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The Society

The Integrated Assessment Society is a not-for-profit entity created to promote the community of inter-disciplinary and disciplinary scientists, analysts and practitioners who develop and use integrated assessment. The goals of the society are to nurture this community, to promote the development of IA and to encourage its wise application.

Integrated Assessment Defined

Integrated Assessment (IA) can be defined as the interdisciplinary process of integrating knowledge from various disciplines and stakeholder groups in order to evaluate a problem situation from a variety of perspectives and provide support for its solution. IA supports learning and decision processes and helps to identify desirable and possible options for addressing the problem. It therefore builds on two major methodological pillars: approaches to integrating knowledge about a problem domain, and understanding policy and decision making processes. IA has been developed to address issues of acid rain, climate change, land degradation, water and air quality management, forest and fisheries management and public health.

Feature

Uncertainty and Models in Policy Processes for Water Management

Ilke Borowski, Institute of Environmental Systems and Daniel Petry, Global Water System Project

On May 9, TIAS together with the International Water Association - Specialist Group on Systems Analysis and Integrated Assessment (IWA-SAIA) and the Global Water Systems Project (GWSP) met in Adelphi, Maryland to share their respective experiences in scientific approaches towards water management, and specifically the issue of uncertainty analysis and models in decision making. The three scientific communities attempted to strengthen the interconnections between the social and natural sciences within the field of modelling the human-environment system and, supported by the European Action Harmoni-CA (www.harmoni-ca.info), also lived up to the spirit of the recently renewed agreement between Europe and USA to foster scientific exchange (<http://www.ec.europa.eu/research/press/2007/pr0902-2en.cfm>).

Presentations and ensuing discussions focused on the role of models in decision making and how to increase the importance of models within this arena, given a context of uncertainty. Specifically, attention focused on the challenge of increasing trust in models - particularly when dealing with complex problems requiring an integrated approach. The session also served to capture the broad ranges of issues from the mathematical approaches to uncertainty analysis to the conceptual, often more social scientific approaches to dealing with uncertainty. Three guiding questions were introduced by the joint chairs of the day, Claudia Pahl-Wostl and Peter Vanrolleghem, in order to guide discussions and address the above issues:

- Do we need a new system science, a new generation of concepts and tools to address uncertainties in providing support for policy processes?
- Has scientific practice placed too much emphasis on technical and formal methods of characterizing uncertainties and neglected what really matters in the policy process, an

arena many scientists/ modellers are ill equipped to cope with?

- Is there a danger that science may undermine its credibility if uncertainties and the limitations of scientific expert knowledge are more openly communicated in policy processes?

The session included four keynote speakers and, in the afternoon, a set of presentations on uncertainty and decision making.

The opening keynote on "Uncertainty analysis of models used for integrated assessment" by Michiel Blind (RIZA) and co-authored by Jens Christian Refsgaard (GEUS) set the context for the day's theme by placing uncertainty analysis in the broader perspective of Integrated Water Resources Management (IWRM) / Integrated Watershed Management. The advances made and lessons learned in the European HarmoniRiB project (such as developing data bases on various RBM indicators for eight European river basins) were presented, and a strong argument was made for improving communication including a more explicit approach towards dealing with uncertainties and more exchange between various disciplines and fields, including modelling and monitoring.

During the discussion, participants confirmed the difficulties associated with analysing uncertainty. Quantifying uncertainty remains a challenge, especially with respect to data collection. Some attribute it to the lack of available methodologies, while others to lack of time to identify and assess available knowledge on these methodologies. The discussion also touched on the issue of complex versus simple models. US experience suggests that it is often one specific stakeholder group that initiates the model concept. US legislation is now helping to guide model development and validation by providing requirements for

models which are used in decision - making. However, there is a sense that awareness of the measures and efforts necessary to improve decision making and the role of models are not lacking, but the will is. In this context, the work by Lenny Smith (Oxford Centre for Industrial and Applied Mathematics, University of Oxford) was recommended (see <http://www.maths.ox.ac.uk/~lenny/papers.html> for relevant publications). There was some agreement that the lack of trust in models attributable to uncertainty might to a certain extent be reversed with a change of perspective on the part of users: If the focus is on the level of confidences instead of the level of uncertainty, trust might increase. When decision are taken, the uncertainty element within models is not explicit any more (if it ever was before). However, even though uncertainty in models have only rarely prevented decision taking or is named as factor for a specific decision, perceived uncertainty might serve as "hidden reasons" for the policy makers. Being aware of the uncertain basis of their decision they try to balance this with the uncertainty associated with the consequences of a decision (not) taken.

The second keynote by Charles Vörösmarty (Water Systems Analysis Group, University of New Hampshire) presented the perspective of the GWSP on "Analysing human-water interaction: from local scale impacts to syndromes to system-level feedbacks." Vörösmarty opened with the central tenet of the GWSP: Humans are changing the global water system in a globally-significant way without adequate knowledge of the system and thus its response to change. The GWSP's first aim is to document the magnitude of the anthropogenic and environmental changes, thus gaining a more holistic understanding of the linkages and feedback mechanisms within Earth systems arising from the global water system. Resilience and adaptation can then be better assessed and improved. Vörösmarty presented results from the GWSP activities in a series of examples on global water studies. Data from administrative scales was down-scaled to the settlement level. A problem here was that the water use data was often insufficient. The audience discussed the issue of developing a formal means for up and downscaling. Work on downscaling has been carried out in the global climate change modelling community. Traditionally, in hydrology and water management research, coping strategies are on the local scale. However, GWSP's Global Catchment Initiative is initiating a cross-scale dialogue from local to basin to global levels. In addition to this scaling problem, Vörösmarty also encouraged more dialogue between the different local case studies that are "out there" on their own to upscale to global level in order to identify necessary actions. Another message emerging from the presentation and the subsequent discussion was that the main threat for the next 30 years is not coming from climate change but from economic development and unsustainable use of water. To improve the awareness of this GWSP has been initiated and is searching for solutions to these issues.

In the third keynote, Paul Jeffrey (Centre for Water Science, Cranfield University), "Models and modelling in the policy making process" are explored. The focus of the presentation was on the challenge of integrating different disciplines when developing models, especially when combining the social and natural sciences. Jeffrey places models in the context of both ontological diversity (multiple experiences of existence) and epistemological diversity (multiple ways of knowing about existence) that have created a niche for new ways of thinking about collaborative resource management. Through this personal and subject character of meaning, he states that "we are being asked to accept a multiplicity of equally valid experiences as the motivations

for action and no universally reliable epistemology by which to choose knowledge set A over knowledge set B." To implement this in models is a true challenge. Jeffrey presented results from a comparison of different models for IWRM which revealed that the best performance was achieved by the simplest model which was closely aligned to a business process and involved less interdisciplinary interaction. The discussion raised the question of whether the social sciences are a problem or a challenge for the modelling of integrated systems. Given the lack of "fixed rules" and the diversity of schools in social sciences, the need for a dialogue such as that taking place at this joint session was stressed. In particular, the funders of models should be part of this. The capacity to bridge the gap between policy and science through participatory modelling was questioned given the time constraints that restrict their capacity to better understand or delve into models.

Linking with this discussion was the final keynote address on "Putting uncertainty into context: Implications of model purpose in dealing with uncertainty" by Marcela Brugnach and Claudia Pahl-Wostl (University of Osnabrueck). Beginning with the preface that decision making processes prefer to ignore the notion of uncertainty but nevertheless include it, they suggested that the way of dealing with uncertainty in a model depends on its purpose (prediction, exploratory analysis, communication, learning) as well as the causes (errors, complexity, ambiguity, ignorance, values/beliefs) and the manifestations (structure, framing, data) of uncertainty. Rather than searching for the one model, the argument was made for specialized application of diverse models. In particular, the role of models in supporting learning processes should be strengthened and invites more participatory model development approaches.

During the afternoon, three presentations on uncertainty and decision making provided more in-depth insights into specific applications of models for IWRM. Esther Diez Cebollero (School of Water Sciences Cranfield) presented the work she carried out together with Brian McIntosh (ibid) on "Assessing Factors that make decision support tools (DST) useful in water management". Their survey addressed water DST users (about 2/3 governmental authorities) to find out why they are using computer-based information systems that provide facilities for storing, exchanging and analysing data to inform policy and management activities. The work studied the perceptions of the water users. It became clear that reliable information plays a central role in adopting a tool. The perception of reliability depends on the nature of the problem and the perspective of the user, as well as the different levels of uncertainty, (i.e. a given user's trust of the information provided is highly subjective). The assessment for the added value of the DST was based on indicators the users developed themselves. The research revealed that Geographical Information Systems are most frequently used and that it is not possible to establish a "one-fit-all" guideline for the design of any DST due to the high diversity of users and uses.

Jong-Hwa Ham (Cornell University) presented joint work on "Integrated modelling under uncertainty in watershed-level assessment and management" (together with Chun G. Yoon, Kwnag-Wook Jung, Jae-Ho Jang) where the interaction of the watershed and the surrounding region were modelled including the simulation of uncertainty of the results. The discussion reflected the difficulties with uncertainty analysis: in the process of analysis, parameter and methods have to be selected which includes a process of prioritisation. Also, the recommendations for

decisions might shift in response to different methods of uncertainty analysis rather than using or not using uncertainty analysis (the presentation included Monte Carlo Simulation). Also, communication of results to policy makers proved to be difficult. The research stressed the importance of making the basic assumptions explicit to determine the specific value of results in a decision making process.

The last presentation of the joint day was by Olfemi Osidele (Center for Nuclear Waste Regulatory Analyses) who presented his work together with his colleagues Osavaldo Pensado, Jude McMurry, Sitakanta Mhanty, and Bruce Goodwin) on "a decision-analysis framework to support risk assessment for geologic radioactive waste disposal systems". As with groundwater modelling, "geologic" is the word that captures the hidden complexity of the earth that can never be fully analysed. In comparison to their use in integrated water management, models play a much more crucial role in radioactive waste management because of the lack of other information sources, the time scale involved, and the potentially drastic consequences in event of failure. However, as in other modelling exercises the process of setting priorities invites uncertainties. The aim of the presented work was to develop a decision-analysis framework for examining the conceptual assessment models and link those to technical evidence for validation. The results reveal the establishment of a matrix for identifying important technical aspects of conceptual models, statistical analysis of perception of risk and link it to technical evidence. The decision-analysis framework helped to improve the linkage between the experts and the model developers in order to increase transparency and thus confidence in the results.

To conclude this day of diverse and thought-provoking presentations and discussions, a panel comprising the day's presenters, invited the audience to reflect with them on the role of models and uncertainty in bridging the policy-science gap and to promote collaborative activities between IWA- SAIA, TIAS, and GWSP in this area. The ensuing discussion was wide-ranging, but a number of conclusions did emerge on how to narrow the policy gap:

- There needs to be more transparency in methods and results of our science. Models as such are considered to be more of a constraint to building the science-policy bridge.
- Better integration of social and natural science as well as the improvement of applications of tools in decision making strongly depends on shared learning which goes deeper and support of this. Those learning processes required at the individual level include the ability to listen, reflect and also ensure understanding of new issues - an ability increasingly assigned to ambassadors or intermediaries.
- Returning to the three introductory questions for the day's sessions, it became clear that the improved integration of social sciences in water modelling would likely also benefit the application of models in the decision making process.
- Several areas to be considered for future research and cooperation include to help bridge the gap include:
 - developing ensembles of different modelling approaches (see work being done at Stanford);
 - carrying out QAQC on the range of results of modelling analysis in the water sector
 - analysis of the interactions between scientists and policy makers;
 - a lexicon/glossary such as that being developed by GWSP to support communication between all sectors

- There is a need to develop our client base within our respective associations and develop our ability to influence them. In addition, we need 'champions' for our cause,
- Related to the above point, we need to get better at involving policy makers in these discussions or at least the 'advisors' to the policy makers

The participants were less focused on the need for a new science, but on how we could improve the exchange and the integration of existing knowledge. For this reason, there was considerable interest in more cooperation between TIAS, IWA and GWSP in order to jointly develop an integrated water management model, but also to align terminology.

Parts of this article will also appear in a special issue of the journal "Water Science and Technology"

Events

12 - 13 September 2007. **International Conference: Climate changes Spatial Planning.** The Hague, Netherlands. Deadline for registration: 5 Sept. www.climatechangesspatialplanning.nl

25 - 26 September 2007. **Final Harmoni-CA Conference: European Research Input to River Basin Management.** Brussels. http://www.harmoni-ca.info/Conferences/Upcoming_Meetings/

1 - 5 October 2007. **ECCS 2007: European Conference on Complex Systems,** Dresden, Germany. <http://vwitme011.vkw.tu-dresden.de/TrafficForum/dresden/>

5 October 2007. **IWA conference: Risks of climate change to water management and utilities - from impact analysis to adaptation.** Amsterdam, Netherlands. <http://www.moorga.com/test.php>

4 - 5 October 2007. Conference of the EU SSA project SCENARIO on **Shift in Thinking: Perspectives of Vulnerability and Hazard Assessment.** Potsdam, Germany. <http://www.pik-potsdam.de/events/scenario>

10 - 12 October 2007. **Carbon Finance Europe 2007: Risks and Opportunities in Emissions Markets.** <http://www.environmental-finance.com/conferences/2007/CFEur07/intro.htm>

1 - 2 November 2007. **Disasters: Recipes and Remedies.** The New School in New York City www.newschool.edu/disasters

22 - 23 February 2008. Berlin Conference on the Human Dimensions of Global Environmental Change. **'Long-Term Policies: Governing Social-Ecological Change'**. Proposals and abstracts due by 15 September 2007. <http://web.fu-berlin.de/ffu/akumwelt/bc2008/>

11-14 March 2008. **EASY-ECO Vienna Conference 2008: Governance by Evaluation: Institutional Capacities and Learning for Sustainable Development.** Vienna, Austria. Call for Papers and application for EU-Grants until 10 October 2007.

22 - 26 June 2008. **The 3rd International UNESCO-Conference on Geoparks.** Osnabrück, Germany Call for Papers. Deadline 31 October 2007. <http://www.geoparks2008.com/>

5 - 14 October 2008. **4th IUCN World Conservation Congress** (environmental issues and solutions for sustainable development).

Barcelona, Spain. 2nd round proposals accepted until **30 Sept. 2007** <http://www.iucn.org/congress/2008/>.

Courses

New **Master's degree programme on environmental assessment** launched. McGill-UNEP Collaborating Centre at McGill University, Canada. <http://www.mcgill.ca/nrs/graduate/environment/>

New Environmental Impact Assessment Open Educational Resource is available online at <http://eia.unu.edu>

Wageningen University **International Training Programme: Capacity Development & Institutional Change.** <http://www.edic.wur.nl/UK/Courses/Overview+Courses+2007/>

Wageningen courses of interest:

29 Oct - 10 Nov 2007. **Landscape functions and people - applying strategic planning approaches for good natural resource governance.** Bangkok, Thailand. Application deadline: 15 September 2007

4 - 22 Feb 2008. **Participatory planning, monitoring & evaluation - managing and learning for impact.** Wageningen, Netherlands. Deadline for applications: 4 Jan. 2008

Openings

PhD position in Multi-Agent Social-Ecological Systems Modelling. Center for Tropical Marine Ecology in Bremen. Deadline for applications: 15 Sept. 2007.

Researcher sustainable mobility. Information Technology, Ghent University, Belgium. Deadline for applications: 15 Sept 2007. http://ec.europa.eu/eracareers/index_en.cfm

Links

Encyclopedia of Transnational Governance Innovation: The editorial board invites contributors: www.etgi.co.uk.

Online Access to Research in the Environment coordinated by the UNEP, Yale University, and leading science and technology publishers. <http://www.oaresciences.org/en/>

Fraser Basin Council, British Columbia, Canada: **Experiences in Sustainable River Basin Management.** <http://www.fraserbasin.bc.ca/>

The **World Future Council** is a new voice in the global political arena that draws on shared human values to champion the rights of future generations, and works to ensure that humanity acts now for a sustainable future. <http://www.worldfuturecouncil.org/>

From conflict to collective action: Institutional change and management options to govern trans-boundary water courses German-Israeli-Palestinian research initiative. <http://collective.water.umweltoekonomie.tu-berlin.de/collectivewater/>

New Publications

Draft Manual on **Incorporating Biodiversity into Integrated Assessment of Trade Policies in the Agricultural Sector** available online: <http://www.unep.ch/etb/areas/biodivAgriSector.php>

Macartan Humphreys, Jeffrey D. Sachs, Joseph E. Stiglitz (eds). 2007. **Escaping the Resource Curse (Initiative for Policy Dialogue at Columbia: Challenges in Development and Globalization)** Columbia University Press.

Thomas B. Fischer. 2007. **Theory and Practice of Strategic Environmental Assessment: Towards a More Systematic Approach.** Earthscan Books.

David J. Hess. 2007. **Alternative Pathways in Science and Industry Activism, Innovation, and the Environment in an Era of Globalization.** MIT Press.

Chris Blackmore, Ray Ison, and Janice Jiggins (Guest Editors). October 2007. Special Issue: "Social Learning: an alternative policy instrument for managing in the context of Europe's water" in **Environmental Science and Policy.** Volume 10, Issue 6 pp. 493-586 <http://www.sciencedirect.com/science/journal/14629011>

Richard E. Saunier and Richard Meganck. 2007. **Dictionary and Introduction to Global Environmental Governance.** Earthscan Books. <http://shop.earthscan.co.uk/ProductDetails/mcs/productID/777/>

Andrew Farmer. 2007. **Handbook of Environmental Protection and Enforcement: Principles and Practices.** Earthscan books. <http://shop.earthscan.co.uk/ProductDetails/mcs/productID/686/>

Arjen E.J. Wals. 2007. **Social learning towards a sustainable world: Principles, perspectives, and praxis.** Wageningen Academic Publishers. ISBN 978-90-8686-031-9

David Molden (ed). 2007. **Water for Food, Water For Life: A Comprehensive Assessment of Water Management in Agriculture.** Earthscan Books.

Funding

With a budget of €2.143 billion, LIFE+ is a funding instrument providing specific support for the development and implementation of European Community environmental policy and legislation and resulting thematic strategies. It comprises three components: Nature & Biodiversity, Environment Policy & Governance, Information & Communication. For more information: <http://ec.europa.eu/environment/life/funding/lifepius.htm>

Call for Submissions

The E-Journal "Integrated Assessment" for your publications: www.iajonline.org
TIAS Members are encouraged to submit feature articles and/or news items for future issues of TIAS Quarterly. Contact Caroline van Bers cvbers@usf.uos.de

The TIAS Quarterly

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