IAHS Newsletter

NL92 November 2008

The 8th IAHS Scientific Assembly will take place at the Joint International Convention with the International Association of Hydrogeologists in Hyderabad, India, 6–12 September 2009. See http://www.appliedhydrology.org/iahs for details

Hydrological Extremes in Small Basins

Report from the 12th Biennial Conference of the Euromediterranean Network of Experimental and Representative Basins (ERB), in Cracow, Poland, September 2008.

Participants happily assembled on the steps of the Research Centre for Natural Sciences at the Campus of the Sixcentenary of the refounding of the Jagiellonian University, Poland (photo courtesy M. Zelazny).

This event was convened jointly by the Euromediterranean Network of Experimental and Representative Basins (ERB), IHP/UNESCO North European FRIEND Project 5, IAHS PUB, and the Institute of Geography and Spatial Management, Jagiellonian University, Cracow, and >100 people from 21 countries attended. *Continued on page 14.*

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STAHY = IAHS Working group on Statistics in Hydrology

New Statistical Tools in Hydrology

The first STAHY workshop was held in October 2008, Capri, Italy, during the symposium The Role of Hydrology in Water Resource Management. Among several topics, particularly interesting was the speculation on climate change where Demetris Koutsoyiannis explained the critical role of the statistical approaches that should be used in identifying the stationarity of the series and the long persistence. His suggestion, to apply non-static statistics (Kolmogorov-Hurst statistics) to analyse possible effects of climate change on meteorological and hydrological time series seems to be of great importance …. *Continued on page 9.*

River Basins – From Hydrological Sciences to Water Management

The 9th Kovacs Colloquium Report, plus the Conclusions and Recommendations

Kovacs colloquia are designed for discussion. The invited speakers bring their cutting-edge scientific and applied research expertise to a forum that ensures an integrated approach to the hydrological sciences, their practice, application, policy, etc. *See page 3*

Science Focuses on Snow

Snow plays a central role, as a water tower, in Switzerland's capacity to provide water for downstream users. As climate change will have far-reaching consequences for snow conditions, so too will it affect Switzerland's capacity to export water in the future. Research into climate impacts on the availability and use of water is an important part of the Swiss National Research Foundation programme no. 61, which starts this autumn.

Continued on page 10

Need to link up models? The OpenMI can do it for you

The trials and tribulations of attempting to feed information from one model into another were the driver for the Open Modelling Interface – OpenMI. This standard and its supporting software is now available for all researchers to use. Many hydrological and related models are now OpenMI compliant, and the approach is fast developing as an international standard for model linking.

See page 12 for details.

A Note to Members

My last "Note to Members" ran to a page and a half in the Newsletter. This time I shall try to be less verbose and focus on just one topic: that of co-operation between IAHS and other associations.

IAHS was founded back in 1922 by the International Union of Geodesy and Geophysics (IUGG) as one of seven (now eight) member associations, each responsible for one aspect of the geosciences. It is this structure that gives our Association its international legitimacy and also, we must not forget, valuable financial resources. In August this year, Pierre Hubert and I attended a meeting of the IUGG Executive Committee at which the representatives of the International Association of Geodesy (IAG, *www.iag-aig.org*) made an interesting presentation on their project entitled GGOS: Global Geodetic Observing System. We were somewhat surprised to hear them speak of its value to hydrology and meteorology, that is, until we realized that they were speaking of the results now being obtained from the GRACE satellite on changes in the distribution of water above and beneath the surface of the Earth. Our IAG colleagues are well aware of the need to involve hydrologists in their work with GRACE and similar missions, and so we discussed the possibility of IAHS experts meeting with IAG/GRACE experts to discuss current progress in the use of this technology and what the future might hold.

I sought advice from some members of the IAHS Bureau and the final outcome is that I have established an IAHS Task Force on the Use of GRACE Data chaired by the President-elect of ICGW; Chunmiao Zheng (*czheng@geo.ua.edu*). The main focus of the Task Force is to develop plans for holding one or two sessions on the subject at the next IUGG General Assembly that will be held in Melbourne, Australia, in June/July 2011. However, their terms of reference are fairly wide and so, if you have experience in the use of GRACE data and/or have ideas as to what we and IAG might do together on this topic, please do get in contact with Chunmiao.

This is an encouraging development because it responds well to IUGG's desire that the Melbourne Assembly include a larger number of joint inter-association activities and sessions than has been the case in the past. Our plans for the Melbourne Assembly must be nearly complete by the time of our Assembly (joint with IAH) in Hyderabad next September, and so the Commissions and Working Groups of IAHS have already been asked to start the planning process. It is not easy to plan an IAHS session; it is considerably more complicated to plan a session that will be jointly convened by two or more associations. So I would encourage you to spend some time looking through the web sites of the other six IUGG Associations, using the links from the IUGG web site – *www.iugg.org* – with the aim of identifying topics which might be of interest both to them and to us. I would be pleased to receive your proposals – *arthuraskew@greenmail.ch*.

I have already mentioned the next IAHS Assembly which, as you will certainly know by now, is being organized as a Joint International Convention with our colleagues from the International Association of Hydrogeologists (IAH). This truly is a major inter-Association project and one that looks set to be a great success. If, instead of adding the "S" to IAH to make IAHS you add an "R" you have the International Association of Hydraulic Engineering and Research (IAHR). Over the years, IAHS has co-operated with IAHR on various projects and so, when they recently established a Working Group on Applied Hydrology, we approached them to enquire as to what they planned to do. One outcome has been the establishment of an IAHS-IAHR Joint Project on Climate Change. In October a joint working group used the opportunity offered by the IAHS International Symposium on the Role of Hydrology in Water Resources Management to meet and agree on plans for the first phase of this project. The IAHS experts on this team are Valentina Krysanova, Nigel Arnell and Esko Kuusisto. The current plans are to prepare a report on the current state of knowledge as regards the impact of projected climate change on the hydrological regime and the extent to which these impacts are recognized and taken into account in setting standard practices and procedures for the planning, design and operation of water works. Early results will be presented at our Assembly in Hyderabad next September and the final report will be presented at the next IUGG Assembly in Melbourne in June/July 2011. Roberto Ranzi of IAHR is acting as chair and Valentina Krysanova (*krysanova@pik-potsdam.de*) as vice-chair for the next year, after which they will exchange roles (see article by Valentina, see p. 9).

There is no denying IAHS's pre-eminent position as the only international association devoted to scientific hydrology, but it cannot fulfill its objectives by working entirely on its own. It is often at its most effective when it works in co-operation with such intergovernmental organizations as WMO and UNESCO and other non-governmental associations such as IAG, IAH and IAHR. There can be no doubt that such co-operation will remain and grow in importance in the years ahead.

Arthur Askew, IAHS President

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Articles from IAHS members on all aspects of hydrology and related topics are welcomed for publication in the Newsletter. They should be sent to the IAHS Secretary General, Pierre Hubert, preferably to: *pjy.hubert@free.fr*, or to: IAHS, UMR Sisyphe, Université Pierre & Marie Curie, Case 105, 4 Place Jussieu, 75252 Paris Cedex 05, France

Advertisements may be placed in the Newsletter, or inserts may be mailed with it, at the discretion of the IAHS Secretary General. Contact: *cate@iahs.demon.co.uk*

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River Basins – from Hydrological Science to Water Management

Ninth Kovacs Colloquium Report, with Conclusions and Recommendations

6–7 June 2008, UNESCO, Paris

Ioulia Tchiguirinskaia, Siegfried Demuth & Pierre Hubert

This report of the 9th Kovacs Colloquium intends to reflect the general tone, as well as the substantive issues discussed during the Colloquium, and present the conclusions and the specific recommendations that were drawn from the plenary papers. The discussion and debate at the Colloquium strongly supported these recommendations and also raised further questions and unsolved problems in ongoing hydrological research and water management.

Colloquium Background

The Kovacs colloquia are an 18-year-old tradition. They are scientific events jointly organized by the International Hydrological Programme (IHP) of UNESCO and IAHS just before the biennial sessions of the IHP Inter-Governmental Council, and are generally devoted to the challenging fields of water resources research. UNESCO and IAHS, other organizations, governmental agencies, the scientific and interested lay communities have a strong need for objective and credible analyses, assessments and recommendations on crucial issues of hydrological research. The Kovacs colloquia were designed to elicit just such information, to facilitate the international exchange of new ideas and address their most relevant applications.

A colloquium is a discussion meeting. The Kovacs colloquia follow a format in which prominent invited speakers expose their cutting-edge scientific or applied research during a 30-minute lecture, followed by a 15-minute question-and-answer session. Hence, the speakers do not present scientific research *per se*; rather they bring their scientific expertise to a discussion that ensures an integrated approach to important issues of hydrological sciences.

IAHS Publication 323 publishes the plenary papers with the conclusions and recommendations arising from them. The papers are:

De l'hydrologie du bassin à la gestion intégrée par bassin versant / From watershed hydrology to integrated watershed management *Jean-Pierre Villeneuve, Sophie Duchesne, Jean-Pierre Fortin & Alain N. Rousseau*

Bridging the gap between knowledge and policy action: Land use is the key – Confidence is the condition *Giselher Kaule & Hans-Georg Schwarz-v.Raumer*

An overview of water resources systems modelling in South Africa *Caryn Seago & Ronnie McKenzie*

Knowledge Management of water resources in El Salvador *Ana Deisy Lopez Ramos*

Romanian national strategy for flood risk management *Lucia Ana Varga, Daniela Radulescu & Radu Drobot*

Sustainable water management by maintenance of the natural environment in river basins *Elena Asabina*

Water-quality monitoring and process understanding in support of environmental policy and management *Norman E. Peters*

Gestion intégrée et participative des ressources en eau: une perspective de sciences sociales / Integrated and participative river basin management: a social sciences perspective *Bernard Barraqué*

The changing Indian scenario: from river basin studies to water management studies and its scientific rationale *P. Rajendra Prasad*

Measurements, models, management and uncertainty: the future of hydrological science *Keith Beven*

This year, ten internationally recognized speakers delivered lectures during the two day Colloquium. The presentations are published in IAHS Publication 323, *River Basins – from Hydrological Science to Water Management*; the abstracts and Preface are at: http://iahs.info/redbooks/323.htm. Over 100 experts from across the world attended the 9th Kovacs Colloquium. The very positive response of many participants was the best reward for the organizational efforts.

Prospects: Opening Session of the 9th Kovacs Colloquium

The opening addresses were given by Dr András Szöllösi-Nagy (Director, Division of Water and Secretary of IHP/UNESCO), Dr Arthur Askew (IAHS President), Dr Siegfried Demuth (Chief, Hydrological Processes and Climate Section, Division of Water Sciences, IHP/UNESCO), and Dr Pierre Hubert (IAHS Secretary General).

Mr Szöllösi-Nagy emphasized how the Colloquium bridges the gap between the science community and policy makers, being held prior to the IHP Inter-Governmental Council, the decision-making part of the IHP. The IHP Council devoted the colloquia to George Kovacs, who valuably served both organizations, being both Chairman of the Inter-Governmental Council of the UNESCO-IHP and President of IAHS, and who made important contributions to the basics of our science. He remarked: what we want today is not the basics of the science, but the recipes as to how these basics should be applied. And, he explained that for 20 years the IHP programme has tried to move closer to policy making areas in order to link the science community and policy makers; it is not a secret that, often, the policy-making decisions are based on outdated science. It is timely to bring together the policy people and the scientists to discuss how this gap could be closed. Political communities need inputs from the science community to keep updated.

Mr Askew underlined the importance of the trianglular structure between WMO, UNESCO/IHP and IAHS, with one of the branches being the UNESCO–IAHS link that strengthens both organizations, especially because IAHS is nongovernmental. He recalled the time when the hydrologists focused on the hydrology within river bodies, rather than river basins, and expressed his personal satisfaction that we are all back to the river basin, since this is the basic unit of hydrology, even if it is a more difficult issue. And, for management, we should start at the river basin scale and then we can zoom to a local scale and possibly to a global one.

Mr Demuth presented the framework of the Colloquium and its relationships with the IHP-UNESCO activities, acknowledging the close cooperation between IAHS and IHP-UNESCO on the preparation of the Kovacs Colloquium Then he stressed that the integrated river basin management gets more and more important in many parts of the world. Changing the river basin management and design practice would strongly influence our current understanding of the hydrological processes. With this Colloquium, UNESCO aims to foster and intensify the dialogue between scientists, managers, law and policy experts, all stakeholders in addressing locally-defined water-related science and manage-

ment issues. He stressed that a holistic point of view within the river basin is needed. There is also a need to translate scientific knowledge into policy-relevant tools. One good example of this had been made in Europe with the implementation of the EU Water Framework Directive, together with the EU Flood Directive and the Water Scarcity Directive.

Mr Demuth explained that UNESCO invests considerable resources in global change issues and highlighted two cross-cutting IHP programmes: HELP (Hydrology for Environment, Life and Policy) and FRIEND (Flow Regimes for International Experimental and Network Data) that deal with topics tackled by the Colloquium. The HELP initiative has established a global network of catchments to improve the links between hydrology and the needs of society; it intends to provide a platform for sharing experiences across an international network. Within the FRIEND framework, the project focus was now on assessing the impact of land-use and climate changes on hydrological processes within river basins. This allowed exploration of best practices, adequate approaches and adaptation strategies for river basin management at various scales.

Colloquium Scope

The scope of this Kovacs Colloquium was very broad: from modelling the river basin to process understanding, issues dealing with uncertainties, decision support systems and knowledge management, so providing an excellent opportunity for specialists from diverse disciplinary backgrounds to exchange research results and ideas, and critically examine our efforts and abilities to respond to the challenges posed. Mr Demuth expressed his personal conviction that the stakeholder dialogue and capacity development measures are the principal challenges. He suggested that one of our main targets for the future would be bridging the gap between the decision makers interested in scenario analyses of a range of options, and scientists interested in improving the approaches, models and decision-making processes. He was sure that UNESCO's water science sector would be delighted to share the ideas and results of the Colloquium, and to establish a new scientific network to discuss the environmental, policy and water management related issues.

Mr Hubert took the audience through an exciting philosophical lecture constructed from personal considerations on the notion of river basin. He started from references defining "the river basin" and demonstrated how that alone could be a complicated topic. The concept of the river basin can be traced back to the emergence of so-called "scientific hydrology", which in turn can be traced to the first notion of hydrological balance, which has probably existed from antiquity. Then he demonstrated how a classic hydrological exercise, computing the Gravelius basin coefficient, turns out to be an impossible task: the smaller the length scale used to measure the perimeter of a basin, the longer is the perimeter measurement! A real organization of the data appears on a log-log plot, thus a quantitative link exists between the empirical statistics and the corresponding scale, i.e. empirical evidence of scale invariance. With this example Mr Hubert illustrated how such a supposedly technical and routine choice of model could be fraught with many consequences.

Principal Findings: The Plenary Sessions

The Colloquium began with the future of hydrological science: Keith Beven gave a remarkable lecture on models, management and uncertainty. He described a paradox of modelling. The more complexity we introduce, the more parameters we create. Hence, if we have no independent information to identify those parameters, the more equifinality we end up with, in terms of accessing multiple model structures. As scientists, we like to improve our working hypothesis over time, although we do not expect our science to develop over time. But at the moment there is a real question about how we can test the hypothesis, and how we are actually able to show that we are doing better in representing the system. From Mr Beven's viewpoint, the answer is in the data and a new theory alone would not be enough: "*We need better water level measurement, better techniques for closing the water balance. One thing we would really learn from would be to achieve a method of discharge estimation that we could use incrementally down river basins to give us incremental inputs. And it would be really nice to have continuous subsurface storage measurements*". Therefore, according to Mr Beven, a world renowned modeller, the focus in the future should be oriented to new and more accurate measurement techniques.

New experimental designs and new tools for measurement at various space–time scales to accommodate emergent properties of complex catchment systems are still needed, and could be formalized as future IHP-HELP and IAHS activities.

In the second lecture, Bernard Barraqué outlined the possibilities offered by social sciences for an integrated and participative river basin management. The principal message was for the stakeholders and modellers to share a common vision of the river as a policy issue. This generated a discussion. In particular, it was pointed out that this presentation highlighted the value of an independent peer-reviewed physical science, i.e. without government-agency interference, and the results of that science. As Mr Barraqué said: "*the river has no opinion on this matter*", and so the independent peer-reviewed scientists, as participants in the process, should keep their own role and come to the table with facts only, and so help to adjudicate conflicts amongst the stakeholders. Scientists obviously need to know as much as they can about how much water is flowing, and the potential ecological impacts if one abstracts too much water or does it at the wrong time. He clarified how scientists could be influenced by other actors of integrated and participative water management. To his point of view, the scientists would not only have to bring what they know or what they traditionally build as knowledge, but they would have to answer questions from the audience, i.e. the stakeholders. Hence the scientists would start the research "*with their own tools and their scientific approaches from some questions that appeared to be relevant to the stakeholders, even if in their opinion these questions might not be relevant*".

Jean-Pierre Villeneuve took the audience through a comprehensive overview of hydrological models. He reviewed the role of mathematics and computer simulations in currently-practiced hydrological science, "from watershed hydrology to integrated watershed management". Future hydrological models need to be, first of all, as simple as possible. Another important requirement for successful integrated water resources management is the possibility to take account of economic aspects and social behaviour, and their dynamics, while making decisions. Therefore, the principal recommendation is that the next generation of models integrate socio-economics with hydrology while keeping the models simple enough.

Rajendra Prasad's lecture on *The changing Indian scenario: from river basin study to water management*

studies, and its scientific rationale ranged from scientific scenarios to present management studies. He illustrated how dominant the groundwater component is for water use in India. Concerning surface water, he first showed the mismatch between the boundaries of river basins and of administrative entities in India. Then he commented on the concept of management of rivers that flow across state or international boundaries, and how it complicates the situation. In India, the hydrologists are not working on water management within river basins, but rather on management within administrative units gathered together into coherent entities. The latter reflect, to quite a large extent, the areas of concern that are coming under focus in India today.

Giselher Kaule provided a stimulating illustration of applied research according to which, the *Land use is the key – Confidence is the condition*. He emphasized the long-term nature of developing relationships within a community. The important lessons from this presentation were that end-user driven research and the visibility of the scientists in the community are the two key elements of success. The discussion included interesting practical questions, e.g. how to maintain the credibility of a scientist working very close to a community? How to maintain, with a community, the continuity in running long-term projects? This is a major challenge since, for long-term projects, one must have catchments with a long record, long-term modelling and experiments which are important in terms of ecology, sociology and hydrology. Another question concerns the fact that scientists and academics are evaluated on the quality of their peer-reviewed journal papers, and it remains very difficult to publish something that is so applied. Mr Kaule's answer to this was that the present research system reserves this type of applied research project exclusively for senior scientists. Young scientists, unfortunately, are prevented from doing it by the need to nurture the successful beginning of their scientific careers. Thus, a challenge is to change this situation within the scientific community.

Mr Kaule emphasized that there should be a kind of social acceptance of integrated water resource management before it could become effective. There must be a willingness to cooperate between scientists and policy makers, and all the stakeholders sitting around the table. Indeed, the big barrier to the success of integrated water resource management is the psychology of the people involved. Thus, identification of the networks working together is a necessary precondition for integrated water resources management.

The final lecture of the first day was by Norman E. Peters on *Water quality monitoring and process understanding in support of environmental policy and management*. He emphasized that air, water and solids are linked; but we still know very little about sources of water quality. He suggested that we need to increase our knowledge about processes by continuing major projects of monitoring integrated and interdisciplinary environmental response for certain issues, and suggested doing it almost collectively, as a global response. "*It is no longer one person that can go up and do one little piece. We need to incorporate all the pieces to really increase our knowledge*". Mr Peters recommended looking at the watershed response with respect to proposed changes, environmental factors and drivers, in cooperation with stakeholders, including the community, managers and policymakers. He emphasized that before we instrument and implement the technological advances, we need to look to all these facts in the integrated framework.

The second day started with Ana Deisy López Ramos's lecture on "*Knowledge Management of water resources in El Salvador*". She gave surprising details about floods and inputs for food and health, which require quite different types of data. She illustrated software products which have been developed in El Salvador. It was important that the author came to these challenges from the management point of view, as well as from the point of view of impacts on people. The majority of participants in the room, being hydrologists, naturally would think of the river systems first, by taking measurements and then modelling. Mrs López Ramos first discussed the problems and the needs of the people in her country and only then what the data, information, knowledge and understanding required in order to approach the priority challenges.

Daniela Radulescu presented the *Romanian national strategy for flood risk management*. In the last decade alone, more than 2200 major and minor water-related disasters have occurred worldwide. Half of these were due to floods, while droughts have accounted for about one-eighth. She made a strong point concerning the impact of a recent disaster on governmental decisions for the future development of hydrological programmes. Her lecture was followed by a very fruitful discussion on different aspects of the operational system of water management in Romania.

Elena Asabina addressed *Sustainable water management by maintenance of the natural environment in the river basin*. The idea of using the non-populated part of the basin as an indicator of its natural sustainability, and the developed part of the basin as an indicator of changes, was considered as "*an interesting approach to the natural sustainability*". In many parts of Europe there is nothing natural left, so this approach of defining natural conditions as a goal to aim for, in terms of sustainability, is difficult. But it is possible that in some Russian basins, areas remain that are relatively undeveloped, and would enable assessment of what is natural, despite climate variability in time. The uncertainties are such that it can be very difficult to distinguish, in terms of sustainability, the climate impact cf. other changes, or indeed improvements.

The final lecture was by Caryn Seago: *An overview of water resources systems modelling in South Africa*. Her presentation confirmed that South Africa has some unique issues that require careful water resource management, which can be obtained with the help of stochastic modelling. Some were discussed with respect to the hydro-ecological requirement for analyses for the future. Particular attention was paid to the question of how climate change has been considered in that context, whether any protection/ considerations for water transfer strategies were developed, and whether such strategies are special for a country with rather low precipitation? Mrs Seago reported that the country has developed useful techniques which are continuously being improved and updated. Therefore, countries facing similar water management issues are encouraged to consider using these techniques.

From Findings to Recommendations: General Discussion

Mr Kaule began the discussion. Reviewing the contributions of the two days, he considered that one statement was continuously repeated: that extreme events, natural or man-made hazards, remain the driving force for changes and for the acceptance of changes in society. He argued that on the larger scale, the work of the last decade was very successful,

so that, e.g. real-time flood forecasting was much improved. Climate predictions showed that the rain events in small catchments would become more frequent, but their return periods remain very large compared to the time scales investigated by sociologists. The sociological results showed that the time taken for the population to believe and to react correctly to extremes is about two years, whereas after five years have passed the event is generally forgotten. Thus the expectation of the society mismatches the predictions or the warnings that can be carried out. He suggested that hydrologists might need additional and better support mechanisms for implementing their results, rather than just hoping that the next catastrophe will support them.

Mr Demuth responded to this comment with the example of the 2003 drought that affected many countries in Europe. The European Union has reacted to this catastrophe with the decision to produce the Water Scarcity Directive. Therefore, the 2003 drought was not forgotten and had put a strong emphasis on the scarcity of water resources within the European Community. Regarding the extremes that become more frequent and severe, Mr Demuth referred to a study performed in the framework of the FRIEND community on the frequency and severity of droughts in Europe. One of the principal findings was the non-conclusiveness about both the frequency and the severity increases of river droughts. The explanation was found in the data: of about 600 basins in Europe, only two stations had data records >90 years; the other stations all had <30 years of data. It was also found that the initial parameters, the storage capacity of the catchments, and the selection of the time window within the time period, influence the results and make them more inconclusive.

Returning to colloquium theme, Mr Khan suggested a debate on the idea that the new catchments should include a lot of sociology and economics, and non-hydrological issues that might become hydrological ones, in terms of livelihood and getting some kind of balance. "*Where are the frontiers in terms of taking hydrology to the next step?*" he asked.

The discussion that followed was very lively, touching on crucial issues as to the nature and future of hydrological sciences. Although the participants were happy to accept a wider context for hydrological sciences, the question of the new frontiers divided them into two clusters. The first prioritized the management cause and pushed forward the concept of virtual water; the second was more inclined to qualitative and fundamental changes in classical hydrology and remaining attached to physics. In spite of the divergent view points, it was agreed that both approaches are necessary to cope with today's challenges.

Mr Young stressed that, as hydrologists, it was rather reasonable to think of the river basin as a basic hydrological unit and to work within that unit. But, at the same time, he suggested that we should stop thinking of water management issues as being constraints within the river basin, since such issues are not related simply to the river basin. There are many management decisions related to the water which goes far beyond the river basin; e.g. food production, which is water dependent, but the food is not necessarily consumed within the basin, and maybe transported outside the basin. This example introduced the concept of virtual water: the benefits of water can result outside the river basin. Referring to the map of Quebec presented by Mr Villeneuve, he explained that part of Quebec's hydropower is produced in New England; another example of the benefits of water from a basin being transported elsewhere. There are many more examples of such virtual water transport, so we should not limit our thinking to within a river basin unit. From another perspective, many water management issues are very local issues. In particular, sanitation and health issues or drinking water supply issues, are often extremely local, and do not need to be considered at much larger river basin scales. Thus, we should not think only from the river basin view point, i.e. from hydrological science to water management. If we think in terms of benefits to society, we need to put water management considerations first. Only then should we consider what the other problems and challenges are and how hydrology and the knowledge of hydrological systems can contribute to solve these challenges: "*It is just a suggestion that we might put management first and then water science understanding second*", he stressed.

The feedback on this from young researchers was enthusiastic. For example, one young participant, coming from a doctorate dealing with water from a technical side, acknowledged the usefulness of the issues discussed. "*I want to thank everybody because I have been learning a lot in these two days*". She explained that at the beginning of her scientific career, she realised that there must be another level on which water problems should be discussed, because despite the very good and strong technical skills that modellers have shown, the management problems remain unsolved. She reminded the audience that the virtual water concept was fully theorized in a new discipline called *water politics* and suggested that this discipline might become the ground for the discussions of the experts from different communities.

Mr Askew commented that scientists from other disciplines look at the things from other angles. And it is very easy for us in the hydrological community to see everything flowing according to Saint Venant and Darcy without realising that other communities, which have an equal right to view the phenomena, particularly from the social, economic and political points of view, may see things differently.

Regarding water management, Mr Peters recalled that his presentation included an example illustrating that, when tackling water quality issues, we are no longer dealing just with water management: it is the air, land and water, and how all these interact in affecting the quality of water. Atmospheric deposition, the disposal of waste on the land surface, mining, etc. are all related. Recognising that the basin concept, because of atmospheric transport, is no longer relevant, he suggested that there is a very broad context of the physical sciences that we have to start considering.

Mr Khan proposed thinking about scales and boundary conditions. These issues come out of the hydrology. We can be analysing a subsystem connected to the whole by boundary conditions; we can scale up and scale down. He drew a parallel with input–output analysis in economics. In terms of the hydrological science itself, there are important connections with other disciplines and with the needs of the society. Mr Khan suggested using the same kind of paradigm, which looks to scaling up, scaling down and the boundary conditions with links to the political processes, to the economic processes and to the bigger environmental issues as well.

Mr Larson noted that pretty much all the papers had underlined two sorts of key issues. The first is the fact that we are living in a non-stationary climate. Our traditional water balance methods are questionable in that climate. It is profoundly difficult to decide which methods to apply in the future. If we get it wrong, then we tell our governments to spend a lot of money and unnecessarily, either too much or

too soon, or wrongly. And it is a huge and difficult issue for the politicians. This non-stationary/stationary issue is an international issue that will concern hydrologists for the next couple of generations.

The second key issue is Beven's "model of everything". This is also an important direction for hydrology, this link from the cloud to the sea, in crudely-put terms, the link with meteorology and atmospheric science, the link all way through the system. And it is fundamentally changing what we can do with the modelling, and how we can provide the scientific evidence to decision makers, i.e. to the political community, in terms of the consequences.

Mr Schertzer returned to the idea that we cannot understand hydrology at a unique scale nor manage water at a unique scale. Both are multi-scale rather than mono-scale and he raised the question of how to deal with the wide range of scales. He felt that during the two days, two rather opposite points of view had developed. One was that we have a lot of knowledge, we have a lot of software and we have just to use them and that is the way to proceed from the understanding to management. But the alternative point of view called for a kind of re-foundation of hydrological sciences, in particular to be able to answer problems raised by managers. So, the basic question is whether hydrologists feel the need for a completely new approach in hydrology.

Mr Beven commented that this is important. Do we have an adequate hydrology to feed into some of these management problems? Clearly we can use the data we have got, we can use the models we have got, and we can make predictions and thus feed into a management process. But there is a real issue about whether those predictions are adequate and for the long term. He cited Mrs Seago who suggested that by taking stochastic realizations we may be covering the uncertainties. He was sceptical of the possibility of covering some uncertainties by an adequate fault; he believes we should be able to do better. Mr Beven stressed that, as hydrologists, we should be working within a wider context, but we must fit the best hydrology we can to the management process. Thus, the answer to Mr Schertzer's question would be that we are compelled to make some improvements to the hydrology to feed into that management process. But, in particular, we need better measurements, and not necessarily better models. So we need some better measurement techniques to drive and to evaluate those models. And perhaps with better evaluations, measurements and observations, we might be able to make that model improvement.

Finally, Mr Villeneuve observed that one very important topic was missing: education. As a researcher, he considers that we have an obligation to educate young generations. We have to engage personally, as a scientific community and as the society, to ensure that the future water usage will be rational, intelligent and economic. Coming generations should learn to respect water, and this would help to solve some water management problems.

Mr Askew strongly supported this important point, in particular because the Colloquium took place within UNESCO that has not only the letter "S" for science, but "E" for education and "C" for culture, and pointed out that culture is another major aspect.

Mrs Aureli noted how the topic *River Basins – from Hydrological Science to Water Management* had evoked other themes, such as education, policy and integrated management issues, and invited colleagues from regions all over the world to work with the IAHS to make the 10th Kovacs Colloquium even more universal, a truly inter- or trans-disciplinary event, with contributors coming from academic disciplines, management sciences, intercultural and media studies, economics and political sciences.

Mr Askew acknowledged the authors who had prepared such excellent papers and the participants for contributing to the discussions.

CONCLUSIONS AND RECOMMENDATIONS

Reprinted from IAHS Publ. 323, p. 149–151.

State of the Art and Achievements

- Contemporary hydrology is essentially based on mathematical modelling; "models of everywhere" are becoming available.
- Hydrological research and practices are mainly conducted at the watershed scale – a definable unit. We have to keep in mind the existing mismatches between theories developed from small-scale measurements and the scale at which that theory is applied, and between the scale of measurement techniques and the scale at which we need to apply models for management purposes.

Scientific Achievements

- The development of comprehensive detailed GIS, radar and satellite data allows the heterogeneity of watersheds to be taken into account and the use of new technologies in data analysis, so strengthening research. Models integrating these tools are better adapted to evaluate development scenarios and improve the effectiveness of the achievements in the context of integrated watershed management.
- Hydrological understanding and data strengthen governmental capability to manage water resource planning in a sustainable way.
- Watershed hydrology is the science that underpins water resource development and as such it is a necessary, although not the only, requirement for the development and implementation of fully sustainable integrated management strategies.
- Knowledge Management in water resources consists of the gathering of information about the elements of the hydrological cycle and effects on them due to human activity, but also includes activities to ensure that this information will be used by decision makers and users to improve sustainability.
- The water resources system analysis must provide analytical decision-making tools for optimum utilization of available resources and to facilitate development planning to satisfy the increase in water demand.
- Watershed hydrology develops better understanding of biophysical linkages within freshwater ecosystems and provides water resource planners and managers with

information on the costs, benefits and trade-offs of activities.
- In many watershed areas it has became difficult to maintain the hydrological balance in the biosphere that provides the stable replenishment of water resources in river basins.
- The Flood Risk Management Plan is a key-component of the River Basin Development Plan, and should integrate all measures for flood risk management, and be based on regional development strategy, including the options and the interest of communities.
- There is still a gap between the high level of environmental knowledge and policy action. Policy action is often not caused by model results. It is mainly forced by natural hazards and the visibility of global changes at the local scale. There is a lack of cooperation between scientific institutions, operational structures and policy administration.
- Confidence between the policy administration and scientists is the most important key for implementation and launching results. Confidence building between scientists and politicians is a long bilateral process.
- An interface between numerical hydrological models and policy implementation in river watersheds can be formed by land use and land-use changes, since they are the only factors that can be influenced in a short and medium time horizon.
- Watershed hydrology must fit within a holistic framework with other sciences to work together to develop new management approaches. Socio-economic analyses are indispensable integral parts of sustainable water resources management, including the analysis of their impact on the environment.

Recommendations

- Since representation of hydrological processes and the predictions of hydrological models will remain uncertain, two important issues that must be addressed in the future hydrological science are:
  (a) how to estimate that uncertainty (in both gauged and ungauged catchments) and constrain it using the most informative measurements;
  (b) how to present and use the uncertainty in management decisions.
- Solution of these issues will require a framework for spanning scales, for assessing the real information content of observations when testing models as hypotheses about system response, and for robust decision making under uncertainty.
- Greater coordination should be made in the establishment, maintenance and expansion of data networks, and in the installation of technological survey tools to allow development of the most up-to-date information and knowledge.
- Sustainable water resource planning requires a qualitative improvement of data sharing amongst governments, development agencies, and research and academic institutions.
- More detailed investigation of climate variation and the effects of global climate change is necessary, being an important factor in water resources management along with changes in land use, economic development and population growth. In this context, the methods of time series analysis must be improved, making best use of GIS technology, supported by extensive regional analyses.
- We need to pay more attention to groundwater due to its increasing importance as a resource for freshwater supply and irrigation. For watersheds where groundwater is a major part of water resources, effective algorithms need to be developed to evaluate and quantify the local resources, incorporating the heterogeneities of the rainfall, flow patterns and hydrogeological conditions.
- The implementation of the EU Water Framework Directive requires important efforts to improve and standardize the methods of monitoring and analysis of water quality parameters. This requires the introduction of improved indicators of water quality and ecosystem status in water bodies. Efficient mathematical models are indispensable for water quality analysis, particularly for the mitigation of the consequences of water pollution accidents.
- Water quantity and quality are often evaluated by economic necessity and financial gain allocated to water resources. More studies should be devoted to estimation of the quantity and quality of water by evaluating the natural environment conditions in river basins and the condition of the aquatic ecosystem.
- Sustainable water resources management and application of the EU Water Framework Directive cannot be achieved without improved understanding of the water balance under natural conditions and when exposed to change due to human activity.
- Mechanisms for improving renewable water resources in watershed should be strengthened. Priority must be accorded to undertaking eco-restoration works.
- Flood risk maps needs to be provided to increase public awareness of the areas at risk of flooding and to supply information by defining flood risk zones to give input to spatial planning. A clear flood risk map supports the processes of prioritizing, justifying and targeting investments in order to manage and reduce the risk to people, property and the environment.
- It is important to strengthen the cooperation between regions and countries that share watersheds. Mechanisms must evolve for sharing the river waters during deficit rainfall years, normal rainfall years and extreme rainfall years.
- Innovative sociologists and political scientists should make proposals together to combine knowledge building and democratic decision-making processes, which were separated until the rise of the Nation-State and its involvement in the economy.
- The time required for confidence building is longer than the average project duration, thus new project and cooperation structures must be developed. New organization schemes are needed in addition to the re-launching of top-down structured research programmes.
- To encourage the creation, the structuring and the exchange of information, specific mediation projects and the implementation of mediation structures are recommended.
- Continuing education is recommended within the respective technical services, in order to improve the use of efficient hydrological models. Long-term learning by water professionals at all levels, not forgetting the training of decision makers, stakeholders and the general public, must be recognized as an important precondition of the successful application of advanced techniques of sustainable water resources management methods.
- Redistribution and decentralization of financial research resources from the EU to lower administrative levels are recommended to enable the countries and regions to structure applied research directly with respect to their needs.

Reports from IAHS Commissions and Working Groups

New Statistical Tools in Hydrology

The first STAHY Workshop *Continued from p. 1*

for the ongoing discussions in this field. The many facets of hydrological application of statistics and the innovative character of research in this field became especially evident in two contributions: Simon-Michael Papalexiou introduced a new distribution for IDF curves and Alberto Montanari described the uncertainty of hydrological forecasting, proposing a procedure to identify the distribution of errors. Other presenters showed interesting applications, e.g. using copula functions and other sophisticated methods. The applications were dedicated to regionalization, inference procedures on distribution functions useful for hydrological applications, multifractal measures, Bayesian and bootstrap approaches.

A video with the first-day presentations, and pictures of the second-day session, are available at: http://www.stahy.org.

The following initiatives were approved:

- A short course: *Copula Function: Theory and Practice* Columbia University, Polytechnic Institute of New York Universities, New York City, 18–25 July 2009.
- The next official STAHY Workshop will be held in May 2009, in Catania, and organized by Antonio Cancelliere.
- To include the following topics at the STAHY website, and people to collect materials were identified:
  Copula (Salvatore Grimaldi, Francesco Serinaldi, Tomas Bacigal, Emna Gargouri)
  Time Series Linear Modelling (Marcella Corduas, Antonio Cancelliere)
  Distibution Function (Francesco Laio, Ronald van Nooijen, Alla Kolechkina Mauro Naghettini, Iwona Markiewicz, Valerio Noto).

Everyone present at the meeting gave their availability to help the Working Group in developing the webportal, and we hope also that other scientists, who have already given their availability to the Working Group, but were not present in Capri, will actively contribute to the STAHY activities proposed and approved during the meeting.

Capri, 15 October 2008
Salvatore Grimaldi & Andreas Schumann

ICCE – Continental Erosion

The activities of the ICCE and its members continue to flourish. Several important events are planned for the next 18 months.

The symposium *Sediment Dynamics in Changing Environments* takes place in Christchurch, New Zealand, 1–5 December 2008. The conveners: Jochen Schmidt, Sandy Elliot, Les Basher, Chris Philips, Tom Cochrane and Tim Davies have been busy with the reviewing of manuscripts and they have put together an exciting programme. The main aim is "To understand sedimentary systems in changing environments", and to meet this aim the convenors have organised the scientific programme around four themes:

1. Scaling issues in sedimentary systems – from point to continents
2. Dating and source tracing technologies
3. Global change and erosion
4. Linking erosion with environmental and societal impacts: sediment production, river regulations, depositional environments, hazards & risks, management & policy

The proceedings have been pre-published as a 620-page volume (IAHS Publ. 325, available from IAHS Press). Further information on the symposium can be viewed at: http://www.civil.canterbury.ac.nz/icce2008/; or contact Jochen Schmidt, j.schmidt@niwa.co.nz.

At the IAHS scientific assembly in Hyderabad, September 2009, there will be an ICCE workshop on *Sediment Problems and Sediment Management in Asian River Basins*. For information on this workshop contact one of the conveners: Des Walling, Jim Bogen, Chunghong Hu, Anil Mishra, or Manfred Spreafico.

There will also be a symposium on *Ecohydrology: Concepts, Methods and Recent Developments*, sponsored by ICSW, ICCE, ICWQ, ICCLAS and IAH, and Martin Thoms is one of the conveners. This event will focus on the science of Ecohydrology and its contributions to the issues of environmental water allocations and the influence of climate variability on sustainable water management for aquatic ecosystems.

ICCE has a new web site and this can be viewed at: http://www.canberra.edu.au/centres/riverinelab/index_icce.htm.

Martin Thoms, Secretary ICCE

Joint IAHR–IAHS Working Group on Climate Change, the Hydrological Cycle and Water Projects

It is well known that water resources are a critical factor in many if not all facets of socio-economic development, terrestrial ecosystems and human health. This is why the vulnerability of water resources to climate change is a matter of major concern for people and policy makers at all levels. For this reason, efforts are urgently needed to improve the information we have on the expected impacts of climate change on the hydrological regime at river basin scale, and the extent to which these impacts are understood and taken into account by the water management community.

As indicated by the President in his "Note to Members", the objective of the Joint IAHR–IAHS Working Group on Climate Change, the Hydrological Cycle and Water Projects is to investigate the state of knowledge as regards the impacts of projected climate change on the hydrological regime, and the extent to which these impacts are recognized and taken into consideration by water authorities and water managers. This concerns standard practices of planning, design and operation of water works, including both "hard" responses, such as maintenance and updating of engineering structures, and "soft" responses, such as changes in legislation or operating rules of existing structures, and also includes the enhancement of non-structural measures in watersheds. The aim is to encourage the close cooperation between the scientific, engineering and water management communities in taking appropriate and timely actions in response to the impacts of climate change on the hydrological regime.

The Working Group does not intend to create a full inventory of the expected climate change impacts at the river basin scale on different continents, but to collect a set of representative examples of climate impact studies in river basins, and supplement it by an assessment of the level of recognition of climate impacts by the water engineering and water management community, and the level of adaptation to climate change considered in water management practice –

from full ignorance to planned and implemented adaptation measures and strategies.

Readers who know of case studies that are already available, and which present the results of climate impact assessments, are invited to inform the Working Group of the details using the following address: *krysanova@pik-potsdam.de*. Mesoscale and large river basins could be considered ranging from 1000 to 100 000 km^2. Inputs to the other component of the joint project, namely on the level of recognition and the level of adaptation within the engineering and water management communities, are also welcome and will be passed on to our IAHR colleagues.

First results of the project will be presented at the Assembly in Hyderabad next September and the final report will be presented at the next IUGG Assembly in Melbourne in June/July 2011.

Valentina Krysanova
Potsdam Institute for Climate Impact Research

Poor September rains cause crop losses in Kandi region of Jammu

The Kandi region of Jammu Province in India is characterized by low rainfall (<950 mm year^{-1}), undulating topography, a deep water table, low soil organic matter, light soil texture, land infested with stones and frequent droughts. Extreme water stress is experienced during summers (April to September) when even water for drinking becomes scarce. Groundwater is one of the Earth's most widely distributed natural resources and is the only replenishable mineral. Due to high evapotranspiration and surface and sub-surface flows, groundwater recharge in the region is very poor. Normally, the evaporation in the region is greater than the rainwater received during the year, except during July and August when there is a possibility of groundwater recharge. Biophysical features, such as fragility, marginality, low accessibility and resource heterogeneity, are constraints in groundwater management in the region. Frequent droughts cause low agricultural production and dependence on outside sources for food grains and other commodities. The region is affected by droughts, lasting for 1–4 years with a return period of 2–3 years, on average. Groundwater contamination has affected the health of the people; women and children in particular suffer from malnutrition. Since the women constitute the main working force, their poor health affects the socio-economic milieu of the society as a whole. Often the women have to bring drinking water from far-off groundwater sources. The human use of groundwater has taken precedence over its environmental impacts. Diseases, such as cholera, typhoid, dysentery and malaria are common. The consequences are economic losses, environmental degradation, desertification, soil impoverishment and social disorder. There is an adverse effect on water supply schemes due to the reduced flow in seasonal streams and reduced aquifer recharge. The natural water ecosystem in the region has undergone various kinds of stresses caused by frequent droughts.

The significance of water supply to crops, particularly at critical periods of crop growth, can be gauged from the fact that the luxuriant looking crops failed to attain their full potential in this area. This year, the rainfall in September was unprecedently poor, only 47 mm, cf. 125–150 mm in normal years. At this time of year, the crops reach maturity; the grain setting starts and filling takes place. The availability of water is important at this stage because its requirement is higher for many biochemical and biological processes taking place in crop plants. Visits to these areas and visual observations show that, due to extremely low rainfall, the crop grains have shrivelled and reduced in size, which would lead to poor productivity. The following problems are encountered in the region:

- Scarcity of water allocation to various sectors as a result of increase in water demand due to prevailing high temperatures, particularly for agriculture.
- Insufficient clean water supply for drinking and other uses.
- Water pollution
- Paucity of funds for operational and maintenance costs, as well as for new infrastructure.

Water availability is one of the most important indices of sustainable development in modern society. To characterize water availability it is important to have data on both its availability and the dynamics of water resources use. Water resources comprise a stable index during a stationary climate, while water use varies in time and depends on physiographic and socio-economic factors. To forecast the dynamics of water use and water availability in a region, it is necessary to analyse physiographic and socio-economic factors. Socio-economic factors include the population, irrigated area and level of socio-economic development. When assessing future water management budgets for the Kandi region, it is necessary to forecast the economic and social development in the next ~20 years. The forecast can take into account the feedback aspects of the available water resources in different water years and the criteria for creating new infrastructure. The following measures can help in sustainable water use in Kandi region:

- Changing the focus from conservation structures alone to a modern and comprehensive management pattern, such as constructing water works, promoting water saving and improving agriculture production technology.
- Comprehensive management of surface water and groundwater, rainfall, effluent and sewage
- Land-use implementation on a watershed basis.
- Establishing water saving mechanisms.
- People's participation in all water-related programmes.

Uttam C. Sharma, Vice President, ICWQ, Water Quality

Science Focuses on Snow

Continued from p.1

Engadine, Switzerland, Christmas 2098: there is hardly any snow on the lower slopes of the valley. They are white only above about 2200 m. Snow on the valley floor has become a rare phenomenon at this time of year. Winter is two to three months shorter than it was 100 years ago. Even at an altitude of 3700 m the snow no longer remains through the summer. The snowmelt reaches a peak at the beginning of May and is more or less over by June.

This scenario is based on calculations from a model devised by the Swiss Federal Institute for Snow and Avalanche Research (SLF) in Davos. For Tobias Jonas, Head of the Snow-Hydrology Research Group at SLF, just how closely it resembles the future is but one of many unanswered questions concerning the effects of climate change in the

Alps: "If the currently available climate scenarios are accurate, our calculations will on the whole be correct."

The scientists who attended the *Alpine Hydrology – Snow Hydrology* meeting, organised in Davos in mid-August by the Swiss Hydrological Commission, were unanimous: snow plays a central role in the hydrology of Alpine catchments. Snow has a far greater effect on runoff from the Alps than does the ice stored in glaciers. In Switzerland, between 40 and 90% of precipitation above 1500 m falls in the form of snow, and in the summer months up to 80% of the runoff from the Alps is melted snow. Future changes in snowpack will have major impacts on downstream users.

We need a great deal of detailed knowledge

According to Prof. Dr Rolf Weingartner, President of the Hydrological Commission of the Swiss Academy of Sciences, current knowledge indicates that in the Alps not only temperatures but also precipitation will change in the future. Most models indicate that there will be less precipitation in summer but slightly more in winter.

The challenge facing hydrologists today is to downscale these general predictions to a regional or even local context. Hydrologists are in something of a dilemma, because their models are based on those devised by climatologists. This dependence means that the approximations of the climate models are transferred to hydrological models, which are, of necessity, of much finer scale.

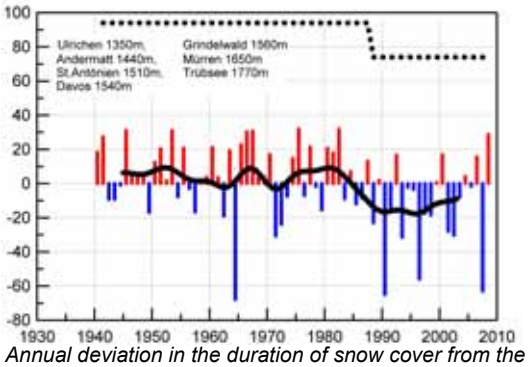
The difficulties of downscaling are easily seen. In the area immediately around a glacier snow transport by wind is central to the fate of the glacier, since wherever the snow accumulates the ice will melt away more slowly. This feature can be seen on the Arolla Glacier: thanks to this drifted snow, more ice has been able to survive on the flanks of the glacier, and may explain the persistence of this glacier in a site where, according to theories, it should not exist at all.

In a computer model, a jagged mountain summit often becomes a rounded peak as computer capacity cannot allow for a greater degree of topographic precision. This approximation is adequate for general predictions of snow behaviour in a mountain area because opposing effects cancel each other out. But, for a precise picture of what happens at the summit, much more detailed rendering is needed.

Forest is also challenging for hydrology researchers, since snow that falls on a forest behaves quite differently from that which falls on non-forested land. Part of it will remain in the forest canopy, from where it will eventually either evaporate or fall to the ground. Furthermore, the canopy protects the snow from solar radiation during the day. So far researchers have been only moderately successful in transferring these factors to a numerical model.

Despite less snow, recurring good winters

The degree of change in the Alps can be seen from a survey of the past 100 years. If we look more closely, the recent "100-year winter" of 2007/2008, which brought tourist resorts and transport companies record earnings, was only an average winter in terms of the historical record. This perception shows how limited our temporal viewpoint has become. Statistics on total snow depth and depth of new snow evaluated by SLF researcher Christoph Marty show a marked change at the end of the 1980s. Since then both snow depths and volumes of new snow have decreased considerably. In Marty's opinion it is too early to talk of a trend; "*We need to have data series from at least three decades to do statistically sound analyses. However, similar changes in the snow cover have been observed not only in Switzerland but in the whole of the Alps*".



Annual deviation in the duration of snow cover from the long-term mean for 1961 to 1990, in Switzerland, and the resulting trend (black line). The change at the end of the 1980s, which has so far not been followed by a come-back, can be clearly seen. (Christoph Marty, SLF).

What will be the consequences?

Carmen de Jong of the Savoy University Mountain Institute has already observed a growing conflict of interests concerning water in the French Alps, an area considered to have a plentiful supply. For example, following the summer heatwaves in 2003, several springs in limestone areas dried up. Farmers had to fetch water for their cattle from the valley by tractor. At the same time, the tourist sector was using an increasing amount of water to create artificial snow to ensure a good cover for skiers. This water was stored in basins and consequently was not available in the valleys. As far as the resort companies were concerned, snow-making was and is an economic necessity, since in 50 years' time only ski resorts above 1500–1800 m will have sufficient snow throughout the season. For this reason, the SLF is also studying the development of artificial snow makers, especially those machines which are able to run without using energy from other sources.

The ski pistes in Samnaun 2006: guaranteed snow is extremely important for winter sports, but snow also plays a central role in Alpine hydrology.

A new National Research Programme

These issues are among those raised in the context of the Swiss National Research Programme 61, entitled *Sustainable Supply and Use of Water*, which, if the Federal Council gives its approval, starts this autumn. For Christian Leibundgut, head of the NRP 61 management group, this programme must address not only climate change but also social and economic issues, since conflicting interests are apparent in many aspects of water use. "So far the whole hydrological system in Switzerland has been able to meet all these demands. Whether this will be the case in the future, with the new global challenges, remains to be seen. With NRP 61 we hope to be able to supply an answer to this question." The priority for this project will therefore be multidisciplinary team work – a challenge for hydrologists too.

Urs Fitze

Introduction to the OpenMI (Open Modelling Interface)

Why was the OpenMI developed?

Modelling has become an increasingly important environmental management tool for understanding a range of issues including the impacts of climate change, the consequences of remedial programmes for the environment and the effect of agricultural policy on biodiversity. With the increasing complexity of the issues and the need to support legislation such as the EC Water Framework Directive (WFD), a requirement emerged for models that could represent the interactions of multiple processes (Fig. 1 summarises the water management drivers). Building new models representing large numbers of processes was neither feasible nor a good use of the huge investment in existing models. A search therefore began to find a way to link the current models.

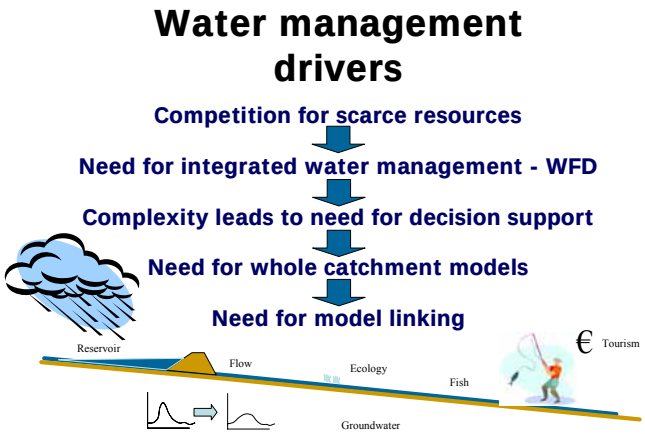


Fig. 1 Water management drivers for integrated modelling.

Following a number of attempts in which much was learned, in 2002 the EC commissioned the FP5 HarmonIT project which led to the development of the OpenMI. During the initial phase of the project, a survey of existing integrated models was made and an initial list of key model linkage requirements established (see Box). Version 1.0 of the OpenMI was released in 2006 and is now in operational use.

Key model linkage requirements

- Ability to exchange data time step by time step
- Ability to link models at different scales
- Ability to cross reference terminology (i.e. no need for a standard terminology)
- Ability to handle iteration
- Ability to run under external control
- Ability to handle most modelling concepts
- Ability to convert units
- Ability to link models running at different spatial and temporal resolutions – and interpolate and extrapolate in space and time
- Ability to revert to a previous state
- Platform independence
- No framework
- Deadlocking to not be possible
- Minimum change to existing code
- Minimum impact on performance
- Open

What is the OpenMI?

The OpenMI is a standard that defines an interface that allows time-dependent models to exchange data at run-time. When the standard is implemented, existing models can be run simultaneously and share information at each time step.

A useful analogy to understanding how the OpenMI works is to think of it as the modelling equivalent of the USB cable (Fig. 2). It allows models from different domains, based on different concepts and from different suppliers, to be linked.

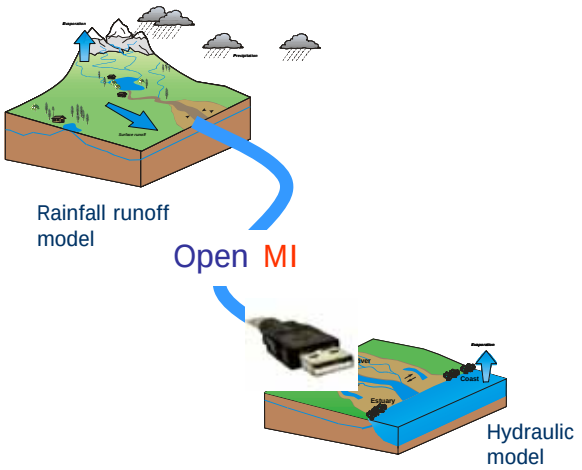


Fig. 2 The OpenMI is the modelling equivalent of a USB cable.

Once models have been made OpenMI compliant, they can be linked using a simple drag-and-drop approach. A software development kit (SDK) is provided to simplify the process of making models compliant, linking and running them. Figure 3 shows an example of model linking using the OpenMI Configuration Editor; two models are linked to each other, a user interface and tool monitoring the exchange process.

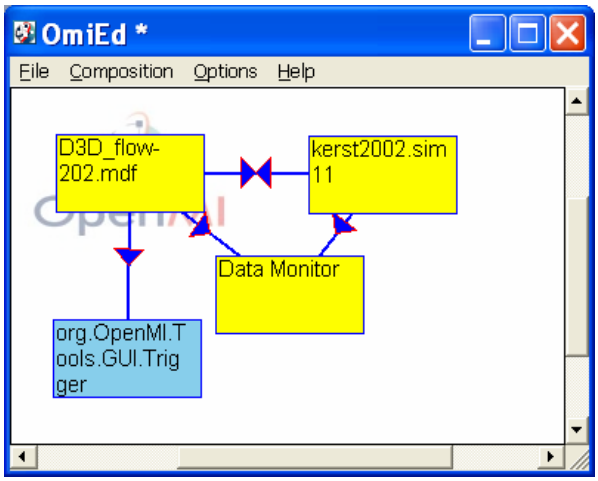


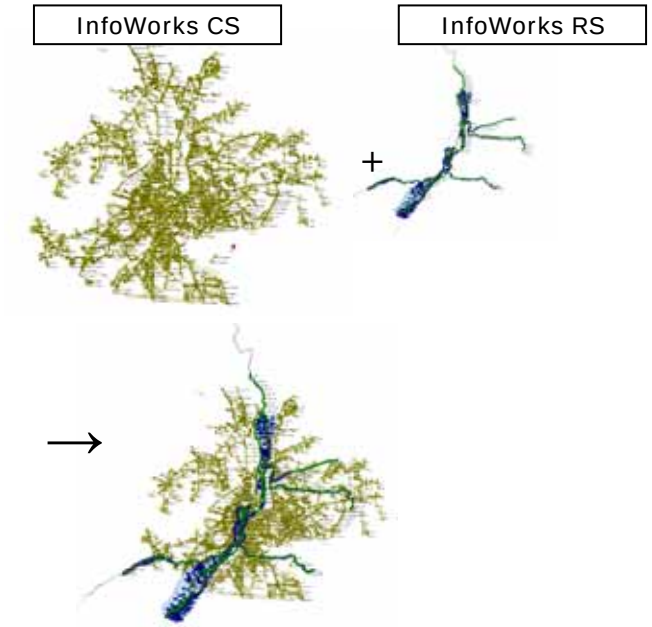
Fig. 3 Example of the OpenMI Configuration Editor.

Current status

The EC is currently funding the OpenMI-Life project, which aims to take the OpenMI from research output to operational standard. As part of this project, there are two operational demonstration areas, the Scheldt, covering Belgium and The Netherlands, and the Pinios in Greece. A new version of the OpenMI Standard will be released late in 2009, which will retain all existing functionality, simplify some existing functionality and provide some additional features requested by the user community. The operational demonstrations have been chosen to cover a range of different scenarios. The four Scheldt use cases are outlined here:

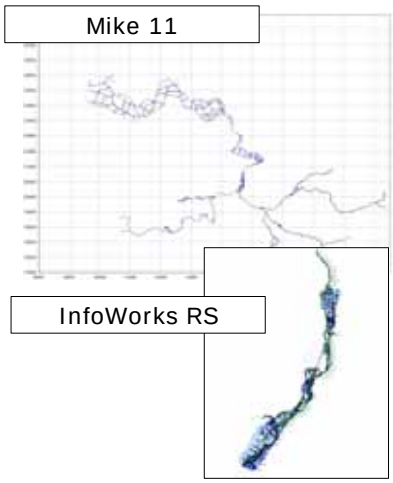
Try-out the OpenMI at:
http://public.deltares.nl/display/OPENMI/Hands+on+-+make+your+own+OpenMI+linked+system

Case A: Linking a sewer model and a river model



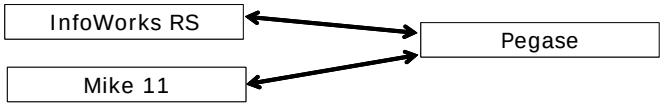
– Objective: Optimise investments and operational strategies for water managers
– Study case: The city of Leuven and the River Dijle
– Partners: Aquafin and VMM-AWA

Case B: Linking a tidal model and a river model



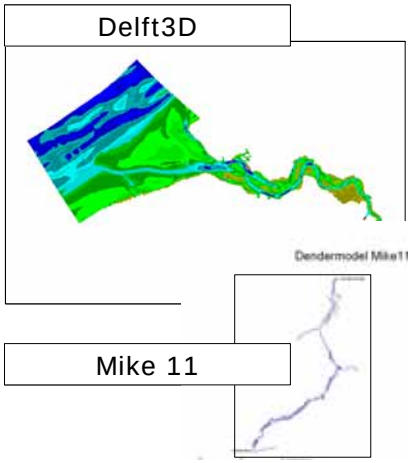
– Objective: improved flood maps and predictions
– Study area: Dijle and River Scheldt
– Partners: Flanders Hydraulics and VMM-AWA

Case C: Linking a river model and a water quality model



– Objective: improved interaction between water quantity and water quality
– Study case: Rivers Dijle and Demer
– Partners: Flanders Hydraulics, Deltares, VMM-AWA, VMM-AK and ULG-CEME

Case D: Linking a 1D-river model and a 2D-tidal model



– Objective: improved flood maps and harbour management for Antwerp harbour.
– Study area: Rivers Scheldt and Dender
– Partners: Flanders Hydraulics and Deltares

A free Open Source product

As part of the OpenMI-Life project, the OpenMI Association has been set up as a long-term support organisation for the OpenMI. Its objectives are to promote the development, use, management and maintenance of the OpenMI, and as part of its Strategy, it has committed to retaining the OpenMI Standard as a free Open Source product, and maintaining at least one SDK.

Going forward

Significant interest is now being shown in the OpenMI by the wider international modelling community, in particular in the USA. Although the OpenMI has been developed with a hydrological focus aiming at the land and water domains, the development approach is entirely generic. As a result, the OpenMI is starting to be used to link models from other disciplines. In 2009, a number of projects will be exploring the use of the OpenMI to link models across disciplinary boundaries. Further international funding is being sought for this work.

In April 2008, a successful workshop was held with US National Science Foundation (NSF) scientists, including members of Consortium of Universities for the Advancement of Hydrologic Science, Inc., USA (CUAHSI), the Community Surface Dynamics Modelling System (CSDMS) and National Center for Atmospheric Research, USA (NCAR). As a result, CSDMS adopted the OpenMI as a programme standard. And the OpenMI Association will take part in a joint session at the AGU Fall meeting, December 2008: H65 – Integrated Modeling in Hydrology: Advances in Model Interoperability, Architectures, and Cyberinfrastructure.

There has also been much communication with the US EPA, resulting in an invitation to contribute to the EPA's planning process for incorporating integrated modelling within its integrated approach to water management.

For more information about the OpenMI and the OpenMI Association, please see the Association website, *www.openmi.org* or contact Roger Moore, *rvm@ceh.ac.uk*.

Hazel Murphy, OpenMI-Life Project Manager

Hydrological extremes in small basins

Continued from page 1.

The three days of oral and poster sessions focused on:
- prediction of hydrological response based on different quality measurement data,
- hydrological model calibration for extreme conditions,
- hydro-chemical and geomorphic response to extremes,
- surface water–groundwater interaction under extreme conditions,
- extreme value statistics,
- extreme streamflow prediction in ungauged basins,
- model data–time-step dependency on basin size, land use and modelling approach,
- new ideas, monitoring and model developments, experience in small basins research.

All the oral and poster presentations on this wide range of topics have been published in the *Book of Abstracts* edited by Wojciech Chełmicki & Janusz Siwek; pdf files can be found at *http://www.geo.uj.edu.pl/konferencja/erb2008/*. The full oral papers will be published in the UNESCO Technical Documents in Hydrology series, and poster papers will be published in the journal *Folia Geographica*, series *Geographica-Physica*.

A day before the Conference, the General Assembly of the Steering Committee of ERB took place. The international coordinator of ERB, Piet Warmerdam, has decided to retire from the post. He made a great contribution to ERB activities over the last six years. The ERB Steering Committee and the General Assembly approved Ladislav Holko as a new international coordinator for ERB until 2012.

The conference programme included a short field excursion to the Field Research Centre of the Jagiellonian University at Lazy, about 35 km east of Cracow. The Centre began operations in 1986 and was modified and renewed in 1993. Field instrumentation for environmental monitoring includes: a meteorological station (a part of the national network), automatic groundwater and river gauges, installations for surface and subsurface runoff measurements, an automatic precipitation collector for wet and dry deposition measurements. The Centre is equipped with hydrochemical, soil and computer laboratories. There are also a conference room, reference library and map collection, the staff office and six other rooms. The building is able to accommodate up to 23 people in comfortable conditions. In spite of unusually cold weather, the excursion provided an intermission during the conference. Continuous rain that afternoon did not discourage the participants from exploring the instrumentation and experimental plots in the field. Afterwards, there was hot tea and coffee for all participants.

On their way to Cracow, everyone visited the royal castle in Niepolomice, where the conference dinner was served. The XIV-century walls and surroundings provided an excellent relaxed venue and the opportunity for informal discussion and networking. The best poster award was made to Luke Omondi Olang of Kenya (co-authors: Peter Kundu, Thomas Bauer & Josef Fűrst) by Wojciech Chełmicki – national ERB correspondent for Poland, and chair of the LOC.

The final session of the conference was the ERB General Assembly chaired by Piet Warmerdam. The issue of research in basins unimpacted by human activities, particularly in pristine basins, was discussed. Such basins should have at least 20 years of continuous hydrological and meteorological data, no significant changes in land use and no river regulation, drainage or deforestation. It should be secured that in future, pristine basins would remain in a state without human impact on their hydrology. Other requirements of such basins should be developed.

The 13th ERB conference will be organized in September 2010 in Austria by Hubert Holzmann and his team. Details of conference preparation will be discussed at the ERB Steering Committee meeting in 2009 and will be presented on the web page of the ERB (*http://www.ih.savba.sk/ihp/friend5/erb7.htm*).

The next event with an ERB contribution will be the *International Workshop on the Status and Perspectives of Hydrology in Small Basins* organized to celebrate 60 years of hydrological measurements in the Bramke research basins in the Upper Harz Mts (Goslar-Hahnenklee, Germany, 30 March–3 April 2009; *http://www.tu-braunschweig.de/geooekologie/abteilungen/hydrolo/forsch/projektakt/harz/workshop*/).

Joanna Pociask-Karteczka, Wojciech Chełmicki
Local Organizing Committee, Jagiellonian University, Cracow

Calendar of Meetings Organized/Sponsored by IAHS

Details of these plus many non-IAHS meetings are provided at *http://iahs.info* – click on *Meetings*

2009	Conference	Contact details
New Delhi, India 12–16 January	International Conference on Water, Environment, Energy and Society (WEES-2009)	National Institute of Hydrology, Roorkee-247667 (Uttarakhand), India wees09@yahoo.com
Port Elizabeth, South Africa 23–26 February	*International Conference on Implementing Environmental Water Allocations*	The Secretariat (Cilla Taylor Conferences), PO Box 82, IRENE, 0062 South Africa tel: +27 (0)12 6673681; fax +27 (0)12 6673680; confplan@iafrica.com
Goslar-Hahnenklee, Germany 30 March–2 April	*International Workshop on Status and Perspectives of Hydrology in Small Basins*	Ulrich Schröder, schroeder@bafg.de; Sybille Schumann, s.schumann@tu-bs.de http://www.ws.small-hydro-basins.org
Puebla Cholula, Puebla, Mexico 13–17 April	*International Conference on Water, Environment and Health Sciences : The Challenges of the Climate Change* (ICWEHS)	ICWEHS Organizing Committee: icwehs@hotmail.com or icwehs@yahoo.com tel:+52 (222) 229 2647 or 229 2031; fax: +52 (222) 229 2096
Vienna, Austria 20–23 April	HydroEco'2009 *Hydrology and Ecology: Ecosystems Interfacing with Groundwater and Surface Water*	Karel Kovar, Netherlands Environmental Assessment Agency, The Netherlands tel: +31 30 274 3360; karel.kovar@mnp.nl; *www.natur.cuni.cz/hydroeco2009*
Ohrid, Macedonia 1–5 September	WMHE2009, 11th International Symposium on Water Management and Hydraulic Engineering	Violeta Gesovska, tel: +389 (2) 3116066/ext. 120/210; fax: +389 3118834; violeta@gf.ukim.edu.mk
Hyderabad, India 6–12 September	8th IAHS Scientific Assembly and 37th IAH Congress	Pierre Hubert, IAHS Secretary General; pjy.hubert@free.fr http://www.appliedhydrology.org/iahs
Bratislava, Slovakia 21–24 September	2nd Int. Conf. Biohydrology 2009: *A Changing Climate for Biology and Soil Hydrology Interactions*	L. Lichner, Institute of Hydrology, Slovak Academy of Sciences, Racianska 75, 83102 Bratislava, Slovakia; lichner@uh.savba.sk. http://www.ih.savba.sk/biohydrology2009
Plitvice Lakes, Croatia 23–26 September	*Sustainability of the Karst Environment - Dinaric Karst and Other Karst Regions*	Jadranka Pejnovic, Centre for Karst, Budacka 12, 53000 Gospic, Croatia tel: +385 53 575 649; fax: 385 53 575 649; jadranka.pejnovic@gs.t-com.hr
Wuhan, China 21–25 October	ModelCARE 2009	Yanxin Wang, China University of Geosciences, Wuhan yx.wang@cug.edu.cn; http://www.modelcare2009.org

5th World Water Forum *Istanbul, Turkey 16–22 March 2009 www.worldwaterforum5.org*

The 5th World Water Forum aims at "Bridging Divides" between all regions, all stakeholders and all sectors of the world. An important goal is to bridge the gap between the technical and political communities at all levels. As such, it is pivotal to the success of the Forum that there is balanced participation, including young people, NGOs, women, etc.

However, the success of the Forum is not just measured in terms of the number of participants or quality of debates, but in its impact on water policies and action. A successful Forum is one in which, as a direct consequence of the Forum Week, a large number of communities around the world are provided with improved drinking water and sanitation services.

The themes to be addressed during the 5th Forum are:

- **Global Changes and Risk Management** (Adapting to climate change; Migration and changing land uses, human settlements and water; Mitigating disasters)
- **Advancing Human Development and the MDGs** (Ensuring water, sanitation and hygiene for all: ensuring adequate infrastructure and protecting public health in the near term; Water for energy, energy for water; Water and food for ending poverty and hunger; Multiple use of water)
- **Managing and Protecting Water Resources and their supply systems to meet human and environmental needs** (Basin management and trans-boundary water cooperation; Ensuring adequate water resources and storage to meet agricultural, energy and urban needs; Preserving natural ecosystems; Managing and protecting surface, groundwater, rainwater)
- **Governance and Management** (Implementing the Right to Water and Sanitation for improved access; Improving performance through regulatory approaches; Ethics, transparency and empowerment of stakeholders; Institutional arrangements for efficient and effective water management)
- **Finance** (Sustainable means of financing local water authorities and systems; Pricing strategies to ensure fairness and sustainability; Pro-poor policies and strategies)
- **Education, Knowledge and Capacity Building** (Education and capacity-building strategies; Water science and technology: appropriate and innovative solutions for the 21st Century; Using professional networks and associations to strengthen the water sector)

The thematic development process for this Forum is slightly different to that for previous Fora. Basically, the 5th Forum has the new ambition of responding concretely to about 100 key questions, around which interactive sessions will be designed. Each will involve different stakeholders in discussing the issues from different perspectives. Therefore, expressions of interest to contribute solutions for particular questions will be welcomed. The Forum does not accept papers or abstracts as it does not aim to be a technical conference.

The thematic process for the 5th World Water Forum follows a "pyramid" approach: all themes, topics and sessions will ultimately lead to the achievement of a clear set of experiences, recommendations and commitments for action on bridging water divides among actors, sectors and among the present and future generations.

Information on how to get involved at the topic level are available on the page "Get involved in developing sessions" at *www.worldwaterforum5.org*. The call for contributions is also available through the Virtual Meeting Space (*http://portal.worldwaterforum5.org*).

The Istanbul Forum gathers Ministers from over a hundred countries during the Ministerial Conference, and facilitates the interaction between them, Parliamentarians and Local Authorities. Also, major United Nations events are timed to coincide with the Forum. Over the years the regular UN World Water Development Reports have been launched at the Forum; following this practice the third Report will be launched in Istanbul.

The Istanbul Forum is a good opportunity to learn about water issues, to meet with water colleagues and establish new partnerships, to promote and advocate ideas and experience, and to promote new projects, products and services. It is a unique platform where the water community and the policy and decision makers from across the world can meet.

Should your organisation wish to participate, please contact the Secretariat:
info@worldwaterforum5.org; tel: +90 216 325 4 992.

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International Association of Hydrological Sciences
Association Internationale des Sciences Hydrologiques

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