

**Announcement of the IAHS symposium on the
"Completion of the IAHS decade on Prediction in Ungauged Basins and the way
ahead"**

Delft, 23-24 October 2012

In October 2012 we celebrate the 90th anniversary of the IAHS and the completion of the IAHS decade on Prediction in Ungauged Basins (PUB). The conference will report on the scientific achievements that were made during the decade and the insights that were gained. We also look ahead to identify the major scientific challenges for the coming period.

During the conference we invite contributions from all scientists that have worked on the main themes of PUB to share their conclusions and views on the advances made during the decade and the remaining research questions. The conference has a general part which provides a summary of the PUB decade, presentations on the Synthesis report and the PUB manual, as well as a visionary session on the future challenges. Subsequently there are thematic sessions organised around the 6 research themes of PUB, as listed below.

Please reserve the dates in your diaries and you may already contact the convenors of the thematic sessions if you would like to make a contribution. In due course more detailed requests for papers will be circulated.

Thematic Sessions:

Session 1: Catchment classification

Convener: Peter Troch

Co-convener: Markus Hrachowitz, Ross Woods

Hydrological response patterns are controlled by the subtle interplay of boundary conditions in catchments such as climate, topography, geology and soil characteristics. To facilitate meaningful model transferability between different catchments, which is one of the core objectives of the PUB initiative, metrics of catchment similarity, relating the hydrological response to the catchment boundary conditions have to be identified. The effectively unobservable spatial heterogeneity of most of these boundary conditions, however, raises the need for identifying generally applicable catchment integrated signatures and organizational principles in order to create catchment similarity frameworks. Such similarity frameworks, based on the relationship of hydrological response patterns and catchment boundary conditions can then be used as the basis for catchment classification schemes, thereby providing means to infer hydrological behaviour of ungauged basins. In this session we invite contributions investigating and assessing ways of conceptualizing catchment similarity and their utility for the development of catchment classification schemes.

Session 2: Conceptualisation of process heterogeneity

Convener: Günter Blöschl

Co-convener: Stefan Uhlenbrook, Doerthe Tetzlaff, Erwin Zehe

This session solicits papers that demonstrate innovative ways to improve our understanding of process heterogeneity and approaches to conceptualise the structure, function and behaviour of catchment systems in different climatic and geomorphic provinces. Particular attention will be given to new approaches for advancing (i) multi-scale catchment monitoring, (ii) encapsulating spatial scale issues, describing non-linearities and emergence of processes, and (iii) developing and establishing geographically and climatically transferable approaches of process and systems conceptualisation.

The space-time variability of dominant hydrological processes and interactions between vegetation, soils and substrate, snow/ice, atmosphere and riverine ecosystems will be investigated and characterised through detailed process studies. Conceptualisation approaches ranging from simple qualitative conceptual diagrams and mapping tools to increasingly complex numerical approaches in physical models will be considered. Natural isotopic and geochemical tracers provide insight into the hydrological functioning of larger catchments and are particularly useful in upscaling studies as their dynamics in natural waters reflect the integration of process interactions at fine spatial and temporal scales. In this way, tracers offer insight into the 'averaging' which characterises the emergent functioning of hydrological systems at larger spatial and temporal scales and will play an important role within session focussing on the PUB theme 2.

Session 3: Uncertainty analysis and model diagnostics

Convener: Hoshin Gupta

Co-convener: Thorsten Wagener, Saket Pande, Jim Freer

During the past decade (since the challenge was posed at the 1999 IAHS meeting in Birmingham), considerable progress has been made in characterizing uncertainties in hydrological model simulations. New methods now try to disentangle the different uncertainty sources (data, parameters, and model structure) in gauged and ungauged basins. And while these methods span a range of approaches, there may be scope to further exploit rich mathematical theories on uncertainty assessment. Concurrently, progress has been made on methods for transferring, extrapolating and regionalising models across basins – a necessary requirement for Predictions in Ungauged Basins, where model calibration is not feasible. While our ability to make such predictions has improved, few approaches produce estimates of predictive uncertainty at ungauged locations. Also, methods for discriminating between alternative model hypotheses remain weak (it has become common to talk about multiple 'equally good' models and parameter sets), and continue to rely heavily on the comparison to observed streamflow for model evaluation. Therefore, attention has turned to the problem of how to characterize, detect, and diagnose model structural inadequacies, and to use this knowledge to develop better models.

In this session, we will report on, and discuss, the past decade of scientific achievements in uncertainty analysis and diagnostic model evaluation in the context of PUB, the insights gained, and the major challenges still facing us. We invite contributions from all scientists that have worked in this area and anticipate a vigorous and productive discussion.

Session 4: New Approaches to Data Collection and Information Gain

Convener: Erwin Zehe

Co-convener: Nick van de Giesen, Vincent Fortin, Theresa Blume, Uwe Ehret, Karsten Schulz, Jens Tronicke.

No prediction without understanding, no understanding without information, no information without data. These statements are valid for any empirical science; the last two statements, however, point to a cardinal problem in hydrological science. In recent years many new approaches to collect data on surface and subsurface properties, states and processes have been developed. This includes geophysical methods (geo radar, active seismic methods, ERT) to collect proxies on subsurface patterns and dynamics; remote sensing methods, cosmic neutrons, scintillometers to collect dynamic proxies on soil moisture, latent and sensible heat fluxes, water stress indices for vegetation; new approaches to assess rainfall variability and variability of air humidity (radar, attenuation of GNSS signals) as well as new smart tracers to discriminate source areas and source volumes of runoff components.

While this is a major step ahead we need a much better picture which combination of these data sources and which metrics – to extract information from these data – are needed to

- Characterize the hydrological relevant architecture of landscape elements (hillslope, catchments), especially with respect to bedrock topography, subsurface heterogeneity and flow path connectivity;
- Understand how structural characteristics, and distributed dynamics control integral mass/water and integral energy flows across scales.

These insights are however the key to find out whether certain elements in the landscape exhibit functional similarity with respect to the dominant process (which might of course change depending on the prevailing boundary conditions). This is deemed as a key to better understand spatio-temporal organization of the water cycle at relevant scales and specifically to design more targeted strategies collected the right for the right reasons to maximize information gain when gauging ungauged catchments.

Within this session we thus solicit studies that combine novel data sources and/or the use of novel metrics to address these two key issues. We also encourage studies that address these issues within virtual realities.

Session 5: New Hydrological Theory

Convener: Murugesu Sivapalan

Co-convener: Hessel Winsemius, Alexander Gelfan

The IAHS PUB decade has seen much activity and many advances in process understanding, methods of predictions, and assessment of the predictive methods. Have the explosion of new knowledge and the methodological advances led to a unified theory of hydrology at the catchment scale compared to before PUB was launched? Theory here is seen as more than the sum total of all knowledge, but as distilled knowledge, and as knowledge that is causally interlinked, i.e., every piece of knowledge makes sense with regard to all other pieces. Theory helps to connect the specific to the general, the local to the global, and the past to the future. Theory provides a framework to assess what we know and what we do not know. Theory provides avenues to seek the knowledge that we do not possess. This session is aimed at soliciting and debating potential new ideas that could contribute to a unifying framework that connects the various advances in knowledge and understanding gained over the PUB Decade towards a coherent new theory of hydrology at the catchment scale and in this way advance our ability to make predictions in ungauged basins and under change.

We seek wide-ranging contributions that approach theoretically the mapping of climate and landscape structure to catchment response from both process-based (mechanistic) and data-based (holistic or functional) perspectives. Our hope is that the new theory of hydrology at the catchment scale will emerge from a synthesis of these two perspectives, through the search for common organizing principles or natural laws that explain observed patterns and transcend knowledge about specific places. Contributions are therefore sought that seek and provide explanations for general or systematic patterns in observed behavior. Examples include patterns, theories, new insights, novel approaches that can reveal organizing principles or natural laws governing:

- the ways that catchments are organized in space and time, in terms of their constituent landscape elements, including the geomorphic and ecological processes that may have led to them;
- the ways that catchments respond to climatic inputs and the nature of the interactions between the heterogeneities in the climatic inputs and the landscape properties;
- the way that the different constituent parts of the catchments, and the catchments as a whole, function, interact with, and feedback on each other.
- the way that catchments respond to human-induced changes in the climate inputs and the landscape properties, in terms of both their form and function (e.g. storage of water, primary production etc.), in the short-term and in the long-term.

Session 6: New Approaches to Modelling

Convener: Hubert Savenije

Co-convener: Fabrizio Fenicia, Martyn Clark

Environmental modelling is confronted with the demand for ever more realistic representation of natural processes. There is a need to understand and describe the complexity of large systems, including the interactions and feedbacks between different biogeochemical cycles and the impact of human activities. In addition, there is the requirement to exploit new sources of data, and quantify their contribution to processes understanding.

On the other hand, the ambition to make predictions in ungauged basins (PUB) stresses the need to develop models that minimize data demand. This requires models that make better use of easily observable quantities, such as globally available remote sensing data (e.g. topography, soil moisture dynamics). As a way to cope with data scarcity, it becomes important to take advantage of independent knowledge, exploiting available understanding on the correspondence between the structure of a system and its functional response, or incorporating other physical constraints. For example, a 'new generation of models' has been envisaged that may reduce data demand by incorporating organizing principles (e.g. minimum energy expenditure and maximum entropy production).

The lack of understanding of catchment scale processes emphasizes the need for improving our ability to implement and test alternative model hypotheses. There is a need for toolboxes that facilitate both model development and diagnostics, allowing for a more objective comparison of alternative model structures and for analysing the behaviour of hydrological systems and their components.

The aim of this session is to bring together new advances in the field of environmental modelling, with particular reference to the specific challenges of PUB. We welcome contributions that elaborate on the correspondence between structure and function of entire systems and their components, that illustrate how to make best use of (often limited) available knowledge, and that undertake the process of building and testing environmental models from a well-designed strategy of hypothesis testing, and that illustrate how the use of different organizing principles may help towards model realism eventually reducing data requirement.

Scientific organising committee:

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