

Preface: Runoff generation and implications for river basin modelling

Special Issue

Runoff generation processes are among the most important processes in catchment hydrology. Understanding where water goes when it rains, water and chemical species residence times, and subsurface flow paths is crucial for catchment modelling and the quantification of solute and contaminant transport. In recent years, tracer methods, combined with hydrometric measurements, have proved to be effective for identifying runoff generation mechanisms in headwater catchments. Nevertheless, many processes are still not well understood at larger basins scales. A challenge in future will be an adequate modelling of the dominant runoff generation processes at the meso- and macro-scale, in order to meet the needs of future water resources management. Thus, the objective of the workshop *Runoff Generation and Implications for River Basin Modelling* was to bridge the gap between field-based experimental research and hydrological basin modelling and to help define the key state variables controlling runoff generation from headwater catchments to larger basins.

More than 80 scientists from all over the world gathered for the workshop (9–12 October 2000, Freiburg, Germany). Both modellers and field hydrologists attended. It was generally agreed that it is not enough for a today's rainfall-runoff model to produce a close fit between measured and simulated runoff data, as this alone does not guarantee a correct reproduction of the internal hydrological processes. Besides the presentations of the participants, various research questions were examined during the workshop. For process research, the following questions were discussed:

- How can we isolate different runoff response mechanisms?
- What is the minimal set of measurements necessary to characterize a hydrological system?
- What are the key state variables controlling runoff generation?

Discussions about modelling studies centred on the following questions:

- How can we use additional information (e.g. tracer data) for model calibration/validation?
- How do we construct models that capture dominant flow response but with a minimal number of tuneable parameters?
- What can remote sensing technologies contribute to process-oriented catchment modelling?

Finally, discussions about regionalization and scaling were about:

- What are the important differences between the well-investigated micro-scale headwaters and the meso-scale catchments?
- How do we scale up our process knowledge?
- Can a catchment be discretized into a simple set of response units? If yes, how?

* Correspondence to: Dr Stefan Uhlenbrook, University of Freiburg, Institute of Hydrology, Fahnbergplatz, 79098 Freiburg, Germany.
E-mail: Stefan.uhlenbrook@hydrology.uni-freiburg.de

The papers of this issue are a collection of the papers presented at the workshop. They give some answers to the raised questions. However, we agree that the questions contain challenges for the next years. All 59 papers that were presented at the workshop are included in a shorter version in the conference proceedings (Leibundgut Ch, Uhlenbrook S, McDonnell J (eds). 2001 *Runoff Generation and Implications for River Basin Modelling*. Freiburger Schriften zur Hydrologie, Band 13. Institute of Hydrology, University of Freiburg: Freiburg, Germany). In addition, the paper of Whitaker *et al.* was included in this issue, as this deals exactly with the topic of the workshop. All papers give an overview of today's state of the art in runoff generation process research and process-oriented catchment modelling.

The workshop was jointly convened by the IAHS and its International Commissions on Tracers (ICT) and Surface Waters (ICSW) and by the German Working Group IHP/OHP-Friend/ERB.

Stefan Uhlenbrook

University of Freiburg, Institute of Hydrology, Fahnbergplatz, 79098 Freiburg, Germany

Jeff McDonnell

Oregon State University, Department of Forest Engineering, Corvallis, OR, 97331-5706, USA

Chris Leibundgut

University of Freiburg, Institute of Hydrology, Fahnbergplatz, 79098 Freiburg, Germany