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Hydrology and Earth System Sciences Discussions

Interactive comment on "Multi-model comparison of a major flood in the groundwater-fed basin of the Somme River (France)" *by* F. Habets et al.

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The paper deals with an interesting topic. The issues of model selection and modeling exercises considering alternative model structures (conceptualizations or conceptual models) are of current concern in many publications and application areas.

The aim of this paper is to asses the ability of 4 hydrological models to reproduce a flood event in France testing them against alternative sources of information (observed discharge, piezometric heads, satellite-derived flooded areas). Authors limit themselves, however, to the comparison of the results from the 4 models whereas going a step further to obtain a combined multi-model prediction/simulation would make the potential impact of the article much higher.

Some comments that might help broaden the scope of the article beyond the study case discussed are

1. It would be helpful for the reader to find measures of model performance for the 4 models (skill, RMS, cross-validation).

2. Clearly states the periods and observed data used in the parameter optimization for each model.

3. A quantitative distinction among the four models would help assess in better way the most plausible hydrological model. For example, different model selection criteria (e.g. AIC, AICc, BIC, KIC see Ye et al., 2008) could be used to determine the *best* model. These criteria are usually obtained as by-products of calibration routines, so no need for extra work.

4. The issue of *missing processes* in the corresponding models (p 6157, 4-5) could be reformulated to ask what are the observed data helping in identifying these missing processes. Then you could focus in collecting those data to rule out the *worst* model.

5. Why not considering an ensemble simulation of the 4 models? It is likely that the ensemble prediction/simulation will have a better predictive coverage than any single model. A suitable technique is Bayesian model averaging (BMA), which additionally allows the estimation of the predictive variance arising from the use of alternative hydrological models.

6. The 4 hydrological models show some fundamental differences in the way the water budget is calculated, in the representation of the unsaturated zone, and in the method to obtain the saturated flows. An assessment of the uncertainty arising from these differences would significantly add to the message of the article.

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7. Clearly (as shown from figures 5, 6 and 9), the predictive variance increases by expanding the modeling exercise to the model structure dimension, i.e. by considering alternative hydrological models. So, What is the relative advantage of the multi-model approach compared to the single-model approach?

8. Some fundamental questions related to the multi-modeling approach: How to define *a priori* the ensemble of proposed conceptual models? In the light of data, How to update this ensemble once the data have been observed? How to discriminate among alternative conceptualizations when all perform equally well in a calibration stage against limited measured data?

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