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Hydrology and Earth System Sciences Discussions

Interactive comment on "Uncertainty, sensitivity analysis and the role of data basedmechanistic modeling in hydrology" *by* M. Ratto et al.

A. van Griensven

a.vangriensven@unesco-ihe.org

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General comments:

The paper presents a comparison of a data based mechanistic (DBM) model to a distributed physically-based TOPMODEL. Model performance, model uncertainty and flow partitioning are discussed, as well as some sensitivity analysis results.

The paper is well written and this topic is interesting, but not well framed in the context of model-purposes. In general, many efforts are done to get the TOPMODEL producing similar results than the DBM model (uncertainty bounds/partinioning of flows/model performance). A lot of confidence is given towards the DBM model! The other way

around would make more sense to me: a DBM model could play a role as “surrogate model” for the physically based model (e.g. in real-time modelling or integrated models), and in that context, it could be interesting to find ways to reproduce the model results of the physically based model.

In addition, there are some questions/remarks regarding the methodology for the comparison:

1. Sensitivity analysis - There is a lot of emphasis on sensitivity analysis (in title, large part of literature review), while it has a minor role in the research that has been presented. While several SA methods are described, the Global Sensitivity Analysis (GSA) is applied without well explaining why this one was chosen. It is applied to the DBM model, and even for the TOPMODEL, it has a minor role. - On pp 3107, a definition of sensitivity analysis is given, but I don’t think this is very general. SA is also used out of the context of uncertainty analysis (e.g. to support calibration/to improve understanding in the model behaviour). 2. Uncertainty analysis - Uncertainty analysis has a larger role in the paper, since it is used to compare the 2 modelling approaches. In contrary, less attention is given to UA in the literature review. Of course, this UA is intensively discussed in recent literature, but a better description of the methods, and what they represent (mainly for DBM) is suggested. - The uncertainty analysis results are compared to each other while they are not comparable: in TOPMODEL, uncertainty covers input, parameter uncertainty and observation uncertainty, where, as mentioned, some subjective decisions are made. One can easily produce smaller or bigger ranges for the model results, depending on the filtering of MC simulations/parameter ranges and defining and weightening in the Likelihood function. - At the other hand, the DBM refers to “noise” for the estimated flow. It is not explained how this noise is quantified. 3 Model performance - The model performance is used to compare the 2 models. But, both models have a large decrease in performance between calibration period and validation period for both models. I wonder if the selected dataset (very short!) is allowing such an analysis. 4 Flow partitioning - One would expect that a physically based model

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should be more reliable in physically decomposing flows than a DBM model. Here, many efforts are done to produce similar results with TOPMODEL compared to the DBM model. This is not logic to me. The overall methodology is strange as well, since one is exploring parameter ranges with lower likelihood to provide good performance, in order to change the partitioning. Should we hence question the model structure of TOPMODEL? Or the model partitioning of the DBM? - It is not clear how the decomposition of flows has been done in the DBM model. Please write equation 8 in such a way that it becomes clear. What are the coefficients that have been optimised?

Specific comments: - Equation 8: explain z-1

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 3, 3099, 2006.