

Interactive comment on “HESS Opinions “The art of hydrology”¹” by H. H. G. Savenije

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Balanced approach needed for predictive modelling

I want to make a brief contribution to the ongoing discussion of this paper. I have no major problems with the tenor of the discussion so far, which is very interesting and useful.

One of the major motivations of watershed models is that they may be used to make predictions of water balance and other kinds of variability, especially in ungauged basins.

¹Invited contribution by H. H. G. Savenije, the EGU Henry Darcy Medallist 2008 for outstanding contributions to Hydrology and Water Resources Management.

The common argument for “models of everywhere” is that they are founded on universal theories of catchment response and associated governing equations. The only remaining issue is to tie the models to reality in actual catchments by, hopefully, estimating the model parameters using available information on climate and landscape characteristics. Alternatively, these parameters are estimated by calibration using observed data on rainfall-runoff response in the actual catchments. I will call this the bottom-up approach to modelling.

The development of more flexible models discussed by Savenije (2008) takes a diametrically opposite approach where model structures and associated parameter values are derived using a top-down or data-based approach. This is a highly effective and flexible approach (“modeling as art”); and leads to considerable richness of understanding of catchment responses.

However, neither approach is suitable for predictions in ungauged basins. The top-down approach, on its own, is not suitable for developing models in this case, because the data does not exist from which the model structure can be derived. The bottom-up approach to modelling is also not feasible because difficulties arising from scale problems in developing various process descriptions, the resulting over-parameterisation and associated problems of equifinality and high predictive uncertainty.

To make predictions, we need guidance to choose an a priori model structure for any ungauged basin, on the basis of known climate and catchment characteristics, and methods to estimate model parameter values. This requires universal theories of catchment response that go beyond the data available in a specific catchment.

Therefore, I support the idea of “modeling as art” only insofar as these lead to development of universal theories of catchment response that help to extrapolate from understanding of the responses of gauged catchments to those of ungauged catchments. Similarly, “models of everywhere” should likewise serve as guides to the dominant processes and model structures to be expected in ungauged

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catchments.

Thus, to make predictions in ungauged basins, we need a combination of both the top-down and bottom approaches to modelling.

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