



Institute of Environmental Systems Research

Report

November 2004 – September 2007



Institute of
Environmental
Systems Research

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Editorial

This report covers the period from November 1st, 2004 to September 30, 2007. It is the fourth report since the Institute of Environmental Systems Research was established in 1994 to carry out interdisciplinary research of complex problems in the environmental field. The unusually long report period of almost three years is a result of several major developments and events, which are described in this report. This report also includes the experiences with and restructuring of the Institute's academic programme "Applied Systems Science".

The second half of the Institute's new building on the former British military base was finished in spring 2006 and the two research groups of Applied System Science (Prof. Matthies) and Theoretical System Science (Prof. Malchow) could move into the reconstructed offices, where the research group for Resource Flow Management (Prof. Pahl-Wostl) is already residing. The two laboratories in the new biology building needed a little bit more time to come into operation. Thanks to our very cooperative colleagues in the ecology group (Prof. Kratochwil) for their kind hospitality in allowing us to use their laboratory facilities during the transition period.

On March 1st, 2007, the new Assistant Professor (Juniorprofessor) for Applied Environmental Systems Analysis, Elke Fries, started her research and lecturing. Since August 15th, 2007, Melanie Wissing, technical assistant, is supporting her with analytical work on environmental fate processes of xenobiotics. The financial support of the university in establishing the laboratory is greatly appreciated. In a joint appointment with the Helmholtz Centre for Environmental Research in Leipzig/Halle the Institute established a new professorship in Ecological Modelling. The assessment procedure is still in progress.

In winter term 2006/07 we started with the consecutive course programmes in Applied Systems Science to meet the study requirements of the Bologna process. Successful students finish their study programme after six semesters with a Bachelor of Science (B.Sc.) and after four semesters with a Master of Science (M.Sc.) degree. The Zentrale Evaluierungs- und Akkreditierungsagentur (ZEVA) has evaluated both programmes and acknowledged the courses as outstanding educational programmes, which are unique in Germany.

The master's course in Integrated Assessment finished in the winter term 2005/06. The programme was run jointly with the University of Twente in Enschede (Netherlands). The implementation of the programme encountered several organizational problems and financial constraints, which made its long-term establishment too difficult. We regret this development.

On September 26th – 28th the Institute, supported by the German Environmental Foundation (DBU), organised the Annual Meeting of the "GDCh-Fachgruppe Umweltchemie und Ökotoxikologie". More than 160 scientists from Germany, Switzerland, Belgium and Austria participated in the conference. Oral and poster contributions were presented in 11 sessions covering aspects ranging from environmental chemodynamics to ecosystem research, risk assessment, and sustainable chemistry. Two plenary lectures dealt with pharmaceuticals in the environment and global issues of persistent chemicals.

Research continues in the various research and development programmes. A major part of the research carried out at the institute was supported by a variety of international and national institutions, e.g. EU, German Federal Environment Agency, German Environment Foundation, and Lower Saxonian Ministry of Science and Culture, as well as by industry and several foundations. Prof. Pahl-Wostl was successful in acquiring the Integrated European Project, NeWater. She is the co-ordinator of more than 40 institutions working together on new adaptive water management methods. Prof. Matthies is a partner in a DFG-Research Group on veterinary medicines in soil. A total of approximately € 3.3 Million was awarded between 2004 and 2007 for the various research projects. During this time 30 diploma and 8 Ph.D. theses have been completed of which most were carried out at the institute. A large number of refereed articles, contributions to conferences, encyclopedia as well as books, reports and other documents were published reflecting the remarkable level of activities undertaken by institute members. I very much appreciate seeing how all these active members contribute to the success and further development of the institute. This is also demonstrated by the various awards received for several diploma and Ph.D. theses.

Thanks to all who are continuously supporting the institute's ongoing development towards a level of national and international renown.

September 2007

Michael Matthies
Head of the Institute

1 The Institute

One of the university's five interdisciplinary institutes, the *Institute of Environmental Systems Research (Institut für Umweltsystemforschung – USF)* was founded in 1994. It is a multi-departmental institution of the Departments of Mathematics/Computer Science, Biology/Chemistry, Culture and Geosciences, and Business Studies. The main research areas undertaken at the Institute include ecosystems analysis and biogeochemical modelling, environmental exposure and risk analysis, eco-balances, environmental management systems, socio-economic issues, agent-based modelling, adaptive water management, and participatory environmental governance. Now accommodating some 40 faculty and staff from the natural, social and planning sciences, the institute provides an inspiring, interdisciplinary intellectual environment.

In 1992, a C4 professorship in Applied Systems Science with a focus on environmental systems research was filled. A further C3 professorship with an emphasis on mathematical modelling was filled in 1996. Thanks to funding from the German Federal Environmental Foundation, another C4 professorship with a denomination of substance flow management (Stoffstrommanagement) was filled in 2001. This spring, a junior professorship (W1) focusing on environmental systems analysis could also be filled.

The study programme *Applied Systems Science*, which is also interdisciplinary and multi-departmental, was founded in 1989. In the following year, a complementary degree programme was also established. Beginning in the winter semester 2006/07, both study programmes are being replaced by a Bachelor of Science and Master of Science in Applied Systems Science in accordance with the Bologna process. In total, six departments are involved in the teaching of Applied Systems Science, with an emphasis on the Department of Mathematics and Computer Science, which is also responsible for managing the courses.

Members of the board of the institute are currently:

- Prof. Dr. Michael Matthies (chairman and managing director of the Institute)
- Prof. Dr. Joachim Härtling (Dept. of Cultural and Geosciences)
- Prof. Dr. Anselm Kratochwil (Dept. of Biology/Chemistry, Ecology Div.)
- Dr. Jens Newig (scientific staff of the Institute)
- Dr. Jürgen Berlekamp (scientific-technical staff of the Institute)
- Nils Kehrein (student of Applied Systems Research)

Research at the Institute is carried out in four working groups, which are briefly portrayed in the following paragraphs.

Applied System Science

Prof. Dr. Michael Matthies

Our research activities comprise the description and analysis of the states of the environment and its compartments, the analysis of chemical fate processes, and the development of meth-

ods for chemical and biological exposure and risk assessment. For these purposes, mathematical and scientific modelling is performed, which targets at quantifying environmental processes and at a better understanding of environmental systems. Furthermore, modelling allows for predicting chemical exposure to humans and ecosystems on local, regional, and global scales.

A major emphasis of our scientific work lies on the validation of developed models using monitoring data for comparison. Therefore, we use geo-referenced data and perform sensitivity and uncertainty analyses, as well. Mass balances are calculated on regional and local scales, and GIS-supported environmental information and management systems are developed.

Our projects are concerned with topics including:

- Analysis, modelling and simulation of chemical pollution in water, soil, air, and plants,
- Calibration and validation of the dynamic and geo-referenced exposure model for river catchments GREAT-ER,
- Multi-medial modelling of long-distance transport potentials, bioaccumulation, and environmental persistence,
- Calculation of mass and energy balances, GIS-supported environmental information and management systems,
- Risk analysis of pharmaceuticals in soils.

Resource Flow Management

Prof. Dr. Claudia Pahl-Wostl

The chair for resource flow management (Stoffstrommanagement) was established in October 2001 and first funded by the Deutsche Bundesstiftung Umwelt. Since October 2006 the chair is integrated in the Department of Mathematics and Computer Science at the University of Osnabrück.

Innovative concepts for managing transformation processes towards sustainability are developed with an emphasis on an improved understanding of dynamics and management of actor networks and the development of flow based indicators for environmental, economic and social sustainability. We develop new concepts for participatory model development and management strategies. Activities proceed in close exchange with industry and public authorities as well as other stakeholder groups.

One focus is improvement of the representation of the human dimension in integrated models and management processes. A promising method is agent based modelling. In this context, agents are autonomous software systems that describe the behaviour of social entities (individuals, organizations). A big advantage of this method is that it allows a more realistic representation of social and cognitive processes. In turn, this allows the exploration of the complex spatio-temporal dynamics of human-technology-environment systems and thus the development of the basic foundations for managing transformation processes in such systems. In particular, agent based modelling is very well suited for participatory model development and application in processes of social learning with different stakeholder groups.

The goal is to increasingly couple tools from network analysis to calculate sustainability indicators with agent based models representing the dynamics.

The main area of application is water resources management at different scales and the implications of the new European Water Framework Directive for river basin management in Europe. New integrated concepts for water resources management need to take the human dimension into consideration more explicitly. Adaptive integrated management concepts are more appropriate to deal with the complex resource management problems society faces nowadays.

Another important area of research is the development of general concepts for interdisciplinary work and integrative systems approaches. The strengthening of innovative approaches in inter- and transdisciplinary research activities in international scientific networks is of paramount importance.

Theoretical Systems Science

Prof. Dr. Horst Malchow

The studies deal with the mathematical analysis and modelling of temporal, spatial and spatio-temporal pattern formation in population-dynamical systems with applications to epidemic spread and biological invasions. The latter are regarded as one of the most severe ecological problems, being responsible for the extinction of indigenous species, sustainable disturbance of ecosystems and economic damage. Therefore, there is an increasing need to control and manage invasions. This requires an understanding of the mechanisms underlying the invasion process. Recently, many factors have been identified that affect the speed and the pattern of the spatial spread of an introduced species or pathogen, such as spatial heterogeneity, resource availability, stochasticity, environmental borders, predation, competition, infection, etc. Mathematics, mathematical modelling and computer science play an increasing if not central role in exploring, understanding and predicting these complex processes. This is especially true in studies of epidemic spread and biological invasion where laboratory experiments cannot embrace appropriate spatial scales, and manipulative field experiments are, if at all ethically acceptable, very expensive, potentially dangerous, and lack the necessary time series.

Bioinvasion and/or epidemic spread are modelled with deterministic and stochastic partial differential equations, i.e., reaction-diffusion-advection equations with external noise. For the mathematical description of the dynamics of higher organisms, not only the traditional equation-based methods are used, since the consideration of their individual behaviour patterns is very difficult or impossible. In addition, modern procedures such as cellular automata and individual-based models are tested and coupled by suitable interfaces.

Environmental System Analysis

Jun.-Prof. Dr. Elke Fries

The research activities focus on the transport and fate of organic pollutants (OP) in the environment. Analytical methods are developed in the laboratory to analyze low concentrations of OP different environmental compartments. Laboratory experiments are performed to

obtain individual compound parameters determining the behavior of chemicals in different compartments. Models are developed to predict the concentrations of pollutants in water, soil and air and the compound distribution between different phases. Concentrations of OP are measured in surface water, ground water, waste water, air and soil to validate model predictions. In the context of the laboratory work a close co-operation exists with the laboratory of the chair ecology.

A second research interest is the economic evaluation of external effects on the environment.

2 Teaching

In summer semester 2005, there were 104 students studying Applied Systems Science, 9 of which in the Supplementary study programme (Ergänzungsstudiengang). Student numbers rose to a peak of 130 students (8 Supplementary) in the following winter semester. Since the winter semester 2006/07, Bachelor students have been admitted. In this semester, 91 diploma students (5 of which Supplementary), 17 Bachelor and 1 Master student were inscribed.

2.1 Courses

Winter term 2004 / 05

- *J. Berlekamp*: Geographical Information Systems II, 3 ECTS
- *K. Brauer*: System Science, 6 ECTS
- *K. Brauer*: Exercises to System Science I, 3 ECTS
- *K. Brauer*: Project Scientific Computing, 3 ECTS
- *F. M. Hilker*: Tutorial System Science I, 3 ECTS
- *J. Klasmeier*: Environmental Systems Analysis, 6 ECTS
- *J. Klasmeier*: Application of Chemical Exposure Models (Project), 6 ECTS
- *H. Malchow / A. Focks*: Selforganization and dynamics of nonlinear systems, 6 ECTS
- *H. Malchow*: System Science and the Internet, 3 ECTS
- *M. Matthies / M. Bischoff*: Introduction into Applied System Science, 6 ECTS
- *J. Newig*: Actor-based *Analysis* in an Environmental Policy Context, 3 ECTS
- *J. Newig / C. Pahl-Wostl / A. van der Veen / C. van Bers*: Integrated Assessment – Introduction, 6 ECTS
- *C. Pahl-Wostl*: Integrated Modelling (lecture and exercises), 6 ECTS

Summer term 2005

- *J. Berlekamp*: Geographical Information Systems I, 4 ECTS
- *K. Brauer*: Solution methods to Partial Differential Equations, 9 ECTS
- *J. Klasmeier*: Application of Chemical Exposure Models (Project), 6 ECTS
- *H. Malchow / F.M. Hilker*: System Science II, 9 ECTS

- *H. Malchow*: System Science and the Internet, 3 ECTS
- *M. Matthies / M. Bischoff*: Environmental Risk Analysis, 6 ECTS
- *M. Matthies*: Advanced Seminar Systems Science, 3 ECTS
- *M. Matthies*: Environmental Modelling, 6 ECTS
- *J. Newig / J. Klasmeier*: Environmental Systems, 6 ECTS
- *C. Pahl-Wostl*: Applied Topics in Integrated Assessment (seminar), 3 ECTS
- *C. Pahl-Wostl*: Proseminar Systems Science (application areas of models), 3 ECTS

Winter term 2005 / 06

- *J. Berlekamp*: Geographical Information Systems II, 3 ECTS
- *K. Brauer*: System Science I, 6 ECTS
- *K. Brauer*: Exercises to System Science I, 3 ECTS
- *J. Klasmeier*: Environmental Systems Analysis, 6 ECTS
- *J. Klasmeier*: Application of Chemical Exposure Models (Project), 6 ECTS
- *H. Malchow / T. Ceglarek*: Selforganization and dynamics of nonlinear Systems, 6 ECTS
- *H. Malchow*: System Science and the Internet, 3 ECTS
- *M. Matthies / M. Bischoff*: Introduction into Applied System Science, 6 ECTS
- *M. Matthies*: Environmental Modelling, 6 ECTS
- *J. Newig / O. Fritsch*: Effectiveness of Participatory Processes, 3 ECTS
- *J. Newig*: Actor-based Analysis in an Environmental Policy Context, 3 ECTS
- *C. Pahl-Wostl*: Complex-adaptive Systems (lecture with exercises), 6 ECTS

Summer term 2006

- *J. Berlekamp*: Geographical Information Systems I, 4 ECTS
- *J. Klasmeier*: Environmental Systems Analysis, 6 ECTS
- *J. Klasmeier*: Application of Chemical Exposure Models (Project), 6 ECTS
- *H. Malchow / I. Siekmann*: System Science II, 9 ECTS
- *H. Malchow*: Proseminar System Science, 3 ECTS
- *H. Malchow*: Project: System Science and the Internet, 3 ECTS
- *M. Matthies*: Advanced Seminar Systems Science, 3 ECTS
- *M. Matthies*: Sustainability: Concepts, Models, Applications, 6 ECTS
- *M. Matthies*: Environmental Modelling, 6 ECTS
- *J. Newig / J. Klasmeier*: Data and Models (Environmental Systems), 6 ECTS

- *J. Newig*: Project colloquium, 3 ECTS
- *C. Pahl-Wostl / S. Schmidt / M. Manez*: Management of resource flows (lecture with exercises), 6 ECTS

Winter term 2006 / 07

- *J. Berlekamp*: Geographical Information Systems II, 3ECTS
- *K. Brauer*: Numerical Treatment of Differential Equations, 9 ECTS
- *O. Fritsch*: Environmental Ethics, 3 ECTS
- *J. Klasmeier*: Environmental Systems Analysis, 6 ECTS
- *J. Klasmeier*: Application of Chemical Exposure Models (Project), 6 ECTS
- *H. Malchow / I. Siekmann*: Selforganization and dynamics of nonlinear Systems, 6 ECTS
- *H. Malchow*: Project: System Science and the Internet, 3 ECTS
- *M. Matthies / M. Bischoff*: Introduction into Applied Systems Science, 6 ECTS
- *M. Matthies*: Environmental Modelling, 6 ECTS
- *J. Newig / O. Fritsch*: The Effectiveness of Public Participation, 3 ECTS
- *J. Newig*: Actor and Stakeholder Analysis. 6 ECTS
- *C. Pahl-Wostl*: Rule-based modelling (lecture with exercises), 6 ECTS

Summer term 2007

- *J. Berlekamp*: Geographical Information Systems I, 4ECTS
- *E. Fries*: Data and models, 6 ECTS
- *K. Kaldrack / M. Manez / C. Pahl-Wostl*: Management of resource flows, with exercises, 6 ECTS
- *J. Klasmeier*: Project Colloquium (Seminar), 3 ECTS
- *J. Klasmeier*: Application of Chemical Exposure Models (Project), 6 ECTS
- *H. Malchow / I. Siekmann*: Equation-based Models I, 9 ECTS
- *H. Malchow*: Project: System Science and the Internet, 3 ECTS
- *M. Matthies*: Advanced Seminar Systems Science, 3 ECTS
- *M. Matthies / M. Bischoff*: Environmental Risk Analysis, 6 ECTS
- *M. Matthies*: Environmental Modelling, 6 ECTS
- *J. Newig*: Proseminar Systems Science (water protection and policy), 3 ECTS
- *M. Schulz*: Applied Statistics for System Scientists, 3 ECTS

2.2 Completed diplomas

Diplom theses marked with the letter “S” have been completed within the supplementary master’s programme. All the other theses have been completed within the diploma course which corresponds to a bachelor course with subsequent master course.

2004

Meyer, Alexander: Dynamisierung GIS-basierter hydrologischer Modellierung: Die Simulationssprache SMILE zur Erweiterung der Map-Algebra am Beispiel von ArcGIS

2005

Fellermann, Harold: Self-Aggregation of Catalytic Amphiphiles using Dissipative Particle Dynamics

Focks, Andreas: Modelling the Transfer of Antibiotic Drug Resistance Genes between E. coli-Strains

Krause, Ulf: Anpassungstests in GARCH-Modellen

Manz, Andreas: Möglichkeiten der Auswertung von Zeitungsdatenbanken zur Charakterisierung der Medienaufmerksamkeit auf Umweltthemen

Mödinger, Olaf [S]: Agentenbasierte Modelle ökonomischen Lernens - eine Literatursynopse

Rasche, Karina: Praktische Hemmnisse intensiver Partizipation – Eine Untersuchung anhand von fünf Wasserbauprojekten in Nordwest-Europa

Schroeder, Ole Benjamin: Ein agentenbasiertes Modell der Entscheidungsprozesse im Wassernutzungsverhalten von Landwirten

Siekmann, Ivo: Agentenbasierte Modellierung von Persönlichkeitsunterschieden auf der Grundlage der PSI-Theorie

Smolinski, Patrick [S]: Modellierung und systemdynamische Analyse ausgewählter Konsequenzen von Basel II innerhalb des Bankensystems

Tietjen, Britt-Kristien: Aggregated modelling of disturbed and undisturbed rainforest dynamics

von Walter, Frank: Modellierung von Vogelartendiversität im gestörten und ungestörten tropischen Regenwald am Beispiel von Französisch Guayana

Zarfl, Christiane: Modellierung von Arsen in der Mulde

Zeibig, Sten: Modellbasierte Analyse der Rolle von Puffern bei wirtschaftlich genutzten Populationen

Zumbrügel, Martin: Bewertung technischer, ökologischer Nährstoffmanagement-Maßnahmen bei der Verwertung von Wirtschaftsdünger am Beispiel des Einzugsgebiets der Hase

2006

- Ceglarek, Tobias:* Irreguläre Oszillationen in drei- und vierkomponentigen populationsdynamischen Modellen
- Frost, Ingo [S]:* Zivilgesellschaftliches Engagement in virtuellen Gemeinschaften? Eine systemwissenschaftliche Analyse des deutschsprachigen Wikipedia-Projektes
- Hüffmeyer, Nina:* Emissionspfade und Belastungsanalyse von Zink in der Ruhr
- Koldehoff, Carola:* Dynamische Modellierung des Ferntransportverhaltens organischer Chemikalien
- Korte, Harjo:* Modell zur Spezifikation von Informationsbedarf für Data Warehouse-Projekte bei der Deutsche Post AG
- Lampa, Florian:* Numerik des 2D-Transports geladener Teilchen in fluktuierenden Magnetfeldern
- Schelhorn, Thorsten:* Implementation eines agenten-basierten Modells für soziotechnische Szenarien der Abwasserbehandlung im ländlichen Raum
- Tran, Ba Kien:* Modellierung biologischer Invasionen mit Reaktions-Diffusionsgleichungen
- Wissing, Jutta:* Georeferenzierte hydromorphologische Charakterisierung von Flussgebieten
- Witt, Johannes:* Pharmacokinetics of Sulfadiazine in Pigs
- Yilmaz, Mesut [S]:* Simulation der Staatenentstehung

2007 (January – September)

- Lenz, Friedrich:* Data-based modelling of motorway traffic with time-dependent Fokker-Planck equations and their validation
- Niemann, Tobias:* Analyse, Konzeption und Umsetzung eines Projektmanagementsystems im EDV-Bereich eines internationalen Auto-mobilzulieferers mit Hilfe von SAP PS
- Priegnitz, Jan:* Analyse von Koffein als Abwassermarker in Fließgewässern
- Avenhaus, Wibke:* Implementation von GREAT-ER mit ArcGIS und ArcHydro

2.3 Systems Science Colloquium

Each winter term a colloquium is held which is open to the public. Efforts are being made to attract experts from the diverse sub-disciplines of systems science. The date, the name of the lecturer and the title of each presentation are listed below:

Winter Term 2004 / 2005: 11th Colloquium

- 21.10.2004 *Prof. Dr. Werner Ebeling*, Institut für Physik, Humboldt-Universität Berlin:
Selbstorganisation - Entwicklung und Perspektiven.

- 28.10.2004 *Dr. Thomas Berger*, Zentrum für Entwicklungsforschung, Universität Bonn: Agentenbasierte Modellierung von Landnutzung und Landwirtschaft.
- 04.11.2004 *Prof. Dr.-Ing. Ernst Dieter Gilles*, MPI für die Dynamik komplexer technischer Systeme, Magdeburg: Komplexität in Technik und Biologie.
- 11.11.2004 *Prof. Dr. Otto Klemm*, Universität Münster, Institut für Landschaftsökologie – Klimatologie: Stadtklimatologie.
- 18.11.2004 *Dr. Ralf Seppelt*, Technische Universität Braunschweig, Institut für Geoökologie: Über Möglichkeiten, Anwendungen und Perspektiven landschaftsökologischer Modelle.
- 25.11.2004 *Dr. Kornelia Smalla*, Biologische Bundesanstalt für Land- und Forstwirtschaft, Berlin und Braunschweig: Bakterielle Antibiotika-Resistenzgene und horizontaler Gentransfer.
- 02.12.2004 *Dr. Hans-Hermann Thulke*, Sektion Ökosystemanalyse, Umweltforschungszentrum Leipzig: Fuchstollwut, Wildschweinherpes und Co – Krankheitsausbreitung und raumzeitliche Muster.
- 09.12.2004 *Prof. Dr. Brigitte Nixdorf*, Lehrstuhl Gewässerschutz, BTU Cottbus: Zwischen klar, trüb und sauer — zur ökologischen Situation der Seen in Deutschland.
- 16.12.2004 *Dr. Martin Scheringer*, Gruppe für Umwelt- und Sicherheitstechnologie, Laboratorium für technische Chemie, ETH Hönggerberg: Persistence und Reichweite.
- 13.01.2005 *Prof. Dr. Martin Riedmiller*, Fachbereich Mathematik/Informatik, Universität Osnabrück: Autonome intelligente Systeme.
- 20.01.2005 *Ines Dombrowsky*, Sektion Ökonomie, Soziologie und Recht, Umweltforschungszentrum Leipzig: Institutionen in der grenzübergreifenden Gewässermanagement.

Winter Term 2005 / 2006: 12th Colloquium

- 19.10.2005 *Prof. Dr. Dirk Helbing*, University of Dresden: Dynamics of Production, Supply and Traffic Networks: From the Slower-is-Faster Effect to Signal Control and Business Cycles.
- 03.11.2005 *Prof. Dr. Hans Markowitsch*, Universität Bielefeld: Gedächtnis als Informationsverarbeitung über die Zeit: Das menschliche Gehirn als komplexes Interface.
- 10.11.2005 *Prof. Dr. Joachim Hertzberg*, Universität Osnabrück: Auf dem Weg zu wissensbasierten Robotern.
- 17.11.2005 *Prof. Dr. Heinz-Christian Fründ*, Fachhochschule Osnabrück: Kupfer im Boden – ökotoxikologische und bodenökologische Beurteilung und Bewertung nach dem Bundesbodenschutzgesetz.

- 08.12.2005 *Prof. Dr. Michael Kleyer*, Universität Oldenburg: Ökologische und sozioökonomische Beurteilung von Management-Systemen für Offenlandschaften – ein integriertes Landschaftsmodell.
- 15.12.2005 *Dr. Valentina Krysanova*, Potsdam-Institut für Klimafolgenforschung: Implications of complexity and uncertainty for integrated modeling and impact assessment in river basins.
- 12.01.2006 *Dr. Timothy Moss*, IRS, Erkner: Zwischen Rhetorik und Realitäten: Institutionelle Anforderungen und Umsetzungsprobleme bei der Wiederherstellung von Überschwemmungsgebieten in England, Frankreich und Deutschland.
- 19.01.2006 *Prof. Dr. Uwe Schimank*, *Dr. Thomas Kron*, Fernuniversität Hagen: Soziologische Akteurmodelle und Agentenmodellierung.
- 26.01.2006 *Dr. Volker Grimm*, Umweltforschungszentrum Leipzig-Halle: 007, oder die Lizenz zum Modellieren agentenbasierter komplexer Systeme.
- 01.02.2006 *Jun.-Prof. Dr. Bernd Siebenhüner*, Universität Oldenburg & Potsdam Institut für Klimafolgenforschung: Soziales Lernen und Nachhaltigkeit. Konzepte und empirische Ergebnisse.

Winter Term 2006 / 2007: 13th Colloquium

- 02.11.2006 *Prof. Dr. Bernd Blasius*, Universität Potsdam: Dynamic of epidemic outbreaks in a network of cities.
- 09.11.2006 *Prof. Dr. Robert Kreuzig*, TU Braunschweig: Rückstandsverhalten von Sulfonamiden in güllegedüngten Böden: Labortests und Testplotexperimente.
- 16.11.2006 *Prof. Dr. Britta Klagge*, Universität Osnabrück: Ansätze einer Finanzgeographie und das Beispiel des deutschen Risikokapitalmarkts.
- 23.11.2006 *Prof. Dr. Arjen Hoekstra*, Universität Twente: Globalization of water.
- 30.11.2006 *Dr. Jan-Ulrich Kreft*, Universität Bonn: Individual-based modelling of microbes.
- 07.12.2006 *Dr. Wolf von Tümpling*, UFZ Leipzig: Schadstoffdynamik im Elbeinzugsgebiet.
- 14.12.2006 *Prof. Dr. Stefan Trapp*, TU Dänemark, Lyngby: Phytoremediation.
- 11.01.2007 *Prof. Dr. Andreas Schäffer*, RWTH Aachen: Non extractable pesticide residues in soil and plants: neglected metabolites.
- 18.01.2007 *Prof. Dr. Stefan Baumgärtner*, Universität Lüneburg: Biodiversität als ökologisch-ökonomische Versicherung.
- 25.01.2007 *Prof. Dr. Joachim Peinke*, Universität Oldenburg: Windenergie.
- 01.02.2007 *Prof. Dr. Max Rietkerk*, Universität Utrecht: Self-organized patchiness and catastrophic shifts in ecosystems.

2.4 Other Teaching

Summer Schools

Together with ‘The Integrated Assessment Society’, the Institute hosted the second of a series of summer schools on the theme of *Integrated Assessment*, in 2005 with a thematic focus on “Stakeholder Participation and Modelling in Sustainable Resource Management” in Osnabrück, Germany. 4-13 July 2005.

With core funding from the NeWater project (New approaches to adaptive water management under uncertainty) and additional support from the Global Water System Project, the Harmoni-CA project and The Integrated Assessment Society (TIAS), the Institute has co-hosted two summer schools in order to train young researchers (mostly PhD level) in *Adaptive Water Management*:

- Adaptive Management in the Context of Integrated Water Resources Management, Peyresq, France. 27 Sept. - 7 Oct., 2006
- Transitions to Adaptive River Basin Management, Bad Krozingen, Germany. 11-21 July 2007

Training Courses

With support from The Integrated Assessment Society (TIAS) and the NeWater Project, the following short training courses aimed at young researchers were hosted by the Institute:

- Qualitative Research Methods, Wageningen, Netherlands. 27-28 Mar. 2007
- Stakeholder Collaboration, Framing, Cognitive Mapping and Group Model Building. Osnabrück, Germany. 15-16 Feb. 2007.
- Guidance for Uncertainty Assessment, Management and Communication. Enschede, Netherlands. 7 Dec. 2005.

3 Research

3.1 Research projects

3.1.1 Applied Systems Science

Aquaculture concepts for Uzbekistan

Prof. Dr. M. Matthies, Prof. em. Dr. Helmut Lieth, Dr. Bert Wecker

Within this project, a feasibility study for new sustainable aquaculture concepts in Uzbekistan is developed. The project is a cooperation of different research institutes and companies in Germany and Uzbekistan. Uzbekistan shares the Aral Sea, one of the largest closed lakes in the world, with Kazakhstan. The basin of the Aral Sea is mostly covered by deserts, but since the ancient times it has been known as the region with highly developed agriculture. For the reason of excessive water use by agriculture, water has moved from the coastline 60-80 km away. A catastrophic shrinking of the Aral Sea, deterioration of water quality and the rapid desertification unfolding in the last decades prompted the UN in 1992 to declare the Aral sea basin as a zone of the ecological crisis. About 500,000 ha spawning areas and migratory ways of fish were totally destroyed. The republic has a great potential for aquaculture development because the climatic conditions are very suitable. Aquaculture in Uzbekistan developed in one form only - pond fish farming which is the most important sector of the fish industry providing 60 to 80% of the total country fish production. Even if aquaculture has a long tradition in Uzbekistan intensive or semi-intensive production systems are hardly available. This may be due to the following issues:

- Due to the extreme continental climate in Central Asia, the seasonal aquaculture and fisheries production is influenced by a wide range of temperatures from -20°C up to 40°C.
- After the independency of Uzbekistan, the aquaculture and fisheries production decreased dramatically due to an economical crisis. Even today the natural water bodies and fish farms are exploited insufficiently. This may be due to bad management and lacking investment. Capital is still a very limited resource in Uzbekistan.
- The intensification of aquaculture and the efficient production of high value species requires the use of commercial fish diets adapted to the species produced. These fish diets are still not available in Uzbekistan.

German Environment Foundation (2005-2007)

GREAT-ER (Geography-referenced Regional Exposure Assessment Tool for European Rivers)

Prof. Dr. M. Matthies, Dr. Jörg Klasmeyer, Dr. Jürgen Berlekamp

GREAT-ER is a powerful software tool for modeling the fate and behaviour of chemical substances in surface waters. It combines a geographic information system (GIS) with chemical models for calculating and modeling spatially explicit substance concentrations.

Substance concentrations calculated by GREAT-ER are displayed in color-coded maps. Input data for calculation are physical-chemical and biochemical substance parameters as well as geo-referenced production and consumption patterns. This way it is e.g. possible to calculate spatially explicit substance concentrations resulting from data for sewage treatment plants and industrial emitters. Concentrations can be analysed on a local scale in terms of the effects of single substance discharges as well as on a regional scale for evaluating immission resulting from the combination of multiple emission sources.

GREAT-ER creates a direct link between emission and immission (concentration) and provides the possibility to analyse potential hot spots showing the highest concentrations within a catchment as well as to identify the most important emission sources on a regional scale.

A number of small projects including scenarios for fragrance materials in Main river, pharmaceuticals in Glatt river (small tributary of the Rhine in Switzerland) and flame retardants in Ruhr river have been conducted in the last three years. All projects were cooperations with industry (IKW Germany, Clariant GmbH) and/or academics (ETH Zurich, University of Duisburg).

Decision Support System (DSS) for the Elbe River Basin

Prof. Dr. M. Matthies, Dr. Jürgen Berlekamp, Sven Lautenbach, Neil Graf, Dr. Volker Berding

A decision support system for integrated river basin management of the German part of the Elbe river basin (Elbe-DSS) is currently under development, which involves taking into account water quantity, chemical quality, and ecological status of surface waters. User needs were identified and refined by repeated consultation of stakeholders. A list of management objectives, measures, and external scenarios turned out, which was taken as the basis for the DSS development. A comprehensive system analysis was carried out to meet the various spatial and temporal scales when dealing with hydrologic, ecologic, economic, and social aspects related to water quantity and quality. System diagrams for the catchments and the river network were worked out, which describe the properties, processes, and data influencing the water flow and substance load. Three models are selected for integration into the Elbe-DSS: MONERIS for the calculation of the long-term nutrient discharges in 132 sub-catchments from non-point and point sources, GREAT-ER for wastewater pathways (point sources) and aquatic fate assessment, and HBV for hydrological dynamics. Diffuse nutrient inputs for the sub-catchments calculated from MONERIS are distributed to the river network provided by GREAT-ER, where further elimination and transport processes are calculated together with inputs from point sources. The interaction of management objectives, external scenarios of climate, agro economic and demographic change, and selected measures to achieve the desired state of good water quantity and quality is investigated. The

effects of reforestation and erosion control measures on phosphate loads and concentrations in the river network are simulated as an illustration. The system delivers georeferenced information for long-term water quality improvement. The project is carried out in cooperation with the University of Twente/Enschede and the institutes RIKS and INFRAM from the Netherlands. Such a DSS helps the water managers to formulate policy for river basin management and to take appropriate measures to realise policy objectives. As such it could also be a very useful tool for the implementation of European Water Framework Directive. Furthermore a DSS is especially suited to support participative decision making.

Funding: Federal Institute of Hydrology (Bundesanstalt für Gewässerkunde). Federal Ministry of Education and Research (Bundesministerium für Bildung und Forschung)

The web-site related to this project is: <http://www.usf.uni-osnabrueck.de/projects/DSS/>

ELPOS - Criteria for persistence and long-range transport potential of pesticides and industrial chemicals

Prof. Dr. M. Matthies, Dr. Jörg Klasmeier, Dr. Andreas Beyer, Christian Ehling

ELPOS runs since October 1999 and is financed by the German Federal Environmental Agency (FEA). The project's aim is to develop and investigate quantitative criteria for the long-range transport potential and persistence of organic chemicals.

The multimedia chemical fate model ELPOS-1.0 was used to calculate the overall persistence and the characteristic travel distance in air as descriptors for these criteria. Both descriptors account for the inter-media transfer and intra-media degradation and are independent of the amount emitted.

Physico-chemical and environmental degradation data of 65 currently used pesticides, 23 industrial chemicals, and 21 persistent organic pollutants were compiled. A sensitivity analysis showed that the sensitivity heavily depends on the characteristics of the chemicals and assumptions with respect to environmental conditions. The ranking of the chemicals can be affected if uncertainty of the parameters is taken into account, e.g. by using 90%-percentile instead of mean values.

The model was modified to account for temperature variations within a range of 5°C to 30°C. The overall residence time and the characteristic travel distance were found to be highly dependent on temperature. While the overall residence time always increases when temperature drops, the characteristic travel distance can increase or decrease depending on the characteristics of the substance. The characteristic travel distance was compared to observed spatial concentration gradients in the environment. Monitoring data of different PCB-congeners that were sampled along a south-north transect lead to the same chemical ranking as predicted by the characteristic travel distance.

Acknowledging the uncertainty and limitations of the underlying multimedia model, the overall residence time and the characteristic travel distance can serve for screening, ranking, and evaluation of substances concerning persistence and long-range transport potential. The assessment of the pesticides currently used identified candidates requiring further investigation and possibly management.

The original version of the programm has been extended in an ongoing project. Major focus of this work is on the automatisisation of model simulations and on graphical output of results.

ELPOS simulations were part of the contributions of the Institute as part of an OECD expert working group in the years 2004 – 2006.

Georeferenced Modelling of Zinc in the Ruhr catchment and analysis of emission pathways

Dr. Jörg Klasmeier, Nina Hüffmeyer

The Geo-referenced Regional Exposure Assessment Tool for European Rivers (GREAT-ER) has been extended to model surface water concentrations of zinc in the Ruhr River basin based on emission load estimations and flow data. Emission pathways and output processes in river basins have been identified and analyzed. Zinc enters surface waters via point source or area-related emissions and is transported along the river system. Removal of zinc from the water phase is solely due to the process of sedimentation. GREAT-ER has proven to realistically simulate zinc concentrations in the Ruhr catchment (immission) based on plausible emission assumptions. The model allows for establishing a causal relationship between emissions and immission on a local and und regional scale.

The project is documented in detail in the Diploma thesis of Nina Hüffmeyer and was financially supported by the Initiative Zinc within the “Wirtschaftsvereinigung Metalle (WVM), Düsseldorf.

Term: August 2005 – March 2006

Identification of important zinc contributions to the overall zinc load in River Rhine by geo-referenced evaluation of observed zinc concentrations

Dr. Jörg Klasmeier, Dr. Jürgen Berlekamp, Nina Hüffmeyer, Jutta Wissing

A tiered model approach is applied to evaluate the most important zinc contributions and their effect on local and regional concentrations in River Rhine. In Tier 1 a detailed analysis of the zinc contributions from tributaries to the zinc concentrations in Rhine River from Lake Constance to the Dutch border has been performed. Main contributors have been identified and possible sources within the respective sub-catchments were analyzed. More than 90% of the measured zinc concentrations in Rhine River could be explained by the identified loads. Based on this information two tributaries were selected for a more detailed analysis in tier 2.

In Tier 2 a detailed geo-referenced analysis of the *Main* River catchment and the *Sieg* River catchment will be performed. The geo-referenced model GREAT-ER will be applied to establish the link between point source and non-point source emissions and local concentrations (immissions) as already exemplarily done for the Ruhr catchment. This will allow for analyzing the effect of different zinc sources on the concentrations on a local and regional scale. This analysis can be extremely helpful in defining the most promising reduction measures in case of exceedance of target values. It is presumed that in the Sieg River catchment former mining activities mainly contribute to the high zinc loads, whereas in the Main River catchment the high population density and the domestic zinc consumption are responsible for the observed zinc concentrations.

The project is financially supported by the International Zinc Association (IZA) Europe, Bruxelles. Term of tier 1: November 2006 – March 2007, term of tier 2: April 2007 – April 2009.

DFG-Research Group “Veterinary Medicines in Soils: Basic Research for Risk Analysis”

Prof. Dr. Michael Matthies, Dr. Jörg Klasmeier, Andreas Focks, Christiane Zarfl

Manure from animal husbandry often contains residues of antibiotics and microbes, which incorporate antibiotic resistance genes. Huge amounts of this manure are applied as fertilizer to agricultural soils. Recently, ecologically active concentrations of antibacterial veterinary medicines are detected in soils. However, in order to make a comprehensive risk analysis basic modelling approaches are missing. In February 2005, the DFG (German Research Foundation) research group “Veterinary Medicines in Soils: Basic Research for Risk Analysis” was founded, in order to investigate the fate of veterinary antibiotics in soil and the possible effects and risks of antibiotic residues on the environment.

The activities of the research group are characterized by an intensive networking between the single subprojects, which are assigned to soil science, environmental chemistry, and microbiology. Experimental investigations are carried out within the context of a central experiment, i.e. they are based on samples of a central experimental setup. The respective investigations can be assigned to “Exposition and Dynamic” and to “Effects”. The subproject “Modelling the Interactions of Dynamics and Effects”, which is located at the USF, deals with the mathematical modelling of the investigated processes and with the integration of the results of the single subprojects.

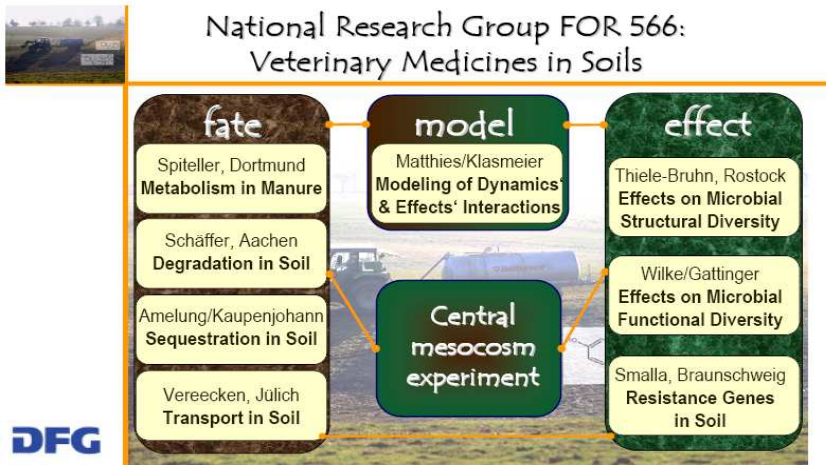


Figure 1: Scheme of the research group "Veterinary Medicines in Soils: Basic Research for Risk Analysis"

The investigations of each of the subprojects (Fig. 1) are supposed to elucidate significant processes, which determine fate and effects of veterinary antibiotics in manured soils. As far as the antibiotic fate is concerned, metabolization of the antibiotic compound in manure, sorption, degradation in soil, formation of non-extractable residues and the vertical transport through the soil column is analyzed. These investigations result in a deeper insight into significant processes, which determine the available substance concentration in soil solution of the antibiotic and its metabolites, respectively.

In the domain of antibacterial effects different endpoints affected by the distribution of contaminated manure are investigated. These are the abundance of resistance genes, soil functions concerning the nitrogen cycle or the structural diversity of soil microorganisms.

The first study is performed with sulfadiazine, an antibiotic compound which belongs to the group of the sulfonamides and is one of the most frequently applied veterinary medicines. Additionally, sulfadiazine is assumed to remain active in soil for a long time. First results indicate that the bioavailable sulfadiazine fraction decreases very fast after manure application. However, effects on the functional diversity of the soil microbes and on the abundance of sulfadiazine resistant bacteria may still occur.

SARISK – Development of a pollutant dispersal model for risk analysis and evaluation of extreme flood events exemplifying the town and district of Bitterfeld.

Prof. Dr. M. Matthies, Dr. Marcus Schulz

SARISK aims to model pollutant dispersal in the Region of Bitterfeld during flood events of River Mulde and to install a decision support system (DSS) for high water events applicable to Bitterfeld and other regions. The USF is responsible for modelling pollutant dispersal (work package 4).

The modelling of pollutant dispersal is performed within the model system Telemac that comprises a hydrodynamic (Telemac2D), a transport (Subief2D), and a water quality module (wq2subief). The transport model relies on simulations of hydrodynamics and sediment transport, which in turn is executed at the Centre of Environmental Research (UFZ Leipzig-Halle) in Magdeburg (Figure 1). Within wq2subief, the pollutant partitioning between solid and soluble phases is modelled. In addition for soluble volatile compounds, gas exchange between water and atmosphere is considered.

Petrol components, such as gasoline from oil tanks, and nutrients cannot be classified as pollutants, but are modelled, as well.

The pollutant dispersal model enables us to calculate scenarios for variable discharge and diverse dam-breaks and flood routes. The results of such scenarios not only are geo-referenced distributions of pollutant deposition within the floodplain of River Mulde, but also pollutant concentrations at the downstream margin of the project area, which again might be a risk for further downstream areas.

Federal Ministry of Education and Research: 2006-2008

3.1.2 Resource Flow Management

HarmoniCOP (Harmonized Collaborative Planning) and Harmoni-CA (Harmonizing Modelling Tools at Catchment Scale)

Dr. Dagmar Ridder, Ilke Borowski, Prof. Dr. Claudia Pahl-Wostl

With the advent of the European Water Framework Directive (WFD), European Water Policy entered into a new phase. The WFD introduces for all member states the river basin as scale for integrated management plans. Stakeholders and the public at large have to be. The EU project HarmoniCOP (www.harmonicop.info – 2002- 2005, coordinated by USF) studied the processes of social learning in nine countries, to improve the interface between decision making processes and formal models and decision support systems. A new concept for social learning has been developed and has been investigated in a number of case studies. HarmoniCOP is the first project that investigates systematically processes of social learning and the influence of cultural, legal and institutional factors. 15 institutes from 9 countries participated in this interdisciplinary project. Next to a number of scientific reports, a handbook for water managers “Learning together to manage together” summarizes rules of good practice for stakeholder and public participation in integrated resources management, in general, and water resources management, in particular. The handbook has been translated into German, Italian, Spanish, Dutch, Hungarian, and French. A Russian translation is in progress. The closing scientific conference took place in October 2005.

The concerted action Harmoni-CA (www.harmoni-ca.info, 2002-2007) has continued its work on improving the use of models and IC tools for the implementation of the European Water Framework Directive. Workpackage 5 on the Science-Policy-Interface (coordinated by USF) supports a social learning process by organizing workshops for both water managers and tool developers, on specific issues such as interaction of the European Common Agriculture Policy and the WFD, or use of tools in participatory processes. Several documents are developed and will partly be published in a Harmoni-CA series of the International Water Association. They are, providing guidance on the human dimensions in modelling and management, on available tools and instruments of environmental economics in water modelling and on models addressing the interaction between agricultural and water management. Activities of USF include also the host and organisation of the 3rd Harmoni-CA Forum and Conference in April 2006 where about 90 water managers and tool developers met to discuss how tools can support the WFD. First results of the Workpackage have been published in a special issue of the Journal Water Resources Management.

Funding: European Union, 2002 – 2007.

Project duration: 1st October 2004 - 30th September 2007.

WADEMED (2003 - 2006) concerted action in the INCO-MED Program of the 5th FP on research and technical development (project number: ICA3-CT-2002-10014).

Bettina Bluemling and Prof. Dr. Claudia Pahl-Wostl

The objective of WADEMED (Water DEMand management knowledge base for the MEDITerranean) was to build an integrated knowledge base about water demand management in the Mediterranean. Water demand management was considered in three regards, i.e. the

application of improved water saving technologies and practices, the design and implementation of economic instruments, as well as new institutional arrangements for improved water management. For each of these aspects, case studies were carried out, and their results were presented and discussed in three subsequent project seminars. The experiences out of the case studies, as well as the presentations at the seminars, contributed to the set of the knowledge base. A further aim of the project was to get different stakeholders (farmers, water managers, agricultural consultants), as well as researchers of different disciplines together to jointly do research in the frame of the case studies. The USF worked in the scientific committee of the project, carried out empirical research, as well as hosted the last synthesis workshop.

Participative Modelling, Actor and Ecosystem Analysis in Regions with Intensive Agriculture (PartizipA)

Prof. Dr. Claudia Pahl-Wostl, Dr. Jens Newig, Karin Berkhoff, Kai Kaldrack, Britta Kastens, Bianca Schlußmeier

The project was carried out at USF and IFF Social Ecology (Vienna) from October 2003 until March 2007 and was funded by the Ministry of Education and Research (BMBF) under grant no. 07VPS10.

PartizipA aimed to develop scenarios and strategies for possible transformation processes in regions of intensive agriculture in the face of European-induced institutional change (Water Framework Directive and the reform of the Common Agricultural Policy). In close collaboration with local actors, structured evaluation methods and models were implemented and applied to assess sustainable development options in the regions of Osnabrück / Hase catchment and St. Pölten region (Lower Austria). Participatory settings (actors' platform, focus groups) allowed for open discussions. Land use simulations through agent-based computer models, a nutrient model (linked to a Geographical Information System) as well as different moderation techniques (e.g. the elicitation of mental models in group model building processes) played an important role. Both regional studies were supported by an analysis of institutions and actors, including guided interviews with local and regional actors of water management, agriculture and administration. The results of the German actors' platform were published in a common final document that was endorsed by all participants; the model built in the Austrian case study was presented to the local actors on a CD-ROM. Project results clearly demonstrate that participatory methods are suitable in different contexts in order to assess regional development options. Thus it was not only possible to elicit, structure and aggregate information, but also to initiate processes of collective learning among the local actors and to foster the transformation of knowledge into the region. The local context turned out to play a decisive role for the success of the different methods.

For more information, please visit <http://www.partizipa.net>.

NeWater (New Approaches to Adaptive Water Management under Uncertainty)

Prof. Dr. Claudia Pahl-Wostl, Dr. Sabine Möllenkamp, Britta Kastens, Dr. Marcela Brugnach, Jörn Möltgen, Nicola Isendahl, Christian Knieper, Patrick Huntjens

NeWater (New Approaches to Adaptive Water Management under Uncertainty) is a research project supported by the European Commission under the sixth framework program, PRIORITY 6.3 “Global Change and Ecosystems” (contract No 511179 (GOCE)), running from 2005 to 2008.

The project NeWater is based on the hypothesis that IWRM cannot be realized unless current water management regimes undergo a transition towards more adaptive water management.

The project identifies key elements of current water management regimes and investigates their interdependence. Research is focused on transformation processes of these elements in their transition to adaptive integrated water resources management. Key IWRM areas where NeWater is expected to deliver breakthrough results include:

- governance in water management (methods to arrive at polycentric, horizontal broad stakeholder participation in IWRM)
- sectoral integration (integration of IWRM and spatial planning; integration with climate change adaptation strategies, cross-sectoral optimisation and cost-benefit analysis)
- scales of analysis in IWRM (methods to resolve water resource use conflicts; transboundary issues)
- information management (multi-stakeholder dialogue, multi-agent systems modeling; novel monitoring systems for decision systems in water management)
- infrastructure (innovative methods for river basin buffering capacities; role of storage in adaptation to climate variability and climate extremes)
- finances and risk mitigation strategies in water management (new instruments, role of public-private arrangements in risk-sharing)
- stakeholder participation (promoting new ways of bridging science, policy, and implementation)

The USF is responsible for the overall co-ordination of the project and has a leading role in Work Block 1 “Transition to adaptive management of river basins” and Work Block 6 “Management and Project Internal Coordination Platform”, as well as in several Work packages. For further information: <http://www.newater.info>

AquaStress

Dr. María Máñez, Dr. Sonja Schmidt, Silke Panebianco, Ole Benjamin Schroeder, Bettina Bluemling

Mitigation of Water Stress through new Approaches to Integrating Management, Technical, Economic and Institutional Instruments

Water stress is a global problem with far-reaching economic and social implications.

The mitigation of water stress at regional scale depends not just on technological innovations, but also on the development of new integrated water management tools and decision-making practices.

AquaStress is an EU funded integrated project (IP) contract n°511231-2 - 6th EC Framework Programme for RTD (<http://www.cordis.lu>), delivering interdisciplinary methodologies, which in turn enable actors at different levels of involvement and at different stages of the planning process to mitigate water stress problems. The project draws on both, academic and practitioner, skills to generate knowledge in technological, operational management, policy, socio-economic, and environmental domains. Contributions come from 35 renowned organizations from 17 countries.

Aquastress adopts a case study – stakeholder - driven approach and is organised in three phases; (i) characterisation of selected reference sites and relative water stress problems, (ii) collaborative identification of preferred solution options, (iii) testing of solutions according to stakeholder interests and expectations. It makes a major contribution to the European Communities objectives stated in the 6th Framework Programme, and supports the Community Directive 2000/60/EC and the EU Water Initiative.

AquaStress generates scientific innovations to improve the understanding of water stress from an integrated multi-sectoral perspective to support:

- diagnosis and characterisation of sources and causes of water stress;
- assessment of the effectiveness of water stress management measures and development of new tailored options;
- development of supporting methods and tools to evaluate different mitigation options and their potential interactions;
- development and dissemination of guidelines, protocols, and policies;
- development of a participatory process to implement solutions tailored to environmental, cultural, economic and institutional settings;
- identification of barriers to policy mechanism implementation;
- continuous involvement of citizens and institutions within a social learning process that promotes new forms of water culture and nurtures long-term change and social adaptivity.

The USF is responsible for the coordination of WB2 and contributes to WB 3, WB 4, WB 5 and WB 6.

More information is given on the project webpage: www.aquastress.net

EU-Asia Cooperation on Water Resources Management (ASEM-Waternet)

Patrick Huntjens, Prof. Dr. Claudia Pahl-Wostl

ASEM Waternet is a multi-stakeholder and scientific platform on water resources management, including 35 participating organizations from Europe and Asia. The overall budget for this project is 1.500.000 Euro. Duration of the project is from September 2005 until August 2009.

Through several types of coordinating activities, the 53 participating organisations of ASEM Waternet gather and organise their experiences on five priority areas, defined during a first workshop in 2002, namely 1) river basin approach, 2) water use efficiency in agriculture, 3) erosion, flash floods and floods, 4) pollution and water quality and 5) water governance as a

cross-cutting issue. Our Institute (USF) is responsible for the coordination of the work package on Water Governance.

The ASEM¹ process is a forum for dialogue between European and Asian partner countries built on a framework of respectful and open cooperation between equal partners. The key role of intensified Science and Technology cross flows has been recognised in strengthening economic links between Asia and Europe during the 1999 ASEM Ministers' Meeting on Science and Technology. To develop joint activities, a set of priority activities for S&T cooperation was identified, such as basic science, joint utilisation of large scale facilities, knowledge transfer, environmental protection, upgrading enterprises. Water Management issues were recognised among the main areas for cooperation, which lead to the creation of ASEM Waternet.

The ASEM S&T strategy underlines the needs for creation of networks, information and communication systems, promotion of centres of excellence, as well as co-operation among universities, industry and other public and private entities. ASEM S&T cooperation on water issues (ASEM-Waternet) is about building bridges between essential knowledge and action around the identified priorities. Concrete, society-oriented results of S&T cooperation require mobilisation and organisation of knowledge, learning and action that concurrently address environmental, socio-cultural and economic dimensions. It also promotes and enables inter-disciplinary networking including existing networks.

3.1.3 Theoretical Systems Science

Study of pattern formation in plankton populations under the effects of toxin producing phytoplankton, infection and environmental factors

Prof. Dr. Horst Malchow. Dr. Ram Rup Sarkar

The aim of this research project is to develop mathematical and stochastic models of the phytoplankton-zooplankton system to understand the mechanisms of planktonic blooms, pulses and succession in the presence of toxic and/or infected phytoplankton and to suggest some control measure of harmful phytoplankton blooming. (Cooperation with Moscow, Bordeaux).

Funding: Alexander von Humboldt Foundation (Alexander von Humboldt Stiftung), 2004-2005.

¹ ASEM = ASia Europe Meeting. A forum for dialogue signed by 43 European and Asian countries, the European Commission and the ASEAN Secretariat.

Patterns in the Spatiotemporal Spread of Infectious Diseases and Biological Invasions

Ivo Siekmann, Dr. Frank M. Hilker, Prof. Dr. Horst Malchow

Infectious diseases have ever been one of the greatest threat of man, animal as well as plant populations and the functioning of ecosystems. Mathematical epidemiology has identified several mechanisms (e.g. spatial seasonal forcing, heterogeneity, or stochasticity) which are responsible for specific patterns in the spatiotemporal dynamics. Fatal diseases may dramatically regulate the host population density. Hence, the vital dynamics become important. This research mainly investigates reaction-diffusion models with an Allee effect in vital dynamics. Moreover, the impact of pathogens on the fate of biological invasions is investigated. Infectious diseases are often suggested as explanation for a spontaneous collapse of a successfully established alien species, but detailed data and studies are lacking. Model results predict that pathogens can slow-down, stop or reverse invasion fronts of their host population, provided that the latter is subjected to an Allee effect. (Cooperation with Bordeaux, Moscow, Hiroshima, Edmonton).

Funding: Japan Society for the Promotion of Science 2004, Deutsche Forschungsgemeinschaft 2005-2007, Deutscher Akademischer Austauschdienst 2006-2007

Modelling Approaches to Metapopulation Dynamics

Dr. Frank M. Hilker

Mathematical and computer-based models are essential tools in understanding the dynamics of spatially structured population. Notably, they greatly contributed to the concept of metapopulations, i.e. collections of habitat patches inhabited by a populations that may go extinct or become recolonized by dispersing individuals. This research is concerned with the emergence of metapopulation dynamics in fragmented landscapes depending upon individual species characteristics. (Cooperation with Würzburg.)

Chaos control

Dr. Frank M. Hilker

Simple ecological interactions can generate irregular oscillations which are known as deterministic chaos. These irregular oscillations exhibit very small or very large abundances, corresponding to a population collapse or outbreak, respectively. Though the chaotic dynamics appear to be erratic, we have devised optimal control strategies for population management. (Cooperation with the Department of Economics.)

3.1.4 Applied Environmental Systems Analysis

Occurrence, behavior and fate of organic compounds in deicing/antiicing fluids from airport application in the environment

Aliz Kiss, Prof. Dr. Elke Fries

Large quantities of deicing/antiicing fluids (ADAFs) are used to ensure flight safety. Deicing activity increases along with increasing air traffic. For deicing/antiicing of aircraft surfaces glycol based fluids are mainly used. The primary environmental concern related to glycols is the high biogen oxygen demand during degradation. Therefore, potassium formate is extensively used for runways deicing as a substitute. Significant toxicological effects of ADAFs are related mostly to additives in ADAFs formulations. ADAFs contain 10-20 % of additives, mainly triazoles.

Little is known about the fate and effect of individual organic chemicals in the environment resulting from airport deicing/antiicing activities. The aim of this project is to study the behavior of ADAFs in the environment. Analytical methods based on gaschromatography/mass spectrometry (GC/MS) and ion chromatography (IC) will be developed for the detection of ADAFs in water, soil, and waste water. Laboratory experiments will be conducted to study degradation and phase distribution of ADAFs. Data will be also collected from a soil filtering unit operated by a German airport and waste water treatment plants receiving waste water from airports. From laboratory and field experiments a simulation model will be developed to evaluate internal measures for individual ADAFs. Sorption coefficients, degradation rates and transport processes are taken into account as fate-determining processes. Model results will be validated by measurements of ADAFs in surface and ground water.

Funding: German Environmental Foundation (DBU) (Deutsche Bundesstiftung Umwelt), 2007-2008

Organic pollutants in snow and ice from Antarctica: Long range transport and deposition processes

Prof. Dr. E. Fries, Dr. J. Klanova

Long range transport (LRT) of organic pollutants (OP) from temperate zones to the polar region is an important phenomenon demonstrating the persistence of organic chemicals in the environment. To evaluate the fate of OP in the environment interactions of chemicals with ice and snow play an important role especially in areas characterized by low temperatures. In the last decade, the focus of research has been put on the occurrence of semi-volatile organic compounds (SVOC) in snow and air in the Arctic. The aim of this project is to analyze snow and ice samples for the occurrence of SVOC (hexachlorohexanes, the more volatile polycyclic aromatic hydrocarbons and polychlorinated biphenyls) and volatile organic compounds (VOC) (alkanes, alkylbenzenes). A special focus will be put on the appropriate design of the analytical methods to distinguish between deposition processes of OP on snow and ice surfaces.

Funding: Erasmus exchange program, 2007-2008

3.2 Research cooperations

Cooperations within the University of Osnabrück

- Department of Ecology: Biogeochemical fate processes (Prof. A. Kratochwil, Jun-Prof. T. Eggers)
- Department of Economics: Controlling chaotic population dynamics (Dr. F. Westerhoff)
- Department of Social Sciences: Sustainability Policy (Prof. Dr. A. Lenschow)

Cooperations on a national basis

- AquaEcology, Oldenburg: Assessment of the water quality of the German Bight using long-term data of marine phytoplankton (Dr. Claus Dürsel)
- Centre of Agricultural and Landscape Research, Müncheberg: Measuring and modelling volatilization of organic pollutants from flowing waters (Dr. Balla)
- Ecological Field Station, University of Würzburg: Modelling metapopulation dynamics (Prof. Dr. H.J. Poethke)
- University of Applied Sciences (Fachhochschule) Osnabrück, Soil Ecotoxicology: Copper in the Hase catchment (Prof. Dr. Hans-Christian Fründ)
- University of Applied Sciences (Fachhochschule) Osnabrück, Process Engineering and Aquatic Biotechnology (Prof. Gerhard Weil)
- Federal Agency of Environment (UBA), Berlin: Measuring and modelling volatilization of organic pollutants from flowing waters (Dr. Stefan Meinicke)
- Helmholtz Centre of Environmental Research – UFZ: Development of a model of pollutant dispersal for risk analysis and assessment of extreme flood events exemplifying the town and district Bitterfeld (SARISK) (Dr. Wolf von Tümpling, Dr. Michael Rode, Olaf Büttner, Michael Böhme, Martina Baborowski)
- Helmholtz Centre for Environmental Research (USF), Social Science Division: Multi-level governance and scale-issues (Prof. Dr. B. Hansjürgens, Dr. I. Dombrowsky)
- Institute for Environmental and Sustainability Communication, University of Lüneburg: The role of media in participatory governance for sustainability (Prof. Dr. H. Heinrichs)
- Institute for Regional Development and Structural Planning (IRS), Erkner: Multi-level governance and scale-issues (Dr. T. Moss; Dr. M. Wissen)
- Leibniz-Institute of Ecological Regional Development (IÖR, Dresden): Development of a model of pollutant dispersal for risk analysis and assessment of extreme flood events exemplifying the town and district Bitterfeld (SARISK) (Dr. M. Schanze, Axel Sauer)
- Leibniz-Institute of Freshwater Ecology and Inland Fisheries: Assessing the origin of river bed substances in the lower River Elbe near Magdeburg (Dr. Martin Pusch)
- Oeko-Institut, Berlin: Governance for Sustainable Development (J.-P. Voß)

- Research Centre on Biotechnology, Society and the Environment at the University of Hamburg, Junior Research Group AgChange: Public Participation, Sustainability and Political Economy (Dr. P. H. Feindt)
- University of Halle, Institute of Geography: Development of a model of pollutant dispersal for risk analysis and assessment of extreme flood events exemplifying the town and district Bitterfeld (SARISK) (Prof. Dr. Cornelia Glaesser, Burkhard Sonnabend)
- Universität Hannover: Occurrence, behavior and fate of organic compounds deicing/antiicing fluids from airport application in the environment (Dr. Kayser)
- University of Oldenburg: Measuring and modelling volatilization of organic pollutants from flowing waters (Jun.-Prof. Dr. Helge Bormann)

Cooperation on an international Basis

- Beijing Normal University (Beijing, China), EAWAG (Dübendorf, Switzerland): Water, Environment and Food Security: Integrating Economic and Environmental Objectives - A case study of the Haihe Basin in China (Liu Changming, Beijing Normal University; Hong Yang, EAWAG)
- Center for Chinese Agricultural Policy (CCAP) (China): Increase Agricultural Water Use Efficiency in the Yellow River Basin (Dr. Jinxia Wang)
- Coastal Habitats and Resources Management (CHARM) (Thailand): Coastal Habitat And Resource Management (Dr. Yves Henocque)
- Department of Water Resources (DWR) (Thailand): Project: Bang Pakong Dialogue Programme (Sukontha Aekeraj)
- Doshisha University, Kyoto (Japan): Biological invasions (Prof. N. Shigesada)
- ETH Zürich, Safety and Environmental Technology Group, Institute for Chemical and Bioengineering (Prof. Konrad Hungerbühler, PD Dr. Martin Scheringer, Dr. Mathew MacLeod)
- Hiroshima University (Japan): Analytical treatment of reaction-diffusion problems (Prof. H. Seno)
- Institute of Environmental Technology (IET) and Institute of Mechanics, National Center for Science and Technology (IOM) (Vietnam): Integrated Water Resources Management in the Red River Basin - Problems and cooperation (Prof. Nguyen Van Diep)
- International Institute for Sustainable Development, Winnipeg (Canada): Participatory Modelling and Scenario Building (Dr. D. S. Rothman)
- Institute of Experimental and Theoretical Biophysics Pushchino (Russia): Modelling marine plankton dynamics (Prof. A.B. Medvinskii, M.M. Gonik)
- Institute of Social Ecology, IFF - Faculty for Interdisciplinary Studies, Vienna (Austria): Participatory Modelling, Agent-based modelling in agrarian regions (Prof. Dr. M. Fischer-Kowalski, Prof. Dr. H. Haberl)
- Instituto Venezolano de Investigaciones Científicas (IVIC), Caracas, Venezuela (Dr. J. Paolini) Shirshov Institute of Oceanology Moscow (Russia): Pattern Formation in Reaction-Diffusion Systems (Dr. A.Y. Morozov)

- Institute of Water Problems, Uzbek Academy of Sciences, Tashkent, Uzbekistan (Prof. Makhudov, Prof. Karimov)
- Laboratório Nacional de Engenharia Civil (LNEC) (Portugal): Analysis of Stakeholder Expectations over Water Project Benefits in Water Scarce Regions: a Contribution to Water Governance (Dr.-Ing. Habil João Paulo Lobo-Ferreira and Susana Neto)
- Masaryk University Brno (Czech Republic), Centre for Environmental Chemistry and Ecotoxicology: Organic pollutants in snow and ice from Antarctica: Long range transport and deposition processes (Prof. Dr. I. Holoubek, Dr. J. Klanova)
- National Institute for Industrial Engineering and Technology (INETI) (Portugal): [Subcontractor of USF], Water Governance issues in the Mondego River Basin (Dr. José Cardoso Duarte)
- Trinity College, Dublin (Ireland), Institute of Zoology: The influence of benthic structures on nutrient retention in Irish headstreams (Dr. Kenneth Irvine)
- University of Aarhus (Denmark), National Environmental Research Institute: Comparative analysis of case studies on participatory and collaborative environmental governance (Oliver Fritsch)
- University of Alberta (Edmonton, Canada): Modelling biological invasions (Prof. Dr. M.A. Lewis, Dr. F.M. Hilker)
- University of Leeds (Great Britain): Modelling marine plankton dynamics (Prof. J. Brindley)
- University of Leicester (Great Britain): Pattern Formation in Reaction-Diffusion Systems (Dr. S.V. Petrovskii)
- University of Marseille (France): Biological-physical interactions in aquatic systems (Prof. J.-C. Poggiale)
- University of Torino (Italy): Numerical analysis (Prof. Dr. E. Venturino)
- University Victor Segalen Bordeaux 2 (France): Mathematical epidemics (Prof. M. Langlais)

Visiting scientists

- Mariya M. Gonik, April 2006, August 2006, Institute of Experimental and Theoretical Biophysics, Russian Academy of Sciences, Pushchino, Russia
- Prof. Dr. Alexander B. Medvinsky, October 2005, Institute of Experimental and Theoretical Biophysics, Russian Academy of Sciences, Pushchino, Russia
- Dr. Bertram Ostendorf, April-June 2004, Soil and Land System, School of Earth and Environmental Sciences, University of Adelaide, Australia
- Dr. Sergei V. Petrovskii, May 2005, May 2006, Shirshov Institute of Oceanology, Russian Academy of Sciences, Moscow, Russia
- Dr. Ram Rup Sarkar, May 2004-April 2005, Embryology Research Unit, Indian Statistical Institute, Kolkata, India
- Dr. Farrukh Shaazizov, Dr. Ayidar Nasrulin, October 2004, Institute of Water Problems, Uzbek Academy of Sciences, Tashkent, Uzbekistan

- Prof. Dr. Ezio Venturino, July 2006, February 2007, Dipartimento di Matematica Politecnico di Torino, Corso Duca degli Abruzzi 24, 10129 Torino, Italy, Moscow, Russia

3.3 Conferences and workshops hosted by the institute

- Alexander von Humboldt Training Workshops in Geographic Information Systems „Introduction to GIS for water and land use management“. Institute of Water Problems, Uzbek Academy of Sciences, Tashkent, Uzbekistan, June 28th – July 5th 2004 (J. Berlekamp, S. Lautenbach, M. Schlüter, H. Lieth)
- Alexander von Humboldt Training Workshops in Geographic Information Systems „GIS and Modelling for water and land use management“. Institute of Water Problems, Uzbek Academy of Sciences, Tashkent, Uzbekistan, 19.-27. Sep. 2005.
- Formalised and Non-Formalised Methods in Resource Management – Knowledge and Learning in Participatory Processes. International workshop, 21-22 September 2006, Osnabrück.
- Workshop on „GIS for desertification and soil degradation management“, Instituto Venezolano de Investigaciones Cientificas (IVIC), Caracas, Venezuela, Oct 30th - Nov 7th 2006 (J. Berlekamp, S. Lautenbach)
- WADAMED Synthesis Workshop . USF in cooperation with CIRAD and Cemagref 11.-15. Dez. 2006 (Bettina Bluemling und Prof. Dr. Claudia Pahl-Wostl).
- Joint workshop on Global Assessments: Bridging Gaps and Linking to Policy, Washington, DC. May 9-11, 2007. Co-hosted by the Institute of Environmental Systems Research, The Integrated Assessment Society (TIAS) and the Global Water System Project (GWSP). Additional support from the Harmoni-CA project and the United Nations Environment Programme.
- Annual Conference “Environmental Chemistry and Ecotoxicology - From Chemodynamics to Risk Assessment” of the German Chemical Society (GDCh), September 26 – 28, 2007, Institute of Environmental Systems Research, Osnabrück
- Harmoni-CA/WP5 Synthesis Workshop: How can models support participatory river basin management according to the WFD? Synthesising the results of the elicitation strategy of the first 2 years of Harmoni-CA/WP5. 4-6 .10.2004. Osnabrueck.
- 1st HarmoniCA WP5 Methods Workshop: Models for Participatory River Basin Management. 16th & 17th of February, 2004, Brussels, Belgium,
- HarmoniCOP Final Conference. 4th October 2005, Osnabrück
- 3rd Harmoni-CA Forum & Conference. 5-7th April 2006. Osnabrück
- 4th Harmoni-CA/WP5 Policy Workshop on "Using Economic Methods and Models for the Implementation of the Water Framework Directive: Status, Options and Challenges for a better integration of water economic research into policy implementation" 14 & 15th June, 2007 in Berlin

- 2nd Harmoni-CA/WP5 Policy Workshop: Interaction of CAP and the implementation of the WFD. 3-5th April 2005. Brussels, Belgium
- 3rd Policy Workshop: From Technical Transferability of Model-based tools to Cognitive Transferability." 4/5th December 06. Osnabrück

3.4 Publications

3.4.1 Applied Systems Science

Edited volumes and special issues

Matthies, M.; Ostendorf, B.; Giupponi, C. (Eds.) (2007): Environmental Decision Support Systems. Special Issue Environmental Modelling & Software 22(2).

Journal articles with peer review

Berlekamp, J.; Graf, N.; Hess, O.; Lautenbach, S.; Reimer, S.; Matthies, M. (2007): Integration of MONERIS and GREAT-ER in the Decision Support System for the German Elbe River Basin. Environmental Modelling & Software 22(2), 239-247.

Fenner, K.; Scheringer, M.; MacLeod, M.; Matthies, M.; McKoone, T.E.; Stroebe, M.; Beyer, A.; Bonnell, M.; Le Gall, A.-C.; Klasmeier, J.; Mackay, D.; van de Meent, D.W.; Pennington, D.; Scharenberg, B.; Suzuki, N.; Wania, F. (2005): Comparing Estimates of Persistence and Long-Range Transport Potential among Multimedia Models, Environ. Sci. Technol. 39 (7), 1932-1942.

Klasmeier J., Matthies M., MacLeod M., Fenner K., Scheringer M., Stroebe M., Le Gall, A.-C., McKone T., van de Meent D., Wania F. (2006): Application of Multimedia Models for Screening Assessment of Long-Range Transport Potential and Overall Persistence. Environ. Sci. Technol. 40 (1), 53-60.

Lessmann K., Beyer A. Klasmeier J., Matthies M. (2005): Influence of Distributional Shape of Substance Parameters on Exposure Model Output. Risk analysis 25 (5), 1137-1146.

Matthies, M., Berlekamp, J., Lautenbach, S., Graf, N., Reimer, S. (2006): System Analysis of Water Quality Management for the Elbe River Basin. Environmental Modelling & Software, 21 (9), 1309-1318.

Matthies M., Klasmeier J., Heß O. (2006): GIS-basierte Modellierung von Gewässerimmissionen. Umweltwissenschaften und Schadstoff-Forschung - UWSF 18 (2), 102-109.

Rüger, N.; Schlüter, M.; Matthies, M. (2005): A fuzzy habitat suitability index for *Populus euphratica* in the Northern Amurdaya delta. Ecological Modelling 184, 313-328.

Schlüter, M.; Rüger, N.; Savitsky, A.; Novikova, N.; Matthies, M.; Lieth, H. (2006): TU-GAI: An Integrated Simulation Tool for Ecological Assessment of Alternative Water

- Management Strategies in a Degraded River Delta. *Environ. Management* 38 (4), 638-653.
- Schulz M.; Gücker B. (2005): Macrophytes increase spatial patchiness of fluvial sedimentary records and evoke transient particulate nutrient storage. *Aquatic Geochemistry* 11, 89-107.
- Schulz M.; Köhler J. (2006): A simple model on phosphorus retention by macrophytes in lowland rivers. *Hydrobiologia* 563, 521-525.
- Schulz, M.; Matthies, M. (2007): Runoff of pesticides - achievements and limitations of modelling agrochemical dislocation from non-point sources at various scales. *Living Reviews in Landscape Research* 1: 1. URL: <http://www.livingreviews.org/lrlr-2007-1>.
- Schulz M., Büttner O., Matthies M., Böhme M.; von Tümpling W. (2007): Modelling arsenic and oil contamination after high water events in the town and floodplain of Bitterfeld (Germany). In: *Information Technologies in Environmental Engineering* (Eds.: Gómez J. M., Sonnenschein M., Müller M., Welsch H. & Rautenstrauch C.), 367-376.
- von Tümpling, W.; Rode, M.; Büttner, O.; Baborowski, M.; Böhme, M.; Gläßer, C.; Sonnabend, B.; Matthies, M.; Schulz, M.; Schanze, J.; Walz, U.; Sauer, A. (2006): Entwicklung eines Schadstoffausbreitungsmodells zur stoffbezogenen Risikoanalyse und -bewertung extremer Hochwasserereignisse am Beispiel des Landkreises und der Stadt Bitterfeld. *UWSF – Z Umweltchem Ökotox* 18, 129-131.
- Zarfl C., Klasmeier J., Matthies M. (2006): Modellierung von Arsen in der Mulde. *Hydrologie und Wasserwirtschaft* 50 (4), 169-177.
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- Berkhoff, K., Lautenbach, S., Berlekamp, J.; Pahl-Wostl, C. (2004): GIS-basierte Ermittlung des Grundwassergefährdungs-Potentials zur Maßnahmenplanung in einer agrarischen Intensivregion. *Mitteilungen der Deutschen Bodenkundlichen Gesellschaft*, Band 104, S. 39-40.
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- Matthies, M.; Klasmeier, J. (2005): Georeferenzierte Expositionsabschätzung. *Mitteilungen GDCh-Fachgruppe Umweltchemie und Ökotoxikologie*, 11(3), 57-59.
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- Berlekamp, J.; Graf, N.; Lautenbach, S.; Matthies, M. (2005): A Decision Support System For Integrated River Basin Management Of The German Elbe. In: Zenger, A. and Argent, R.M. (eds.) MODSIM 2005 International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2005, 1518-1524. (<http://www.mssanz.org.au/modsim05/papers/berlekamp.pdf>)*
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- Hüffmeyer, N.; Klasmeier, J.; Matthies, M. (2006): Analyse der Emissionspfade von Zink in Oberflächengewässer mittels georeferenzierter Modellierung. Oral presentation at GDCh Jahrestagung der Fachgruppe Umweltchemie und Ökotoxikologie, Halle, Oktober 2006.
- Hüffmeyer, N.; Klasmeier, J.; Matthies, M. (2006): Geo-referenced modeling of zinc in the Ruhr River basin - Emissions and immission. Poster at SETAC Europe 17th annual meeting, Porto, Mai 2007.
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- Matthies, M. (2006): Multimediale Expositionsmodellierung – Gesamtpersistenz, Ferntransport und Bioakkumulation. 11. BUA-Kolloquium Expositionsmodellierung und QSAR-Anwendungen in der Chemikalienbewertung, 2006, GDCh, Frankfurt.
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- Scheringer, M.; MacLeod, M.; Matthies, M.; Schulte, C.; Klasmeier, J.; Witt, J.* (2007): Evaluation Persistence under REACH. SETAC Europe 17th annual meeting, Porto, Mai 2007.
- Scheringer, M.; MacLeod, M.; Wegmann, F.; Matthies, M.; Klasmeier, J.* (2006): Identifying Chemicals with high Persistence and Long-Range Transport Potential - The OECD Screening Model. SETAC Europe 16th annual meeting, Den Haag, Mai 2006
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- Scheringer, M.; MacLeod, M.; Matthies, M.; Klasmeier, J.; Witt, J.* (2007): Persistence Criteria in the REACH Legislation: Critical Evaluation and Recommendations. Final Report, Umweltbundesamt, Berlin, 2007.
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3.4.2 Resource Flow Management

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Newig, J.; Voß, J.-P.; Monstadt, J. (eds.) (2007): Special issue on Governance for Sustainable Development: Steering in Contexts of Ambivalence, Uncertainty and Distributed Control. *Journal of Environmental Policy and Planning* 9 (3/4).

Pahl-Wostl, C.; Borowski, I. (2007) (Eds.): Special Section "Methods for Participatory Water Resources Management" has been published as part of issue 21/7 of *Journal Water Resources Management*.

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Bluemling, B.; Yang, H.; Pahl-Wostl, C. (2007): Making Water Productivity Operational – A Concept of Agricultural Water Productivity exemplified at a wheat-maize Cropping Pattern in the North China Plain. *Agricultural Water Management* 91 (1-3), 11-23.

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- Holtz, G.; Brugnach, M.; Pahl-Wostl, C. (2007):* Specifying “Regime” - A Framework for defining and describing Regimes in Transition Research, *Technological Forecasting and Social Change*. <http://www.sciencedirect.com/science/article/B6V71-4NDDSWG-1/2/e08390422eea3026fdd676954c1786a6>
- Kastens, B.; Newig, J. (2005):* Die aktuelle Umsetzung der Wasserrahmenrichtlinie - Konsequenzen und Perspektiven für die Landwirtschaft am Beispiel Niedersachsens. *Berichte über Landwirtschaft* 3, 463-482.
- Kastens, B.; Newig, J. (2007):* Auf dem Weg zu einem flächendeckenden Gewässerschutz? Die Umsetzung der WRRL in Bezug auf landwirtschaftliche Nitratbelastungen. *Zeitschrift für Umweltpolitik und Umweltrecht* 30 (4).
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- Máñez Costa, M.; Renner, S. (2005):* Unos crían la fama y otros cardan la lana. Pagos directos a los que realmente conservan. *AgroNuevo*, 5, 31-51.
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No. 32: Frank M. Hilker and Frank H. Westerhoff: *Control of chaotic population dynamics: Ecological and economic considerations*. November 2005.

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No. 34: Jens Newig, Oliver Fritsch (Eds.): *Effektivität von Entscheidungsprozessen*. May 2006.

No. 35: Ba Kien Tran (Diploma Thesis): *Modellierung biologischer Invasionen mit Reaktions-Diffusionsgleichungen*. Juli 2006.

- No. 36: Ivo Siekmann (Diploma Thesis): Agentenbasierte Modellierung von Persönlichkeitsunterschieden auf der Grundlage der PSI-Theorie. July 2006.
- No. 37: Tobias Ceglarek (Diploma Thesis): Irreguläre Oszillationen in drei- und vierkomponentigen populationsdynamischen Modellen. September 2006.
- No. 38: Horst Malchow (Ed.): Komplexe Systeme und nichtlineare Dynamik in Natur und Gesellschaft. Dezember 2006.
- No. 39: Jens Newig / Veronika Gaube / Karin Berkhoff / Kai Kaldrack / Britta Kastens / Juliana Lutz / Bianca Schlußmeier / Heidelinde Adensam / Helmut Haberl / Claudia Pahl-Wostl / Armand Colard / Bettina Aigner / Rudolf Maier / Wolfgang Punz: Partizipative Modellbildung, Akteurs- und Ökosystemanalyse in Agrarintensivregionen. Schlussbericht des deutsch-österreichischen Verbundprojekts. September 2007.
- No. 40: Bert Wecker, Bakhtiyor Karimov, Bakhtiyar Kamilov, Uwe Waller, Michael Matthies, Helmut Lieth: Sustainable Aquaculture in Recirculating Systems. Feasibility Study for the Catchment Area of the Aral Sea. März 2007.
- No. 41: Michael Matthies (Hrsg.): Klimawandel. September 2007.

3.5 PhD dissertations and Habilitationen

3.5.1 Completed PhD dissertations

2005

Gaucel, Sébastien (2005): Analyse mathématique et simulations d'un modèle prédateur-proie en milieu insulaire hétérogène. PhD Thesis in *Applied Mathematics*, University of Bordeaux. Referee: Prof. Dr. Horst Malchow.

Hilker, Frank Mathias (2005): Spatiotemporal patterns in models of biological invasion and epidemic spread, July 2005, Referees: Prof. Dr. H. Malchow, Prof. Dr. M. Langlais (University of Bordeaux 2), Dr. S.V. Petrovskii (SIO, Moscow).

Lautenbach, Sven (2005): Dissertation „Modellintegration zur Entscheidungsunterstützung für die Gewässergütebewirtschaftung im Einzugsgebiet der Elbe“, Referee: Prof. Dr. M. Matthies, Prof. Dr. Ralf Seppelt.

2006

Ebenhöh, Eva (2006): Modelling human behaviour in social dilemmas using attributes and heuristics, June 2006, Referees: Prof. Claudia Pahl-Wostl, Prof. Thomas Berger.

Müller, Birgit (2006): Sustainable grazing management in semi-arid rangelands. An ecological-economic modelling approach, June 2006, Referees: Prof. Dr. H. Malchow, Prof. Dr. C. Wissel (UFZ Leipzig).

Rüger, Nadja (2006): Dynamics and sustainable use of species-rich moist forests - A process-based modelling approach, Referees: Prof. Dr. H. Malchow, PD Dr. Andreas Huth.

Schmidt, Sonja (2006): Ökobilanz Bioabfallsorgung - Ökologische Bewertung von Entsorgungsoptionen für Bioabfälle unter Berücksichtigung räumlicher und ökonomischer Aspekte, Referees: Prof. Dr. Claudia Pahl-Wostl, Univ. Prof. Stefan Salhofer.

2007 (January – September)

Sigel, Katja (2007): Unsicherheit bei Umsetzung der EU-Wasserrahmenrichtlinie - Eine konzeptionelle und empirische Analyse. Referees: Prof. Dr. Claudia Pahl-Wostl.

3.5.2 Completed *Habilitationen*

Dr. Frank, Karin (2006): Stochastic metapopulation persistence in heterogeneous landscapes – model-based contributions to metapopulation theory and conservation management, July 2006, Referees: Prof. Dr. H. Malchow, Prof. Dr. W. Alt (University of Bonn), Prof. Dr. H. Possingham (University of Queensland, Brisbane).

3.6 Awards

Lieth, Helmut, Prof. em. Dr.: Honorary Professor of the Usbekian Academy of Science 2007, Institute of Water Problems, Taschkent, Usbekistan

Avenhaus, Wibke: Homann Studienpreis 2006 für herausragende Leistungen im Hauptstudium

Hüffmeyer, Nina: Innovationspreis 2006 der Intevation GmbH für die Diplomarbeit „Modellierung von Zink in der Ruhr – Emissionspfade und Belastungsanalyse“

Wissing, Jutta: Förderpreis 2006 für innovativen Umweltschutz des Rotary Club Osnabrück für die Diplomarbeit „Georeferenzierte hydromorphologische Charakterisierung von Flussgebieten“

Zarfl, Christiane: Förderpreis 2005 für innovativen Umweltschutz des Rotary Club Osnabrück (185. Distrikt)

4 Faculty and staff members

4.1 Faculty: Applied Systems Science

- Michael Matthies, Dr.rer.nat., Professor of Applied Systems Science, Managing Director
- Helmut Lieth, Dr., Prof. emeritus. International Ecological Projects
- Jörg Klasmeier, Dr. rer. nat., staatl. gepr. Lebensmittelchem., assistant professor
- Marcus Schulz, Dr., Dipl.-Geol., senior researcher
- Jürgen Berlekamp, Dr. rer. nat, Dipl.-Biol., appointed lecturer
- Bert Wecker, Dr. rer. nat., Dipl.-Biol., Dr. rer. nat., researcher (until 4/2007),
- Olga Alexandrova, Dipl.-Phys., Ph.D. student
- Maik Bischoff, Dipl.-Umweltwiss., Ph.D. student
- Andreas Focks, Dipl.-Systemwiss., Ph.D. student
- Nina Hüffmeyer, Dipl.-Systemwiss., Ph.D. student
- Jutta Wissing, Dipl.-Systemwiss., Ph.D. student
- Christiane Zarfl, Dipl.-Systemwiss, Ph.D. student

4.2 Faculty: Resource Flow Management

- Claudia Pahl-Wostl, Dr. rer. nat., Prof. of Resource Flow Management
- Karin Berkhoff, Dipl.-Umweltwiss., Ph.D. student (until 03/2007)
- Bettina Bluemling, Dipl.-Ing., Ph.D. student
- Ilke Borowski, Dipl.-Ing., Ph.D. student
- Marcela Brugnach, Dr. phil., Dipl.-Ing., senior researcher, project manager
- Eva Ebenhöf, Dipl.-Systemwiss., Ph.D. student
- Oliver Fritsch, M.A., researcher (from 10/2005 to 05/2007)
- Dirk Günther, Dipl. Soz.-Wiss., Ph.D. student
- Georg Holtz, Dipl.-Systemwiss., Ph.D. student
- Patrick Huntjens, Ph.D. student
- Nicola Isendahl, Dipl.-Ing., Ph.D. student
- Stephan Jätzold, Dipl.-Math., Ph.D. student
- Kai Kaldrack, Dipl.-Systemwiss., reseacher
- Britta Kastens, Dipl.Geogr., Ph.D. student
- Christian Knieper, Dipl.-Geogr., researcher (since 09/2007)
- Maria Manez, Dr., senior researcher

- Möllenkamp, Sabine, Dr., Dipl.-Geogr., DEA; Politikwiss., M.A.; senior researcher
- Jörn Möltgen, Dipl.-Geogr., project manager and researcher
- Jens Newig, Dr. iur., Dipl. Geo-Ökol., assistant professor
- Silke Panebianco, Dipl.-Ing., Ph.D. student
- Dagmar Ridder, Dr. Ing., Dipl.-Ing., project manager and senior researcher
- Bianca Schlußmeier, Dipl.-Psych, researcher (until 12/2006)
- Sonja Schmidt, Dipl.-Ing., Dr. rer. nat., senior researcher
- Ole Schroeder, Dipl.-Systemwiss., Ph.D. student
- Caroline van Bers, researcher
- Chun Xia, MSc, Ph.D. student

4.3 Faculty: Theoretical Systems Science

- Prof. Dr. Horst Malchow, Head
- Klaus Brauer, Dipl.-Math., Akad. Director, appointed lecturer
- Frank M. Hilker, Dipl.-Systemwiss., Ph.D. student (until July 31, 2005)
- Ivo Siekmann, Dipl.-Systemwiss., Ph.D. student (since April 1, 2006)

4.4 Faculty: Applied Environmental Systems Analysis

- Elke Fries, Dr., Junior professor of Applied Systems Science
- Aliz Kiss Dipl.-Umweltwiss., doctoral candidate

4.5 Technical and administrative staff

- Elke Altekruse, Institute administration
- Jürgen Berlekamp, Dr.rer.nat.
- Irene Brink, Secretary
- Johannes Wösten, Dipl.-Math.
- Melanie Wissing, Technical Assistant