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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Regional water-balance modelling using flow-duration curves with observational uncertainties" *by* I. K. Westerberg et al.

Anonymous Referee #3

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The manuscript by Westerberg et al. (2013) presents a method to estimate predictive uncertainty in conceptual hydrological modeling of ungauged river basins by using flow-duration curves as information source. The idea is to account for output data uncertainty when transferring parameters inferred in gauged watersheds to similar ungauged watersheds. The methodology for uncertainty assessment combines fuzzy regression analysis and informal inference methods.

In my view the paper is well written and its topic is relevant for the HESS audience since it stresses the need to account for different uncertainty types in hydrological modeling. There are however some critical issues that need to be addressed before publication.

I. The scientific method used for uncertainty analysis is not the most appropriate one. Indeed, after having discussed all the flaws of the GLUE methodology (e.g., Mantovan et al. [2007], Stedinger et al. [2008], Clark et al. [2012]) it is astonishing that this "pseudo-Bayesian" approach is used without any explanation of its appropriateness and shortcomings. It seems necessary, at least to properly justify why this approach has been preferred given the availability of new promising statistical approaches for uncertainty analysis (e.g., Renard et al. [2010], Reichert and Schuwirth [2012]). More importantly, the authors should clearly discuss the limitations of the interpretation of the resulting uncertainty bounds. As Clark et al. [2012] pointed out, GLUE uncertainty estimates appear to lack quantitative significance and the use of "new triangular pseudo-likelihoods" do not seem to solve this problem nor other fundamental weaknesses of GLUE. If the uncertainty intervals are not even intended to encompass the relevant fractions of validation data what is the meaning of these predictions and how can we practically use them?

II. The citation of other studies dealing with uncertainty analysis in ungauged basins and concerning errors in calibration data, especially those applying formal statistical methods, is quite limited. In order to present a more balanced view I suggest to discuss at least the following papers:

Honti et al. [2013]: uses a recent Bayesian approach to deal with several uncertainty types (included observation uncertainty which is disentangled from the other contributions) to reliably quantify the uncertainty of flow duration curves and discharge.

Sikorska et al. [2012]: shows how to assess runoff predictive uncertainty in ungauged basins by using autroregressive error models.

Renard et al. [2010]: tries to quantify different uncertainty components in a Bayesian framework by also separately accounting for uncertainties in the measured runoff.

Minor points:

i. “Reliability” and “precision” should be also defined in relation to the probabilistic performance measures of “reliability” and “sharpness” (see e.g., Breinholt et al. [2012]). How do these concepts relate?

ii. Define “behavioral simulations”: for researchers not familiar with the previous papers of the authors it can be hard to understand this concept without further explanation.

iii. The Discussion is currently a big block of text. It think it would help understanding it better if the authors would structure it into subsections.

iv. Section 3 (Model) is not optimally structured: first, the model would fit better in the methods; second, the description of the model structure is mixed with the prior definition and the numerical implementation of the uncertainty analysis routine. I think these three concepts should be separately explained and better organized.

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