Hydrology and Earth System Sciences Discussions

Interactive
Comment

Interactive comment on "Gauging the ungauged basin: how many discharge measurements are needed?" *by* J. Seibert and K. Beven

Anonymous Referee #2

General comments:

This paper left me with mixed feelings. On the one hand the design of the experiment is rather good and the results interesting. The paper is well written and the methodology well described. On the other hand I consider this paper has some flaws, the most significant one relating to the fact that it is very poorly referenced. The authors claim that 'there is almost no guidance in the hydrological modelling literature about the worth of measurements in model identification'. This apparent lack of literature on the subject enhances the need for mentioning the (rare?) existing papers on this subject. There are a number of references discussing the influence of calibration data length and variability on model results dating from as far back as the 80s. The authors missed to mention some significant contributions in the field (e.g. Moss, 1979; Sorooshian et al.,

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1983; Gupta and Sorooshian, 1985; Yapo et al., 1996, Perrin et al., 2007; Fenicia et al., 2008). As a matter of fact they failed to discuss the scientific merit of their paper in the light of the papers that have been published in the past. When looking at some of these papers, the work that has been presented here does not appear to be that new. If I refer, for instance, to the work of Perrin et al. (2007), the methodology is very similar and it would have been interesting to discuss the findings of the two studies. I thus recommend a major revision of the introduction and discussion of the manuscript.

Another major issue concerns the fact that the authors decided to put their research in the context of PUB. I believe that the paper does not address the main theme of PUB ("moving from model calibration to process understanding"). Here the authors start with a model structure that has been fixed a priori and look at the sensitivity of the calibration with respect to the number and timing of discharge measurements. It can be argued that what is shown here is a mere model calibration exercise that is leading towards no or little process understanding. This is very much due to the use of the Nash criterion as single objective function. The information on catchment behaviour that is conveyed by the Nash performance measure is very limited. It would be necessary to include in the analysis other criteria that represent various aspects of catchment behaviour (e.g. high flows, low flows, recession, rising limb). Moreover, it would have been interesting to discuss the identifiability of individual model parameters with respect to the adopted sampling strategies and data length (cf. Perrin et al., 2007). Using variable performance indices and looking at parameter identifiability would probably allow to see whether important catchment "signatures" (Sivapalan, 2009) can be inferred (e.g. recession parameter, runoff coefficients, time lag etc.) from a limited amount of data. Considering parameter identifiability with respect to various performance measures that were obtained with a limited amount of data would eventually allow to better understand the merit of each sampling strategy. In my opinion, this would result in a study that is much more in line with the key idea of the PUB initiative.

Specific comments:

p. 2281 l.27: why did you not weight the parameter sets based on the Reff? p. 2283 l. 23: why this was clear? p. 2285 l. 13. might be due to the fact that you chose the Nash criterion as the objective function. Fig. 1 The efficiencies of the tested models are rather bad. Why is that? Fig. 4 seems to indicate much better efficiencies for the individual ctachments. Fig. 1 How did you compute the 100 best para sets if there are no measurements available. I suppose that you took all model runs but then the legend is misleading

References:

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Moss, 1979. Some basic considerations in the design of hydrologic data networks, Water Resources Research, 15(6): 1673-1676.

Perrin et al., 2007. Impact of limited streamflow knowledge on the efficiency and the parameters of rainfall-runoff models. Hydrological Sciences Journal, 52(1): 131-151

Sivapalan, 2009. The secret to 'doing better hydrological science': change the question!, Hydrological Processes. 23(9). 1391-1396.

Sorooshian et al.m 1983. Evaluation of Maximum Likelihood Parameter Estimation Techniques for Conceptual Rainfall-Runoff Models' Influence of Calibration Data Variability and Length on Model Credibility, Water Resources Research, 19(1): 251-259.

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