'Can predictive models map soil lead concentrations in urban environments?'** *Sarah Donoghue, University of Edinburgh, U.K.*
09.55 – 10.15	**'Daytime and night time VOC concentrations in Finnish schools'** *Dr. Maija Leppänen, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*
10.15 – 10.40	**Coffee and poster session**
10.40 – 11.00	**'Cadmium isotope fractionation of the surface waters in a mining area impacted by acid mine drainage'** *Wenjun Yang, School of Environmental Science and Engineering, Sun Yat-sen University, P.R. China*
11.00 – 11.20	**'Metal mining in fresh water ecosystems – metal distribution and the effects of seasonality on ecological risk assessment'** Kristiina Väänänen, *Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*
11.20 – 11.40	**'Direct and indirect effects of metal nanoparticles on toxic HAB species *Alexandrium tamarense* (dinophyceae)'** *Dr. Yuelu Jiang, Graduate School at Shenzhen, Tsinghua University, P.R. China*

11.40 – 12.00	**'Distribution among the dissolved and particulate phase of endocrine disruptors in urban wastewater, effluents and receiving waters and estrogenic activity with YES-assay'** *Professor Sébastian Sauvé, Directeur académique Institut EDDEC, University of Montreal, Canada*
12.00 – 13.00	**Lunch**

Session 2

Air Quality and Health Finland	**Chair: Professor Jorma Jokiniemi, University of Eastern Finland,**
13.00 – 13.20	**'Enhancing China's Environmental Health Studies of PM2.5 through Satellite Remote Sensing'** *Zong-Wei Ma, State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, P.R. China*
13.20 – 13.40	**'One year of aerosol size and black carbon measurements in Nanjing, China'** *Dr. Ari Leskinen, Finnish Meteorological Institute, Finland*
13.40 – 14.00	**'Toxicological responses of human alveolar epithelial cells exposed to size-segregated urban air particulate matter from Nanjing, China'** *Teemu Rönkkö, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*
14.00 – 14.20	**'The immunomodulatory effects of farm dust and urban air particulate matter: A pilot study'** *Maria-Viola Martikainen, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*
14.20 – 14.50	**Coffee and poster session**
14.50 – 15.10	**'A Novel Device for Cell Exposure at the Air-Liquid Interface'** *Dr. Mika Ihalainen, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*
15.10 – 15.30	**'Novel exposure system for combustion emissions and nanoparticles'** *Dr. Pasi Jalava, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*
15.45	Visit to the UEF/ILMARI Aerosol Physics, Chemistry and Toxicology Research Unit and the UEF/Savonia University of Applied Science Water Laboratory at Kuopio Science Park
17.45	Bus transfer Kuopio Science Park – City Reception at Kuopio City Hall

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18.00 – 19.30	**Reception hosted by the City of Kuopio at Kuopio City Hall**

Tuesday, 23.8.2016

08.00 Bus transfer Hotel Scandic – University / Tietoteknia

Session 3

Environmental Processes **Chair: Professor Rainer Schulin, ETH Zürich, Switzerland**

08.30 – 08.50 **'Role of natrual organic matter (NOM) in binding uranium and incorporating radiocarbon'**
Michael R. Muir, School of GeoSciences, University of Edinburgh, U.K.

08.50 – 09.10 **'Mechanistic understanding of key factors controlling mercury bioaccumulation and risk in rice paddy fields'**
Dr. Huan Zhong, State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, P.R. China

09.10 – 09.30 **'Modelling greenhouse gas exchange from heterogenous Seida landscape in Northwestern Siberia'**
Dr. Narasinha Shurpali, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland

09.30 – 10.00 **Coffee and poster session**

10.00 – 10.20 **'DECONOMIX – Deconvolution of Complex Mixtures'**
Dr. Margaret C. Graham, School of GeoSciences, University of Edinburgh, U.K.

10.20 – 10.40 **'Bioavailability of organic compounds in various environmental matrix'**
Xinyi Cui, State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, P.R. China

10.40 – 11.00 **'The filed decomposition and DOM release dynamics of typical trees leaf litter'**
Dr. Shizhong Wang, School of Environmental Science and Engineering, Sun Yat-sen University, P.R. China

11.20 – 11.40 **'Effects of species characteristics on bioaccumulation of polychlorinated biphenyls (PCB) in mussels and fish'**
Kaisa Figueiredo, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland

11.40 – 12.00 **'Antimony in shooting range soil - an environmental problem in Switzerland'**
Professor Rainer Schulin, Institute of Terrestrial Ecosystems, ETH Zürich, Switzerland

12.00 – 13.00	**Lunch**

Session 4

Green Technologies	**Chair:** Assistant Professor Amit Bhatnagar, University of Eastern Finland, Finland
13.00 – 13.20	**'Water treatment residuals as soil amendments'** *Dr. Ian W. Oliver, School of Physical & Geographical Sciences, Keele University, U.K.*
13.20 – 13.40	**'Bioelectrochemical Systems: Harnessing Electricity from Microbes'** *Dr. Chang-Ping Yu, Graduate Institute of Environmental Engineering, National Taiwan University, Taiwan*
13.40 – 14.00	**'Removal of recalcitrant organic pollutants by magnetically separable heterogeneous Fenton like catalytic technology'** *Dr. Mingce Long, School of Environmental Science and Engineering, Shanghai Jiao Tong University, P.R. China*
14.00 – 14.20	**'Synthesis of nanofibrillar cellulose (NFC) from cotton and adsorption studies with lead (Pb^{2+})'** *Emmanuel Abu-Danso, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*
14.20 – 14.50	**Coffee and poster session**
14.50 – 15.10	**'Transformation of selenium species by green fresh water algae'** *Professor Dirk Wallschläger, School of the Environment, Trent University, Canada*
15.10 – 15.30	**'Spinel ferrites based nanocomposites for environmental remediation'** *Dr. Chella Santhosh, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*
15.30 – 15.50	**'Arsenate and arsenite removal using nano.TiO2-feldspar impregnated chitosan: pH-dependence and UV irradiation studies'** *Roza Yazdani, Department of Built Environment, School of Engineering, Aalto University, Finland*
15.50 – 16.10	**'Sediment amendments and remediation of aquatic systems'** *Dr. Jarkko Akkanen, Department of Environmental and Biological Sciences, University of Eastern Finland, Finland*
16.10 – 16.30	**Discussion**

16.30	Bus transfer University – Hotel Scandic

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17.45	Bus transfer Hotel Scandic – Puijo Tower
18.00	**Visit to the Puijo Tower FMI/UEF/ICOS Measurement Station**
19.00 – 22.00	**Dinner at Puijo Tower Restaurant**
22.00	Bus transfer Puijo Tower – Hotel Scandic

Wednesday, 24.8.2016

08.00	Bus transfer Hotel Scandic – University / Tietoteknia
08.30 – 09.30	**Discussion**
09.30 – 10.00	**Coffee and poster session**

Session 5

Environmental Policy	**Chair: Professor Mikko Kolehmainen, University of Eastern Finland, Finland**
10.00 – 10.20	**'The effects of China's control policies on historical and future trends on atmospheric pollutant emissions'** *Professor Yu Zhao, State Key Laboratory of Pollution Control and Resource Reuse, School of the Environment, Nanjing University, P.R. China*
10.20 – 10.40	**'China's Hg policies and their implications for the overall success of Minamata Convention'** *Dr. Yan Lin, Norwegian Institute for Water Research (NIVA), Norway*
10.40 – 11.00	**'Educating for Environmental Sustainability: Promoting sustainable mindsets and actions through interdisciplinary education'** *Dr. Asaf Zohar, Sustainability Studies Program, Trent University, Canada*
11.00 – 11.30	**'Mediated Negotiations in Forest based Responsive Bioeconomy'** **&** **The Institute for Natural Resources, Environment and Society: Example of our research interests** *Adjunct Professor Irmeli Mustalahti, Department of Geographical and Historical Studies, University of Eastern Finland, Finland*
11.30 – 11.45	Closing of the Meeting
11.45 – 12.45	**Lunch**
12.45	Bus transfer to the Airport
13.00	Bus transfer to Hotel Scandic

POSTER PRESENTATION

P01 Isabell Rumrich, Matti Viluksela, Kirsi Vähäkangas, Otto Hänninen: Potential of health registers in environmental health research in Finland

P02 Samuel Hartikainen, Tine Bizjak, Tamara Gajst, Jari Leskinen, Jouni Sorvari, Pertti Pasanen, Arto Koistinen: Microplastic pollution in Finnish lakes: a potential threat for freshwater sources and human health

P03 Kokkola, H., Kühn, T., Partanen, A.-I., Laakso, A., Lu, Z., Bergman, T., Mikkonen, S., Korhonen, H., Räisänen, P., Streets, D. G., Romakkaniemi, S., and Laaksonen, A.

P04 Sippula O., Kuuspalo K., Koponen H., Orasche J., Abbaszade G., Torvela T., Leskinen A., Jalava P., Wang Q., Ruusunen J., Hao L., Fang D., Ruuskanen A., Lehtinen K.E.J., Schnelle-Kreis J., Zimmermann R., Komppula M., Gu, C., Hirvonen M.-R., Jokiniemi J.: Seasonal and diurnal variation in chemical composition of urban air PM in Nanjing

P05 Tissari, J., Sippula, O., Lamberg, H., Jokiniemi, J.: Gaseous and particle emissions from residential wood combustion

P06 V. Lappalainen, A. Salmela, M. Honkanen, A. Karvinen, I. Kulmala, P. Pasanen: Laboratory experiments on indoor bioaerosol deposition onto various surface materials

P07 Hanna de Ruyter, Isabell Rumrich, Matti Viluksela, Kirsi Vähäkangas, Mika Gissler, Heljä-Marja Surcel, Jukka Jokinen, Otto Hänninen: Evaluation of needed study size to investigate the association between exposure to source specific $PM_{2.5}$ and adverse outcomes in pregnancy

P08 Y.-T. Tang, T.-H.-B. Deng, C. Cloquet, T. Sterckeman, W.-J. Yang, G. Echevarria, N. Estrade, J. L. Morel and R.-L. Qiu: Zinc and Nickel Isotope Fractionation in hyperaccumulating and non-accumulating plants

P09 Yaodan Zhang, Virpi Virjamo, Riitta Julkunen-Tiitto, Hongyan Guo: Soil pyrene contamination affects young Norway spruce (*Picea abies*) growth and phenolics

P10 Pauliina Halimaa, Daniel Blande, Erol Baltzi, Sirpa Kärenlampi, Arja Tervahauta: Transcriptomics of metal hyperaccumulator *Noccaea caerulescens* populations reveal intraspecies differences at gene expression and sequence

P11 Tero Luukkonen, Emma-Tuulia Tolonen, Hanna Runtti, Kimmo Kemppainen, Ulla Lassi: Novel water treatment materials from low-cost clay minerals and industrial side-products

P12 Ehsan Daneshvar, Arya Vazirzadeh, Amit Bhatnagar: A comparative study on the Methylene Blue (MB) dye biosorption onto different modified marine macroalgae

P13 Giorgio Lanzani, Ari P Seitsonen, Marcella Iannuzzi, Kari Laasonen, Simo Pehkonen: Isomerism of trimeric aluminium complexes in aqueous environments explored with DFT-based metadynamics simulation

P14 Danielle Harris and Emma Langley: Renewable Energy and Reconciliation in Canada: Professional and Continuing Education Programs Related to Indigenous-Settler Relationship-building and the Duty to Consult

P15 Antti Korhonen, Otto Hänninen, Isabell Rumrich, Arja Asikainen, Heli Lehtomäki, Jarkko Tissari: Analysis of air pollution exposure in Finland

016 Heli Lehtomäki, Antti Korhonen, Isabell Rumrich, Arja Asikainen, Camilla Geels, Jørgen Brandt, Otto Hänninen: Disease burden of ambient air pollution in five Nordic countries

017 Yanmei Chen, Wenjun Yang, Yuanqing Chao, Shizhong Wang, Rongliang Qiu: Enhanced phytostabilization by the metal-tolerant *Enterobacter* sp. strain EG16 presenting selected plant growth-promoting strategy under metal contamination

ABSTRACTS – ENVIRONMENTAL HEALTH

ORAL PRESENTATIONS

Abstract for 2nd Annual International Institute for Environmental Studies (IIES) Scientific Workshop. Aug 21-24, Kuopio, Finland

Can predictive models map soil lead concentrations in urban environments?

Sarah Donoghue[1], Margaret Graham[1], Fiona Fordyce[2], Neil Stuart[1] and Murray Lark[2]

[1] The University of Edinburgh, [2]British Geological Survey

Lead (Pb) is toxic to all life and even low blood Pb levels can have neurological effects, especially in children <6. With >50% of the global population now living within urban areas, elevated Pb levels in urban soils is of concern due to the greater number of children exposed and higher soil Pb contents. The elevated levels in these soils are a legacy of Pb pollution from the historical use of leaded-petrol, lead-based paints, and industrial emissions. Pb persists today due to its low mobility, and consequently long residence time in the soil. Subsequent ingestion and inhalation of polluted soil can allow Pb to enter the bloodstream. Remediation of polluted soils can reduce this health risk. Effective remediation requires that the spatial distribution of soil Pb is understood. This is commonly achieved by extensive soil sampling, however predictive models offer a low cost alternative. Predictive models have recently been trialled in Baltimore, USA, where they estimated soil Pb with >70% accuracy, but their regional and international applicability was not tested. This study aims to build on such models, using Glasgow, Scotland, a city with an industrial past, as a case study. This involves combining city-scale controls, namely land use, industry and housing age, with local-scale influences on soil Pb levels i.e. distance to road and buildings. Different types of models will be tested on Glasgow, and will be applied to other British cities with similar and differing development histories, where they will be validated against existing high-resolution soil chemistry datasets.

Daytime and night time VOC concentrations in Finnish schools

Maija Leppänen[1,*], Marko Hyttinen[1], Rauno Holopainen[2], Kari Salmi[2], Pertti Pasanen[1]

[1] University of Eastern Finland (UEF), Department of Environmental Science, Kuopio, Finland
[2] Finnish Institute of Occupational Health, Helsinki, Finland

In many public buildings, ventilation is turned off or the air-change rate is decreased during night time. However, this may cause indoor pollutants to accumulate into the air. The aim of this study was to investigate how turning the ventilation off during night time affects the concentration of volatile organic compounds (VOCs) in Finnish schools. The samples were collected from eight schools by Tenax TA adsorbent and analysed by thermal desorption GC-MS method. During daytime, TVOC concentrations in the schools were 15-348 $\mu g/m^3$. The most dominating compounds were decamethyl cyclopentasiloxane, D5 (max 234 $\mu g/m^3$) and limonene (max 187 $\mu g/m^3$), and they probably emitted from e.g., personal care and household care products. During night time, TVOC concentrations in seven schools varied between 30 and 127 $\mu g/m^3$. In one school, substantially higher night time TVOC concentrations were measured, being 311 and 644 $\mu g/m^3$. The concentrations of single compounds were low, except for the one school, where high night time concentrations were measured for terpenes (e.g., α pinene 71 $\mu g/m^3$ and 3-carene 40 $\mu g/m^3$) and acids (e.g., n-hexadecanoic acid 127 $\mu g/m^3$ and tetradecanoic acid 82 $\mu g/m^3$). In conclusion, night time TVOC concentration did not differ considerably from the daytime TVOC concentrations. However, the compound profiles differed. During daytime, VOC emissions were due to the occupants and activities in the premises, whereas night time VOC concentrations reflected material emissions.

Cadmium isotope fractionation of the surface waters in a mining area impacted by acid mine drainage

Wenjun YANG[†,‡], Yetao TANG[*,†,‡] and Rongliang QIU[*,†,‡]

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[‡]Guangdong Provincial Key Laboratory of Environmental Pollution Control and Remediation Technology, Guangzhou 510275, China

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Abstract: The pollution of natural waters and sediments with metals derived from acid mine drainage (AMD) is a global environmental problem. However, the processes governing the behaviors of transportation and transformation of metals like Cd in mountain area are poorly understood, the complicated hydro-geomorphic settings of mountain catchments are difficult to access . And few reports have been reported about the effects of. In this study, the concentration and the isotopic composition of Cd selected filtered stream samples from the Hengshi river affected by AMD have been determined. The Cd concentrations were determined for collected sediments samples, which cover the entire river valley from upstream to the downstream regions. Results

showed that reducing concentrations for Cd were found in the river water from upstream to downstream, and also high enrichment factor for Cd in all the sediments, suggest that Cd mainly is derived from Liwu dam and easily enter into solid phase. The isotopic data show that the dissolved Cd in rivers is characterized by $\delta^{114/110}$Cd, ranged from 0.09 ‰ to 0.40 ‰ in term of $\delta^{114/110}$Cd , the mean is 0.25 ± 0.06 ‰, and the content of Cd from the sediments is 0.18 to 39.85 μg/g. The river isotope values are similar to the isotope signature of Liwu dam, which contain significant amounts of contaminants under a deep water cover, such as mine tailings, sulfide-rich rocks and minerals. Large fractionated Cd ($\delta^{114/110}$Cd = 0.40 ± 0.09 ‰) was found in water sample collected from midstream near a farmland, which imply there is a new source different from the LIWU dam depend on the heavier Cd signature. We hypothesize that this shift results from either hydrology changes over time in the main and tributaries stream, and some new pollution source imported. The change in the behavior of sorption of cadmium on oxides and hydroxides in the sediment system under low pH cause indistinguishable fractionation. Our result is encouraging for application of Cd isotopes as a novel tracer for identifying and tracking metal sources and attenuation mechanisms in mountain watersheds.

Keywords: cadmium isotope; rivers; sediments; trace; AMD

Metal mining in fresh water ecosystems – metal distribution and the effects of seasonality on ecological risk assessment.

Authors: Kristiina Väänänen[a]*, Tommi Kauppila[b], Jari Mäkinen[b], Matti Leppänen[c], Merja Lyytikäinen[a] and Jarkko Akkanen[a]

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[a] University of Eastern Finland, Department of Environmental and Biological Sciences, Joensuu

[b] Geological Survey of Finland, Kuopio

[c] Finnish Environmental Institute, Jyväskylä

Metal emissions downstream from the mining operations may induce adverse effects on aquatic ecosystems. Site-specific metal bioavailability determines the toxicity and the risks of metals. Risk assessment (RA) of metals is challenging due to variations in metal distribution and bioavailability. Four lakes in Finland were analyzed for their metal content in sediment, sediment pore water and overlying water. We also measured the water chemistry in the sampling points (pH, O_2, conductivity, redox potential). Sampling was performed in spring and autumn to evaluate the possible seasonal changes in metal bioavailability and ecological risk levels. RA was conducted with simultaneously extracted metals – acid volatile sulfides method (sediment), US EPA environmental quality guidelines (waters) and biotic ligand models (waters). The majority of metal loadings were in sediment compartments and there was an elevated risk to benthic organisms in all of the lakes. Metal profiles followed the metals that were mined within the area. The bioavailability of metals varied among the lakes and the seasons. Risks were slightly higher in spring than in autumn, which could be explained by changes in pH, O_2 and dissolved organic carbon (DOC). During autumn, O_2 was high (>89%), pH neutral and DOC 24–75 mg/l. The corresponding values for spring were <6%, slightly acidic (3.5–6.5) and 12–60 mg/l. These parameters change the metal bioavailability and if the risk assessment is conducted during autumn, the risks may be underestimated.

Direct and indirect effects of metal nanoparticles on toxic HAB species *Alexandrium tamarense* (dinophyceae)

Yuelu Jiang[1,2], Manlu Li[1,2]

[1] *Graduate School at Shenzhen, Tsinghua University, Shenzhen, China*

[2] *School of Environment, Tsinghua University, Beijing, China*

Abstract:

Frequent human activity such as pollutant discharge increased the occurrence of harmful algal bloom (HAB) events in coastal regions, which are closely related to public health and marine ecosystem. Engineered nanoparticles (ENPs) are inevitably to enter aquatic environment due to the extensive application of in electronics, cosmetics, and biomedicine, and cause unpredictable risks to marine organisms and ecosystem. Knowledge of the influence of ENPs to harmful algal bloom (HAB) species is still lacking. In order to assess the overall risk posed by ENPs, the direct and indirect effects of this emergent pollutant to aquatic ecosystems must be evaluated. In this study, we explored the effects of three metal oxide ENPs: (1) $nTiO_2$, (2) nZnO and (3) nAl_2O_3 on growth rate, photosynthesis, reactive oxide species (ROS) and paralytic shellfish poisoning (PSP) toxin production of *Alexandrium tamarense*. We found dose-dependent decrease in photosynthetic activity of *A. tamarense* under all three ENPs ($p<0.01$) and significant inhibition of growth rate under nZnO ($p<0.01$). The ROS production AND cellular PSP toxin content of *A. tamarense* was induced by ENPs. The changes of PSP toxin content and composition may be a stress response of *Alexandrium* when exposed to ENPs. Our study provided further information of nanoimpacts on the HAB species and PSP production to better evaluate the risks of ENPs on human health and aquatic ecosystem.

Distribution among the dissolved and particulate phase of endocrine disruptors in urban wastewater, effluents and receiving waters and estrogenic activity with YES-assay

Sébastien Sauvé, Simon Comtois-Marotte, Thomas Chappuis, Sung Vo Duy, Nicolas Gilbert, André Lajeunesse, Salma Taktek, Mélanie Desrosiers, Éloïse Veilleux

Oral preferred – Topic 1 – Environmental proccesses

Abstract

The analysis of trace emerging contaminants (ECs) is gaining more interest and several studies have reported their occurrence in waste and surface water. However, wastewaters are rich in particulates that have been found to sorb several organic contaminants. Thus, an analytical method based on off-line SPE-LC-APCI-HRMS was developed for the detection and quantification of 31 ECs from surface water, wastewater, suspended particulate matter (SPM) as well as sediments. Lyophilized sediments and air-dried SPM were subjected to ultrasonic extraction. Then, water samples and extracts were concentrated and cleaned-up by an off-line SPE. Quantification was realized using a Q Exactive mass spectrometer in both full scan (FS) and targeted ion fragmentation (t-MS2) modes. These two modes were optimized and compared to determine which one was the most suitable for each matrix studied. The solid-liquid distribution coefficients varied from log Kd of 1 to 4. Yeast estrogen screen assay (YES-assay) adapted from the direct measurement of estrogenic activity without sample extraction was tested on filtered wastewater samples. An endocrine disrupting effect was detected in all effluent samples analyzed with estradiol equivalent concentrations ranging from 4.4 to 720 ng eq E2 L-1 for the WWTP-1 and 6.5 to 42 ng eq E2 L-1 for the WWTP-2. The chemical methods were also applied on six samples of surface water, the corresponding SPM, the sediments and thirty-nine effluent samples from two wastewater treatment plants (WWTPs) sampled over a period of five months (February to June 2014).

ABSTRACTS – ENVIRONMENTAL HEALTH

POSTERS

Potential of health registers in environmental health research in Finland

Isabell Rumrich[1,2], Matti Viluksela[1,2], Kirsi Vähäkangas[3], Otto Hänninen[2]
[1] Department of Environmental Science, University of Eastern Finland, Kuopio, Finland
[2] Department of Health Protection, National Institute of Health and Welfare, Kuopio, Finland
[3] School of Pharmacy/Toxicology, Faculty of Health Sciences, University of Eastern Finland, Kuopio Finland

In 1953 the Finnish Cancer Registry was established as the first health register in Finland. Since then numerous other health registers have been established. They include the personal identification number (PIN), which has been assigned to permanent citizens of Finland since 1968. The legal basis for the registers is EC directive on the protection of personal data and Section 4 of the Act on National Personal Data Registers Kept under the Health Care System (556/1989).

Health registers are an interesting option in epidemiology since they provide large datasets for health endpoints and confounders, providing large potential for analysis of environmental risk factors. Different registers can be linked using the PIN and location information. Using these data in epidemiology reduces the need to recruit and contact study populations to collect information. This reduces the costs significantly. There is also an ethical need to utilize publicly collected data for science and improvement of health. Bias is potentially reduced by not needing to rely on self-reported diagnoses and retrospectively collected information.

Data protection is crucial when register data are used. Individuals may be identified based on their characteristics and health history, even if the PIN is stripped off. In human biomedical studies an ethical statement from an ethics committee is required by law in Finland before filing the request to the register holder for obtaining data. Among the crucial aspects are that data protection is sufficient and that a plan exists, what will be done with the data once the study is finished.

Topic: Environmental Health

Word count: 250 words

Microplastic pollution in Finnish lakes: a potential threat for freshwater sources and human health

Samuel Hartikainen[1*], Tine Bizjak[1], Tamara Gajst[1], Jari Leskinen[1], Jouni Sorvari[1], Pertti Pasanen[1], Arto Koistinen[1]

[1]University of Eastern Finland, Kuopio, Finland

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Microplastic pollution is mainly studied in the marine environment, while freshwater ecosystems remain understudied. There are 187 888 freshwater lakes in Finland. The tenth biggest is Lake Kallavesi. It lies in the Finnish Lake District in the eastern Finland and is part of the largest freshwater catchment area in Finland. Lake Kallavesi, that has 5442 km of shore line, surrounds the eight biggest city in Finland – the City of Kuopio. For five months each year the surface of Lake Kallavesi is frozen, thus offering interesting possibilities for microplastic research.

In Finland microplastic pollution studies have already been conducted in the Baltic Sea. Our research is the first to focus on the microplastic pollution in the Finnish freshwater ecosystems. Microplastic was alredy found in the Arctic Sea ice, however for all we know our study is the first estimation of microplastic pollution in freshwater lake ice.

This research confirms the presence of microplastics in Lake Kallavesi. Observed concentrations are high compared to other microplastic studies. Ecosystems in shallow lakes are easily affected by anthropogenic pollution. Lake Kallavesi is also used as a source for the city's drinking water supply, which is why the continuation of research on microplastic pollution is even more important.

ABSTRACTS – AIR QUALITY AND HEALTH

ORAL PRESENTATIONS

Abstract submitted to 2nd Annual IIES Scientific Workshop

Enhancing China's Environmental Health Studies of $PM_{2.5}$ through Satellite Remote Sensing

Zongwei Ma[1], Jun Bi[1], Miaomiao Liu[1], Kai Chen[1], Yang Liu[2]

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Numerous epidemiologic studies conducted in developed countries have shown that $PM_{2.5}$ is associated with many adverse health effects. In recent years, rapid economic development has caused severe $PM_{2.5}$ pollution in China. However, environmental health studies of $PM_{2.5}$ in China have been hindered by the limited exposure data. Estimating $PM_{2.5}$ from satellite-sensed aerosol optical depth (AOD) data is a new method to evaluate the spatiotemporal $PM_{2.5}$ exposures. We developed a two-stage statistical model to estimate ground-level $PM_{2.5}$ from 2004-2013 in China using the newly released Moderate Resolution Imaging Spectroradiometer (MODIS) Collection 6 (C6) level 2 AOD, assimilated meteorology data, land use information, and ground-measured $PM_{2.5}$ concentrations from China's recently established monitoring network. We used the first-stage linear mixed effects model to represent the temporal variability of $PM_{2.5}$ and the second-stage generalized additive model to represent its spatial contrast. Validation shows that our model estimated $PM_{2.5}$ concentrations with little bias at the monthly level (R^2 = 0.73, regression slope = 0.91). Based on this data, a series of environmental health studies were conducted. For examples, 1) we studied the spatial-temporal characteristics of the $PM_{2.5}$ related health burden from 2004-2012 in China; 2) we studied the nexus between urbanization and air pollution related health in China; and 3) we studied urbanization level and vulnerability to heat-related mortality in Jiangsu, China, which included this $PM_{2.5}$ data to identify possible effect modifiers of heat-related mortality risk. Our results show that this satellite-driven $PM_{2.5}$ data can potentially advance environmental health studies of $PM_{2.5}$ in China.

One year of aerosol size and black carbon measurements in Nanjing, China

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Aerosol size distribution and black carbon (BC) concentration were measured for one year (November 2014 – November 2015) at Nanjing University Xianlin campus on the rooftop of a five-floor building. The size distribution was measured in the range of 10 nm to 10 µm with a TSI 3910 Nanoparticle Sizer and a TSI 3330 Optical Particle Sizer. The BC concentration and aerosol light absorption coefficient were measured with a Magee Scientific AE-42 at seven wavelengths (370 – 950 nm). Temperature, relative humidity, rain intensity and duration as well as wind speed and direction were measured with a Vaisala WXT520 weather station.

During the measurement period the average (of hourly averages) and peak (99th percentile of hourly averages) concentrations were 14700 and 30700 cm^{-3} for particle number, 80 and 244 µg m^{-3} for mass of particulate matter smaller than 10 µm in diameter (PM_{10}), and 3.45 and 14.6 µg/m^3 for black carbon (at 880 nm). The overall average of BC-to-PM_{10} ratio was 0.069.

The biggest number and mass concentrations (of both PM_{10} and BC) were observed during southerly winds. Also diurnal variation in the concentrations were observed. The particle number concentration had two peaks every day: One at 6 am and the other at 6 pm. The BC concentration, in turn, was at its highest in the nighttime and at its lowest at around noon.

TOXICOLOGICAL RESPONSES OF HUMAN ALVEOLAR EPITHELIAL CELLS EXPOSED TO SIZE-SEGREGATED URBAN AIR PARTICULATE MATTER FROM NANJING, CHINA.

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Abstract

A549 human alveolar epithelial cells were exposed to four size-ranges of urban ambient air particulate matter (PM) collected in Nanjing, China during August and October 2013. Day- and nighttime PM samples were collected using a High Volume Cascade Impactor (HVCI) and processed separately. Cells were exposed to five doses of PM (25, 75, 150, 200 and 300 µg/ml) on a cell culture plate for 24 hours. The cytotoxic responses of A549 cells were measured using MTT and PI -assays. Oxidative stress was assessed by DCF-assay. Cellular vitality as measured by intracellular reduced thiol level was analyzed by VB48-assay. Genotoxicity was assessed by single cell gel electrophoresis (COMET) and cell cycle analysis was conducted by flow cytometry. Inflammatory cytokines were measured by enzyme-linked immunosorbent assay (ELISA).

PM exposed A549 human alveolar epithelial cells showed clearly dose-dependent responses in MTT and DCF assays. In general, smaller particle fractions elicited stronger cytotoxic responses, with down to 53 % cellular metabolic activity when exposed to 300 µg/ml $PM_{0.2}$ from August. Instead, $PM_{10\text{-}2.5}$ caused generally the greatest oxidative stress. Cellular vitality, based on level of reduced thiols, was reversely proportional to PM-dose, but differences to untreated control cells were small. Cells of impaired condition were primarily characterized by damaged cell membranes as only a small portion of cells showed both intact cell membranes and decreased reduced thiol levels.

The immunomodulatory effects of farm dust and urban air particulate matter: A pilot study

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Backround: Air pollution, especially particulate matter (PM), increases cardiovascular morbidity and mortality worldwide, but less is known about its effect on the development of immune diseases such as asthma. It can be hypothesized that PM exposure disrupts human immunoregulatory mechanisms, thus predisposing exposed individuals to the development of asthma. In contrast, farm environment provides a protection against asthma, potentially via immunomodulation induced by farm dust exposure.

Aim: To investigate the effect of urban air PM ("high risk environment") and farm dust ("protective environment") on human immune responses.

Methods: We stimulated peripheral blood mononuclear cells (PBMC) of five adults with increasing doses of farm dust extract (farm stable in Northern Savonia, Finland) and PM samples (PM2.5-1 OR PM1-0.2, Nanjing, China). Flow cytometry was used to measure numbers and functional properties of circulating dendritic cells, monocytes and B-cells. Results of monocytes and mDCs are reported in this presentation.

Results: Both farm dust and PM induced immune responses in monocytes and mDCs. After PM stimulation the expression of immunogenic CD80 decreased in a dose-dependent manner in mDCs. Farm dust increased the expression of CD80 in both cell types. The expression of tolerogenic marker ILT4 was decreased in monocytes and in mDCs after stimulation with PM. Similar phenomenon was seen after farm dust stimulation in monocytes, but not in mDCs.

Conclusions: Studied environmental samples were able to shape the immunogenicity and tolerogenicity of human peripheral blood immune cells. Interestingly, samples from "high risk" and "protective" environment had partly differing effects.

A Novel Device for Cell Exposure at the Air-Liquid Interface

Mika Ihalainen, Pasi Jalava, Kari Kuuspalo, Maija-Riitta Hirvonen, Jorma Jokiniemi

Inhalation exposure is the main route causing health effects by the air pollutants. Air-liquid interface (ALI) in-vitro exposure mimics most realistically real life conditions. In ALI devices it is crucial to know the dose for the cells accurately. The dose from inhaled particles is determined by particle size and concentration at the air-liquid interface. The most important natural deposition mechanisms at the air-liquid interface are interception, impaction, gravitational settling and diffusion. However, diffusion is strongly dependent on particle size and thus dose determination becomes difficult. Also deposition by diffusion is very inefficient for particles larger than about 10 nm. Hence it is not possible to get high enough dose for toxicological studies by diffusion in most applications. Deposition by thermophoresis does not depend much on particle size up to several hundred nanometers. Thus from various initial size distributions it is fairly easy to determine the deposited amount of particles by thermophoresis.

We have designed a novel ALI device where it is easy to control flow rates, temperature and relative humidity. Deposition of various nanoparticles has been determined by collecting particles on foils for subsequent microscopic analysis. The aerosols were characterized with the scanning mobility particle sizer (SMPS) prior the ALI device. A model describing the deposition of the ALI device was constructed and validated with the experimental results. The results show that the online data (SMPS) estimated quite well the size distribution of the deposited particles (SEM).

Our ALI device shows several advantages compared to existing commercial devices as high deposition efficiency, uniform deposition over the whole cell area, reliable determination of the exposure dosage and possibilities to select parameters without compromising the well-being and viability of the target cells. So far the ALI device has been used to expose cells with silver and zinc oxide nanoparticles and wood smoke.

Novel exposure system for combustion emissions and nanoparticles.

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Air liquid interface (ALI) methods have been introduced to improve the accuracy of aerosol toxicology studies. However, particle deposition in the ALI methods have been least effective with the particles <100nm in aerodynamic diameter. In our new system, thermophoresis has been applied to increase deposition of the particles in combustion emission and, thus, reliably study the toxicological effects of emissions and nanoparticles.

We used the new exposure device in exposing human alveolar A549 cells to wood combustion aerosol. The aerosol was measured for the gaseous and particulate compounds. The cells were cultured at the membrane inserts for four to six days to form an epithelial barrier at air liquid interface. The cells were exposed at air liquid interface for one hour to diluted wood combustion aerosol from a stove operated with the batches of beech wood logs. We also studied the effects of ZnO nanoparticles. After the one hour exposures, cell culture inserts were moved to the support plates and allowed to recover in an incubator for 24 hours. Thereafter, toxicological endpoints were measured including fluorescence imaging of the cells in the inserts. The other toxicity endpoints using detached cells, included analyses of thiol reduction, mitochondrial potential, cellular metabolic activity, genotoxicity and oxidative stress. In addition, the cell culture mediums were analyzed for cytokine concentration.

In the experiments we saw differences in toxicological responses between the clean air and aerosol samples. The new ALI exposure device showed to be well suited for combustion emission and nanoparticle toxicology studies. The constantly good viability of the clean air exposed control cells provides good repeatability of the studies and reduces artifacts in the comparability between the clean air and aerosol exposed cells.

ABSTRACTS – AIR QUALITY AND HEALTH

POSTERS

Kokkola, H., Kühn, T., Partanen, A.-I., Laakso, A., Lu, Z., Bergman, T., Mikkonen, S., Korhonen, H., Räisänen, P., Streets, D. G., Romakkaniemi, S., and Laaksonen, A.

Global warming was suggested to experience hiatus during the first fifteen years of this century. One cause for this was hyphothesized to be increased aerosol emissions over Asia. While European and and North American aerosol emissions have decreased since the 1980's, emissions in China and India have increased during that period. Even though total global aerosol emissions have have remained constant, increases in aerosol concentrations near the Equator are expected to have large cooling effect due to strong irradiance there. We examined this hyphothesis by studying the effect of sulphur and black carbon (BC) emission changes between 1996 and 2010 on the global energy balance using a global aerosol-climate model ECHAM5-HAM. Our study suggests that the increased Asian emissions have had very little effect on the regional and global radiative balance. However, emission reductions in Europe and the U.S. have caused a positive radiative forcing. According to our model, the global-mean aerosol direct radiative effect changes by 0.06 W/m^2 during 1996 to 2010. The effective radiative forcing (ERF) is 0.42 W/m^2. This suprisingly large positive ERF is caused by the combination of changes in cloudiness, especially in Europe as well as warming of the atmosphere by BC due to absorption of sunlight. This warming effect of BC has largely offset the cooling caused by sulphate aerosols over Asia.

Seasonal and diurnal variation in chemical composition of urban air PM in Nanjing

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China has encountered air quality problems because of rapid industrialization. Mixed emissions of energy production, traffic, industry, construction and traditional agricultural combustion simultaneously occur in the air. Particulate and gaseous pollutants cause shortening of life expectancy (Samet et al., 2000). The mechanisms through which the particulate pollutants cause adverse health effects are partly connected to their chemical composition and morphology. In this study the urban air particulate day- and night-time variation of chemical composition, size, and morphology of air samples collected from Nanjing urban air were studied in several field campaigns in 2013-2014.

The collected size-segregated particulate samples were analysed for elemental composition (ICP-MS), water soluble anions (Ion chromatography), PAH, Oxy-PAH, hopanes and alkanes (GC-MS) as well as for single particle morphology (TEM). The major chemical components in fine particles (PM2.5) were sulfate and nitrate showing high secondary aerosol contribution, while coarse particles (PM2.5-10) contained large amounts of various dust minerals. In addition, fine particles contained considerably higher concentrations of Pb, Cu and high molecular weight PAH than coarse particles. PAH and Oxy-PAH concentrations were considerably higher during winter than during summer and generally higher in night-time than in daytime. The results indicate high variation in the urban air concentrations of several known toxic chemical components, both in respect to particle size fraction, and yearly season.

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Gaseous and particle emissions from residential wood combustion

Tissari, J., Sippula, O., Lamberg, H., Jokiniemi, J.

Aerosol particles in the atmosphere have been linked with both adverse health effects and climatic impacts. In addition, more than 3 billion people are exposed to emissions from the use of solid fuels (wood, charcoal, agricultural residues etc.) as the primary source of household energy, often in inefficient open fires or cookstoves in indoor air. Biofuel combustion is a significant source of Particulate Matter, producing about 20% of global carbonaceous aerosol emissions. The majority emissions are originated from Asia, Latin America, and Africa. Also in Europe, Residential Wood Combustion (RWC) is responsible for 33% of the total primary carbonaceous emissions. According to models the RWC aerosols in the Nordic countries have also clear effect to the Arctic climate. The reduction of climate and health effects of fine particles from RWC is very challenging. Various combustion technologies (boilers, burners, stoves, masonry heaters, open fireplaces etc.) and fuels (wood logs, pellets from different species etc.) are used, which all generate different specific particulate and gaseous emissions. In addition, operational practices have large effect on the emissions and fine particle properties. The major emission problems are connected to the batch-wise combustion in cookstoves, stoves and masonry heaters where emission factors are high and particles are composed of soot and organic material such as polycyclic aromatic hydrocarbons (PAHs).

Laboratory experiments on indoor bioaerosol deposition onto various surface materials

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Key words: Indoor air quality, deposition, bioaerosol, mould spores, surface samples

Abstract

Increasingly, people spend their time indoors and at the same time cases of unacceptable indoor air quality are on the rise. Poor indoor air quality has been shown to cause respiratory symptoms, irritation, and other short- and long-term health outcomes. Indoor air quality problems are usually complex and a sum of several factors or failures in the building or structures. Unbalanced or poor maintained ventilation system induce uncontrolled air leakages through building envelope. In case of moisture damage, air leakages may transport microbial spores, smaller fragments and metabolic products from microbial growth inside building structures into indoor environment, surfaces and air.

In BITEFA project, bioaerosol deposition on various decoration materials were studied with *Penicillium brevicompactum* spores in a duct form test chamber at VTT with the air velocity similar to ventilated apartment building. Three commonly used materials were situated on horizontal and vertical surfaces in various flow fields in the test chamber. Deposition were measured with cultural and microscopic methods. Clear differences were observed on deposition rates which was highest for horizontal upward facing surfaces and lowest for sealing with low air velocity. Results indicate that bioaerosol deposition rate is highly dependent on particle size, air velocity and air flow direction towards the surface. This study gives more information on practice of surface sampling in indoor environment investigations.

2nd Annual IIES Scientific Workshop
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Evaluation of needed study size to investigate the association between exposure to source specific $PM_{2.5}$ and adverse outcomes in pregnancy

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Introduction. Maternal exposure to $PM_{2.5}$ has been associated with a large number of birth outcome risks. Recent studies have suggested health effects occur in a non-linear manner below internationally accepted air quality standards. We are developing a Finnish registry based epidemiological study to investigate birth outcomes at $PM_{2.5}$ exposure levels of 2-8 $\mu g\ m^{-3}$ and including emission source separation.

Methods. A literature review on C-R relationships for eleven birth outcomes which have been reported in literature was conducted. We evaluated the Finnish registry data for study power to investigate these associations at low exposure levels. Background incidence rates for six promising outcomes ranged from 0.3% to 6% and proposed relative risks from 1.19 to 2.63.

Results. Study size estimations confirmed that the Finnish birth cohort (1987-2013) containing specific data on 1 624 821 births, larger than most preceding studies, is sufficient to observe statistically significant ($p<0.01$) results for all six primary endpoints (preterm birth, low birth weight, small head circumference, pre-eclampsia, gestational diabetes, stillbirth). The expected cohort sizes range from 162 000 to 1.6 million.

Conclusions. At least for the six proposed outcomes it is feasible to conduct a register-based study in Finland to confirm/reject birth outcome effects from source specific $PM_{2.5}$ exposure at internationally low levels. This will allow us to investigate the national differences in exposures, population sensitivity and PM characteristics, and, possibly, to determine a safe threshold of exposure.

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Analysis of air pollution exposure in Finland

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Ambient air pollutants, especially fine particles ($PM_{2.5}$), are known to cause adverse health effects. In this study aim is to quantify local sources and regional background concentrations of air pollutants by utilizing continuous air quality (AQ) monitoring data.

AQ data was gathered from air quality portal (ilmanlaatu.fi). Temporal profiles and rural monitoring stations were used to estimate local and remote contributions to annual average concentrations of $PM_{2.5}$, PM_{10}, NO_2, and SO_2. Regional background concentrations were estimated from rural stations using municipality-based regression methods and local contribution as the difference between regional and monitoring stations concentrations.

Further, the local sources were identified either by studying diurnal profiles, combined to information about sources in stations description (residential wood combustion (RWC)) or making assumption that type of the station (traffic and industrial) represents local source.

Using described methods local and regional sources was estimated to thirty $PM_{2.5}$ stations and about 53 % of fine particles were originated from remote sources. RWC contribution to exposure levels are about 2,8 $\mu g/m^3$ in capital region areas where wood combustion is frequent. Contribution of traffic is about 2,3 $\mu g/m^3$ in traffic environments in whole of Finland and about 1,8 $\mu g/m^3$ in industrial sites outside of the capital region.

Statistical methods and temporal profiles can be used to quantify local and regional sources and thus enlarges the usability of monitoring data. Estimations can be used in planning of air pollution abatement strategies and health impact assessments.

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5. Air Quality and Health

Disease burden of ambient air pollution in five Nordic countries

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Background In Nordic countries the air pollution concentrations are relatively low in comparison to other EU countries. Nevertheless, ambient air pollution is still causing adverse health effects. A large interdisciplinary project between all Nordic countries named NordicWelfAir gives an opportunity to get comparable exposure information of those countries and makes it possible to conduct disease burden calculations for ambient air pollution covering the whole Nordic region.

Objectives (i) To calculate disease burden estimates for ambient air pollution in five Nordic countries for $PM_{2.5}$, PM_{10}, NO_2 and O_3 and (ii) compare the disease burden estimates and background disease burden profiles of each of the Nordic countries. (iii) Calculate two different population weighted average exposure estimates for Finland using air pollution estimates carried out with the Danish Eulerian Hemispheric Model (DEHM) in a 50x50 km grid over Europe and Finnish measurement stations network data.

Methods Disease burden estimates will be calculated based on established environmental burden of disease methods (Prüss Üstün et al., 2003) and using WHO's background disease burden data and population weighted annual average exposures. Health endpoints' CR functions will be selected based on WHO's HRAPIE working group's recent recommendations (Heroux et al., 2015).

Results Main results include estimates of the disease burden caused by the four selected air pollutants for five Nordic countries, comparisons of population weighted average exposures for Finland calculated using data from the DEHM in a 50x50 km grid versus data from Finnish measurement stations network and corresponding differences in burden of disease estimates.

This work was funded by NordForsk under the Nordic Programme on Health and Welfare project NordicWelfAir (#75007), Academy of Finland project BATMAN (285672), and intramural funding by the participating institutes.

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ABSTRACTS – ENVIRONMENTAL PROCESSES

ORAL PRESENTATIONS

Role of natural organic matter (NOM) in binding uranium and incorporating radiocarbon

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Peaty soils in the vicinity of natural uranium (U) mineralisations are often highly enriched in U with concentrations of up to 3000 mg kg^{-1}, 4000 mg kg^{-1} and 2500 mg kg^{-1} having been found in the US[1], Switzerland[2], and the UK[3], respectively. The NOM within these soils has been implicated in U retention but the controlling processes and the nature of interactions are poorly characterised. The Needle's Eye natural mineralisation, SW Scotland, provides a rare opportunity within the UK to investigate long-term U-NOM interactions which will be important for predicting the behaviour of U in the far-field environment of deep nuclear waste disposal repositories.

This PhD project, part of a large UK Natural Environment Research Council-funded consortium project, has developed methods of organic matter extraction, fractionation and analysis to probe the detailed structural composition of NOM and investigate the association of uranium with specific organic matter components. The NOM characterisation techniques employed range from the simple and easily accessible methods of UV/Vis and FT-IR spectroscopy to the higher complexity and higher resolution methods of multi-dimensional Nuclear Magnetic Resonance (NMR) spectroscopy and Fourier Transform Ion-Cyclotron Resonance Mass spectrometry (FTICR-MS). Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) analysis of NOM fractions has been used to determine those with the highest affinity for U.

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Mechanistic understanding of key factors controlling mercury bioaccumulation and risk in rice paddy fields

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Recent studies indicate elevated methylmercury (MMHg) production and bioaccumulation in soil-rice systems, raising health concerns. However, mechanistic understanding about key factors controlling biogeochemistry and risk of Hg in rice paddy fields are lacking. Here, we explored the controls of: (1) organic input (e.g., rice straw and biochar); (2) selenium (Se); (3) clay; (4) Hg-soil contact time on MMHg dynamics and risk in contaminated soil-rice systems. Our results indicated that: (1) Rice straw amendment could largely enhance net MMHg production in paddy soils and thus MMHg accumulation in rice plants;[1-4] (2) Biochar amendment would largely reduce phytoavailability and thus bioaccumulation of MMHg (49–92% in rice grain);[5-6] (3) Se amendment into soils could significantly reduce net MMHg production in soils, by forming refractory Hg-Se complexes (XANES analysis), which in turn reduced MMHg accumulation in rice plants. In contrast, Se accumulation in plants could have minor effects on reducing MMHg accumulation in rice;[7-10] (4) Humus-coated clay could largely decrease Hg phytoavailability;[11] (5) Bioavailability of inorganic mercury (IHg) and MMHg decreased sharply within short period of Hg-soil contact (2-28 days), while the reduction was more evident in soils with lower organic content;[12] (6) Consumption of crayfish (commonly cultured in paddy fields) and thus dietary exposure to MMHg poses a health risk to high rate consumers in China but not to general population.[13-14] The effects of those key factors on Hg biogeochemistry, as well as the mechanistic explanation, improve our understanding about Hg dynamics and risk in contaminated rice paddy fields.

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Modelling greenhouse gas exchange from heterogenous Seida landscape in Northwestern Siberia

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Arctic tundra ecosystems are among the world's fastest warming biomes. These ecosystems, underlain by permafrost, are extremely vulnerable to the impacts of anthropogenic climate change (Koven et al., 2013). They have been a huge store for organic C since last glaciation. The current warming arctic trend poses a threat to these ecosystems as their soil temperature is likely to rise above 0 °C leading subsequently to the thawing of the underlying permafrost. While the fact that these ecosystems are fast undergoing changes has been established with a fair degree of certainty based on field data (Romanovsky et al., 2010), how these ecosystems will respond to the future climate is still uncertain. Therefore, with a view to understanding the future ecosystem responses better, we have modelled CO_2 and CH_4 methane exchange from the Seida region in the northeast European Russia. This region is not yet well represented in the Arctic studies. For the purpose, we have validated NEST-DNDC, a biogeochemical and permafrost model (Zhang et al., 2012) with the field GHG flux data from all major land cover types in the region classed with a high resolution (2.4 m pixel size) land cover classification scheme (Marushchak et al., 2013). This study synthesizes data from working groups involved in an EU funded CARBO-North project whose broad objective was to quantify the carbon budget in Northern Russia across temporal and spatial scales. The model results are extended to include the impact of future climate by the end of the 21st century using the HIRHAM5 regional climate model outputs. We present here a few scenarios highlighting the most probable changes in the regional landscape associated with thawing of the permafrost and consequent feedbacks to climate.

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DECO*NOM*X – Deconvolution of Complex Mixtures

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Humic substances (HS), a major component of natural organic matter (NOM) in soils, sediments and water, comprise an extremely complex mixture of organic molecules produced by microbial and/or abiotic degradation of plant and animal residues. They are involved in many important environmental processes, e.g. soil stabilisation, nutrient cycling and transport/retardation of contaminants. A mechanistic understanding of these processes is, however, often lacking because we have limited comprehension of their molecular make-up. Chromatographic methods are currently incapable of resolving these mixtures which contain many 1000s of compounds. Recently, Fourier Transform Ion Cyclotron Resonance Mass Spectrometry (FT-ICR-MS) and Nuclear Magnetic Resonance (NMR) spectroscopy have been applied to shed light on HS composition at the molecular level. The former yield molecular formulae and elemental ratio maps which may provide a fingerprint of samples. Purposely designed multi-dimensional NMR experiments in conjunction with isotopic labelling of the NOM can, however, result in unambiguous structural identification. The approach uses ^{13}C methoxy groups as "spies" to reveal information (from chemical shifts) about its surrounding chemical environment. Results for peat samples reveal that: (i) identified aromatic molecules can be linked to the parent organic plant material, e.g. sphagnum moss, heather; (ii) unique ring substitution patterns can be used to distinguish between NOM from different locations; (iii) contaminant metal (e.g. uranium) binding with specific NOM components can be explained.

This approach presents a major advance in our characterisation capabilities which has many possible applications (including industrial) that we would be keen to explore.

Bioavailability of organic compounds in various environmental matrix

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Abstract

Risk assessment for organic compounds are often based on total contaminant concentrations. However, mounting evidence suggests that understanding contaminant bioavailability in soil, food, dust, or even air particles is necessary for accurate assessment of exposure to humans via the ingestion pathway. Animal-based in vivo tests have been used to assess contaminant bioavailability. However, due to ethical issues and high cost, it is desirable to use physiologically based in vitro methods as alternatives. Although in vitro assays offer an attractive alternative to predict bioavailability, their application for refining POP exposure is still in the developmental phase. Here we present work about bioavailability of several categories of contaminants, i.e., perfluorooctanoic acid (PFOA) in food, DDT in soil, flame retardants in indoor dust, and lead in PM2.5. The current in vitro methods were optimized for predicting bioavailability of these contaminants in various environmental matrix.

Keywords: Bioavailability; physiologically based in vitro methods; perfluorooctanoic acid (PFOA); flame retardants

The filed decomposition and DOM release dynamics of typical trees leaf litter

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Abstract: An understanding of the field decomposition and dissolved organic matter (DOM) release dynamic of leaf litter is of important significance in revealing the material circulation and soil carbon pool dynamic in the forest ecosystems. In this study, leaf litters from *Pinus elliottii* and *Schima superba*, which are needle-leaved and broad-leaved tree species, were decomposed in wild for 0, 30, 60, 90, 150, 210, 240 and 365 d. The concentrations, composition and properties of DOM in decomposing litters, as well as soil dissolved organic carbon (DOC) were measured. Results showed that DOM derived from *S. superba* (HD) and *P. elliottii* (SD) leaf litter presented the same trend as the decomposition time is extended. The concentration of DOM showed a downward trend, and HD was higher than SD at various decomposition stages. The aromatization and molecular weight of DOM increased during decomposition. Fulvic acid and humic acid in DOM increased and simple aromatic protein (e.g. tyrosine) decreased during the decomposition. At the initial phase of decomposition, DOM was generally composed of hydrophilic neutral and acidic components, which were easy to decompose and migrate so that the impacts on surface soil DOC were not significant. At later stages, DOM was mainly composed of humic and fulvic acid and other aromatic, complex structure substances, which could easily adsorb on soil and decreased the DOC of surface soil ($p< 0.05$). In conclusion, the soil carbon pool showed a dynamic changing process with the decomposition of leaf litter. These results could contribute to further understandings of material circulation in the forest ecosystems.

Key words: Forest litter; Dissolved organic matter (DOM); Dissolved organic carbon (DOC); *Schima superba; Pinus elliottii*; Field decomposition

Kaisa Figueiredo / UEF

Effects of species characteristics on bioaccumulation of polychlorinated biphenyls (PCB) in mussels and fish

Equilibrium partitioning of hydrophobic organic chemicals (HOCs) drives chemicals towards equilibrium between the biota and their environment. However, several biological characteristics disturb passive partitioning process and either accelerate or restrain bioaccumulation resulting species specific body residues of HOCs. Within species, age, sex, diet, biotransformation capability and habitat-specific characteristics may affect on body residue in addition to site-specific concentrations of HOCs. To understand the importance of the biological characteristics in the bioaccumulation process, this study explored the PCB-contaminated freshwater lake, and studied the species-specific characteristics in bioaccumulation in different taxa from invertebrates to top predators. As a comparison, predicted body residues from equilibrium passive samplers were used as reference concentrations. The results generally indicated that the PCB concentrations between the tissues and the environment were species-specific. For example, the PCB concentration of free-swimming macroinvertebrates correlated best with the PCB concentration of the water phase indicating bioconcentration as the main phenomena of the bioaccumulation. On the other hand, the PCB concentration of the higher predator fish species correlated best with the concentration of their diet, indicating that diet has major influence on bioaccumulation for HOCs. Closer examination of perch and roach revealed that metabolation capability changes during the life span. In addition, source of nutrition determined the biomagnification of HOCs being different between roach and perch. As a conclusion, the biological characteristics of species modify strongly bioaccumulation of HOCs. Thus species composition in the given ecosystem, and hence available prey selection composes a unique bioaccumulation scenario for each food web.

ANTIMONY IN SHOOTING RANGE SOIL – AN ENVIRONMENTAL PROBLEM IN SWITZERLAND

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Contamination of shooting range soil by antimony (Sb) released from corroding ammunition has become an issue of public concern in many countries. In Switzerland, up to 25 tons of Sb enter the pedosphere every year from more than 2,000 active shooting ranges. A key concern is the leaching of antimony from contaminated soils through the subsurface zone into ground and surface water. The latter risk is in particular given in soils subject to permanent or periodic waterlogging. Waterlogging not only leads to lateral subsurface flow, but also strongly affects soil redox potential, thereby influencing the entirety of soil chemical and biological conditions that control the transport behavior of a solute.

In this study we compared Sb leaching from shooting range soil in field lysimeter experiments, comparing water-logging and drained conditions. In addition, microcosm and column experiments wee performed to identify the role of specific factors and processes affecting Sb mobility. The results show that conversion of Sb(V) to Sb(III) decreased Sb leaching under water-logging, due to increased Sb adsorption on Fe (hydr)oxides. In assessing the risk situation, however, it must also be considered that Sb(III) is more toxic than Sb(V) that over longer times of waterlogging Sb leaching could increase again again upon reductive dissolution of Fe (hydr)oxides leading to the release of adsorbed Sb(III). The study also showed for the first time that Mn (hydr)oxides may play an important role for the mobility of Sb(V) in moderately-reduced soils.

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ABSTRACTS – ENVIRONMENTAL PROCESSES

POSTERS

Zinc and Nickel Isotope Fractionation in hyperaccumulating and non-accumulating plants

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Understanding mechanisms of zinc (Zn)/nickel (Ni) uptake and transport in plants is of critical importance for nutrition and pollution issues. Until now, there has been few data on the isotope fractionation of Zn and Ni in higher plants and how this technique can be used for investigating the mechanism of uptake and transport of heavy metal by plant. Based on our previous field survey and hydroponics, we postulate that the pattern and degree of Zn isotope fractionation in the Zn hyperaccumulator *Noccaea caerulescens* may reflect Zn nutritional status in media and plant Zn requirement. While in plant-soil system, δ^{66}Zn was substantially differentiated among *N. caerulescens* from the three localities (Viviez, Vosges, Sainte Eulate), they all exhibited an enrichment in heavy Zn isotopes of 0.40 − 0.72 ‰ from soil to root, followed by a depletion in heavy Zn from root to shoot (−0.10 to −0.50 ‰). The enrichment of heavy Zn in roots is ascribed to

the transport systems responsible for Zn absorption into root symplast and root-to-shoot translocation, while the depletion in heavy Zn in shoots is likely to be mediated by a diffusive process and an efficient translocation driven by energy-required transporters (e.g., NcHMA4). As for hydroponics, the average isotopic compositions in plant as a whole relative to solution Zn ($\Delta^{66}Zn_{plant\text{-}solution}$) were –0.12 to –0.06‰ for *N. caerulescens* exposed to 1 and 50 μM Zn, and –0.26 to –0.16‰ for *T. arvense* exposed to 20 nM and 5 μM Zn, indicative of the predominance of high-affinity (*e.g.* ZIP transporter proteins) and low-affinity (*e.g.* ion channel) transport pathways across root cell membrane respectively. Within root tissues, the apoplast fraction accounted for around 30% of Zn mass in the high Zn treatment and the heaviest $\delta^{66}Zn$ was observed in the nonexchangeable apoplast, and a large fractionation was observed during root-shoot translocation with an identical $\Delta^{66}Zn_{root\text{–}shoot}$ value of 0.79‰ for *N. caerulescens* under 50 μM Zn and for *T. arvense* under 5 μM Zn; whilst under low Zn exposure, the fractionation between root and shoot was substantially reduced. Compare to Ni hyperaccumulating and non-accumulating plants, all plants prefer to take up light Ni, suggesting that Ni is taken up via a low-affinity transport system in roots, Ni isotope fractionation is greater than that of Zn. The mass balance yielded a bulk Zn or Ni isotopic composition between plant and soil/solution in different hyperaccumulating and non-accumulating plants indicate that different transport systems might be choosed and different uptake and translocation processes have activated. We confirm that quantifying stable isotopes is useful for understanding Zn/Ni absorption, translocation

and sequestration mechanisms in plants and could be a novel tool to investigate plant physiological processe.

Keywords: isotope fractionation; MC-ICPMS; plant physiology; zinc; nickel

Soil pyrene contamination affects young Norway spruce (*Picea abies*) growth and phenolics

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Abstract

According to the fifth assessment report of the IPCC, remarkable increase in both CO_2 concentrations and in global mean temperature are expected. Simultaneously soil contaminated with polycyclic aromatic hydrocarbons is becoming a global environmental problem. Here we conducted an experiment in greenhouse rooms to investigate the combined effects of elevated temperature (+2 °C), elevated carbon dioxide (720 ppm) and soil pyrene contamination (50 mg kg^{-1}) on growth and phenolics of young Norway spruce (*Picea abies* (L.) Karst.) seedlings from five different origins in Finland. The results showed that elevated temperature decreased concentrations of total phenolics. Elevated CO_2 increased needle biomass and stem total phenolics, while several individual phenolic compounds in needles were decreased. Soil pyrene contamination decreased spruce growth and total phenolics in both needles and stems. In addition to main effects, we also found T×Pyr interaction effect on height growth, CO_2×Pyr interaction effect on basal diameter growth and T×CO_2 interaction effect on phenolic concentrations. Spruce origin showed significant differences on growth and phenolics of all seedlings. Our results show that responses of plant growth and phenolics to multiple and changing environmental factors are complicated. Soil pyrene contamination affects strongly spruce defensive phenolics, but more studies on mechanisms and different tree species are needed. The change of the quantity and quality of secondary metabolites caused by climate change and soil pollution may affect the ecosystem function and adaptability of plants. Based on our preliminary findings, the negative influence of soil pollution on forest ecosystem would be aggravated under climate change.

Acknowledgements

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ABSTRACTS – GREEN TECHNOLOGIES

ORAL PRESENTATIONS

2ND ANNUAL IIES SCIENTIFIC WORKSHOP
UNIVERSITY OF EASTERN FINLAND, KUOPIO

Session: Chemical Processes

Title: Water treatment residuals as soil amendments

Authors: Ian W. Oliver and Steven J. Lewis

Affiliation: Keele University, School of Physical & Geographical Sciences, United Kingdom

Abstract
Water treatment residuals (WTRs) are the by-products when raw drinking water is clarified through addition of aluminium and/or iron salt flocculants to remove particulates and other impurities. WTRs are thus composed of amorphous clay minerals, organic matter and precipitates of Al- and Fe- hydroxides and oxides. In the UK alone 131000 t (dry mass equivalent) are generated annually and almost all of it is disposed of via landfill. This disposal is expensive and may be wasting a useful resource, as WTRs have potential use as soil conditioners thanks to their organic matter and nutrient contents and their potential ability to sorb and retain contaminants such as heavy metals and excess phosphorus. Scientific and economic interest is therefore growing in regards to using WTRs in land management, as a low cost disposal option and as a soil amendment. This raises questions such as whether 1) WTRs can immobilise, or 'lock-up', pollutants in contaminated soils and render them ecologically inactive, and 2) WTRs positively or negatively influence microbial function and plant health in amended 'clean' soils or treated contaminated soils. Our experiments aim to answer these questions using WTR-amended and non-amended contaminated and pristine soils and examining:

- Metal and metalloid leachability (neutral salt solution extractions)
- Metal and metalloid associations (sequential extraction)
- Plant growth (ryegrass)
- Microbial basal and glucose induced respiration
- Microbial enzyme activity (fluorescein diacetate hydrolytic activity)

Experiment results and developments will be presented at the workshop.

Bioelectrochemical Systems: Harnessing Electricity from Microbes

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Energy crisis and water shortage in the world have increased the need for development of technologies to reduce energy input during wastewater treatment and water recycle. Bioelectrochemical systems are promising wastewater treatment technology, which employ exoelectrogenic bacteria in the anode to directly convert biochemical energy in the organic matter to electricity. In this presentation, we will briefly introduce our past study related to bioelectrochemical systems as follows: We have isolated and characterized the exoelectrogenic bacteria and also apply the exoelectrogenic bacteria in dye removal. We have developed on-site wastewater treatment systems based on bioelectrochemical principles and we can achieve good COD and total nitrogen removal. We also successfully used the electricity from bioelectrochemical systems to drive the capacitive deionization device to achieve good desalination.

Removal of recalcitrant organic pollutants by magnetically separable heterogeneous Fenton like catalytic technology

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With the rapid development of industry, the discharge of wastewater containing recalcitrant organic pollutants is inevitable. It is still a big challenge to remove these pollutants through a cost efficient approach. Heterogeneous Fenton or Fenton-like reaction is a type of advanced oxidation technology that uses iron or other metal containing materials (e.g. Fe_2O_3, Fe_3O_4, FeOOH, $CuFe_2O_4$, etc.) as catalysts for production of hydroxyl radicals. It has stimulated increasing interests due to their efficiency in the degradation of recalcitrant organic pollutants. However, the crucial is to develop highly efficient and conveniently separable catalytic functional materials.

In our previous studies, several efficient core-shell catalysts were developed by immobilizing iron, copper and aluminum onto mesoporous MCM-41 silica. It was revealed that the interaction between Fe and oxides of Al or Si in the catalyst would result in a significantly enhancement of H_2O_2 activation, and the favorable role of aluminum were explored. Considering the aluminosilicate frameworks of montmorillonite, a highly efficient composite, maghemite/montmorillonite, was successfully developed. The composites retained magnetism after calcinations because the presence of montmorillonite inhibited the growth of γ-Fe_2O_3 nanoparticles, as well as their phase transition. The composite calcined at 350 ℃ had the highest catalytic activities, with more than 98% phenol reduction after only 30 min reaction. It displays high catalytic activity and stability, low iron leaching, and can be conveniently separated by an external magnetic field for recycle applications. This work offers a promising heterogeneous Fenton reaction technology to remove recalcitrant organic pollutions in wastewater treatment.

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Synthesis of nanofibrillar cellulose (NFC) from cotton and adsorption studies with lead (Pb^{2+})

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ABSTRACT

This work evaluated the performance of nanofibrilar cellulose (NFC) obtained from a pre-conditioned and non-pre-conditioned adsorbent cotton to adsorb Lead (Pb^{2+}) metals. As a pre-treatment, a dewaxing step with ethanol/toluene (2:1) was applied to the cotton (precursor) under optimized conditions followed by simple dissolution with a NaOH-Urea-thiourea at -3 ^{0}C. The synthesized cellulose was characterized by SEM and FTIR to gain an insight on the morphology and different surface functional groups, respectively on cellulose surface. Adsorption efficiency (qe) of both conditioned and non-pre-conditioned NFC was evaluated for Pb(II) removal from aqueous solution as a function of contact time. The pre-conditioned NFC reached maximum adsorption efficiency of 98.1 mg/g after 50 minutes contact time representing 87% Pb(II) removal while the non-conditioned NFC achieved a maximum adsorption efficiency of 97.1 mg/g after 105 minutes contact time representing 86% Pb(II) removal. Further work to examine the effects of solution pH, adsorbent dose, temperature and competing ions on Pb(II) adsorption by NFC is currently under progress.

Transformations of selenium species by green fresh water algae

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The mechanisms of selenium bioaccumulation in contaminated aquatic ecosystems are still not well understood. It is known that algae take up inorganic selenium oxyanions and convert them into organic species, particularly selenomethionine, which is incorporated erroneously into proteins and causes reproductive effects in top predators. However, our research shows that algae also change the speciation of selenium in the impacted waters, and thereby alter its bioavailability. Specifically, we find that green freshwater algae produce reduced organic and inorganic selenium species and emit them into the surrounding water. The algal production and release of selenocyanate and selenomethionine, as well as some of its oxidation products, are demonstrated in laboratory and field experiments, and related to the nutrient status of the surrounding waters. The results are discussed in the context of developing site-specific water quality criteria for selenium-emitting industrial processes.

Spinel ferrites based nanocomposites for environmental remediation

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Abstract

A series of spinel ferrite nanocomposites viz. manganese ferrite-graphene ($MnFe_2O_4$-G), cobalt ferrite-graphene ($CoFe_2O_4$-G) and nickel ferrite-graphene ($NiFe_2O_4$-G) were prepared by solvothermal process. The as-prepared ferrite based nanocomposites were characterized using X-ray diffraction, FE-SEM, TEM, VSM, XPS and BET surface analysis. The as-prepared ferrites were further used as adsorbents for removal of aquatic pollutants. The Langmuir model correlated well to the experimental data showing an adsorption capacity of 100 mg/g for Pb(II) and 76.90 mg/g for Cd(II) ions onto $MnFe_2O_4$-G. The highest adsorption equilibrium for Pb(II) was found to be 142.8 and 111.1 mg/g at pH of 5 and 310 K for $CoFe_2O_4$-G & $NiFe_2O_4$-G; while for Cd(II) it was 105.26 and 74.62 mg/g at pH of 7 and 310 K. The results show that these materials could be fruitfully used for the removal of heavy metal ions from water and wastewater.

Keywords: Magnetic nanoparticles, graphene, spinel ferrites, adsorption, environmental applications.

Arsenate and arsenite removal using nano.TiO_2-feldspar impregnated chitosan: pH-dependence and UV irradiation studies

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Abstract

In this study, an environmentally friendly bio-based photoactive composite, nano.TiO_2-feldspar impregnated chitosan, has been successfully tested for arsenic removal. The effect of initial solution pH on the adsorption of both arsenate and arsenite is investigated. No significant effect of pH on arsenite uptake was observed over studied pH range (4-10), which can be due to the dominant neutral H_3AsO_3 species in most of the pH range. In the case of arsenate uptake, a slight pH-dependence was observed. Arsenate predominantly appears as negatively charged species, $H_2AsO_4^-$ and $HAsO_4^{2-}$, under this pH range which can favor its adsorption process by the positively charged surface of the composite in acidic medium. However, unlike other TiO_2-based adsorbents, the composite was able to remove arsenic in a wide range of pH (> 70% removal efficiency). Due to the photo-catalytic characteristic of TiO_2, the effect of UV irradiation on both arsenate and arsnite removal by the composite was explored. It was observed that UV irradiation results in enhanced arsenic removal for both species. In addition to the improved properties compared with chitosan, the developed composite would also eliminate the need for an energy intensive post-filtration, which is needed in the case of nano-sized TiO_2 application as adsorbent. Therefore, this composite can be superior to each of its precursor materials from the perspective of implementation for arsenic remediation.

Sediment amendments and remediation of aquatic systems

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Sediments are sinks for many types of contaminants in aquatic systems. Once contaminated sediments can affect the ecological quality and ecosystem services given by that particular system even though the original source of contamination has stopped and the water quality has improved. There are quite limited number of methods for remediation of contaminated sediments. Dredging and subsequent containment is quite common as well as capping with clean materials. Monitored natural recovery can be used when there is evidence of natural improvement. Sediment amendments have been introduced as a new direction in *in-situ* remediation of contaminated sediments. The method is based on introducing sorbents that bind chemical contaminants such as persistent organic pollutant into the contaminated sediments. The principle is to reduce bioavailability and transport of contaminants in and from the sediments. The method has been introduced as cost-effective, less risky and less stressful to the environment than for example dredging. Activated carbon has been shown to be really effective material sediment remediation by reducing bioaccumulation of contaminants from sediments to benthic organisms and even transfer to terrestrial food chains. However, there are also some things that need to be considered. For example activated carbon causes adverse effects in benthic organisms and the effects are linked to remediation potential. Higher sorption capacity towards contaminants results also stronger adverse effects. In addition, there are other questions that need to be considered when evaluating the applicability of sediment amendments for remediation.

ABSTRACTS – GREEN TECHNOLOGIES

POSTERS

Transcriptomics of metal hyperaccumulator *Noccaea caerulescens* populations reveal intraspecies differences at gene expression and sequence

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Heavy metals such as Cd and Ni pose a risk to human health. This is mainly due to the entrance of the metals into the human diet via crop plants grown on contaminated soils. To prevent this, it is important to know the mechanisms of how plants take up and transport the metals from the soil into the shoots. Accessions of the metal hyperaccumulator plant *Noccaea caerulescens* show remarkable differences in their abilities to accumulate and tolerate metals, and have a great potential to serve as an excellent model in plant evolutionary genomics. Hyperaccumulator plants could also have practical applications in remediation of metal-contaminated soils.

We used the Illumina sequencing system and de novo assembled the transcriptomes of four contrasting accessions of *N. caerulescens*. The transcriptomes were assembled in search of sequence differences that might affect gene function. Two of the accessions, Ganges (GA) and La Calamine (LC), were also used to analyse their transcriptomic responses to Cd exposure. Under natural high Zn and Cd concentrations LC accumulates less Cd than GA does.

The transcriptomic response of two accessions differed significantly, especially in the shoots. LC showed a dramatic downregulation of photosynthesis-related genes, which was not seen in GA. In GA, leaf iron homeostasis was clearly affected, and the roots responded by changing the synthesis of root structural components. Furthermore, we have found differences in the sequences of metal transporter genes from different accessions. Functional analysis of these transporters in yeast suggest that the differences affect the transporter's metal specificity.

Novel water treatment materials from low-cost clay minerals and industrial side-products

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Efficient and economical water treatment methods are needed to remove water pollutants such as ammonium, nickel, arsenic, antimony, and sulphate. Ammonium (NH_4^+) is a major contributor to the eutrophication of water bodies since nitrogen is commonly the nutrient in shortest supply. Sulphate emissions cause environmental problems indirectly via salting effect, turbidity enhancement and sedimentation. In anoxic conditions sulphate can be reduced to toxic hydrogen sulphide. Arsenic is toxic and carcinogenic. Nickel and antimony are toxic and potentially carcinogenic. The application of natural or low-cost sorbents has attracted a great deal of interest due to the simplicity of its process and its potential effectiveness. In this research novel water treatment materials from low-cost clay minerals and industrial side-products are developed, characterized, and their performance as sorbents is tested with real wastewater matrixes in laboratory and pilot scale. The developed sorbent materials are metakaolin geopolymer, blast-furnace-slag geopolymer, barium-modified blast-furnace-slag geopolymer, and ettringite formed in sulphate removal from mine drainage water. The metakaolin geopolymer can be used for ammonium nitrogen removal from municipal wastewaters and landfill leachates and it can also be regenerated. The blast-furnace-slag geopolymer could simultaneously remove nickel (Ni^{2+}), arsenite (As(III)), and antimony (Sb^{3+}) from a spiked mine effluent. The barium-modified blast-furnace-slag geopolymer was found to be efficient in sulfate removal from model solution as well as real mine water. Ettringite formed during sulphate removal from mine water was used for the removal of arsenate (As(V)) from model solution.

A comparative study on the Methylene Blue (MB) dye biosorption onto different modified marine macroalgae

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Abstract

Dye effluents are one of the most important environmental problems. Algae have been found to be the potential biosorbents due to their ubiquitous occurrence in nature, low cost and high biosorption potential towards different pollutants. Physical and chemical pre-treatments showed enhancement or reduction in biosorption capacity, depending on the biomass type and treatment procedures used. In the present study, the removal of a cationic dye, Methylene Blue (MB) with untreated and pretreated (physical and chemical) brown (*Nizamuddinia zanardinii*), red (*Gracilaria parvispora*) and green (*Ulva fasciata*) macroalgae was studied. The results at equilibrium were successfully described by the Langmuir model. The estimated biosorption capacities by untreated brown, red and green algae was determined as 861.6, 81.2 and 1500 mg/g, respectively. Biosorption capacities of NaCl (0.1 M) treated brown, red and green algae increased to 3072, 334.3 and 3541 mg/g, respectively. Different kinetic models were applied to describe the biosorption kinetics, and the pseudo-second-order model showed the best fit of the experimental data (R^2 = 0.99). The negative values of ΔG^0 (kJ/mol), and positive value ΔH^0, (kJ/mol), confirm that the biosorption of MB dye was feasible and endothermic at all studied temperatures for algae. FT-IR spectrum analysis suggested that amido or hydroxyl, C=C and C–H groups, present on algae surface, could take part in MB dye biosorption. This study demonstrated that the marine macroalgae could be used as effective biosorbents for the treatment of cationic dye-containing effluents.

Keywords: Biosorption; Textile dyes; Macroalgae; Isotherm; Thermodynamics.

Isomerism of trimeric aluminium complexes in aqueous environments explored with DFT-based metadynamics simulation

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Abstract

The chemistry of aluminium or oxo-aluminium in water is still relatively unknown, although it is the basis for many chemical and industrial processes, including occulation in water treatment plants. Trimeric species have a predominant role in the formation of the Keggin cations, which are the basic building block of aluminium-based chemicals. Despite this, the details of the structural evolution of these small solvated clusters and how this is related to the processes leading to the formation of larger aggregates is still an open issue. In order to address these questions, here we have applied the metadynamics (MTD) simulation technique with density functional theory-based molecular dynamics to disclose the dynamics and structural conversions of trimeric aluminium complexes in an aqueous environment. The existence of a variety of competing meta-stable conformations, eg., book-like, cyclic boat and linear shapes is revealed in the MTD simulation. Further equilibrium simulations of the various intermediate states encountered along the MTD trajectory are used to assess their (meta-)stability, to determine the rearrangement of the OH ligands and to discuss the role of the solvating water.

Enhanced phytostabilization by the metal-tolerant *Enterobacter* sp. strain EG16 presenting selected plant growth-promoting strategy under metal contamination

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Abstract

High levels of metals impede both plant and bacterial growth by affecting physiological processes, negatively impacting the efficiency of microbally assisted phytoremediation. This study investigated the efficient plant growth-promotiing strategies of the metal-tolerant *Enterobacter* sp. strain EG16 under metal stress and its potential to associate in phytoremediation. Results showed that inoculation with EG16 significantly improved plant growth, probably through promoting plant Fe uptake, immobilizing free heavy metal ions and decreasing toxic metal accumulation in plant. Increased siderophore production was believed to be the selected PGP strategy in the *Enterobacter* sp. EG16 - *H. cannabinus* association. It was involved in the Cd stress response systems of EG16 and devoted to Fe uptake of both the bacterium and the plant. Furthermore, it contributed to the alleviation of Cd-induced inhibition of IAA production and probably associated in immobilizing toxic metal ions. In general, we suggested the potential usage of the *Enterobacter* sp. EG16 - *H. cannabinus* association in phytostabilization of elevated metal polluted soils, due to the well plant growth, low metal concentration in the above-ground parts of the plant and significant reduction of metals bioavailability in soil.

Keywords: *Enterobacter* sp. EG16, Plant growth-promoting strategy, Siderophore, Cadmium, Metal contamination, *Hibiscus cannabinus*, Phytostabilization

ABSTRACTS – ENVIRONMENTAL POLICY

ORAL PRESENTATIONS

The effects of China's control policies on historical and future trends on atmospheric pollutant emissions

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To examine the effects of China's national policies of energy conservation and emission controls, inter-annual emission trends of air pollutants are estimated with a bottom-up framework from 2000 to 2014 and the future emissions are projected through 2030 based on available energy scenarios and emission control strategies. Despite fast growth of the economy and energy consumption, reduced SO_2 and primary PM emissions are respectively found from 2007 and 2006, respectively, suggesting successful emission control of those species. However, the NOx emissions are estimated to keep growing until 2012. The emission control strategies are expected to have more effects than the energy paths on the future emission trends. The estimated emission trends raise concerns about current pollution control strategies. Compared with total PM, there are fewer gains in control of fine particles and carbonaceous aerosols, the components most responsible for damages to public health and effects on radiative forcing. A much faster decrease of calcium in primary PM than that of SO_2 may have raised the acidification risks to ecosystems, indicating further control of acid precursors is required. Moreover, with relatively strict controls

in developed urban areas, air pollution challenges have been expanding to less-developed neighboring regions, and the potential for emissions abatement in key sectors may be declining due to the near saturation of emission control devices use. A more comprehensive emission control strategy targeting a wider range of pollutants (volatile organic compounds and NH_3, etc) and taking account of more diverse environmental impacts is urgently needed.

China's Hg policies and their implications for the overall success of Minamata Convention

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The Minamata Convention (MC), which aims to protect human health and the environment from the adverse effects of Hg, was agreed upon at the fifth session of the Intergovernmental Negotiating Committee on 19 January 2013. There have been various studies on the global Hg emission inventory, though big difference from different estimates by using different method at different year, all testified that China is currently the biggest emitter of atmospheric Hg, accounting for 1/3 to 2/5 of global emission depending on the study methods. What policies China currently have to reduce the impacts of Hg contamination, and whether there are major gaps in the current policies are key questions for the overall success of MC.

We reviewed the current Chinese policies related to Hg under the context of MC. Based on the information, we assessed compliance situation for the different convention obligations, and identified important policy gaps.

Table 1: Overview of substantive articles of MC and relevance for China

Article No.	Content	Obligation strength	Existence of specific policy	Major compliance hurdles
Article 3	Supply and trade	Hard	No	New mines
Article 4	Hg-added products	Hard	Yes	Medical devices
Article 5	Manufacturing	Hard	Yes	Hg catalyst for VCM
Article 6	Exemption	-	-	-
Article 7	ASGM	Middle	No	No
Article 8	Emissions	Hard	Yes	BAT/BEP, monitoring
Article 9	Release	Middle	No	BAT/BEP
Article 10	Interim Hg storage	Hard	No	Law enforcement
Article 11	Hg-containing wastes	Hard	Yes	Law enforcement
Article 12	Contaminated sites	Soft	No	No since soft

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Educating for Environmental Sustainability: Promoting sustainable mindsets and actions through interdisciplinary education

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Many voices within institutional and academic communities have recently drawn attention to the central role of higher education in tackling the challenges of environmental, economic and social sustainability. A critical mass of leading higher education institutions are signatories on various international declarations[i], and have committed to grounding their operations, education and research in sustainable principles and practices[ii]. In response to these declarations and policy developments, an emerging academic field focused on sustainability education has made significant strides towards the identification of key competencies considered critical for preparing students to meet these challenges. Following Weik et al. (2011)[iii], the key competencies examined in this paper include systems thinking competence, anticipatory competence, normative competence, strategic competence, and interpersonal competence. The development of these key competencies is examined in relation to approaches that promote critical and non-traditional approaches to environmental sustainability education that are increasingly being identified as a promising path towards the transformational solutions demanded for our future survival.

This paper argues that the fundamental challenge of an education in sustainability studies is to successfully engage students in questioning the core assumptions of traditional disciplines that address the challenges of environmental sustainability. This paper presents a model of sustainability education that is grounded in an interdisciplinary and inter-cultural approach to realize core learning objectives related to sustainable values, principles and practices[iv]. These in turn are grounded in a curriculum that promotes key competencies for sustainability required to address real world sustainability problems. The paper concludes with a reflection on the current challenges, future directions and implications for pedagogy and a curriculum for interdisciplinary education in environmental sustainability.

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Mediated Negotiations in Forest based Responsive Bioeconomy

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This paper connects the mediation and negotiation field to the highly topical field of bioeconomy. The main objective of the paper is to discuss a new mediated negotiation approach to foster understanding the complexities of forest based bioeconomy. The aim is to develop and test this approach during an action research with multi-level bioeconomy actors in Finland and in Mexico. The project proposes the new mediated negotiation approach, which could improve the communication between the different bioeconomy actors and help to avoid cumulative impacts and conflicts related to growing needs for natural resources. The research project supports opportunities to utilize the new approach in mediating those conflicts which are related to natural resources protection, utilization and governance on the emerging bioeconomy. The main partner for testing, utilization, impact mechanisms and processes will be Akordi Ltd., a Finnish enterprise specialised in conflict management and mediation services and in Mexico, the well-known research institute called CIDE. The aim of this paper is to discuss the proposed new approach which will be developed and tested during the coming action oriented research project.

ABSTRACTS – ENVIRONMENTAL POLICY

POSTERS

Abstract of Poster Presentation
Topic: Environmental Policy

2nd Annual Scientific Workshop of The International Institute for Environmental Studies
University of Eastern Finland, August 21-24, 2016.

Renewable Energy and Reconciliation in Canada: Professional and Continuing Education Programs Related to Indigenous-Settler Relationship-building and the Duty to Consult

by
Danielle Harris and Emma Langley

Recent years have witnessed an unprecedented number of initiatives in Canada aimed at pursuing reconciliation and renewed relationships between Indigenous peoples, Settler Canadians, and other non-Indigenous Canadians. This shift has occurred in the national context of the release of the Final Report of the Truth and Reconciliation Commission (TRC) of Canada in 2015[1] and the Government of Canada's decision to become a full supporter of the United Nations Declaration on the Rights of Indigenous Peoples (UNDRIP) in 2016[2]. This change is also happening in the context of a growing international movement, led by Indigenous peoples, to advocate for Indigenous peoples' rights and knowledges. In addition, it is increasingly acknowledged that Indigenous Knowledges, Indigenous peoples, and renewed Indigenous-non-Indigenous relationships are crucial to addressing current environmental challenges[3]. The renewable energy sector offers a potentially unique context for Indigenous-non-Indigenous partnerships, because it has been in the non-renewable energy sector where the majority of contentious issues and cases have arisen. The potential for economic development in general, and renewable energy projects in particular, to contribute to reconciliation is an understudied area in the Canadian context. At the same time, there are many contentious dimensions to Indigenous-Settler relations around energy projects in Canada. While Canadian law requires a "Duty to Consult" Indigenous nations when development projects affect Indigenous territories and peoples, the way this process unfolds in practice lacks clear guidelines for how this process must be followed by all parties involved. Additionally, there is a great discrepancy in the resources that are available to Canadian governments, to private organizations, and to Indigenous nations, to participate in this process. This makes it more difficult to ensure mutually beneficial partnerships around energy projects, and thus furthers existing power imbalances.

This study presents an assessment of continuing education, professional and educational programs in Canada related to the Duty to Consult; reconciliation; intercultural learning and communication; and to Indigenous-Settler partnerships. It examines a wide range of courses, with special attention to those programs that target renewable energy professionals, legal professionals, scholars, governmental bodies, students, and members and leaders of Indigenous nations. The study aims to contribute to a base of foundational knowledge for future research on program design and delivery around the Duty to Consult, and its potential role in advancing reconciliation through successful collaborative economic development initiatives. Finally, it highlights both the opportunity and the need for educational and collaborative programs in the renewable energy sector in which Indigenous and non-Indigenous participants involved in Duty to Consult processes can build relationships, foster understanding, and explore possibilities for mutually beneficial collaboration.

Endnotes

[1]The Final Report of the Truth and Reconciliation Commission of Canada. Truth and Reconciliation Commission of Canada. 2015. Website: www.trc.ca

[2]The United Nations Declaration on the Rights of Indigenous Peoples. Canada's Endorsement of the Declaration. Indigenous and Northern Affairs Canada. Available at: http://www.aadnc-aandc.gc.ca/eng/1309374407406/1309374458958#a2

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UNIVERSITY OF EASTERN FINLAND KUOPIO CAMPUS

WORKSHOP WEBSITE

www.uef.fi/iies-workshop-kuopio

INTERNET ACCESS CODE

Wireless: UEF-CONF

Password: Sanni2016

BUS TRANSFER TIME TABLE

Saturday, 20.8.2016

18.00 Bus transfer from Kuopio Airport – Hotel Scandic

Monday, 22.8.2016

08.00 Bus transfer from Hotel Scandic – University / Tietoteknia building

17.45 Bus transfer from Kuopio Science Park / Microteknia building – City Reception at Kuopio City Hall

Tuesday, 23.8.2016

08.00 Bus transfer from Hotel Scandic – University / Tietoteknia building

16.30 Bus transfer from the University – Hotel Scandic

17.45 Bus transfer from Hotel Scandic – Puijo Tower

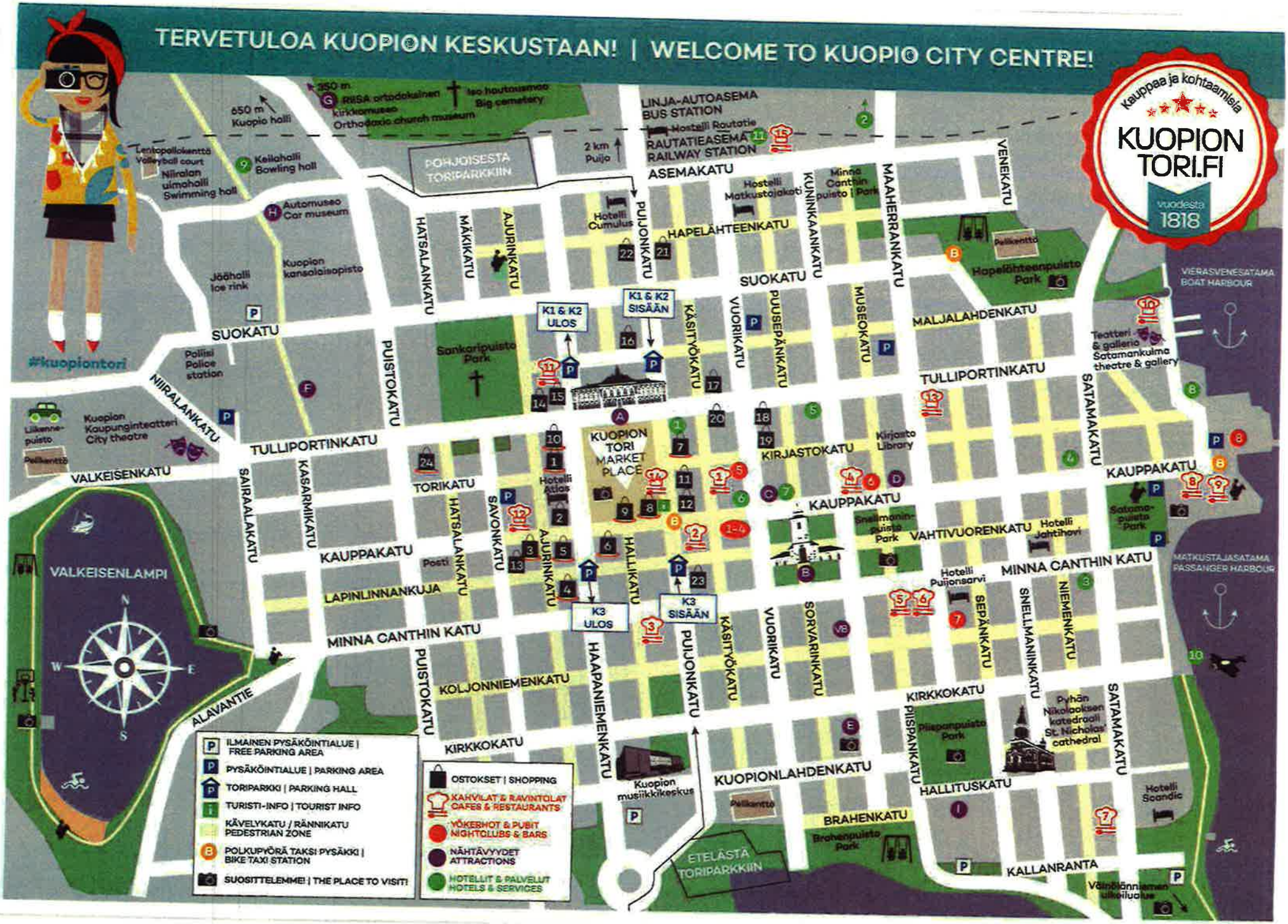
22.00 Bus transfer from Puijo Tower – Hotel Scandic

Wednesday, 24.8.2016

08.00 Bus transfer from Hotel Scandic – University / Tietoteknia building

12.45 Bus transfer from the University – Kuopio Airport

13.00 Bus transfer from the University – Hotel Scandic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650 m Kuopio halli
350 m
RIISA ortodoksinen kirkkomuseo
Orthodoxic church museum
Iso hautausmaa
Big cemetery
LINJA-AUTOASEMA
BUS STATION
Hostelli Rautatie
RAUTATIEASEMA
RAILWAY STATION
2 km Puijo
POHJOISESTA TORIPARKKIIN
Lentopallokenttä
Volleyball court
Niiralan uimahalli
Swimming hall
Keilahalli
Bowling hall
Automuseo
Car museum
Jäähalli
Ice rink
Kuopion kansalaisopisto
Poliisi
Police station
Sankaripuisto
Park
K1 & K2 ULOS
K1 & K2 SISÄÄN
ASEMAKATU
HATSALANKATU
MÄKIKATU
AJURINKATU
PUIJONKATU
Hotelli Cumulus
HAPELÄHTEENKATU
Hostelli Matkustajakoti
KUNNINKAANKATU
Minna Canthin puisto | Park
MAAHERRANKATU
VENEKATU
Pelikenttä
Hapelähteenpuisto
Park
SUOKATU
VUORIKATU
PUUSEPÄNKATU
MUSEOKATU
KÄSITYÖKATU
MALJALAHDENKATU
VIERASVENESATAMA
BOAT HARBOUR
Teatteri & galleria Satamankulma
theatre & gallery
SUOKATU
PUISTOKATU
NIIRALANKATU
Liikennepuisto
Pelikenttä
Kuopion Kaupunginteatteri
City theatre
TULLIPORTINKATU
SATAMAKATU
VALKEISENKATU
SAIRAALAKATU
KASARMIKATU
TORIKATU
KUOPION TORI
MARKET PLACE
Hotelli Atlas
KIRJASTOKATU
Kirjasto
Library
KAUPPAKATU
Satama-puisto
Park
Snellmanin-puisto
Park
VAHTIVUORENKATU
Hotelli Jahtihovi
SAVONKATU
HATSALANKATU
AJURINKATU
HALLIKATU
Posti
LAPINLINNANKUJA
MINNA CANTHIN KATU
MATKUSTAJASATAMA
PASSANGER HARBOUR
Hotelli Puijonsarvi
SEPÄNKATU
SNELLMANINKATU
NIEMENKATU
VALKEISENLAMPI
K3 ULOS
K3 SISÄÄN
SORVARINKATU
ALAVANTIE
PUISTOKATU
KOLJONNIEMENKATU
HAAPANIEMENKATU
KIRKKOKATU
Piispanpuisto
Park
Pyhän Nikolaoksen katedraali
St. Nicholas cathedral
PIISPANKATU
SATAMAKATU
Kuopion musiikkikeskus
KUOPIONLAHDENKATU
Pelikenttä
BRAHENKATU
Brahenpuisto
Park
Hotelli Scandic
ETELÄSTÄ TORIPARKKIIN
KALLANRANTA
Väinölänniemen ulkoilualue
ILMAINEN PYSÄKÖINTIALUE | FREE PARKING AREA
PYSÄKÖINTIALUE | PARKING AREA
TORIPARKKI | PARKING HALL
TURISTI-INFO | TOURIST INFO
KÄVELYKATU / RÄNNIKATU PEDESTRIAN ZONE
POLKUPYÖRÄ TAKSI PYSÄKKI | BIKE TAXI STATION
SUOSITTELEMME! | THE PLACE TO VISIT!
OSTOKSET | SHOPPING
KAHVILAT & RAVINTOLAT CAFES & RESTAURANTS
YÖKERHOT & PUBIT NIGHTCLUBS & BARS
NÄHTÄVYYDET ATTRACTIONS
HOTELLIT & PALVELUT HOTELS & SERVICES