



# PREDICTIONS IN UNGAUGED BASINS

Issue 2.3  
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## Newsletter



PUB is an IAHS initiative aimed at uncertainty reduction in hydrological practice  
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### MESSAGE FROM THE PUB CHAIR

It is with some awe that I sit to write my first "Message from the Chair". Awe at the fabulous successes of PUB to date and awe at the work ahead to maintain the stellar standards set by Jeff McDonnell and Siva Sivapalan. This is particularly so given that we are embarking on the third biennium – an exciting phase of PUB, where the main objective is to take stock of what has been achieved in PUB, and to look ahead. So what is new in the third biennium?

A brief look back at the first two biennia. The PUB decade was launched in 2003, and during the first biennium Siva master minded the science plan and formed working groups with enthusiastic support by the then IAHS President Kuniyoshi Takeuchi and many others as part of the PUB Community. The second biennium, led by Jeff McDonnell, was a period of growth where many new working groups were formed and the PUB Secretariat was established at IWMI, among a long list of other achievements. Have a look at the impressive report on <http://pub.iwmi.org/UI/Images/Final%20PUB%20Report%20July%202007.pdf>! Now the third biennium will build on the strengths of the previous years with continued growth and continuity but a slight change of focus. I believe it is now time to gauge, in a quantitative way, to what extent the hopes and plans have borne fruit for the PUB community. In other words, a **Benchmark Assessment of Predictions in Ungauged Catchments**.

I have taken over as the PUB chair in summer and have discussed future PUB activities with many friends and colleagues. Clearly, the activities in the working groups need to continue and grow but it was felt by many that a benchmark report is needed now to review the current state of hydrological predictions in the absence of data. Specifically, the report would address

- Where are we now?
- What have we achieved in the past 4 years?
- What are the challenges for the remaining years?

I believe we still need some discussion on the benchmark report - main thrust, format, process etc. - and I'd very much like to get your thoughts on this at this stage. How can we maximize the usefulness and the impact of the PUB-report? I did learn from the discussions I had so far that many think it is a good idea to model the benchmark report after the IPCC report, albeit at a smaller scale. What sets the IPCC report

apart from other reports, I believe, is that it is a consensus report that reflects the judgment and experience of more than just a small group of people. Can we achieve something similarly grand in hydrology?

The idea would be that the report focuses on the collective message. We may need book captains to coordinate chapters, and we will likely need review teams. But PUB is a grassroots initiative so I would be keen to learn of any other ideas you may have on the PUB report in particular and PUB activities in general – so we can better serve the PUB community. Please send me an email with your thoughts or give me a phone call on the number below. We may even think of a sweepstake to choose an acronym for the benchmark report – "PUB-report" may be dull, but what about "PUB-bench"?

The working groups will continue and I would hope that new working groups will form. I have received a number of suggestions already that would complement the existing working groups. As discussed in Perugia, we will also maintain the six Key Themes – they have become a brand identity of PUB:

- KT 1: Basin inter-comparison and classification
- KT 2: Conceptualization of process heterogeneity
- KT 3: Uncertainty analyses and model diagnostics
- KT 4: Develop and use of new data collection approaches
- KT 5: New hydrological theory
- KT 6: New model approaches

And there will be other activities such as national working groups and the Blue Nile community project. Let me thank the Theme Leaders profusely for their time and efforts over the past biennium. Your input has really made a difference to PUB. There has been a terrific amount of work done. It is important to have, over PUB's 10-year life span, broad community involvement and a constant flow of new ideas. I am hence keen to attract new people to PUB but, at the same time, maintain some level of continuity. As I will discuss the new team of theme leaders in the next weeks I hope that you all can remain active within PUB and contribute to your pet working groups.

A hallmark of my own past research has been collaborative effort, and it is this that attracted me to chair the steering group of PUB – PUB being among the best examples of collaboration in hydrology at the international scale. However, what really stands out to me is how PUB is both building substantial capacity within the IAHS community as well as reaching beyond via various working groups. The key message I believe is that, as a PUB community, we will be judged not by

piecemeal research but by what we are delivering in a coherent way. This makes the PUB-report all the more important. It is a showcase for PUB in action and also provides an "on ground" assessment of the commitment and skills of the many PUBers. It is essential information that will help us to continue to improve our methods of predictions in ungauged catchments. I encourage you to become involved in the PUB benchmark report project.

Finally, I am sure all will join with me in a wholehearted vote of thanks to Jeff McDonnell for his outstanding leadership over the past two years. I am relishing the chance of working with you all on the vision Jeff and Siva have so clearly articulated to date.

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### **TODAY'S SERIES CONTRIBUTION TO PUB: VALUE-ADDED WATER CYCLE INFORMATION INCLUDING FLOOD RISK PREDICTION**

On September 6 to 7 in 2007, the 9<sup>th</sup> typhoon in this year, *Fitoh*, trespassed over the eastern and northern parts of Japan. It caused 3 casualties (including 2 missing), and about 1200 houses inundated in many parts of Japan including Tama river basin (in Kanagawa and Tokyo Prefecture) and Kano river basin (in Shizuoka Prefecture) (FDMA, 2007). As PUB's mission states that "reduce the predictive uncertainty of stream flow in hydrological science and practice," those hydro-meteorological researchers who are involved in PUB should take great effort to prevent or decrease such damages.

The Institute of Industrial Science of the University of Tokyo has been operating the "Today's" numerical monitoring series (<http://hydro.iis.u-tokyo.ac.jp/LIVE>) since 2006 with several purposes including contribution to the PUB's mission. The *Today's* series contribute to add original values for various hydrological aspects on the real-time atmospheric prediction data from the Japan Meteorological Agency (JMA). We now have *Today's Earth*, *Today's Japan*, and *Today's Indochina*, which are for a whole globe, Japan, and the Indochina region, respectively.

*Today's Earth* estimates and visualizes the situations of the global water cycle from current through a-few-days-ahead. The core system consists of four global models, iso-MATSIRO land surface model (Yoshimura *et al.*, 2006), TRIP river routing model (Oki *et al.*, 1999), the

isotope circulation model (ICM; Yoshimura *et al.*, 2003), and colored moisture analysis (CMA; Yoshimura *et al.*, 2004) model. All models are directly or indirectly driven by the JMA's global model forecast data, namely GSM-GPV (Global Spectral Model, Grid Point Values, data archived at <http://gpv.tkl.iis.u-tokyo.ac.jp/GPV/>), in 1-degree horizontal resolution. The hourly outputs are categorized in four groups regarding their degree of value-added, *i.e.*, level 1 (spatial interpolation) to level 4 (our unique products, such as global stream flow discharge and global moisture origins) as shown in Figure 1 and Figure 2. When a 72-hour-ahead new forecast is produced by JMA in every 12 hours, *Today's Earth* is updated. *Today's Japan* and *Today's Indochina* are somewhat similar to *Today's Earth*, but for more detail in specific domains. *Today's Japan* uses JMA's MSM (mesoscale spectral model) GPV with horizontally 0.1-degree resolution and up to 18-hour-ahead prediction and it is updated every 6 hours.

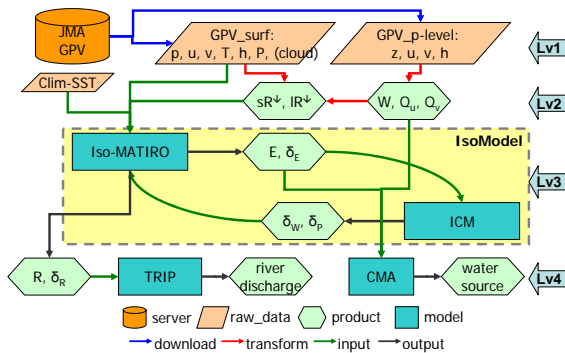


Figure 1: Data processing flow schematics for *Today's Earth*

Regarding our contribution to PUB, short term prediction of the discharge probability index (DPI) over Japan, which was just started in the beginning of 2007, should be mentioned. DPI is an equivalent quantity with a statistical return period in years of an annual maximum discharge, which interprets the real time estimation of stream flow discharge to flood risk nearby. DPI is calculated as follows:

$$\Pi = (1 - F_{(D)})^{-1} = \left( 1 - \exp \left( - \exp \left( - \frac{D - \mu}{\beta} \right) \right) \right)^{-1}$$

where  $D$  is discharge,  $F$  is exceeding probability in a year,  $\mu$  and  $\beta$  are the location and scale parameters of the Gumbel distribution, respectively, which were estimated based on a historical 29-year simulation in advance. The Gumbel distribution showed good agreement with the observed values, and even more strikingly, high DPI in the simulation corresponded to actual flood damage records. Detailed descriptions are found in Yoshimura *et al.* (2007).

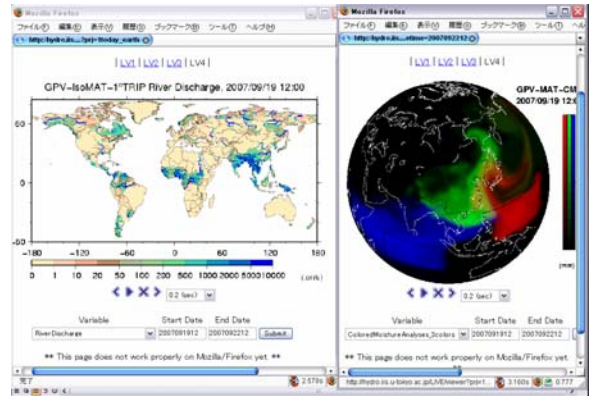


Figure 2: Sample screen shots of global stream flow and moisture origins from *Today's Earth*

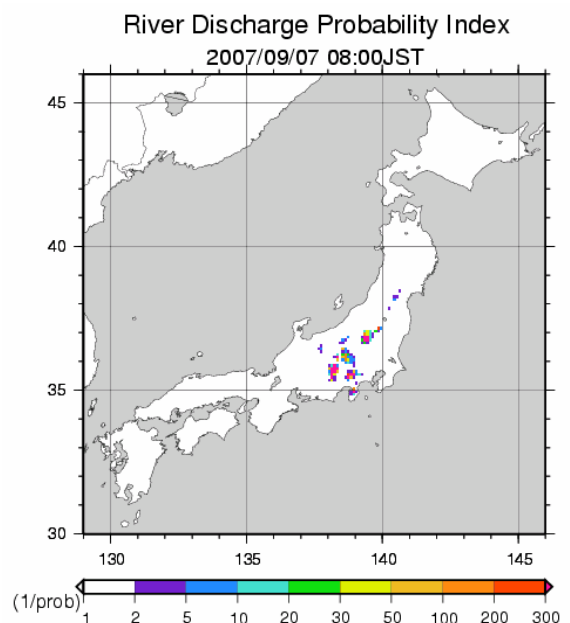


Figure 3: 17-hour-ahead prediction of discharge probability index issued at 2007/09/06 15:00 JST during typhoon *Fitoh*

Figure 3 shows 17-hour-ahead DPI prediction from 2007/09/06 15:00 JST, which was released about 09/06 18:30 JST. It clearly illustrates some high risk regions in Chubu and Kanto regions (138-140E and 35-37N), where damages had occurred during the mid night through morning periods from 6<sup>th</sup> to 7<sup>th</sup>. Including further verification in detail, the DPI prediction has many issues should be resolved, but we believe it has certain potential for contribution toward the PUB's effort on practical and scientific prediction enhancement.

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## A NEW PUB WORKING GROUP

### (WG 18) - EXTREME FLOOD ASSESSMENT AND PREDICTION IN THE MONSOON CLIMATE ZONE OF NORTH-EAST ASIA.

A new pub working group has been formed on the topic of Extreme Flood Assessment and Prediction in the Monsoon Climate Zone of North-East Asia.

#### Objectives

- To develop a network-distributed model of extreme rain floods reflecting the strong non-linearity of basin response, which is formed in both slope and river network subsystems of the basin.
- To develop methods for short-time flood prediction, design flood assessment, spatial analysis of flood regime and assessments of its changes because of human activity, suitable for very poorly investigated basins of North-East Asia (Russian Far East).
- To investigate the scenarios of flood regime transformation under expected climate changes in the region mentioned.

## Participants

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## Detailed Description of the Approaches

Up-to-date assessments of hydrological predictions of extreme events due to climate and landscape changes show the absence of adequate research tools from which reliable conclusions can be drawn. The severity of the problem has increased over years. Hydrological consequences of expected climate changes (involving increased flood and drought risks) are recognized as factors of social-economic importance. It is reflected in the programs of international organizations such as UNESCO, WMO and IAHS.

Over the last decade (started from 1993), seven flood disasters alone (in USA, Europe, China and Korea) have caused damage of more than 10 billion dollars. Climate change consequences are now projected to be more intensive and expensive than anticipated previously. The occurrence of disastrous flood events during the last ten years, which had an extremely small chance of occurrence, suggests that new models for maximum runoff estimation in changing conditions are urgently needed.

Extensive investigations into estimating and predicting maximum runoff characteristics have been conducted in the Russian Federation (USSR) during the past 50 years. Within the very large territory of Russia there are rivers with floods of all types - snowmelt (Central Region, Ural and Siberia), rainstorm (South, Caucasus and Russian Far East), and ice-jam (Russian North) floods. Disastrous floods are observed practically every year and especially often in the last decade – in North Caucasus, Yakutia and the Far East, where the damages amounted to 5-15 billions rubles (around 02-06 billion dollars).

Although a vast literature on flood hydrology exists in Russian, the most current publications conclude that the problem of the statistical assessment of floods is still

not theoretically solved even for the stationary case. The most challenging issue is the flood estimation for small river basins where all types of floods may occur. A principal conclusion was made that the problem cannot be solved on the basis of a statistical approach alone but it is necessary to use knowledge of the physical processes that produce floods. While this seems an obvious thing to do very little work has been done so far on linking physical processes with statistical methods.. Methods of analyzing potential changes of the extreme flood regime caused by climate change are not well developed in Russia. Pioneering works of the Water Problems Institute of the Russian Academy of Sciences based on dynamic models is the first steps towards this important research agenda.

The problems are most important in the Russian Far East – the largest but least investigated region of Russia. It is common knowledge of the Russian hydrologists that the methods for flood assessment and prediction, basically developed in European Russia, are poorly applicable in the Far East. The specific problem is an abnormal (even for Russia) lack of hydrological observation data in the region. In the southern part of the Russian Far East, rain floods prevail in the river runoff regime, in the northern part spring snowmelt floods, but this simple regularity is complicated by the very variable physical-geographical conditions of the region, providing very intricate space pattern of floods. To develop a new basis of flood assessment and prediction in such conditions, it is necessary to expand the conceptual basis of flood modeling and the data pool, by studying the interrelationship between the flood behavior and the river network pattern in particular.

Three main directions of the investigations are planned by the Work Group to realize Objectives 1-3:

- Analysis of statistical characteristics of floods in a wide geographical framework and, at the same time, improvement of the statistical tools.
- Thorough study of the strong non-linearity phenomena and effects in river system dynamics and structure. Developing and adapting models with strongly non-linear behavior.
- Investigations and modeling of the river network and basins structure as a general basis to study the origin, evolution and dynamics of river systems. The research will adopt modern technology of Digital Elevation Models (DEM) processing and validate several new models in the Russian Far East region, both deterministic and probabilistic ones.

The final aim of the Group investigations is the development of a so called “regional hydrological model- RHM”. The term relates to a distributed rainfall-runoff model based on the real river network, which should be suitable on different scales but mostly at the middle and large scales (1:200000-1:10000). The RHM should present a set of hydrologic characteristics (discharge, velocity and so on) in every link of a network at every step of calculation but should be validated by means of observation data at arbitrary points (stations). The aim seems difficult but achievable on the basis of a thorough process analysis the use of distributed modeling. The RHM would be a natural basis for different engineering methods and investigations of consequences of climate and landscape changes in the region.

### Data Availability

The research group has available two datasets to develop the approaches presented above.

One is the data of the Russian Far East region (southern part). It includes daily discharges and precipitation of about 150 river basins, observed by the regular network of the Russian Hydrometeorological Service. Annual maximum discharges series of about 250 stations and a large amount of meteorological data are available too from the same source. A 90-meter DEM of the region is prepared on the basis of an open source (NASA, <ftp://e0srp01u.ocs.nasa.gov>).

The second is a unique dataset of the Komarovka river experimental basin (so called Primorsky water-balance station, about 1500 km<sup>2</sup> in total). It includes daily and hourly datasets of discharge of 20 nested basins and precipitation at 40 gauging stations. A lot of meteorological observations and different kinds of special water-balance observations (evapotranspiration, soil moisture, ground water level etc.) are available too in the period from 1954 till 1993. A high-resolution DEM is also available for the experimental basin.

### Industry Partners and Potential User Groups

- Bureya Hydro Power Station Ltd.
- Province governments
- Hydropower industry
- Building and constructing industry
- Cities and towns municipalities
- Transport industry

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## A WORKSHOP ON EVALUATING THE INFORMATION CONTENT OF DATA FOR REDUCING UNCERTAINTY IN HYDROLOGICAL MODELS

The Top-Down Modelling Working Group, and the Uncertainty Working Group are planning to run a workshop on “Evaluating the information content of data for reducing uncertainty in hydrological models” at the next biennial meeting of the International Environmental Modelling and Software Society to be held in Barcelona, Spain, July 7-10, 2008 (<http://www.iemss.org/>). The proposed workshop will be co-organised by Barry Croke, Thorsten Wagener, David Post, Jim Freer and Ian Littlewood.

### Workshop Description

The inclusion of additional information in a model should improve its performance and reduce associated uncertainties. The additional information may take the form of higher temporal and/or spatial resolution of data already used, or additional (potentially soft) data. However, additional data is not necessarily equivalent with additional information, or with information that can be used by a particular model. Consideration of the information-to-noise ratio is needed in order to evaluate whether the information will indeed improve the model's ability to simulate the system. Evaluating the information-to-noise ratio and the information content of data in general are difficult, but one possible approach is to compare the performance and uncertainty of a model with and without the additional information. This session/workshop will focus on the use of additional information in improving the performance of and reducing the uncertainty in hydrological models. This includes consideration of the uncertainty in datasets as well as techniques to evaluate the effectiveness of the additional information in improving

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## SPECIAL PUB SESSIONS AT CANADIAN WATER CONFERENCES IN 2007

The Canadian National Committee for PUB and Working Group 16 - IP3 for Cold Regions - organized special sessions at both of Canada's premiere annual water conferences in 2007. First, the Canadian Geophysical Union met jointly with the Canadian Meteorological and Oceanographic Society in St. John's, Newfoundland May 28 – June 1. At this meeting, two sessions were held. The first focused on hydrometeorological prediction in cold regions and

seasons, with papers on improved process understanding, parameterization of land surface hydrology and model improvements for better prediction of surface climates and water resources. Marc Steiglitz from the Georgia Institute of Technology was an invited speaker in a second general PUB session that included contributions that discussed the progress of science in the context of the PUB initiative in Canada and abroad.

A PUB session was also held at the Canadian Water Resources Association annual general meeting from June 25 – 28 during which presentations focused on the application of predictive tools and techniques for water resource management in Canada and abroad. A fruitful discussion at the end of the session led to the proposal for a model intercomparability project. This project would be used to gauge past and current ability to predict hydrological fluxes in ungauged basins and highlight gaps to be addressed in the future.

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## NEWS IN BRIEF

### eFlowNet

The Global Environmental Flows Network was officially launched during the 10th Int. River Symposium, 2-6 Sept. 2007 in Brisbane, Australia. [www.eflownet.org](http://www.eflownet.org)

### Positions Open :

The International Centre for Water Hazard and Risk Management in Tsukuba, Japan seeks suitable persons to fill four positions of Research Specialists.

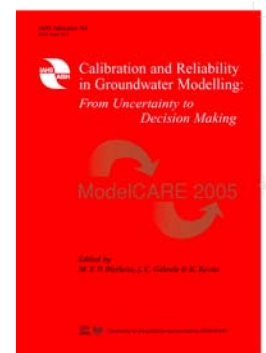
<http://www.pwri.go.jp/eng/news/20070803/senmon.htm>

## PUBLICATIONS

### Calibration and Reliability in Groundwater Modelling: From Uncertainty to Decision Making

IAHS Publication 304  
(published May 2006) ISBN 1-901-502-58-9; 316 + xii pp; price £59.00

*Edited by M. F. P. Bierkens, J. C. Gehrels & K. Kova*

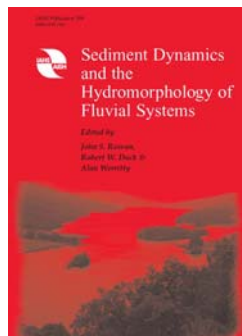


This volume contains papers selected for publication from ModelCARE 2005 conference and contains state-of-the-art presentations on methodologies and techniques of calibration and uncertainty assessment in groundwater modelling and needs for future development.

## Sediment Dynamics and Hydromorphology of Fluvial Systems

IAHS Publ.306 (June 2006)  
ISBN 1-901502-68-6 630 + viii  
pp price £96.00

*Edited by John S. Rowan, Robert W. Duck & Alan Werritty*



This volume links sediment dynamics to hydromorphology, and by extension to the biogeochemical functioning and eco-hydrology of fluvial systems. Fluvial sediment dynamics are explored over a range of spatial and temporal scales, spanning global and continental-scale flux rates to detailed, process-oriented work on small instrumented catchments, with particular to the role of extreme events.

## Water in Celtic Countries: Quantity, Quality and Climate Variability

IAHS Publication 310 (2007)  
I978-1-901502-88-6 358+ viii  
pp, price £66.00

*Edited by J. P. Lobo Ferreira & José M. P. Viera*



This volume contains the papers presented at the Fourth Inter Celtic Colloquium, held in Portugal in July 2006, some 34 in all. They are divided between six themes: Climate Variability, Water Quality, Groundwater, Hydrology, Modelling, Management and Environmental Impact Assessment . The papers reflect the complex nature of the Celtic environment and point the way for the future development and management of the precious resource, water.

## A New Focus on Groundwater–Seawater Interactions

IAHS Publ. 312 (2007) 978-1-901502-04-6 344 + x pp, price £64.00

*Edited by Ward Sanford, Christian Langevin, Maurizio Polemio & Pavel Povinec*



This volume includes papers of a symposium organized jointly by the IAHS International Commission on Groundwater and the International Association for the Physical Sciences of the Oceans, 2007, present research by those working from the marine and terrestrial sides of the issues, and cover a variety of investigative approaches applied at locations worldwide.

## Sustainability of Groundwater Resources and its Indicators

IAHS Publ. 302 (July 2006)  
ISBN 1-90150243-0; 220 + viii  
pp; price £45.00

*Edited by Bruce W. Webb, Ricardo Hirata, Eduardo Kruse & Jaroslav Vrba*

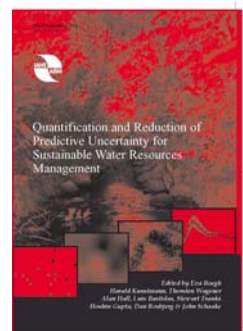


The contributions in this volume summarize much of the state of the art in the field of groundwater

## Quantification and Reduction of Predictive Uncertainty for Sustainable Water Resources Management

IAHS Publ. 313 (2007)  
ISBN 978-1-90150278-09-1  
508 + iv pp. price £87.00

*Edited by Eva Boegh, Harald Kunstmann, Thorsten Wagener, Alan Hall, Luis Bastidas, Stewart Franks, Hoshin Gupta, Dan Rosbjerg & John Schaake*

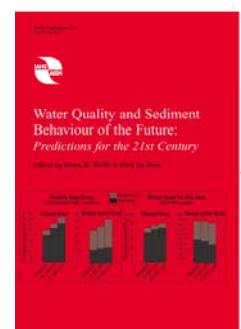


The contributions in this volume consider the uncertainties in the end-to-end prediction of hydrological variables, beginning with the atmospheric driving, and ending with the hydrological calculations for scientifically-sound decisions in sustainable water management. The book is organized in two main parts; the first addresses the Quantification and reduction of predictive uncertainty in hydrometeorological forcing, and the second includes studies aiming at Minimizing risks in water management decisions by improving the understanding and spatial representation of the coupled land–atmosphere system.

## Water Quality and Sediment Behaviour of the Future: Predictions for the 21st Century

IAHS Publ. 314 (2007) ISBN 978-1-901502-14-5; 322 + x pp price £62.00

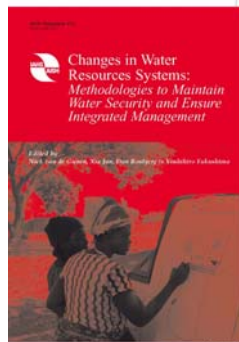
*Edited by Bruce W. Webb & Dirk De Boer*



This volume is an outcome of a symposium organized by the IAHS International Commissions on Water Quality (ICWQ), Continental Erosion (ICCE), and Groundwater (ICGW), and the Predictions in Ungauged Basins (PUB)

Working Group, with the objective of bringing together experts to provide a state-of-the-art review of our current understanding of how water quality and sediment behaviour might alter as a result of climate and land-use change during the 21st century. Thirty-six reviewed papers are grouped in three sections in this volume: Sediment and Nutrient Behaviour in Surface Waters; Metals and Other Water Quality Problems; and Management Issues.

**Changes in Water Resources Systems: Methodologies to Maintain Water Security and Ensure Integrated Management**  
**IAHS Publ. 315 (2007) ISBN 978-1-901502-19-0 330 + viii pp; price £62.00**



*Edited by Nick van de Giesen, Xia Jun, Dan Rosbjerg & Yoshihiro Fukushima*

This volume specifically addresses changes in water resources systems and provides a good sample of the many of issues that are dealt with in the context of IWRM.

**Remote Sensing for Environmental Monitoring and Change Detection**  
**IAHS Publ. 316 (2007) ISBN 978-1-901502-24-4, 288 + viii pp. Price £55.00**



*Edited by Manfred Owe & Christopher Neale*

This publication is a compilation of papers that were presented at the IAHS Symposium on *Remote Sensing for Environmental Monitoring and Change Detection* organised by the IAHS International Commission on Remote Sensing, in Perugia, 2007. The 30 contributions cover approaches using the thermal infrared, microwave and radar; studies monitoring vegetation, snow and ice, and evapotranspiration; and the combination of remote sensing techniques and GIS for hydrological applications.

For ordering/ further details: [www.iahs.info/publications](http://www.iahs.info/publications)

### FORTHCOMING PUB-RELATED EVENTS

Second Annual workshop of the PUB Working Group on Improved Process and Parameterization for Prediction in Cold Regions (IP3) will be held from 8-10

November 2007 at Cold Regions Research Centre, Wilfrid Laurier University, Waterloo, ON, Canada  
 Contact:, Julie Friddell, [ip3.network@usask.ca](mailto:ip3.network@usask.ca)  
[www.usask.ca/ip3](http://www.usask.ca/ip3)

PUB Session: Building Towards New Hydrological Models at MODSIM07 Conference, Christchurch, New Zealand, 10-13 December, 2007,  
<http://modsim.lincoln.ac.nz/>

International Conference on Water, Environment, Energy and Society (WEES-2007), Roorke, India, 18-21 December 2007, [www.nih.ernet.in/wees/wees.htm](http://www.nih.ernet.in/wees/wees.htm)

Second Space for Hydrology Workshop on Surface Water Storage and Runoff Modelling, In-Situ Data and Remote Sensing, Geneva (Switzerland), 12-14 November 2007, <http://www.aviso.oceanobs.com/>

IWA World Water Congress 2008 will be held in Vienna, Austria to discuss the latest developments in sustainable water management and exchange knowledge on all aspects of the water cycle. Congress Tracks: Water resources and river basin management, Water treatment, Wastewater treatment, Design and operation of water systems, Managing and planning water services, Health and the environment. Cross-Cutting Themes: Climate change in practice: adaptively managing impacts on water, The science and practice of sustainable development, Managing urban water metabolism in cities in an IWRM context  
 website: [www.iwa2008vienna.org](http://www.iwa2008vienna.org)

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