

Interactive comment on “Multi-objective regionalisation for lake level simulation, the case of Lake Tana in the Upper Blue Nile, Ethiopia” by T. H. M. Rientjes et al.

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Anonymous Referee #1

This is an interesting contribution, sound science, well written, and appropriate to the special issue focus. The authors do a commendable job making clear their goal – improving the Tana water balance compared with previous studies. The following comments/ suggestions are offered:

While well written, there are a few instances of minor grammatical mistakes that could be fixed with an additional careful read-through.

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P7342,L12; HVB should be HBV

Reply :Done

P7345,L10-12; how does this delineation compare with previous studies, and is that important?

Reply : We presume that differences in catchment delineation only are minor since the same SRTM digital elevation model is used while also similar delineation algorithms are applied. We note that it is most unlikely that any small difference could impact the simulation results in this study.

P7346,L8; “Runoff time-series were analyzed for consistency. . .” How? Method?

Reply : A small description has been added following the suggestion by the reviewer.

P7348: Variable names (initials_ do not all seem to match figure 2 (e.g. don't see 'R' there.)

Reply : We thank the reviewer for the comment and necessary modifications are made to figure 2.

P7350,L15-16; Are parameter bounds based on physically reasonable limits?

Reply: We thank the reviewer for the comment and elaborate here on two issues. First, all parameters of HBV only have weak physical interpretability and as such values cannot be related directly to real world properties. Second, in MCS the selection of the prior parameter value range is an important step. In this work we revisited various studies to identify prior ranges. These ranges have been set to the first runs. For a second MCS run, the narrowed prior ranges have been selected based on model performance assessments. We believe that such procedure is sufficiently accurate to identify plausible prior ranges. As described, it is difficult to interpret such ranges in terms of 'physically reasonable limits' as asked by the reviewer.

P7350,L17-24; Assume it's possible that the effects of 2 'unreasonable' parameter val-

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ues are canceling each other out. Can this be checked?

Reply: Indeed it is possible that two (or more) 'unreasonable' values could cancel out each other. After checking the calibration data we could not identify clear outliers of parameter value combinations of 2 or more parameters that could result in a possible effect such as suggested by the reviewer. We note that we repeated the MCS procedure some 15 times to also prevent that 'unfortunate' random draws eventually could impact the results. Also the HBV model does not require a large number of parameters.

P7353,L7-8; Reference for this statement?

Reply : We refer to Beven and Binley, 1992 where first applications of the MCS are shown.

P7353,L6-9; Do the 25 sets contain significant differences between parameter values? So no single set is probably appropriate, but an average gets back to something reasonable? Is this expected (e.g. central limit theorem)?

Reply: We checked the calibration data and conclude that for all parameters the parameter values for single best parameter sets and the average for the 25 best performing parameter sets do not differ largely (see figure 3 for ALFA and PERC). We note that averaging causes that parameter values may be interpreted as more robust as preferred in regionalization studies since values reflect over a wider range of optimized parameter values for which the model performed satisfactory.

P7355,L1-6; Does order of adding individual variables matter in either process? Please clarify.

Reply: We agree that order of adding individual parameters matters. For that reason, when entering a second (and following) variable first the significance level of the independent variables is tested. If the level is not exceeded then the most significant independent variable is added. As such a systematic procedure is followed and results

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for all combinations of PCCs are tested.

P7355,L6-14; There is a lot information here – difficult for the reader to process. Is it possible to present in another fashion (e.g. steps as bullets, etc.)?

Reply: We thank the reviewer for the suggestion but hesitate to extend the description since reviewer 3 prefers to have the entire section removed. For a full description of the procedure we refer to Perera, B.U.J.: Ungauged catchment hydrology: The case of Lake Tana. MSc thesis ITC, Enschede, The Netherlands, 61 (2009).

P7358,L10; So is it fair to say that one can't be confident that the right parameter values are selected. . .only an optimal combination? This should be stated.

Reply: We appreciate the comment by the reviewer and a sentence has been added to elaborate on the remark.

P7358,L16; Figure 4: is this essentially sensitivity or uncertainty? Is it possible to communicate the uncertainty of individual parameters?

Reply: Box and Whisker plots indicate uncertainty of the parameters as Box-Whisker plots only visualize statistical information of the sample data. We note that the MCS procedure applied does not aim at identifying sensitivity of model parameters but primarily aims to find well performing parameter sets. Obviously plot information on parameter uncertainty implicitly relates to sensitivity since the box information indicates weather parameters have large or small values ranges.

P7359,L20-P7361,L1; Is there a physical basis for PCC selection for each MP? The statistical strength/procedure is clear, but are the associations physically meaningful? Might be useful to connect the physical relationship of predictor and predictand with a sentence or two per predictand.

Reply: We thank the reviewer for this comment and following the suggestion we added short descriptions on hydrologic plausibility between predictors and predictands.

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P7361,L2; So are NS and RVE values potentially higher than one would expect on validation of independent (not in regionalization) basins? Please clarify.

Reply: We thank the reviewer for this comment that actually touches on an important set-back of the validation procedure in this study. Indeed, when reusing a catchment for validation a bias is introduced since the regional model is based on information of the same catchment. If this automatically leads to higher NS and RVE values, however, cannot be concluded since the regional model is based on a group of catchments. We added a statement to the manuscript following the suggestion by the reviewer.

P7362,L17-25; The authors acknowledge uncertainty. . .but is it possible to quantify?

Reply: Probably the only way to indicate on uncertainty is to find approaches that better describe the individual processes. Such, however, is far from trivial since better and (much) more real world data in time and space dimensions is required to allow for uncertainty (or accuracy) assessments. This comment has been added to the manuscript.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 7341, 2010.