Special Session
IHDP Open Meeting
Tuesday, 28.4.2009, 18.00-19.30

Integrative Approaches in Global Change Research

-The Experience with Different Integration Methods-

Agenda

The circle of human-nature interaction is complex in the feedbacks of processes in the natural system, in the interactions among the members of society and in the interaction of societies with nature. Although it is obvious that an understanding of human-nature interactions necessarily has to cover all three parts, conventional research approaches usually root in disciplinary perceptions of the world. It has therefore been widely assumed that this lack of interdisciplinary is the underlying cause, why conventional research approaches has been largely inefficient in analysing complex questions in human-nature interactions in Global Change Research.

Over the past 5 years many large integrative projects have been initiated in the field of Global Change Research. German interdisciplinary projects, like GLOWA, BIOTA, Storma, CABRI-Volga or GoBi Research Group, integrate social- and natural aspects of science and are well established in different parts of the world and in international Global Change Programs. In the light of these few years of experience with integrative research it is time to discuss the use of the different methods and levels on integration and to derive lessons for future integrative research endeavors.

The session draws on the sub projects of GLOWA that all focus on water catchments in different parts of the world and they all address water management issues but use different approaches to integration and different techniques in dealing with complex human-nature interactions of Global Change Research.

This session is convened by
the German National Committe on Global Change Research.
www.nkgcf.org

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German National Committee on Global Change Research

GLOWA-Danube - a new approach to integrate natural and socio-economic sciences for water related Global Change research

18.00 • **Wolfram Mauser** *(Ludwigs Maximilians University of Munich)*

GLOWA-Danube is a large integrative water related Global Change research project which aims at exploring the natural and anthropogenic impacts on the water resources of the Upper Danube Basin in Central Europe. It develops the spatially explicit decision support system (DSS) DANUBIA to simulate and analyse the influence of different regional adaptation strategies to Global Change and to explore their impact on the future sustainability of the water resources in the area. New ways of integration of the socio-economic and natural science partners were developed and explored in the process of commonly developing DANUBIA as a fully coupled system, which explicitly represents feedbacks within the natural system and between the different actors as well as between nature and actors. The structure and components of the integrated DSS DANUBIA was developed by all project groups using the Unified Modelling Language as common computer language. The components of the modelling system communicate through standardized interfaces. Human decision making is represented by a generic actor concept, which simulates decisions of individuals, groups and companies in the area. The detailed population distribution and social structure was taken from Microm marketing data. Differentiated actors, which simulate the decisions the main water related actors (farmers, households, water suppliers and tourists) based on scenarios of changing climate, demography and external factors for the next 50 years are then derived from the generic actor.

DANUBIA is fed with different scenarios for regional climate, demographic development and external factors (environmental and agricultural policy, world market prices, etc.) and the natural processes and actor decisions are simulated. The results are presented to a group of stakeholders from politics, administration, NGOs, energy and hydropower sector and agriculture and proposed adaptation strategies are taken up and played through in an iterative dialogue with the stakeholders to come up with consolidated adaptation strategies.

GLOWA Danube

www.glowa-danube.de

Socio-economic water resources impact assessment in sub-Saharan Africa: The M³ WATER Model for the Volta Basin

18.15 • **Paul Vlek** *(Center for Development Research, University of Bonn)*

In the Volta River Basin, infrastructure watershed development with respect to the impact of climate conditions is hotly debated due to the lack of adequate tools to model the consequences of such development. The Volta basin drains an area of approx. 400 000 km² of the subhumid to semiarid West-African savannah zone and is shared by six riparian countries. The region is characterized by erratic rainfall patterns, and domestic and agricultural water users in the upper regions of the Basin compete with hydropower generation in the south for increasingly scarce water resources. There is an ongoing debate on the impact of further socio-economic development like e.g. investments in irrigation or population growth on the highly competitive water resources of the Volta Basin.

The GLOWA Volta Project (GVP) has developed the M³ WATER model for the Volta Basin, a coupled hydro-economic model that allows assessing the impact of economic and demographic development in the basin on the availability of current and future water resources, given the current or future climate conditions. The simulated historic and future discharge time series of the distributed coupled climate-hydrological model (MM5/WaSiM-ETH) serve as input data for the river basin management model MIKE BASIN (DHI, Copenhagen). MIKE BASIN uses a network approach, and allows fast simulations of water allocation and of the consequences of different development scenarios on the available water resources. The calculation of water demand for every water user likee.g. household water or irrigation water of every hydro-economic catchment is dynamically coupled to the economic model GAMS. The economic model receives in turn the available water supply of every hydro-economic catchment from the river basin management model according to the applied water use rate. With this hydro-economic loop the GAMS model optimizes the water use for every year with respect to the predefined boundary conditions of the M³ WATER model. Furthermore it allows the user to set up climate scenario time series scenarios fo an assessment of the consequences of extreme climate conditions like e.g. a sequence of two dry years. For example, the impact due to the expansion of small reservoirs, further large dam development, and that of other water users on the available water resources of the Volta basin can be assessed. With a chosen water policy scenario of the M³ WATER model the effect on the water level of Lake Volta, which is important for power generation of Akosombo hydro-station, can be assessed under regular and extreme climatic conditions.

www.glowa-volta.de

GLOWA Jordan River – Scientific support for sustainable water resources management under global change in highly

18.00 • **Katja Tielbörger** *(University of Tübingen)*

The GLOWA Jordan River project aims at developing strategies for sustainable water and land management in a highly water-stressed region under global change. It integrates among many different disciplines and supports an active transboundary dialogue between science and stakeholders in the Jordan River region. The specific niche of GLOWA JR is the focus on green water management, i.e. management of water in soils and plants via adaptive land use management. In this framework several land-use scenarios have been developed and tested for their sustainability under conditions of increased resource demand and decreasing water availability under climate change.
An integrated approach to water management faces several challenges particular for this region:
1) Excellent data may exist but may be not accessible for transboundary analyses due to political constraints.
2) Spatial and temporal resolution of data varies greatly between partner countries.
3) Expert knowledge in water management is often provided in qualitative than quantitative terms.

Two interacting integration tools are used for addressing these challenges:
The decision-support system WEAP (Water Evaluation and Planning) was developed and established with regional stakeholders. WEAP integrates among the scientific results and quantifies the effect of management options of the water situation under global change. It accounts for heterogeneous data by using a nested scaling approach and it integrates between blue and green water management options.
Integration of qualitative and quantitative information is furthermore realized by developing, jointly with stakeholders, scenarios of the water situation and potential adaptation strategies via the so-called story-and-simulation (SAS) approach. The scenarios are then investigated for their impact on the water situation using WEAP.
GLOWA Jordan River can serve as a model for integrated research aiming at developing science-based adaptation strategies to global change. The focus on green water enables us to come up with highly innovative solutions of sustainable land management that can be transferred to other Mediterranean, semi-arid, and arid regions in the world.

Jordan River

GLOWA

www.glowa-jordan-river.de

The GLOWA-Impetus Approach

18.45 • **Andreas Fink**[1], *M. Christoph*[1], *B. Diekkrüger*[2], *H. Goldbach*[3], *T. Heckelei*[4], *B. Reichert*[5], *M. Rössler*[6] *and P. Speth*[1]

IMPETUS assesses the impact of Global Change on the hydrological cycle of two watersheds in tropical West and subtropical North-West Africa within a multidisciplinary approach, involving natural, socio-economic, and health sciences. The first project phase was dedicated to the comprehensive assessment of the status quo. In the second phase, qualitative and quantitative models were adapted or newly developed for both regions. Projections of future developments were derived from scenario calculations and from expert knowledge. In the current project phase, spatial decision support and information systems (SDSS/IS) are developed within a set of multidisciplinary "problem clusters". Problem clusters are meta-problems which require a multi-disciplinary analysis in order to allow for reliable projections for regional planning. Each problem cluster is composed of many single "thematic complexes" (= processes or process chains) that reflect the different disciplinary approaches involved in this project. The transition from disciplinary sub-projects to the cross-cutting themes dealt within the problem clusters in the second phase was accompanied by an intense stakeholder dialogue and facilitated the capacity building measures.

To overcome the problem that a deep insight into natural processes and constraints is not enough to motivate decision makers as well as the general public to take the appropriate measures, there is a need for an even higher degree of integration of both areas for a sustainable implementation of measures. This increases model and DSS complexities but may be the only way to achieve long-term improvements within a short time frame. The GLOWA-IMPETUS experience shows that the identification of problem clusters and multidisciplinary approaches together with a continuous stakeholder dialogue for problem solutions was a successful approach. Moreover, the coupling of the respective multidisciplinary models by data exchange into e.g. DSS came out as a manageable way of integrating different model and data types.

www.impetus.uni-koeln.de

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The Integrated Methodological Approach of GLOWA-Elbe

19.00 • **Frank Wechsung** *(Potsdam Institute for Climate Impact Research)*

The system analytical approach that underlies the scenario analyses of global change trajectories for the water household in the Elbe region (GLOWA-Elbe) aims at reducing perceptional, evaluative, and objectification gaps in order to achieve the sustainability imperative. The Integrated Methodological Approach (IMA) developed for this purpose combines scenario techniques with comprehensive use of simulation models, multi-criteria impact evaluation, and analysis of diverging evaluations between groups of actors and those affected. The first step, scenario development, is followed by impact analysis, evaluation, and conflict analysis. Conflict analysis finalises a sequence of steps, but can also be the starting point for specifying the scenarios and hence for another iteration of the IMA. Developing scenarios is perceived as an integrative search inspired by feedbacks with conflict analysis, for relevant exogenous scenarios, alternative management strategies and indicators for impact analysis. The conflict analysis subsumes the results of previous IMA iterations. The IMA allows considerable space for each step to be implemented. The definition and execution of subtasks consistent with the overall aim is supported by a system of categories and definitions. The significance of the GLOWA-Elbe iteration in the IMA process lies in the explicit reference to steps in the IMA and the related transparency produced by using a self-contained system of terms and definitions, and its qualitative direction and long-term orientation up to 2055 and even beyond.

www.glowa-elbe.de

German National Committee on Global Change Research (NKGCF)

To address the need for interdisciplinary cooperation in the field of global change research, the NKGCF was established in 1996 to bring together the different scientific approaches in Germany.
The NKGCF is mainly involved in coordinating German global change research and acts as an interface between the national research funding organisations (DFG and BMBF) and the international global change programmes.

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