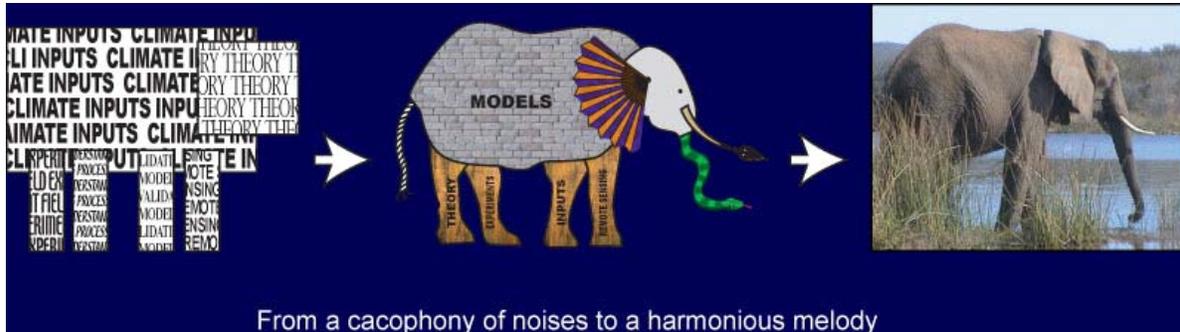


PUB Annual Report to IAHS Bureau

4 July 2010 John Pomeroy, PUB Chair



1. Introduction.

PUB, the IAHS Decade for Prediction in Ungauged Basins is now in its 4th biennium with the transition to this biennium at the IAHS Scientific Assembly at Hyderabad, India in September 2009. PUB is a revolutionary movement to improve hydrological prediction in regions where streamflow measurements do not exist or are sparse. It accomplishes this by reducing calibration, and enhancing prediction based on hydrological understanding in order to compensate for the lack of streamflow gauges. PUB is also a vehicle to transform hydrology by contributing to the improvement of the scientific basis of hydrology and a mechanism to make international efforts in hydrology relevant to local needs, especially in the under-developed world. The strengths of PUB to date have been its i) scientific rigour, ii) development of new methods for basin comparisons, classification and diagnostics, iii) development of new theory, iv) advanced consideration of regionalisation approaches, v) application of parameter estimation techniques, vi) enhancement of uncertainty quantification in modelling and vii) improvement of application of existing models and methods. A substantial advance is progress in writing the PUB Benchmark Report. Challenges remain for PUB in i) defining the appropriate use of sparse gauge observations, ii) integration of inductive and deductive methods in practise, iii) applying new ideas as new models, iv) demonstrating PUB techniques in ungauged regions.

2. PUB Structure and Secretariat for 4th Biennium

PUB is structured around a Science Steering Group who work to ensure delivery of PUB science along the themes, cross-fertilization of ideas and an international perspective on solutions to the PUB problem. The PUB SSG that formed in autumn 2009 is listed below. Its members were selected to ensure some continuity but also new ideas and viewpoints. PUB is now supported by both IWMI through the work of Vladimir Smakhtin in hosting the PUB website and through a new PUB Secretariat that employs Michael Allchin who is updating the website and implementing a new PUB communications strategy that will involve the latest social media and web-hosted meeting techniques.

PUB Science Steering Group 2009-2011

Chair:	John Pomeroy (Canada)
Communications	Vladimir Smakhtin (Sri Lanka)
Theme 1. Catchment classification	Ross Woods (New Zealand)
Theme 2. Conceptualization of process heterogeneity	Doerthe Tetzlaff (UK)
Theme 3. Uncertainty analyses and model diagnostics	Thorsten Wagener (USA)
Theme 4. New data collection approaches	Danny Marks (USA)
Theme 5. New hydrological theory	Alexander Gelfan (Russia)
Theme 6. New model approaches	Hubert Savenije (Netherlands)
Theme 7. Working Groups	Denis Hughes (South Africa)
Theme 8. Integration and Demonstration Projects	Berit Arheimer (Sweden)
Young Hydrologist	Olga Semenova (Russia)
Young Hydrologist	Yukiko Hirabayashi (Japan)

Advisors (ex officio)

Guenter Bloschl (Austria), Jeff McDonnell (USA), Siva Sivapalan (USA), Kuni Takeuchi (Japan)

Secretariat (ex officio)

Michael Allchin

3. PUB Goals for 4th Biennium

The goals of this new biennium are several. One is to address the PUB Science Plan by working to reduce uncertainty in hydrological prediction by reducing model calibration and increasing hydrological understanding and by moving to the development of new innovative models in hydrology. Another is to carry on development of the existing PUB Themes (basin intercomparison, process heterogeneity, uncertainty and diagnostics, new data collection, new theory, new models and PUB working groups) and the consolidation of their achievements, through completion of the PUB Benchmark Report and by soliciting for new inputs from the scientific community to the Themes. A major thrust of the next year will be moving from Themes to Teams by the solicitation of proposals for “Integration and Demonstration Projects” teams which will develop local solutions for prediction in national and regional ungauged basin situations. PUB will also work to contribute to international hydrology by working to enhance the communication of PUB ideals, concepts and technologies throughout the world and by developing a practical handbook on “How to Predict in Ungauged Basins” that reviews the PUB experiences including successes and challenges throughout the world.

4. PUB Activities 2009-2010

i) *Meetings*: PUB has been very active since Hyderabad with well attended scientific sessions at the AGU (Dec 2009), EGU (April 2010) and CGU (May 2010), a Townhall Meeting at AGU and a PUB Benchmark Report workshop at Vienna (April 2010). The contributions and diligence of A. Castellarin, B. Arheimer, P. Claps, D Tetzlaff, S Carey, J McNamara, M Sivapalan, A Montanari, G Bloschl, K Bennett and others to organising these meetings is greatly appreciated.

ii) *Major PUB Publications*: two red books and a special issue of a journal have been completed this year.

IAHS Red Book Publ 333 “New approaches to hydrological prediction in data sparse regions” is completed and published and thanks go to K Yilmaz and co-editors for their work in editing this volume.

IAHS Red Book Publ 335 “Hydrological modelling and integrated water resources management in ungauged mountainous watersheds” is completed and published and thanks go to W-L Xu, T-Q Ao and X-H Zhang for their work in editing this volume on a meeting of the China PUB group.

A special Issue of Hydrological Processes on “Catchment Processes and Heterogeneity at Multiple Scales” is completed and will be published in 2010. Thanks go to D. Tetzlaff, S. Carey, H. Laudon and K McGuire for their contribution in editing this issue.

Progress continues on the PUB Benchmark Report under the leadership of G. Bloschl.

“Runoff prediction in ungauged basins - a benchmark assessment”

Purpose:

- to assess, on a comprehensive, objective, open and transparent basis, the state of runoff predictions in the absence of local runoff data and identify what are the prediction challenges for the future
- to serve as a reference to gauge future achievements, to quantify the degree to which uncertainty in hydrological predictions can be reduced in clearly specified contexts

Contents:

- Focus on runoff only. There have been extensive discussion on whether 'ungauged' should be interpreted in terms of various hydrological variables or to be more specific and address runoff only. The general opinion was that the latter was more useful as it would allow a more coherent and quantitative treatment. Other variables such as rainfall and sediment could be dealt with in a separate report at a later stage if necessary.
- Will contain elements that are quantitative and elements that are broader and speculative to provide an exciting case for future research

Science Question:

How and how well can we estimate runoff characteristics in the absence of **at-site** runoff data?

iii) *Communications*: A new web domain has been obtained and is currently being populated www.iahs-pub.org . By mid-summer the website, a PUB information list server and other social media techniques will be used to popularize PUB amongst scientists and to enhance communications about PUB.

5. PUB Plans 2010-2011

PUB will continue to have substantial sessions at AGU, EGU and CGU to provide a broad geographical distribution of locations where PUB can be discussed and advanced. We are also working to host a *world-wide PUB* meeting in Canada in 2011 with a focus on implementing Integration and Demonstration Projects for various parts of the world and comparing appropriate PUB techniques for various situations of ungauged and sparsely-gauged regions. A local arrangements committee has been struck for the PUB Integration and Demonstration Symposium and we are attempting to obtain funding so that speaker expenses can be at least partly defrayed. *PUB would also like to offer to organise the Kovacs Symposium for 2011.*

At Melbourne, PUB will contribute to a fundamental Union Symposium and to two related workshops and a symposium that deal with specific aspects of PUB of interest for enhancement: water quality, mountains, climate change and cold regions.

Union Symposium: Do We Really Know the Hydrological Cycle?

Principal Convenor: Pierre Hubert (France)

Co-convenors: Andrea Flossman (France), Manfred Lange (Cyprus), John Pomeroy (Canada), Paul Tregoning (Australia), Susan Wijffels (Australia)

Scope: Based on the observation of the continuous movement of water, the idea of a hydrological cycle appeared in the most remote antiquity, but the corresponding scientific concept was coined only three centuries below by Pierre Perrault and Edmund Halley, based on their measurements and water balance computations. Today the hydrological cycle is well known and taught as soon as in primary schools. But do we really understand this extraordinarily complex system, which operates over huge time and space scales, involves the flow of liquid, solid and vapour phases of water and whose processes shape the face of the Earth by impacting biology, geochemistry, geophysics, climatology and redistributing matter and energy? We still have a lot to learn about the hydrological cycle. To take only a few examples: what is the uncertainty regarding the Earth's water inventory, water phase and fluxes? Do we really know what a cloud is and how it behaves? Can we predict streamflow from physical first principles? Do we really know the paths of water on the continents, between precipitation and the continental reservoirs of surface, ground, snow and glacier water and the oceans? This symposium will be devoted to these gaps which jeopardize many scientific and practical activities such as water resources prediction and assessment and to the ways to overcome them. All contributions from geoscientists developed in an interdisciplinary spirit will be welcome.

IAHS Workshop: Water Quality and Sediment Prediction in Ungauged Basins

Lead Convenor: Berit Arheimer (Sweden)

Co-Convenors: Michael Rode (Germany), Scott Wilkinson (Australia)

Scope: The IAHS “Predictions in Ungauged Basins” initiative (PUB) has had focus on river discharge and water budgets in catchments. However, one of the major driving forces for PUB in many countries is mapping environmental status and estimating effects of control measures. For instance, the European Water Framework Directive (WFD) requires detailed reporting with high resolution, including ecological status and hydromorphological information of each defined waterbody. Since it is not possible to monitor everywhere, some kind of expert judgements is necessary for the reporting procedure. Methods for predictions of water quality and sediments in ungauged basins are thus highly requested and desired by practitioners. The hydrological research community can contribute with experiences from PUB in this context. However, model applications always include assumptions about unknown input data and unknown model coefficients and parameters. The increase in problems when modelling water quality and sediments are twofold: 1) The lack of information is increasing with the number of variables to be predicted, and thereby, the uncertainty is higher when modelling transport of substances compared to ordinary water predictions. 2) The monitoring programmes normally include only grab samples once a week or once a month, which does not reflect the temporal concentration variation in surface water. Hence, it is also difficult to calibrate and validate a model. This workshop asks for integrated methods, using PUB approaches for water quality and/or sediment modelling of waterbodies, river reaches and the catchment scale. It also welcomes clever assumptions for unknown input variables, monitoring strategies for various variables and purposes, and definition of evaluation criteria for data sparse variables and for spatial variation. Demonstration projects are especially appreciated to flavour the discussion with practical examples.

IAHS Symposium: Cold Regions Hydrology in a Changing Climate

Lead Convenor: Daqing Yang (United States of America)

Co-Convenors: Alexander Gelfan (Russia), Phil Marsh (Canada), Doerthe Tetzlaff (United Kingdom)

Scope: The high latitude and lowland cold regions of the globe are experiencing some of the most rapid changes in climate. These also represent one of the most severely ungauged regions on Earth and suffer from sparse meteorological observations. Although the hydrology of these regions is dominated by snow and ice, our understanding of the hydrological response to a changing climate over cold regions is incomplete. Changes in hydrology related to changing frozen soils, snowfall/rainfall ratio, snowcover, river and lake ice, glacier cover and vegetation are not well known. Our ability to model the effect of these changes on both the fluxes of energy and water between the land surface and the atmosphere, soil and water bodies needs improvement. A particular issue for modelling is the impracticability of model calibration due to the sparse gauge network and rapid climate change. There is also lack of knowledge on process emergence with scale change across these regions. This session will address major issues and challenges in cold regions hydrological research and applications with an emphasis on snow and ice hydrology. It will examine changes in the characteristics and functioning of rivers, lakes,

and wetlands in cold regions, and their interactions with changing human activities and ecosystems. It will explore and examine the biological, physical, and social impacts of hydrological and climatic change in cold regions.

IAHS Workshop: Snow and Ice Hydrology: Principles, Processes and Prediction

Lead Convenor: Tim Link (United States of America)

Co-Convenor: Michele Reba (United States of America)

Scope: This poster only session encourages papers on all aspects of snow and ice hydrology including physical principles underlying hydrological behaviour with snow and ice involvement, measurement using remote sensing and surface observations, snow and ice processes and hydrological prediction in regions where snow and ice affect flow regimes. The storage and modulated release of water from snowpacks and glaciers are major components of hydrological systems in many parts of the world, particularly in mountainous and circumpolar areas. In these regions, the seasonal snowcover, permanent snow and glacial ice are critical components of the annual water cycle, controlling soil moisture, soil temperature, streamflow, and the development and stability of terrestrial and aquatic ecosystems. This session will bring together operational, experimental and modelling experts to address a broad range of topics that are important to understanding this important resource. The session is scheduled for an entire day to facilitate interactions between snow and ice hydrology and related researchers.