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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.

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General comments

The paper addresses the problem of calibration and uncertainty analysis in hydrological modeling using two different modelling approaches, respectively, a data-based model, and a physically-based model. Special emphasis is given to the use of sensitivity analysis for calibration of physically-based models.

The overall quality of the paper is good, it is well written, and, in general, technically sound. It provides an interesting comparison of two different modeling philosophies. However, it is important to emphasize that the two approaches addresses different model applications, and hence one should be careful directly comparing their gen-

eral performance. The data-based model is a forecast model that includes information of previous runoff for prediction, whereas the physically-based model is a simulation model that uses information about rainfall and potential evapotranspiration for prediction. The data-based model cannot be used for general simulation studies. The physically-based model can, however, also be used as a forecast model, but in this case better performance can be obtained by updating the model with recent runoff observations using data assimilation (the same information as used by the data-based model).

This basic difference between the modeling approaches is briefly discussed in the Discussion section. However, I think it should be emphasized up-front in the Introduction to put the analysis into the right perspective.

Overall, the paper provides a valuable contribution to the research field on calibration and uncertainty estimation in hydrological modelling.

Specific comments

1. In the calibration of the models only 3 months of data are used. This is a rather short period. In general, one should include a sufficiently long data set in the calibration to cover the full hydrological variability of the catchment, which is often several years in practice. The problem of using a too short calibration period is that the model is overfitted to the specific conditions for that period and not generally applicable to other conditions. That this is a problem in the present application is reflected in the validation results. Application of the models on validation data provides a much poorer performance, reducing the coefficient of determination from about 90-92% for the calibration period to about 75% for the validation period. This aspect should be elaborated. Indeed, not much is said in the paper on the validation results (just referring to calculated performance measures on page 3118).

2. For the Elementary Effect Test described on p. 3112 elementary effects are calculated for different selected points. How are these points selected? The Morris design

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(Morris, 1991) provides an efficient design in this regard. Besides the average of the elementary effects one can calculate the variance, which is a measure of interactions between factors and non-linear effects.

3. In the GLUE analysis a sample size of 1024 is used. This seems a rather small sample size as compared with other GLUE studies. Were any sensitivity analyses performed to check if this sample size was adequate?

4. How are the "simulation" results of the MODFLOW GLUE analysis as shown e.g. in Fig. 5 derived from the posterior distribution? Median?

5. There is some confusion with respect to the curves shown in Fig.1. I would expect that the dash-dot line is the parametric estimate and the full line is the non-parametric estimate, and not the opposite as described in the text on page 3113 and in the figure text.

6. The operator z in Eq. (8) is not defined. And this should not be confused with z used in Eq. (10).

7. There is some confusion on the coefficient of determination for the data-based model: 92.4% on page 3114, line 19, 92.3% on page 3118, line 14, and 94% on page 3133.

8. On page 3113 two sentences are more or less repetitions: (1) "During the summer months water abstractions from the reservoir strongly influence the flow", and (ii) During summer time, the flow is affected by abstractions from the reservoir situated in the catchment".

9. The figure referencing is somehow confusing. Fig. 5 and Fig. 8 are referred to before the first reference to Fig. 4, and later Figs. 6-7 are referred the first time (page 3118).

Technical corrections

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Interactive Comment

1. Page 3101, line 1: “provide” instead of “provides”.

2. Page 3109, line 14: “factors prioritization” instead of “factors fixing”.

3. Page 3114, Eq. (8): insert a comma between the two last equations.

4. Page 3122, line 17: I think “groundwater storage” is more appropriate than “root store”.

5. Page 3131: unit of flow is missing.

6. Page 3132: unit of flow is missing.

7. Page 3133: “Calibration of the DBM model ” rather than “Calibration of the data”

8. Page 3134: “Validation of the DBM model”.

References

Morris, M.D., 1991. Factorial sampling plans for preliminary computational experiments. Technometrics, 33, 161-174.

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