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Hydrology and Earth System Sciences Discussions

Interactive comment on "Hydrologic predictions in a changing environment: behavioral modeling" *by* B. Schaefli et al.

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Schaefli et al. propose a new framework which they call behavioral modeling which is based on the assumption that (i) some universal time and space invariant principle exist, and (ii) that they can be used to overcome problems related to the transferability of hydrological models in space and time. The challenge is to discover these organizing principles and make use of them.

My overall judgment of the paper is that although the topic is interesting and challenging, there is little novelty in the argumentations, as the problem has been widely debated by several commentators, and insufficient evidence supports the assumptions made. As a result, it is difficult to see how the proposed theories can be useful in practice.

The introduction discusses the importance of feedbacks, the lack of understanding associated with it, and the incompleteness of hydrological models that do not account for them. It then proposes a way forward that makes uses of 'organizing principles' that can 'potentially' summarize a catchment and its evolution and that can 'potentially' be used to generate a predictive framework. The paper then proceeds by introducing different 'optimality principles' present in nature, different evidence of self organization and patterns in catchments, arguing that it is 'tempting' to think that there may be a connection between the two. It then proposes the philosophy of behavioral modeling, where models that obey the optimality principles are retained, while those that disagree are discarded.

With respect to the questions raised, this paper does not add much to, for example, Sivapalan [Sivapalan, 2006], where the importance of feedbacks, organizing principles, patterns, self organization are more broadly discussed. Sivapalan also clearly discusses the implications for modeling, in the top down and bottom up direction, of the interactions between processes and patterns, where processes can be used to constrain patterns and vice versa. These arguments are not dissimilar to the concept of behavioral modeling proposed by the authors.

This paper would make a contribution if it presented a convincing application illustrating how organizing principles can be used to generate hydrological models. In absence of this, it is simply a repetitive reformulation of existing concepts which, rather than expressing our progress in understanding, reflects our lack of ideas.

I also noted that the authors are often redefining terms that are already used in the hydrological jargon with other meanings. For example, the term 'behavioral modeling' is used by Beven within the GLUE framework [e.g. Beven and Freer, 2001]. I suggest avoiding this overlapping, which potentially generates confusion. The authors also define a 'structure problem'. Many have already discussed it [e.g. Beven, 2001], hence there is no need to define it for the first time.

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Finally, I was surprised to see this paper not labeled as an 'opinion' paper, as it currently reflects rather opinions than facts. If this paper will be resubmitted as an opinion paper, I think the authors should seriously reconsider their arguments, identifying issues that can justify a new contribution considering the existing literature in this respect. If this paper will be resubmitted as a science paper, the authors should provide a case study that demonstrates (i) how their approach can be implemented in practice, and (ii) what are the advantages in comparison with traditional approaches. In absence of this, I do not see how the present work would make a new and significant contribution to the existing literature.

Beven, K. (2001), Rainfall-runoff modelling : the primer, xi, 360 p. pp., J. Wiley, Chichester, UK New York.

Beven, K., and J. Freer (2001), Equifinality, data assimilation, and uncertainty estimation in mechanistic modelling of complex environmental systems using the GLUE methodology, J Hydrol, 249(1-4), 11-29.

Sivapalan, M. (2006), Pattern, Process and Function: Elements of a Unified Theory of Hydrology at the Catchment Scale, John Wiley & Sons, Ltd.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 7779, 2010.