

4 New Modelling Approaches and Methods for Testing Models against Observations

The overall goal of the PUB initiative is development of models and/or predictive tools for meso-scale basins satisfying the following key requirements:

- the models should be based on understanding of how dominant structures in a landscape and the various landscape compartments determine hydrological functioning in different hydro-climates;
- the models should incorporate and use meaningful parameters and state variables that can, at least in principle, be estimated from landscape properties and environmental observables; and
- the models should permit useful predictions with a minimum of calibration.

In this context the focus of Session 7.6, held at the Scientific Assembly of IAHS in Foz do Iguacu in 2005, was on studies addressing the following themes:

- advanced or new concepts for representing hydrological processes in distributed models for meso-scale basins, especially how these processes are affected by the dominant surface/subsurface heterogeneities;
- advanced or new concepts for up-scaling and parameterizing the effects of subscale structures and heterogeneities on hydrological processes at the meso-scale; and
- advanced or new concepts to relate the parameters of these new models to observable landscape properties at the meso-scale.

The papers presented here represent just the first instalment of the papers that were presented in Session 7.6 at Foz do Iguacu. They address important, practical aspects related to modelling for meso-scale basins, ranging from modelling water and energy fluxes in frozen soils, the usefulness of the geomorphological unit hydrograph for predictions in ungauged basins, downscaling of morphometric parameters, the effects of soil shrinkage on runoff generation at different scales, effects of soil preparation on runoff generation, and last but not the least, the application of hydrological models for predictions at various scales, and in various countries and climatic regions. All these contributions are of considerable importance for the PUB initiative.

The second instalment of these papers will be published in a special issue of *Hydrology and Earth System Sciences* (HESS) journal, under the title “Towards a new generation of hydrological process models for the meso-scale”. The papers to be published in HESS demonstrate that new types of hydrological models are currently being developed, and used, that are beginning to satisfy the key requirements outlined above.

In spite of this progress, it appears that the development of a new generation of hydrological models that will completely satisfy all of these requirements is still some way off. Indeed, in spite of the PUB initiative, the model development activities worldwide are still not coordinated well enough. Real progress will only be achieved when different modelling approaches begin to be harmonized and modelling research becomes much more target oriented.

Reasonable progress in the advancement of physically based models requires, from our point of view:

- the combination of top-down and bottom-up thinking;
- a real collaboration between experimentalists and modellers, where models are used for guiding the design of field experiments, and field observations are in turn used for testing model-based hypotheses and for guiding model development; and
- a stronger cooperation between the different water related geosciences such as hydrology, landscape ecology, geomorphology and meteorology, to enrich the intellectual basis for predictions.

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