EUGRIS Mercury Projects Listing November 2017

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The Minamata Convention (www.mercuryconvention.org) on Mercury is a global treaty to protect human health and the environment from the adverse effects of mercury. It was agreed at the fifth session of the Intergove, 19 January 2013 and adopted later that year on 10 October 2013 at a Diplomatic Conference (Conference of Plenipotentiaries), held in Kumamoto, Japan. September 2016 saw the first meeting of the Conference of the Parties to the Minamata Convention. Various submissions have been made related to Article 12 - Contaminated sites.

The Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety in Germany (BMUB)has supported the collation of a significant amount of EU funded R&D outcomes related to mercury contamination of land held by EUGRIS (www.eugris.info). This has included the retrieval of information from archive sources where previously listed web pages are no longer available on line. The updated information has been summarised in a series of tables (below):

- Table 1 EU supported R&D projects (22 entries)
- Table 2 Outputs of the listed EU R&D projects (30 entries)
- Table 3 Additional mercury contamination related EU funded R&D projects listed on CORDIS

In addition we suggest these two key note resources:

Name	EUGRIS Link	Summary
Risk-based management of mercury-impacted sites	http://www.eugris.info/displayResource.aspx?r=7999	This technical booklet has been prepared on behalf of the Network for Industrially Contaminated Land in Europe (NICOLE) Mercury Working Group to share case studies and best practice related to the characterisation and management of industrial sites impacted by Mercury (Hg). NICOLE was formed in February 1996 for the stimulation, dissemination and exchange of knowledge regarding industrially contaminated land. Its 100 members from 20 European countries come from industry, trade organizations, service providers, technology developers, universities, independent research organizations and governmental organizations.
Tackling mercury pollution in the EU and worldwide	http://www.eugris.info/displayResource.aspx?r=8000	This In-Depth Report from Science for Environment Policy summarises the latest scientific studies and research results on mercury pollution in the global environment. Of the many aspects of mercury pollution, five main topics are addressed: • Mercury sources and impacts • Mercury cycling: movement and deposition • Monitoring and modelling approaches • Reduction, treatment and storage • The Minamata Convention on Mercury and the EU mercury policy
		Other documents with mercury related content are available on EUGRIS, but resource collation was not in the scope of this review activity

Table 1 EUGRIS Mercury Related Projects Summary

Project	EUGRIS Link	Summary
AQUATERRA Integrated modelling of the river-sediment-soil-groundwater system; advanced tools for the management of catchment areas and river basins in the context of global change Framework 6 Project	http://www.eugris.info/DisplayProject.asp?P=4476	The objectives of Aquaterra were to: • Provide better understanding of the river-sediment-soil-groundwater system at various temporal and spatial scales. • To provide the scientific basis for improved river basin management. • To develop specific tools for water and soil quality monitoring. • To develop integrated modelling for impact evaluation of pollution as well as climate and land-use changes for definition of long-term management schemes. Mercury related issues are mentioned in several project outcomes (listed below)
BIOMERCURY (Worldwide remediation of mercury hazards through biotechnology) FP6-NMP	http://www.eugris.info/DisplayProject.asp?ProjectID=4804	The objectives of the project were: - evaluating the applicability of the new, microbe-based technology, which is a biotechnological process lying on the enzymatic transformation reactions of live mercury resistant bacteria, in order to clean up contaminated air, wastewater, groundwater, soil, the soil waste from former industrial operations, contaminated rivers, lakes, coastal areas, gold and mercury mines as well as mine tailings; - monitoring the long-term performance of the operation of the first industrial microbe-based mercury removal plant; - comparing the costs, safety and efficiency of this new biotechnological approach with the corresponding ones of the traditional methods; - disseminating knowledge of this new biotechnological approach into regions such as in Eastern and Southern Europe, Asia, South America and Africa in which the need for mercury remediation is more urgent; - coordinating activities and exchanging information with agencies of United States which

Project	EUGRIS Link	Summary
		were involved in implementing new control technologies such as technologies for coal fired power plants. Mercury constitutes a severe environmental pollutant owing to its extreme toxicity, its atmospheric transport which allows it to travel throughout the earth as well as its accumulation in the food chain. The BIOMERCURY project aimed to assess a new microbe-based technology, which is environmentally friendly and cost-effective, in order to remove mercury from contaminated environments. Mercury resistant microbes have evolved a mechanism to transform toxic ionic Hg2+ into non toxic elemental Hg0 using specialised transport proteins and the mercuric reductase enzyme. The elemental mercury diffuses out of the bacterial cells and can be collected in an appropriate bioreactor. On this basis, a novel biotechnology for clean-up of mercury polluted waste water has been developed, demonstrated and put into industrial practice at a chloralkali electrolysis factory by the GBF in cooperation with industrial partners. It was placed in a standard mobile container, controlled by telephone modem and proven to be efficient, robust, environmentally friendly and cost effective.
BIOMETA: Biomethylation and Biovolatilisation of Arsenic in Soils: Using Carbon and Hydrogen Isotopes to Unravel the Mechanisms and Pathways Involved FP7-PEOPLE-2012-IEF	http://www.eugris.info/DisplayProject.asp?ProjectID=4806	Arsenic (As) is a ubiquitous element found in almost every environmental compartment. Moreover, inorganic As is a Class 1 non-threshold carcinogen and globally, millions of people are at risk, mainly through drinking tainted water which is also used to irrigate agricultural soils. As is found in soils in its inorganic form but also as organic As, mostly mono- and dimethylarsenic (MMA(V) and DMAV(V), (III) and (V) being the different oxidation states). The process leading to these compounds, biomethylation, is biological and it is still not fully understood. Moreover, it is linked to another remarkable mechanism: biovolatilisation. Microorganisms in soil transform inorganic As to much less toxic methylated compounds, mostly MMA(V) and DMA(V), producing as well reduced methylated compounds (MMA(III) and DMA(III)) which are even more toxic than inorganic As. Biovolatilisation leads to the production of four highly volatile As compounds (arsine, mono-, di- and trimethylarsine) and their toxicity is still highly discussed.

Project	EUGRIS Link	Summary
		Although the products are known, only indirect evidence exists on the different possible pathways, which are still highly debated. We propose here to employ a dual isotope approach, using 2H and 13C labeled methyl groups, placed on different methylated As molecules, to unravel As biomethylation & biovolatilisation pathways. These compounds will be injected in As methylating bacteria, fungi & protozoa cultures and in soil microcosms. The resulting molecules (including volatiles) will be measured/traced using analytical speciation techniques such as cryotrapping & GC coupled with state of the art IRMS instruments. These experiments will shed light on processes that lead to an array of As molecules of varied toxicities and physico-chemical properties being released in soils. Indeed, such knowledge is essential in order to better assess the threat of As pollution but also in order to potentially use these processes as tools for soil remediation.
Bridging Gaps between Sensor Developers and (End) Users in a Pragmatic Approach (NICOLE project 2002-2004	http://www.eugris.info/displayproject.asp?projectid=4571	This project executed between September 2002 and June 2004 was a joint study between NICOLE members and the SENSPOL-network to share expertise and identify available sensors and instruments that have a potential to be applied in site characterisation and monitoring of contaminated land.
Development of Options for Damage Limitation and Environmental Rest oration of the Mercury-Contaminated Areas in North-Central Kazakhstan FP4-INCO 1997-99	http://www.eugris.info/DisplayProject.asp?ProjectID=4803	Accidental release of mercury from the acetaldehyde plant AO Karbide in the Karaganda region of north-central Kazakhstan has resulted in serious contamination of the surrounding region. Mercury is highly toxic at very low concentrations, due to its ability to accumulate in the food chain. Soluble mercury has been measured at 20 times maximum permitted levels in the water of the river Nura, and 30 times in the soil of the city of Temirtau. This has immediate serious implications for the health of the people of the region. In the long term it also poses a threat to the unique ecology of the lakes of the Kurgaldzhinskaya nature reserve. Preliminary investigations suggest there are approximately 130 tonnes of mercury in the river bed near Temirtau. In most areas the contamination decreases with depth, but in the region of the plant it increases sharply, suggesting that substantial quantities of mercury were

Project	EUGRIS Link	Summary
		deposited during earlier periods of operation. The total quantity of mercury in the vicinity of Termitau is believed to be on the order of 1000 tonnes.
DROPS Development of macro and sectoral economic models to evaluate the role of public health externalities on society. Framework 7 2006-2009	http://www.eugris.info/DisplayProject.asp?p=4688	The project aims thus on extending existing methodologies and models to provide an impact-pathway-based model for evaluation of the role of public health externalities on society, made operational for the selected compounds. Specifically, the objectives are related to the following pollutants: ozone, heavy metals (mercury, cadmium, arsenic, nickel, lead), polychlorinated biphenyls (PCBs), dioxins and indoor air pollution. The analysis should as much as possible look at the different components of particulate matter. The project will: • Identify emission reduction measures and their costs for PCBs, Dioxins and indoor air pollution, and review such information for ozone and heavy metals, particularly through the ESPREME project progress for heavy metals. • Evaluate benefits of such measures in terms of reduction of health impacts, including possible ancillary benefits, based on data derived from current and previous relevant projects (e.g. ESPREME, MERLIN, INFOS)
EMECAP: Conference on mercury as a global pollutant	http://www.eugris.info/displayproject.asp?Projectid=4696	The objective of the EMECAP Project was to improve the tools at Regulatory Bodies disposal to plan the actions to safeguard citizens health from mercury pollution. The EMECAP project took forward two innovative mini-devices for measuring atmospheric mercury concentration, an enhanced mathematical model to simulate mercury dispersion, a smart software to render explicit the correlation between the data acquired through epidemiological and environmental researches and improved diffusion samplers/dosimeters for gaseous mercury to measure personal exposure level to mercury. Relevant results on human health risks of mercury emissions from Mercury Cell Chlor-Alkali (MCCA) plants were obtained from the combined epidemiological and environmental studies carried at three demonstration sites.
ESPREME: Integrated assessment of heavy metal releases in Europe Framework 6, 2004-2007	http://www.eugris.info/DisplayProject.asp?p=4689	The aim of ESPREME was to develop methods and to identify strategies to support EU environmental policy-making for reducing the emissions and thus the harmful impacts of heavy metals (HMs). The core aim of the research was to carry out damage assessment considering heavy metals to the environment and human health in the long term. The priority metals mercury, cadmium, lead, nickel, arsenic and chromium have been covered.

Project	EUGRIS Link	Summary
Fate of Genetically Engineered Microorganisms (GEMs) and Genetically Engineered DNA Sequences (GEDs) in some environmental hot spots: polluted soils, river sediment, decaying and diseased plants; role of BHR plasmids and development of cont FP2-BRIDGE 1991-1993	http://www.eugris.info/DisplayProject.asp?ProjectID=4811	The study of the behaviour and influence of GEM's in microbial environmental "hot spots" with special emphasis on the role of broad host range plasmids in gene dissemination and the development of bacterial containment systems. Current objectives for the continuing project include; monitoring of the fate genetically engineered microorganism (GEM's) and genetically engineered DS (GEDS) in potential environmental hot spots with special emphasis on the role of broad host range (BHR) plasmids; study of the genetic transfer potential in the environmental hot spots using exogenous plasmid isolation; development of a rapid method for total extraction of deoxyribonucleic acid (DNA) from soils; development of bacterial containment systems. Different GEM's and GEDS were constructed which will be used in the different microcosms to study gene escape. The GEM's contain marker genes based on heavy metal resistance and organic xenobiotioc degradation. Heavy metal resistance genes can be used as useful marker genes to study gene transfer form P putida and E coli to A eutrophus in microcosms as they allow the use of very selective media against donor and the natural microbial population. On the other hand in order to study the escape of genes from an introduced micro-organism to the indigenous micropopulation marker genes are needed which are expressed in a broad range of bacteria. Genes encoding resistance to mercury and encoding the meta cleavage of 2,3-dihydroxybiphenyl or catechol into an easily detectable yellow cleavage product were found to be expressed in a wide range of bacteria.
Feasibility study regarding the in-situ remediation of mercury contaminated soil	http://www.eugris.info/DisplayProject.asp?p=4551	The feasibility of a new in-situ remediation technique was tested. The remediation technique makes use of the principles of electro remediation, combined with the use of iodic complexants to solubilize the mercury from the soil, and solvent extraction to isolate the recovered mercury from the waste solutions. The complexants are introduced into the soil by means of an electric field (electroremediation). This field is also used to remove the solubilized (ionic) mercury complexes from the soil. Soil electrodes are flushed with process solution, which is treated above the ground to isolate the mercury and to reuse the iodic complexes.
Fundamentals of	http://www.eugris.info/displaypr	The effect of calcium competition on cadmium binding on humic acids has been measured

Project	EUGRIS Link	Summary
chemical and physical aspects of soil and ground water protection against inorganic pollutants	oject.asp?projectid=4538	using voltammetric methods. Adsorption of humic acids on the mercury aqueous solution interface has been studied. Copper binding to humic acids was measured by ion selective electrode at pH 4, 6 and 8 with copper activities varying from 1E-3 to 1E-14 M. 10 different types of iron oxides were synthesized and characterized for specific surface area and porosity. Binding of cadmium on several of these oxides was measured as a function of pH and metal ion activity. The charging characteristics of these same oxides were determined as a function of pH and ionic strength. Although the charging properties varied considerably for the various materials, the cadmium binding behaviour was quite similar. Adsorption of humic acid on hematite was studied as a function of pH, indicating increased adsorption with decreasing pH. Cadmium binding on 2 different soils was measured using pH stat and a cadmium selective electrode, allowing the exchange stochiometry between hydrogen and cadmium ions to be established. A collection of 28 different soils was intensively characterized and the soil extracts analyzed for approximately 50 elements. A theoretical analysis was made on wetting front instability leading to fingering wetting, profiles. This type of water movement can also affect solute transport in the field. The combination of physical and chemical heterogeneity on solute transport was analysed. A new analytical mathematical solution for this type of problem was derived and results were compared with those of numerical methods. The longitudinal spreading of the retarded plumes is greatly affected by the interplay of physical and chemical heterogeneity.
ICP Vegetation International Cooperative Programme on Effects of Air Pollution on Natural Vegetation and Crops	http://www.eugris.info/displayproject.asp?projectid=4646	The ICP Vegetation is an international research programme investigating the impacts of air pollutants on crops and (semi-) natural vegetation. The programme focuses on two air pollution problems: impacts of ozone pollution on vegetation and the atmospheric deposition of heavy metals to vegetation. In addition, the ICP Vegetation is taking into consideration impacts of pollutant mixtures (e.g. ozone and nitrogen), consequences for biodiversity and the modifying influence of climate change on the impacts of air pollutants on vegetation.

Project	EUGRIS Link	Summary
IMAGH: Enhanced knowledge in mercury fate and transport for improved management of Hg soil contamination 2011-2014 Snowman project	http://www.eugris.info/displayproject.asp?Projectid=4812	The overall aim of the project is to provide recommendations and to highlight needs to improve management of sites contaminated by mercury. Recommendations and needs will be established based on i) enhanced understanding of mercury forms fate, transport and modelling in the vadose zone and on ii) comparison of available and currently used practices in characterisation, assessment and remediation of mercury contamination. Recommendations for improved management of mercury contaminated sites are proposed to be formulated through achieving the following specific objectives: To compile knowledge on various forms of mercury fate and transport (chemical species and physical states) in the vadose zone and associated available physical, chemical and thermodynamic constants To improve mercury geochemical modelling to assess and predict mercury species partitioning in the different compartments (air, soil and water) of the vadose zone To compare available and currently used European approaches and practices in characterisation, risk assessment and management of mercury through both literature review and feedback from European practitioners To draw some recommendations and identify further research needs for mercury characterisation, risk assessment and management, based on enhanced understanding of mercury forms behaviour in the vadose zone and on available and currently used practices.
MCN Northern Sweden Soil Remediation Center EC Structural and nationally funded project 2001 to present	http://www.eugris.info/displayproject.asp?Projectid=4519	MCN is funded by the EU structural funds objective 2 northern Sweden, with the basic objective to contribute to regional development and increased employment. Research on various issues of contaminated land has the objective to rationalise processes and increase the understanding of risk assessment of contaminated land. Rapid implementation of new methods and competence in specialised member companies is required in order to increase competiveness and growth. For the period 2009-2012 the specific objective is to increase the international presence of members research groups and private companies. Some of its outputs and resources relate to mercury issues (see below)
Pavlodar	http://www.eugris.info/displaypr	Pavlodar is a large industrial town in northeast Kazakhstan where air, water and soil pollution

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environmental project IC-INTAS 1993 onwards	oject.asp?projectid=4805	is severe. The current project will focus on monitoring and assessment of mercury contamination caused by processes used at a major petrochemical installation. The objectives are: to define the distribution and degree of the mercury contamination in the Pavlodar region; to carry out a detailed survey and a sampling programme in the critical areas; to prepare cost measures to remediate soil and groundwater in the heavily contaminated areas; to develop protocols and guidelines for monitoring and assessment of mercury contaminated areas in Kazakhstan.
PEREBAR Long-term performance of permeable reactive barriers used for the remediation of contaminated groundwater Framework 5 2000-2003	http://www.eugris.info/displayproject.asp?Projectid=4290	The overall objective of the PEREBAR project was to evaluate and enhance the long-term performance of permeable reactive barrier systems, with focus on systems based on sorption and precipitation of heavy metals and sorption and decomposition of organic compounds, respectively. Processes that impaired the barrier performance during barrier lifetime were studied qualitatively and quantitatively. The major steps of the projects were: • Selection and characterisation of suitable reactive matrix materials (e.g., zero-valent iron, natural or organophilic zeolites, oxides, phosphates, lime, Mg hydroxide) • Characterisation of relevant attenuation processes • Development of contaminant-binding chemical compounds ('ligands') Accelerated testing methods to assess the long-term performance of the attenuation mechanisms in PRBs Development of a scheme to predict the long-term behaviour of PRBs • Evaluation of the influence of site characteristics on PRB performance • Monitoring of existing and new field installations • Inclusion of electrokinetic techniques to PRB systems • Field tests
PERSPEC Perspectives on mobilisation of prioritised contaminants in soil	http://www.eugris.info/displayproject.asp?Projectid=4653	The aim of the PERSPEC project is to compile current knowledge on how atmospheric and hydrological processes influence the mobilisation f contaminants to, within, and from soils focus is on priory substances according to the European Water Framework Directive (WFD) such as metals (e.g. mercury, lead and aluminium), and persistent organic pollutants (POPs;

Project	EUGRIS Link	Summary
SNOWMAN Project 2007-2008		e.g. polycyclic aromatic hydrocarbons (PAHs), brominated diphenylethers, chlorophenols, chlorobenzenes, PCBs and dioxins). Metals and organic contaminants have often been studied separately in the past, mainly due to their different chemical properties. However, in the environment they coexist and are subject to the same environmental processes. By including both metals and organic contaminants in the same research framework, differences as well as similarities in their environmental fate and response to climate factors will become apparent, and different scenarios may be explored.
PHIME - Public health impact of long-term, low-level mixed element exposure in susceptible population strata FP6-Food, 2006-11	http://www.eugris.info/DisplayProject.asp?ProjectID=4807	The project will contain four pillars, each with several work packages (with several sub-projects). In addition, there will be cross-cutting work packages. I. What are the problems? i) We will epidemiologically assess the impact of toxic metals (particularly cadmium, mercury, lead and manganese) exposure through foods on diseases of public health concern (nervous system, cardiovascular, osteoporosis/fractures, kidneys, diabetes). Some studies will utilize unique biobank material. ii) Particular interest will be paid to interaction between toxic elements in mixed exposures (several metals and other pollutants), and on ???new??? elements (platinum, palladium, rhodium and manganese). iii) We will characterize benefits of exposures to essential elements (selenium, zinc)/other dietary components (fatty acids, fibre), and describe some aspects of risk/benefit relationships. iv) We will address pathomechanisms. v) We will focus on susceptible groups (fetuses/infants/children, fertile women and elderly, nutrition and gene-environment interactions), as regards metabolism and toxic effects. II. Where are the problems? vi) We will develop and validate new methods for biomonitoring of exposures. vii) We will define geographical patterns/sources of exposure in EU Member States, especially in children and women. viii) We will assess time trends of exposure, retrospective and prospectively. III. Possible solutions to the problems ix) We will develop probabilistic models, describing the exposures and exposure-response patterns. This will enable scientifically-based decisions by national, EU and international bodies on preventive actions. x) We will explore mechanisms of uptake and distribution of toxic and essential elements in plants, which will make it possible to breed species with low concentrations of toxic elements and high of essential. This gives a possibility to change the intakes through plant foods and the transportation into animal foods
SENSPOL Sensors for	http://www.eugris.info/displaypr	The overall objective is to enhance the development of chemical sensors, biosensors and

Project	EUGRIS Link	Summary
monitoring water pollution from contaminated land, landfills and sediments FP5 2000-2003	oject.asp?projectid=4447	biomimetic systems for practical applications in the abatement of water pollution from contaminated land, landfills and sediment. The aim is to provide 'in situ' monitoring of environmental pollutants in water and contaminated soil and sediments, to facilitate optimisation of remediation technologies and natural attenuation processes. The proposed work programme is based on a series of European meetings, a centralised information facility and a broad collaboration programme. SENSPOL will cluster the sensor development activities in the EU's environmental projects and act as a catalyst for the advancement of European technology for monitoring the environment. Paths will be identified to resolve the most effective sensor systems for use in monitoring multiple pollutants contaminating water, soil and sediments and for use in site management in order to protect g round and surface water from pollution
Speciation of antimony in contaminated soil and groundwater FP4 1996-1997	http://www.eugris.info/displayproject.asp?Projectid=4810	The region of Marktredwitz (Bavaria, Germany) is highly contaminated by heavy metals like mercury or antimony (Sb). Bioavailability and toxicity of Sb is strongly dependent on the chemical 'species'. Toxicological aspects of different Sb-species are increasingly realized during the last few years. Determination methods for Sb species are not available up to now. The planned project will start with a methodical developement for a Sb-speciation in soils and groundwaters. Principally, combinations of separation techniques (HPLC, CE) with element specific detection (ICP-MS) will be employed. In the beginning, method evaluations will be well to the fore. Afterwards, the method should be applied to a great number of samples, to find out the distribution pattern of Sb-species, due to anthropological and environmental influences. These results provide information about health risks to the population in this contaminated area.
Study of sorption of the mobile forms of mercury by fly ash from thermal power plants with the aim of immobilising them in silts and soils	http://www.eugris.info/displayproject.asp?p=4808	The work investigates if fly ash from Ekibatuz Power Plant can stabilise low concentrations of mercury in the environment and prevent it from becoming soluble in water and in preventing it transforming into the methylated form.

Project	EUGRIS Link	Summary
IC-INTAS 2001-2003		
SUSAN Sustainable and Safe Re-use of Municipal Sewage Sludge for Nutrient Recovery Framework 6 Project 2005-2008	http://www.eugris.info/DisplayProject.asp?P=4626	The FP6 project SUSAN started in November 2005 with the aim to develop technologies and strategies for safe and efficient recovery of nutrients as fertilisers from municipal sewage sludge. The project focused on developing and validating a thermo-chemical process enabling heavy metals removal and transfer of phosphorus into mineral phases with high bioavailability. This technology was intended to be suitable for large scale facilities handling up to 50,000 tons of ashes per year.

Table 2 EUGRIS Mercury Related Project Outputs Summary

Output	EUGRIS Link	Summary
AQUATERRA ONLINE INFORMATION SYSTEM (ATOIS) Technical Summary Contaminants AquaTerra Technical Summary	http://www.aquaterra.eugris.info/summary/FINAL%20Technical%20Summary%20CONTAMINANTS.pdf	A wide range of contaminants are transmitted to and transported within river basins in a range of forms and they can pose a threat to flora, fauna and human health, as well as to the functioning of the environmental system as a whole. The study of contaminant transport and behaviour under a variety of conditions, including global change, is the core of AquaTerra work. Understanding how contaminants are transported through the river basin system, how they are transformed, the compartments they are stored in, the quantity of contaminants stored, the conditions that cause their release and how these conditions are affected by change at a range of scales are fundamental questions that are addressed, in part, by AquaTerra sub-projects. The majority of work undertaken in the BIOGEOCHEM, TREND, FLUX and COMPUTE sub projects relates to the subject of contaminants to some extent. This summary is divided into two sections; the first describes the work undertaken in relation to the quantification of contaminants, while the second describes work undertaken to improve understanding of contaminant behaviour in the environment. Each section is subdivided according to the contaminant groups of relevance.
AQUATERRA ONLINE INFORMATION SYSTEM (ATOIS) Technical Summary Danube Basin AquaTerra Technical Summary	http://www.aquaterra.eugris.info/summary/FINAL%20Technical%20summary%20BASIN-DANUBE.pdf	AquaTerra work in the Danube basin was centred on a sampling expedition, the AquaTerra Danube Survey (ADS), using a laboratory boat. The ADS collected suspended matter and sediment samples from 30 sites along a stretch of the river from Klosterneuburg in Austria to Calafat in Romania. Analysis of existing data, as well as the new work undertaken in the ADS led to the identification of relevant organic and inorganic pollutants in Danube suspended solids and sediments in the context of Water Framework Directive (WFD) priority substances. Cadmium and lead are the most serious inorganic contaminants in the Danube basin. In the case of organic substances, 4-iso-nonylphenol and di[2-ethyl-hexyl] phthalate are the most significant substances. Taking into account the monitoring data for the water column, lindane, DDT and atrazine should be included in a list of priority substances for the basin.
AQUATERRA ONLINE INFORMATION SYSTEM (ATOIS) Technical Summary	http://www.aquaterra.eugris.info/summary/FINAL%20Technical%20summary%20BASIN-ELBE.pdf	AquaTerra work in the Elbe basin has concentrated on several case studies at different sites along the Elbe River that have studied the processes of pollutant behaviour in the river-sediment-soil-groundwater system. The main pollutants in the Elbe river system are heavy metals originating from centuries of ore mining and smelting, and organic substances from

Output	EUGRIS Link	Summary
Elbe Basin AquaTerra Technical Summary		more than 100 years of chemical production in the Bitterfeld megasite and, to a lesser extent, the Pardubice area. Today diffuse pollution from secondary sources like groyne fields, floodplains and river sediments exceeds the inputs from industrial point sources. Observed contamination and toxicity levels in the water, sediments and soils in the Elbe river basin are a result of complex transport, immobilisation and remobilisations processes. The results show that diffuse inputs and remobilization of pollutants are long-term risks for water, sediment and soil quality. One major challenge for the future will be the integration of surface water and groundwater on the river basin scale. The results from the Elbe basin reveal that pollutants are released from floodplain soils during inundation, are transported downward and pose threads to the groundwater. Conversely, due to the discharge of contaminated groundwater to the surface, considerable contaminant mass fluxes can be expected.
AQUATERRA ONLINE INFORMATION SYSTEM (ATOIS) Technical Summary Elbe Basin AquaTerra Technical Summary	http://www.aquaterra.eugris.info/summary/FINAL%20Technical%20summary%20BASIN-EBRO.pdf	The Ebro basin is one of five main study areas of the AquaTerra project. It is the only one of the large study basins that is, to all intents and purposes, located within one country. It is characterised by wide variations in terrain, land use, water availability and climate. The basin as a whole is characterised by a low population density, with isolated concentrations around major settlements: there is extreme pressure on the available water resources. Water is often seen as a political as well as a natural resource. The condition of soil and water in the basin is strongly influenced by the underlying geology, which produces water and soil containing high levels of salts. The quality of water and soil has been further deteriorated by anthropogenic inputs. AquaTerra work in the Ebro basin has been wide ranging, but has focused on chemical monitoring and climate modelling. Chemical monitoring has taken place throughout the basin, with several new monitoring techniques being developed to monitor emerging compounds such as pharmaceutical compounds and brominated flame retardants in water, soil, sediments and air, as well as monitoring soil-air fluxes. Rainfall, weather and water scarcity models have been applied to both the Gallego sub-catchment and the Ebro basin itself. As in other AquaTerra catchments, stakeholder interaction has been an important aspect of the project. In the case of the Ebro, this has led to the development of a model combining of biophysical analysis with economic analysis to assess the impacts of global changes on the environmental problem of salinity in the central basin.
AQUATERRA ONLINE	www.aquaterra.eugris.info/sum	The work of AquaTerra in relation to sediment has largely been in relation to pollutant

Output	EUGRIS Link	Summary
INFORMATION SYSTEM (ATOIS) Technical Summary Sediment AquaTerra Technical Summary	mary/FINAL%20Technical%20summary%20SEDIMENT.pdf	quantification and behaviour; work has been undertaken within the MEUSE, ELBE and DANUBE basins as part of a range of work packages, including TREND, FLUX and BIOGEOCHEM. This work has been undertaken at a range of scales, from laboratory experiments to large scale surveys. This Technical Summary has been divided into four sections; a brief background on the general sediment quality in the relevant AquaTerra study basins is followed by a description of the specific experimental work undertaken in the project, divided into sections on sediment quality, sediment characterisation and sediment behaviour in the environment.
AQUATERRA ONLINE INFORMATION SYSTEM (ATOIS) Technical Summary Surface Water AquaTerra Technical Summary	http://www.aquaterra.eugris.info/summary/FINAL%20Technical%20Summary%20SURFACE%20WATER.pdf	The work undertaken within AquaTerra in relation to surface water has largely been within the DANUBE, EBRO, ELBE and MEUSE river basins. This summary provides a brief background on the state of surface water in each basin, before describing the work in AquaTerra in relation to surface water categorised by surface water quality and hydrological modelling is followed by a description of AquaTerra work.
BIOMERCURY Bioremediation of Mercury: Current Research and Industrial Applications Book	http://www.eugris.info/DisplayResource.aspx?r=7994	Mercury is a heavy metal with extreme toxicity, the ability to biomagnify, and long range atmospheric transport of its gaseous form. Past and present industrial uses of mercury have resulted in the pollution of soils, groundwater, rivers and marine ecosystems worldwide, the clean-up of which, using standard technology, is either not feasible or is prohibitively costly. A low cost and environmentally friendly alternative is bioremediation: the use of microbes or plants (phytoremediation) to remediate contaminated sites. In this timely book, established mercury experts review the latest research in this area, including the genetic engineering of bacteria and plants. The gap between laboratory research and field application is bridged using case studies: An abandoned chlor-alkali electrolysis factory in Kazhakhstan, a former PVC plant in Albania, and the Madeira River Basin in the Amazon region. The remaining chapters cover: the mercury-cell process of the chlor-alkali electrolysis industry; a pilot plant for wastewater bioremediation; and a comparison of the efficiency of microbial bioremediation to clean-up three types of industrial wastewater. The book covers the complete range from laboratory scale research to full scale industrial operation and shows a multitude of options

Output	EUGRIS Link	Summary
		for future mercury bioremediation technologies. Essential reading for research scientists, graduate students, and other specialists interested in mercury bioremediation, the book is also recommended reading for environmental microbiologists, chemists and engineers.
DROPS project Leaflet	http://www.eugris.info/displayResource.aspx?r=8019	The project builds upon a large number of recent or ongoing research projects, and builds upon methodologies such as the ExternE, and is expected to further contribute to the development of European policies on emissions and clean air.
Electro-Remediation of Mercury Contaminated Soil, First Results of a Pilot Test OVAM Project Conference abstract	http://www.eugris.info/displayResource.aspx?r=8004	METALogic NV., in collaboration with the Laboratory of Colloid Chemistry (Catholic University Leuven), developed an integrated in-situ remediation technique for mercury contaminated soils. This technique is based on the mercury-desorbing properties of the oxidizing $I^-/IO_3^-/I_3^-$ complexing agent, and the principles of electro-remediation. This complexing agent is inserted into the soil and the resulting negatively charged mercury-complexes are extracted from the soil using the principles of electrokinetic transport, caused by an electric field applied between 2 electrodes inserted in the soil. These electrodes are surrounded by electrode solutions, containing the complexing agent at the cathode and the mobilized Hg-complex at the anode. Chemical reactions, taking place at the cathode surface are controlled and used to bring part of the complexing agent in an appropriate form before it enters into the soil. The electrolytic processes taking place at the anode, where the mercury arrives after desorption and migration through the soil, are used to convert the mercury-complex into a specific compound, that can be extracted from the anode waste solutions by means of solvent-extraction. The complexing agent is recycled from the anode waste solutions, using a chemical reactor, where it forms a precipitate of iodine (I_2). This precipitate is solubilized to I_3^- in the cathode solution so that it can be reused. The recycling of the complexing agent is important from the economical point of view, because of the high costs of the lixiviant.
EMECAP: European mercury emission from chlor-alkali plants Booklet	http://www.eugris.info/displayResource.aspx?r=8003	The EMECAP (European Mercury Emission from Chlor- Alkali Plants; QLK4-CT-2000-00489) project faced the mercury problem and aimed to develop a new multidisciplinary approach to manage environmental problems and support the safeguard of citizens health from mercury pollution. The EMECAP project, which involved twelve partners from six European countries (Italy, Norway, Poland, Romania, Slovenia and Sweden), tested and validated the presented methodology on three different Mercury Cell Chlor-Alkali (MCCA) Plants located in Italy, Poland and Sweden. The EMECAP methodology includes innovative mercury monitoring

Output	EUGRIS Link	Summary
		devices, biomedical and environmental methods and databases, a mercury dispersion model and a data mining software to investigate possible relationships with mercury emissions, environmental damage and onset of pathologies in human population living in the neighbourhood of mercury sources.
EMECAP: Mercury and human genotoxicity: Critical considerations and possible mercury mechanisms. Journal paper	http://www.eugris.info/displayresource.aspx?r=7032	In the present manuscript, studies about the genotoxicity of mercury compounds, performed in vitro, in vivo, and/or including epidemiologic studies of human populations were reviewed
EMECAP: Urinary mercury and biomarkers of early renal dysfunction in environmentally and occupationally exposed adults: A three-country study Journal paper	http://www.eugris.info/displayresource.aspx?r=7031	We conducted a cross-sectional study in Sweden, Italy and Poland to assess environmental and occupational exposure to mercury from chloralkali (CA) plants and the potential association with biomarkers of early renal dysfunction. Questionnaire data and first-morning urine samples were collected from 757 eligible subjects. Urine samples were analysed for mercury corrected for creatinine (U-HgC), alpha-1-microglobulin (A1M), N-acetyl-â-glucosaminidase (NAG) and albumin. Determinants of urinary mercury excretion were examined.
ESPREME: Estimation of willingness-to-pay to reduce risks of exposure to heavy metals and cost-benefit analysis for reducing heavy metals occurrence in Europe	http://www.eugris.info/displayresource.aspx?r=8011	In report four macro-economic models and their environmental moduls are presented. GEM-E3 (General Equilibrium Model for studying Energy-Economy-Environment interactions) is model developed in 5FP and representing 22 EU countries and 10 pollutants. Model has the environmental module. GTAP (Global Trade Analysis Project) is general equlibrium model developed in the USA with an Energy-Environmental version (GTAP-E model) which covers individually 32 European countries and 6 greenhouse gases. NEMESIS (New Econometric Model for Environmental and Sustainable development and

Output	EUGRIS Link	Summary
Project Report		Implementation Strategies) is model developed by European consortium and covers EU-15 countries plus Norway and 8 pollutants. Model has Energy/Environmental module (NEEM). E3ME (Energy-Environment-Economy Model for Europe) is model developed by European consortium and covering EU25 countries plus Norway and Switzerland and 14 air-pollutants. Model has emissions submodel.
IMAGH: A reactive transport model for mercury fate in contaminated soil—sensitivity analysis Journal Paper	http://www.eugris.info/displayresource.aspx?r=8006	(Abstract) We present a sensitivity analysis of a reactive transport model of mercury (Hg) fate in contaminated soil systems. The one-dimensional model, presented in Leterme et al. (2014), couples water flow in variably saturated conditions with Hg physico-chemical reactions. The sensitivity of Hg leaching and volatilisation to parameter uncertainty is examined using the elementary effect method. A test case is built using a hypothetical 1-m depth sandy soil and a 50-year time series of daily precipitation and evapotranspiration. Hg anthropogenic contamination is simulated in the topsoil by separately considering three different sources: cinnabar, non-aqueous phase liquid and aqueous mercuric chloride. The model sensitivity to a set of 13 input parameters is assessed, using three different model outputs (volatilized Hg, leached Hg, Hg still present in the contaminated soil horizon). Results show that dissolved organic matter (DOM) concentration in soil solution and the binding constant to DOM thiol groups are critical parameters, as well as parameters related to Hg sorption to humic and fulvic acids in solid organic matter. Initial Hg concentration is also identified as a sensitive parameter. The sensitivity analysis also brings out non-monotonic model behaviour for certain parameters.
IMAGH: A reactive transport model for mercury fate in soil—application to different anthropogenic pollution sources. Journal Paper	http://www.eugris.info/displayResource.aspx?r=8007	(Abstract) Soil systems are a common receptor of anthropogenic mercury (Hg) contamination. Soils play an important role in the containment or dispersion of pollution to surface water, groundwater or the atmosphere. A one-dimensional model for simulating Hg fate and transport for variably saturated and transient flow conditions is presented. The model is developed using the HP1 code, which couples HYDRUS-1D for the water flow and solute transport to PHREEQC for geochemical reactions. The main processes included are Hg aqueous speciation and complexation, sorption to soil organic matter, dissolution of cinnabar and liquid Hg, and Hg reduction and volatilization. Processes such as atmospheric wet and dry deposition, vegetation litter fall and uptake are neglected because they are less relevant in the case of high Hg concentrations resulting from anthropogenic activities. A test case is presented, assuming a hypothetical sandy soil profile and a simulation time frame of 50 years

Output	EUGRIS Link	Summary
		of daily atmospheric inputs. Mercury fate and transport are simulated for three different sources of Hg (cinnabar, residual liquid mercury or aqueous mercuric chloride), as well as for combinations of these sources. Results are presented and discussed with focus on Hg volatilization to the atmosphere, Hg leaching at the bottom of the soil profile and the remaining Hg in or below the initially contaminated soil layer. In the test case, Hg volatilization was negligible because the reduction of Hg2+ to Hg0 was inhibited by the low concentration of dissolved Hg. Hg leaching was mainly caused by complexation of Hg2+ with thiol groups of dissolved organic matter, because in the geochemical model used, this reaction only had a higher equilibrium constant than the sorption reactions. Immobilization of Hg in the initially polluted horizon was enhanced by Hg2+ sorption onto humic and fulvic acids (which are more abundant than thiols). Potential benefits of the model for risk management and remediation of contaminated sites are discussed.
IMAGH: Enhanced knowledge in mercury fate and transport for improved management of Hg soil contamination Final workshop Report	http://www.eugris.info/displayresource.aspx?r=8005	The overall aim of the project is to provide recommendations and to highlight needs to improve management of sites contaminated by mercury. Recommendations and needs will be established based on i) enhanced understanding of mercury forms fate, transport and modelling in the vadose zone and on ii) comparison of available and currently used practices in characterisation, assessment and remediation of mercury contamination. Series of presentations from the project
Kd functions to define relation between inorganic pollutant mobility (soil to water), the main biogeochemical characteristics of soils and the main parameters of global change	http://www.eugris.info/displayResource.aspx?r=8017	Contaminated sediments and floodplain soils: Kd measurements of sediment samples in the Ebro and associated Kd function determination for mercury enabled to improve sediment samples characterisation and the understanding of the transfer of mercury in soil/water. It also enabled to give recommendations on monitoring parameters and predict evolution of release of mercury from soil to water with climate change.

Output	EUGRIS Link	Summary
AquaTerra Technical Summary		
MCN Northern Sweden Soil Remediation Center: Chemical speciation and transformation of mercury in contaminated sediments PhD Thesis	http://www.eugris.info/displayResource.aspx?r=8014	Biomagnification of mercury (Hg) in aquatic food webs occurs almost exclusively as mono-methyl Hg (MeHg). In this thesis, the influence of chemical speciation and environmental conditions on transformations of inorganic Hg (HgII) and MeHg was studied at eight sites in Sweden with Hg contaminated sediments. The source of contamination was either Hg0(l) or phenyl-Hg, and total Hg concentrations ranged between 1.0-1100 nmol g-1. The environmental conditions, e.g. salinity, temperature climate, primary productivity, redox conditions and organic matter content and quality, varied substantially among sites. The results show that MeHg production (HgII methylation) is relatively more important than MeHg degradation (demethylation) and input-output for accumulation of MeHg in contaminated surface (0-20 cm) sediments. The total Hg concentration influences MeHg production, likely by a control of the concentration of bioavailable HgII species. The most important factor determining differences in accumulation of MeHg among sites is indicated to be the availability of electron donors to methylating organisms, as a result of differences in primary production and subsequent input of organic matter to sediments. In contrast, the availability of sulphate is not indicated to limit MeHg production in the sediments studied. Within sub-sets of sites with similar properties, a great proportion of the variation in MeHg concentration is explained by the concentration of dissolved neutral HgIIsulphides [Hg(SH)2 0(aq) and possibly HgOHSH0(aq)]. MeHg degradation is influenced by ambient concentrations of MeHg and/or HgII, but the effect appears to vary among sites. It is suggested that the rate of oxidative demethylation is positively related to the concentration of dissolved MeHg-sulphides [MeHgSH(aq) and MeHgS-(aq)]. For improved risk assessment of Hg contaminated sediments, measurement of MeHg concentration and solubility is advised. It is shown that %MeHg (of total Hg) can be used as a proxy for MeHg production, across sites. It is also shown that filtration of pore water for analysis of MeHg concentrations must be done in an anoxic atmosphere to avoid oxidation artefacts.
MCN Northern Sweden Soil Remediation Center:	http://www.eugris.info/displayResource.aspx?r=8015	(Abstract) Accurate determination of methyl mercury (MeHg) concentrations in sediment pore waters is crucial for an improved understanding of mercury (Hg) biogeochemistry, and for improved risk assessment of Hg contaminated sites. In the present study, effects of oxic (air)

Output	EUGRIS Link	Summary
Effects of oxic and anoxic filtration on determined methyl mercury concentrations in sediment pore waters Journal Paper		and anoxic (N2) filtration (after centrifugation) on determined pore water MeHg concentrations were investigated in severely Hg contaminated pulp fibre sediments from two estuaries of the Bothnian Sea, Sweden. MeHg was determined in the filtrate using species-specific isotope dilution gas chromatography inductively coupled plasma mass spectrometry (SSID–GC–ICPMS), after ethylation with sodium tetraethylborate. Determined concentrations of MeHg were greater after anoxic filtration than after oxic filtration for all samples investigated, with MeHg(N2)/MeHg(air) ratios ranging between 3.4 and 343. Adsorption to newly formed Fe(III)/Mn(III/IV)-oxy/hydroxide surfaces is proposed as the main mechanism responsible for MeHg removal during oxic filtration. This is supported by decreases in dissolved Fe and Mn concentrations during oxic filtration, and by decreases in dissolved sulphur concentrations during oxic filtration in the samples with largest effect on MeHg concentrations. The latter is explained by adsorption of SO42− to newly formed Fe(III)/Mn(III/IV)-oxy/hydroxide surfaces. The effect of oxidation during filtration on pore water MeHg concentrations was largest in samples in which FeS(s) was not present, but with calculated pe-values below −3. Thus, our results indicate that the largest errors with respect to pore water MeHg concentrations when filtering in air can be expected in samples with an intermediate redox potential, possibly buffered by a mixture of oxidation sensitive Fe(II/ III) minerals.
MCN Northern Sweden Soil Remediation Center: Importance of Dissolved Neutral Mercury Sulfides for Methyl Mercury Production in contaminated Sediments Journal Paper	http://www.eugris.info/displayResource.aspx?r=8016	(Abstract Extract) Biotic transformation of inorganic mercury, Hg(II), to mono methyl mercury (MeHg) is proposed to be largely controlled by passive uptake of neutral Hg complexes by sulfate reducing bacteria (SRB). In this study, the chemical speciation of Hg(II) in seven locally contaminated sediments covering environments such as (i) brackish water, (ii) low-productivity freshwater, and, (iii) high-productivity freshwater was related to potential Hg methylation rates, determined by incubation at 23 °C for 48 h under N2(g), and to total MeHg concentrations in sediments.

Output	EUGRIS Link	Summary
MCN Northern Sweden Soil Remediation Center: Complexation of cadmium, copper and methyl mercury to functional groups in natural organic matter PhD Thesis	http://www.eugris.info/displayresource.aspx?r=5771	Due to various human activities contamination of soils, sediments and waters with trace metals like cadmium (Cd), copper (Cu) and mercury (Hg) are widespread. It is generally accepted that concentrations of specific metal species are of higher significance than total metal concentrations for the bioavailability and toxicity of trace metals. Thus, in order to make proper risk assessments of contaminated sites it is vital to know the speciation of the metals. Of special importance for the speciation are chemical interactions with colloidal and particle surfaces. The associations of trace metals with inorganic surfaces like minerals and metal oxyhydroxides are fairly well described, but less is known about metal associations with natural organic matter (NOM). In this thesis extended X-ray absorption fine structure (EXAFS) spectroscopy was used to determine the coordination chemistry of Cd and Cu in NOM and binding affinity experiments, using competitive complexation and ion selective electrodes (ISE), were used to determine the bonding strength of Cd and methyl mercury (CH3Hg) to functional groups in soil organic matter (SOM).
PEREBAR: Long-Term Performance of Permeable Reactive Barriers, Volume 7 1st Edition Book	http://www.eugris.info/displayResource.aspx?r=8018	(EXTRACT) While extensive research has been performed on many technological aspects of permeable reactive barriers and a number of contaminants have so far been successfully treated by PRB systems, long-term performance has not been extensively considered and little is known about the processes influencing long-term behaviour. This gap in our knowledge is all the more disadvantageous as design life has a decisive influence on the economic viability of PRBs. The book describes methods for evaluation and enhancement of the long-term performance of PRB systems, especially of those targeting heavy metals, specifically uranium, and organic contaminants by sorption and/or precipitation mechanisms. Major topics in the book are: • Selection and characterisation of suitable reactive materials • Characterisation of the relevant contaminant attenuation processes • Developing new contaminant-binding chemical compounds ("ligands") • Accelerated testing methods to assess the long-term performance of the attenuation mechanisms in PRBs • Evaluation of the influence of site characteristics on PRB performance • Monitoring of existing and new field installations • Coupling of electrokinetic techniques and PRB systems

Output	EUGRIS Link	Summary
		• Large-scale laboratory and field tests and their results It addresses the long-term performance of PRBs, an important feature of this novel remediation technology, systematically. It deals extensively with heavy metal removal, with special emphasis on uranium. A number of case studies, experiences with large-scale modelling and test site experiments provide insight into the practical application of the results. This volume will contribute to the science underpinning groundwater remediation, and this will result in the improvement of quality of life and health and safety.
PEREBAR: Use of Copper Shavings To Remove Mercury from Contaminated Groundwater or Wastewater by Amalgamation Journal Paper	http://www.eugris.info/displayresource.aspx?r=4466	The efficacy of chemically processed copper shavings (Fluka) and recycled copper shavings from scrap metal for the removal of Hg2+ from aqueous solution by amalgamation is demonstrated.
PERSPEC Perspectives on mobilisation of prioritised contaminants in soil Project Summary Sheet	http://www.eugris.info/displayresource.aspx?r=8009	The aim of the PERSPEC project is to compile current knowledge on how atmospheric and hydrological processes influence the mobilisation of contaminants to, within, and from soils. The focus is on priory substances according to the European Water Framework Directive (WFD) such as metals (e.g. mercury, lead and aluminium), and persistent organic pollutants (POPs; e.g. polycyclic aromatic hydrocarbons (PAHs), brominated diphenylethers, chlorophenols, chlorobenzenes, PCBs and dioxins).
PERSPEC Perspectives on mobilisation of prioritised contaminants in soil Final Research Report	http://www.eugris.info/displayresource.aspx?r=8010	As part of the PERSPEC project, levels of HOCs in surface water along the water path from Krycklan to the Gulf of Bothnia were measured and preliminary results are given in this report. The results varied depending on if the concentrations were calculated as amount per water volume or if the values were normalised to the amount of organic carbon present in the water (pg/g OC), once again underlining the importance of organic carbon. Nonetheless, the results show that atmospherically derived diffuse pollution has an impact in addition to downstream point sources.

Output	EUGRIS Link	Summary
		The data from Krycklan was also modelled with various state-of-the-art models in an attempt to describe the fluxes of contaminants and the processes that regulate these fluxes within the studied catchment and water path. The results from the modelling of HOCs were used to estimate total atmospheric inputs for each season, compare HOC exports for the different seasons and different catchment types (forested / mire), compare exports to total soil inventory, calculate relative contribution of snowmelt to total HOC exports, quantify the role of the spring flood in delivering HOCs to the Krycklan catchment, and estimate the influence of enhanced soil contamination on export of HOCs to the stream. The modelling of metals was focused on comparing two different approaches: WITCH and PHAST. The WITCH code is a geochemical model that allows calculations of soil solution composition and mass balance calculations of elements in different soil compartments based on a series of parallel reactions of dissolution, plant uptake and precipitation. PHAST is a multi-box model that allows hydrology to be connected to both thermodynamic and empirical kinetic rate laws. This permits a more flexible model structure and varying depth in model complexity. In summary, the presented data shows that although metals, trace elements and HOCs are governed by significantly different chemical properties, they are subject to the same soil - water controlled processes, such as interaction with organic matter (OM) and dissolved organic carbon (DOC), and this has a considerable impact on their environmental fate. The PERSPEC project also serves as a great example on how an interdisciplinary approach where hydrology, soil science, and organic and inorganic environmental chemistry working in tandem contributes significantly to the fundamental understanding of pollution mobility.
PHIME - Public health impact of long-term, low-level mixed element exposure in susceptible population strata	http://www.eugris.info/displayResource.aspx?r=7996	PHIME focused on producing scientific data, through close cooperation between research groups with knowledge, methods and study groups that complement each other. A closely cooperating working party was formed, which planned and executed collaborative studies and discussed findings, resulting in, up to date, 181 articles in peer-reviewed (most international) journals; seven are in press. Much additonal data is collected and will be published soon. A wealth of important, novel information has been produced. For example, the exposure to lead and cadmium seems to be fairly similar in many Europan countries, with the exception of particularly polluted areas. The exposure to lead and mercury is decreasing, while cadmium

Output	EUGRIS Link	Summary
Final Report		does not show such a favourable time trend. The tissue concentrations of "catalytic converter elements" platinum, palladium and rhodium are much lower than previously thought. The toxic effect of methylmercury on the central nervous system of fetuses and the myocardium of adults is markedly modified by nutrition. Arsenic and manganese, ingested mainly through drinking water and food, affect development and health of fetuses, infants and children. Lead exposure is toxic to children´s central nervous system at very low exposures. Data cast doubt on the excretion of low-molecular weight proteins as a biomarker of cadmium risk at low exposure, but, at the same time, there is evidence of low-level cadmium exposure causing toxic bone effects, with decrease of bone mineral density, increase of osteoporosis and fractures. Preventive actions are needed, in light of the continuous exposure world-wide. PHIME has also profoundly increased the understanding of molecular mechanisms for the uptake of metals in plants, which will enable breeding of cereals with increased levels of essential elements, and - hopefully - decreased toxic. Gene-environment interaction is important in metal toxicity. Thus, the metabolism (toxicokinetics) of mercury, arsenic, and lead is modified by genetics, as is toxicodynamics of arsenic, lead, cadmium and manganese. This should be considered in risk assessment, as the risk may vary between individuals, and between populations with different gene frequencies.
SENSPOL Final Report: Executive Summary (Sensors for monitoring water pollution from contaminated land, landfills and sediment) Project Report	http://www.eugris.info/displayresource.aspx?r=4291	The activities undertaken by SENSPOL have accelerated the development of sensor systems for practical applications in the abatement of water pollution from contaminated land, landfills and sediment. The usefulness of new environmental monitoring devices that can be used on site has been demonstrated. Promising results were obtained with measurements of heavy metals, calcium, chloride, general toxicity and genotoxicity. Sensor technologies are sufficiently mature to be used in routine analysis where legislative compliance through a rigid validation and verification process is not required. Many of the instruments are ready for commercial demonstration. Hindrances to moving from prototype environmental sensing devices to sensor system products remain. Although better analytical technologies, including toxicity sensors, are important to society and public health, the market size is a factor that often seems to deter serious investment. Validation and implementation of the prototype sensing devices requires future mechanisms and funding.
SENSPOL survey of sensor capabilities,	http://www.eugris.info/displayResource.aspx?r=8008	This report is based on the findings arising from a questionnaire designed specifically to identify current sensor development research and the capability of the devices in monitoring

Output	EUGRIS Link	Summary
Sensors for the Abatement of Water Pollution from Contaminated Land, Landfills and Sediment Project Report		groundwater, sediment and contaminated land pollution. The questionnaire was distributed in November 2002 amongst the European research institutions, universities, organisations and companies that are members of the SENSPOL network. The questionnaire was well received, resulting in 48 returned questionnaires by December 2002. The present report analyses all responses from the questionnaire. The report focuses on: • heavy metals with specific attention to mercury-related problems; • aromatics and non-chlorinated hydrocarbons; • chlorinated volatile, semi-volatile chlorinated compounds with particular attention to DNAPLs (Dense Non-aqueous Phase Liquids); • General pollutant toxicity testing. • Other targets including: pH, conductivity and redox potential; phenolic compounds; anionic and cationic analytes; nitrogen dioxide gas. The report features 42 sensors, biosensors and detection kits within the 32 included entries (7 Companies, 15 Universities and 10 Research Institutes), spanning 13 European countries. Many of the sensors featured are biosensors or immunoassay based platforms. However, there are other monitoring systems included that are able to measure the specific analytes addressed by this report.
SUSAN Sustainable and Safe Re-use of Municipal Sewage Sludge for Nutrient Recovery Summary and Publication List	http://www.eugris.info/displayresource.aspx?r=8012	Municipal sewage sludges are often highly polluted with organics, such as hormones, antibiotics, endocrine disruptors, persistent organic pollutants (POPs), and inorganics such as heavy metals e.g. cadmium, chromium, copper, nickel, mercury and zinc. In the last couple of years, the agricultural application of sewage sludge has decreased in the European Union, while the interest in alternative sludge disposal routes to protect farmland and human health has increased. However, following this strategy, nutrients (most notably phosphorus) are irreversibly lost and the need for mineral fertiliser products will increase. The scarce resource phosphorus could be recovered if a sound recycling strategy is developed and applied.
SUSAN Sustainable and Safe Re-use of Municipal Sewage Sludge for Nutrient	http://www.eugris.info/displayResource.aspx?r=8013	In the SUSAN-project an environmentally friendly technology for sewage sludge treatment was developed and optimised aiming at nutrient recovery. The SUSANoption is a two step thermal treatment. In a first step sewage sludge is monoincinerated under energy recovery and destruction of organic pollutants. In a second thermochemical step heavy metals are

Output	EUGRIS Link	Summary
Recovery Final Activity Report		removed and the valuable nutrient phosphorus is transferred into a form that is available for plants. This treatment step works at 850-1000°C. The thermochemically treated ashes contain approx. 20 % P2O5 in a bio-available form and are thus suitable raw materials for manufacturing marketable fertilisers such as P-, PK- or NPK-fertilisers. The nutrients phosphorus, calcium, magnesium and potassium that were present in sewage sludge are transferred into the ash based fertilisers and thus can be recovered with this technology. Recovery of phosphorus is most important in this context as phosphorus is a non-renewable resource that can become scarce in the future. The P-resources of the European Union are negligible. Consequently, the EU depends on a world market that is dominated by a small number of exporting nations. Main phosphorus reserves are located in China, Morocco, South Africa and the United States of America. Dramatic increases of the prices for rock phosphate were observed in the years 2007 and 2008 with significant effects on the agronomic sector. However, those developments on the fertiliser market positively affect the evolution of recycling strategies such as the SUSAN management option for nutrient recovery. An economic operation of large-scale facilities treating sewage sludge ashes according to the SUSAN-technology is expected in the near future. A pilot plant for fertiliser production from sewage sludge ashes is currently in operation. The SUSANparticipant ASH DEC Umwelt AG will build up the first demonstration facility with an annual capacity of approx. 15,000 tons of ashes in the years 2009/2010.

Table 3 Wider search of "mercury" projects on: http://cordis.europa.eu/projects/home_en.html

Project	Link	Summary
ARCRISK (Arctic Health Risks: Impacts on health in the Arctic and Europe owing to climate-induced changes in contaminant cycling) FP7-ENVIRONMENT	http://cordis.europa.eu/result/rcn/161281_en.html http://www.arcrisk.eu/	ArcRisk used modelling tools to study the transport of several persistent organic pollutants (POPs) and mercury to the Arctic via the atmosphere and oceanic currents under both present climate and projected future climate scenarios. Models were used to compare the influence of climate change on contaminant cycling in the Arctic as well as European regions, with a particular assessment of climate influence on contaminant transport and fate in the Baltic Sea region for comparison. A bioaccumulation model describing the food-web transfer of organic contaminants in an Arctic marine food web was developed to determine the possible role of climate change on future dietary exposure to pollutants.
Demonstration of high temperature oxidation, technology for the recovery of mercury from hazardous wastes FP4 ENV-LIFE 1; 1994-1995	http://cordis.europa.eu/project/rcn/24565_en.html	The project aims to demonstrate the suitability of the High Temperature Oxidation process to remove metallic reusable mercury from hazardous wastes. The project owner foresees a confirmation of an earlier study that the technology can be used to treat a wide variety of mercury containing wastes. The innovative High Temperature Oxidation process makes it possible to recover mercury from hazardous wastes which are at present being stored in salt mines. The total amount of dutch treatable waste will be between 1000 and 2000 tonnes per year.
Environmental Chemicals : Soil - Water and Waste, 1992-1994 JRC 1992-1994	http://cordis.europa.eu/project/rcn/17155_en.html	Subproject 2: interlaboratory comparison of total mercury and organic mercury species in fish; Subproject 3: on trace metals in sediments; subproject 4: persistent organochlorine compounds in sediments are in progress.
Final Report Summary - GMOS (Global Mercury Observation System)	http://cordis.europa.eu/result/rcn/186910_en.html	Launched in November 2010, the GMOS has established a global monitoring system for measuring mercury concentrations in ambient air and deposition at more than 40 background monitoring sites worldwide at different latitudes and altitude. The project has filled an important monitoring gap and gives scientists a truly global

Project	Link	Summary
FP7-ENVIRONMENT		picture of current mercury pollution levels. From these monitoring sites data continues to be gathered with the intention to analyse future emission reduction measures and their effectiveness. Prior to the GMOS project, there were almost no monitoring sites in the tropics or in the southern hemisphere.
Harbours - silting and environmental sedimentology FP4-TRANSPORT 1998-1999	http://cordis.europa.eu/project/rcn/44666_en.html	1.Identification of the sediment sources, transport pathways and deposition in a harbour setting having limited tidal influence. 2. Evaluation of the geographic and vertical associations between sediment components and the geo-chemical transfer mechanisms involving pollutants, with particular reference to bottom turbulence. Establishment of a generic model for component and process quantification, and to suggest model scenarios involving dredging and environmental change in harbour settings. Larsson, L.B. & Stevens, R.L. 1999: Time-dependent changes of PCB and mercury in harbour channel sediment, Göteborg, Sweden. Accepted for publication in CATS 4 (Proc. Intern. Congress on Characterisation and Treatment of Sediments, Antwerpen, Sept. 15-17, 1999), 71-80. Brack, K. & Johannesson, L.T.: Mercury and methylmercury in estuarine sediment and porewater, Göteborg Harbour, SW Sweden. Submitted to Applied Geochemistry
Mercury species over Europe. Relative Importance of depositional methylmercury fluxes to various ecosystems. FP4-ENV 2C 1998-2001	http://cordis.europa.eu/project/rcn/40093_en.html	The general objective is to identify and quantify sources of atmospheric mercury species focusing on production and fluxes of methylmercury (MeHg). The primary objective is to find the relative importance of the atmospheric deposition of MeHg, in comparison to methylation/demethylation processes in terrestrial and limnic ecosystems, in various parts of Europe. The intention is to provide the missing important pieces on the occurrence of direct and diffuse emissions, and of atmospheric production, of the mercury species contributing to the MeHg found enriched at different trophic levels in our ecosystems. From this, the capability of MeHg of atmospheric origin to act as a net source for MeHg transport over transition zones between, terrestrial, wetland, and limnic ecosystems, will be assessed. The

Project	Link	Summary
		information will be necessary in constructing adequate multicompartment models for the fate and effects of ecotoxicologically relevant mercury species, e.g. MeHg, and assessing impacts from environmental changes. For this purpose, techniques for identifying and quantifying the potential sources of atmospheric MeHg and other relevant mercury species, will be developed and used, In particular, possible direct MeHg releases form fossil-fuelled combustion facilities and household waste incinerators, or alternatively through chemical production in the plumes or in the atmosphere, are of major interest.
MEROXRE Understanding the fate of Arctic atmospheric mercury (Hg) deposition – A Hg stable isotope investigation of redox processes and Hg re-emissions H2020	http://cordis.europa.eu/project/rcn/195407_en.html	In the MEROXRE project proposed here we will combine the latest innovations in gaseous Hg measurements in porous media (soils, snow) with state-of-the-art Hg isotope techniques to investigate: (i) Hg isotope fractionation of Hg2+ reduction and gaseous Hg0 oxidation in interstitial snow air and soil pores. (ii) Hg isotope fractionation factors associated with net gaseous Hg0 re-emission fluxes from soil and snow. (iii) the importance of gaseous Hg0 oxidation and Hg2+ reduction and re-emission for the global Hg cycle by incorporating the results in a global Hg isotope model.
Microorganisms in mercury polluted soils and sediments: Changes in the biodiversity, spread of resistance plasmids and biochemistry of microbial resistance IC-INTAS 1999-2001	http://cordis.europa.eu/project/rcn/66199_en.html	No info posted
Novel remediation technology for vaccine production effluents containing organomercurials	http://cordis.europa.eu/project/rcn/51527_en.html	Extremely toxic organomercurials are used as disinfectants during the production of vaccines. The resulting process waste water is strongly polluted and can presently not be remediated. We propose a novel biotechnology based on the selective extraction of the organomercurial from the waste water using a new type of ion

Project	Link	Summary
FP5-LIFE QUALITY, 2000-2004		exchange membrane, incorporating selective liquid salts. The organomercurial will then be degraded to metallic mercury by previously constructed highly efficient genetically engineered strains. A micro pilot plant will be developed which allows continuous operation, contained use of the genetically engineered bacteria and recovery of the produced metallic mercury. Different vaccine production effluents will be remediated and in a final stage the micro plant will be tested at a vaccine production factory.
Origin and fate of methylmercury FP1-ENVPROT 4C	http://cordis.europa.eu/project/rcn/14077_en.html	The present sub-project will address in particular the following subjects: 1.- isolation of bacteria from natural soil, freshwater and sea water environments, as well as from experimental microcosmos. 2.- screening of isolated bacterial strains regarding their ability to produce mehg and other chemical hg species. 3.- identification and quantification of chemical forms of hg produced by microorganisms in the natural environment and in experimental systems. 4.- investigations on the ecotoxicity of mehg and other organomercury compounds to microorganisms.
Preparation of a certified oyster tissue reference material for species of tin, mercury and selenium	http://cordis.europa.eu/project/rcn/46528_en.html	The objectives of the proposed programme are: to prepare an oyster reference material certified for tributyl-, dibutyl-, monobutyl-, triphenyl-, diphenyland monophenyl- tin, for methylmercury, for selenomethionine and selenocystine. The programme includes a feasibility study prior to the certification campaigns in order to assess the capacities of the participants, and to identify and eliminate shortcomings, and a certification study. This programme will improve the quality of the speciation analyses which are important for environmental management and health care. The certified oyster tissue reference material which will become available will contribute to a higher standard of analytical capability in this field and thus to more reliable information from research and monitoring programmes.
RELIGHT (Sustainable Recycling of Lighting Products)	http://cordis.europa.eu/result/rcn/168299_en.html	The outcomes of the project have determined the type, scale, set up and cost of process equipment that will turn Compact Fluorescent Lamps into clean, high value constituent materials of glass, plastic, metal and phosphor powder. A compact

Project	Link	Summary
FP7 SME		crusher has been developed to separate these component parts and prepare them for sale.
Study of the mercury of the river Nura with a view to the development of an effective management strategy for the polluted technogenic sediments	http://cordis.europa.eu/project/rcn/37938_en.html	Industrial activity in the Karaganda region has resulted in serious mercury contamination of the river Nura. Preliminary investigations suggest there are at least 130 tonnes of mercury in the river bed near the city of Temirtau and a further 30 tonnes downstream. During the spring floods, sediments are transported down the river and discharged over the flood plain. Water from the river is also used to irrigate thousands of hectares of land. As a result, raised levels of mercury are found in the soils far downstream. The objectives in the programme, therefore, will be: to study the chemical fate of mercury in the river Nura with the objective of identifying conditions of water flow and water quality that will reduce the transport of mercury downstream and its spread into the wider environment; to study the distribution, transport and behaviour of the mercury-laden silts, with the aim of defining economic containment techniques; to identify economically viable engineering, chemical, biological and river management strategies which will minimise risks to the people of the area and to the environment.
TOMCAR-PERMAFROST - Terrestrial organic matter characterization in Arctic River through molecular and isotopic analyses FP7 People	http://cordis.europa.eu/project/rcn/98104_en.html	he object of this research project is to improve our understanding of organic carbon cycle in Arctic River basins, with a particular focus on carbon transfer from soils to rivers based on morphoedaphic characteristics. In order to achieve this goal we decided to work on watersheds with various permafrost influences and with the combination of two complementary tools: Geographic Information System and biogeochemical analysis of river organic carbon (elemental, isotopic and molecular).

Project	Link	Summary
		Output includes: Role of Arctic rivers in carbon and mercury cycles