Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-557-RC2, 2016

Hydrology and Earth System Sciences
Discussions

Interactive comment on "High-Resolution Virtual Catchment Simulations of the Subsurface-Land Surface-Atmosphere System" *by* Bernd Schalge et al.

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Received and published: 22 December 2016

Please find my comments in the attached pdf.

Best regards,

Erwin Zehe

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/hess-2016-557/hess-2016-557-RC2-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-557, 2016.

General comments and evaluation: This manuscript introduces a coupled, cross compartment simulation of the water and energy cycles using the Neckar basin as a case study. I very much agree with the authors that coupled simulations of water and energy cycles are a key for a) advancing our fundamental understanding of environmental system dynamics and b) to identify and rectify deficiencies in data assimilation schemes. The scope of the manuscript is hence highly suited for the audience of HESS and I think that the proposed coupled model bears a huge scientific potential.

Unfortunately, the implementation of the coupled model study and its scientific presentation in the manuscript are far below the quality standard required for a publication in HESS. In the present form the paper has no clear scientific objectives. Page 3 of the introduction reads very much a like project proposal which lists all possible advantages of virtual realities – yet the manuscript does not address a single of these possible scientific objectives. This is a missed opportunity! Instead the authors provide hand waiving arguments, that plausibility of virtual simulations results is sufficient to use the virtual reality for scientific learning. I think this is a) wrong (see major point below) and b) implies that the manuscript is not reviewable, simply because plausibility of model results is nothing that can be falsified based on the provided model evidence (if the authors have a different opinion, they need to explain how to measure plausibility in an objective sense). In consequence the manuscript presents a large set of diverse and possibly very interesting simulation in results in a manner, which does not support a targeted scientific learning process beyond the fact the model may provide those results in a form that is in accordance with the mind setting of the authors.

Given the huge potential of the coupled model I strongly encourage the authors to re-submit a much more focused study, particularly with clear scientific objectives. I hope that the points listed below will be helpful for this. I have doubts whether this can be achieved within the period usually granted for major revisions, particularly also because the revision requires additional sensitivity tests with the model system.

Major points.

- In contrary to the authors' statement, I think that virtual realities are only suitable for scientific learning, if they portray non-linear systems dynamics and its sensitivity to meaningful changes in environmental characteristics in an acceptable manner. This needs to be tested using predefined evaluation criteria and acceptance thresholds, thereby avoiding bias correction, to avoid that we find what we wish to find. Data assimilation procedures which work well in an error-prone virtual reality, must not necessarily do a good job in reality, particularly not if the model is biased! A revised study could hence focus on the question whether the proposed model system performs already good enough to act as virtual reality, thereby exploring related model sensitivities. Even if this will be not the case yet, the study would be extremely interesting and valuable. Computational expense is not really a bottle neck here, as there are suitable methods to assess sensitivity of also of computational very expensive models within less than 50 runs. Another possible objective could be to quantify how much skill in water balance simulations stems from the fact that we usually drive the SVAT part of hydrological models with observed dependent data of air temperature and air humidity. In the coupled model this equivalent to the case of perfect predictions of T and air humidity in the reference layers.
- The referencing is absolutely inappropriate. The authors should acknowledge past work of competing groups in the area of coupled, cross compartment modelling, of water in energy

Fig. 1.