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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Modelling the Mara River Basin with data uncertainty using water levels for calibration" *by* Petra Hulsman et al.

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Review of "Modelling the Mara River Basin with data uncertainty using water levels for calibration" By Petra Hulsman, Thom A. Bogaard, Hubert H.G. Savenije

The manuscript describes an approach to reduce the effect of discharge uncertainty in the calibration process of hydrological models. The authors suggest using water level observations instead of discharge data to evade the uncertainties related to rating curves. They have calibrated FLEX-Topo model to water level observations at three gauges of Mara watershed located in Kenya and Tanzania. Overall, the research is interesting; however, I have several major and minor concerns regarding the manuscript. I hope the authors find my comments helpful as summarized in the following.

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Major concerns:

1. As far as I have understood, the authors have used water level observations (dobs) to calibrate the model. So, Manning-Strickler formula has been implemented in the model (line 60) to simulate both discharge, Qmod, and water levels, dmod. Moreover, the authors have produced discharges based on dobs using Manning-Strickler formula and named it QStrickler. Then they compared the recorded observed discharge, Qrec, with QStrickler and Qmod in Figure 12. How did the authors produce QStrickler? Have you had information about the cross-section details at three locations indicated in Figure 12? The research method explanation is hard to follow and understand.

2. The explanation of the methodology used in the manuscript is vague. Table 5 can be improved significantly.

3. There is no information about the calibration process of either the FLEX-Topo model or the Manning-Strickler formula. What were the initial ranges of parameters? How many parameters have been calibrated? Did the authors used an optimization algorithm or an uncertainty-based method? What were the final ranges/values of parameters? Have you tried any other objective function rather than Nash-Sutcliffe? Why have the authors used two validation periods for Mines (lines 221-222)?

4. The time-step of the model seems to be neglected. The information about the time-step is not discussed in the paper expect a minor reference under Table 4 caption. Have you tried different time-steps? Could results improve if you use a smaller time-step?

5. One of the main purposes of hydrological models is producing the hydrographs at different locations. Although authors have tried to indicate the water level time series (Figures 7, 8, 9 and 14), the hydrographs are missing.

6. The details of sensitivity analysis to produce thresholds of different landscape slopes and HAND values are missing. Is the HAND model based on the research of Nobre et al. (2011)? Have you used any specific sensitivity analysis algorithm/approach?

7. Are calibrated roughness values in accordance with the streambed material for Manning-Strickler formula?

8. How did the authors specify the average flow velocity (line 165)? Would changing this parameter value impact the overall results? Does it change the hypothesis of using Manning-Strickler formula?

Minor concerns:

1. The use of English language should be improved significantly. A number of grammatical errors could be found (e.g., in line 237 “an sub-catchment”) and also some sentences are not clear and easy to understand (e.g., “a large scatter is found in the observations which could not be the case assuming one rating curve was used.” (lines 317-318), “... the parameter c compensates for non-closure of the water balance” (lines 207-208) and etc.)

2. The title of research seems awkward. What does ‘modeling [...] with data uncertainty’ mean? Where did the uncertainty of streamflow, either water level or discharge, come into consideration?

3. I do suggest a separate section for data as different data sources have been mentioned in different places (e.g., field trip data (lines 108 to 112), digital elevation map (line 128), Africover database (line 133), precipitation and evaporation data (lines 195-196, line 423), etc.)

4. Some of the mentioned sources are not available in the reference list. For instance, Karamuz et al. (2016) (lines 57-58), GLOWS-FIU (2012) (line 326). Also, some of the reference details are flawed, such as the reference to the paper by Gharari et al. (2014) which is wrong. The paper is published in 2014, not 2015 (line 453).

5. Equation 1 indicating Nash-Sutcliffe formula is wrong (lines 230 to 233).

6. In several figures, there are plenty of sub-figures (Figures 5, 6, 11, 12, 13,14 and several ones in supplement) which could be denoted by letters or numbers to avoid

confusions. In Figures 1 and 2, the sub-catchment boundary lines are not introduced in figure legends. Moreover, in Figures 10, 11 and 13 the number of months could be replaced by their actual names.

7. What is the time period of discharge data indicated in Figure 12?

8. The 'Strickler' formula is also known as 'Manning' equation/formula. Authors could have used the 'Manning-Strickler' term which is more general.

9. Instead of using the phrase "see supplement" in multiple locations the authors could refer to the specific figure or table in the supplements. For instance, in line 198, they could have specifically referred to Table S1 and Table S2.

10. The number of temperature stations is different as declared in line 89 compared to Figure 1 and supplement spreadsheet data.

11. Section 4.4 needs more discussion as no general suggestion to future research is made. Moreover, it is not apparent whether these strategies have improved the results of calibration.

12. The conclusions need to be considered again as many ideas have been repeated from the introduction/abstract part. It could have been more concise and explicit.

Given the major and minor comments provided in this review, the manuscript should be improved significantly in my point of view to meet the minimum levels of quality for publication in HESS.

With kind regards,

Kasra Keshavarz

PS. I would like to thank Dr. Jeffrey McDonnell and Dr. Shervan Gharari who helped in reviewing this paper.

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