

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

### **Anonymous Referee #1**

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The objective of this paper is to build a model for the Mara basin in Kenya. I found the paper potentially interesting in terms of the methodologies it introduces for dealing poorly gauged catchments. However, it needs major improvements. Below my detailed comments.

Section 1. The paper states that the “The goal is to develop a reliable hydrological model for the semi-arid and poorly gauged Mara”. In my opinion, this is not the kind of objectives that warrants a publication. I am convinced that the authors can identify a set of more appealing objectives for their work.

Section 1. Can the authors clarify why using water levels for model calibration avoids the effect of discharge uncertainties? This is presented as a fact, with no references to previous literature, and no explanations. I do not find the explanation obvious. Do they

imply that rating curves are constant, and that the whole procedure of updating rating curves, as commonly done, is flawed and useless?

132: to further delimit HRUs. Which HRUs? Even reading the paragraph further, it is unclear how many HRUs are used. You say 4, but then mention “are mainly cropland and forest, whereas further south the land use is dominated by grassland”, which are not in the 4 HRUs.

Section 3.3. This section, which is key to explain what was done in the paper, is very convoluted, and impossible to understand. The first sentence states “Parameters and process constraints have been applied to eliminate unrealistic model results”. Which model results? “For example, the maximum storage” – why for example? I want to know exactly what was done and how it was done. Instead, there are just a few sentences of how the methodology was carried out, relegating the essential details to even more unclear supplementary materials. “The model was calibrated and evaluated” how was this done? What is the difference between calibration and evaluation? “For the evaluation of this calibration”, why this? Is there another calibration? In general every paragraph contains a lot of information in a very convoluted way. It is necessary to describe the methodology in a much more streamlined way.

205. Needs to be expanded and clarified. The procedure for calibration using  $h$  and the procedure for evaluation using  $Q$  needs to be clearly distinguished. You write that you use  $d$  for model calibration and flow duration curves for model evaluation. Flow means  $Q$ , but all the plots show  $d$  duration curves. Where is the flow used? The value  $d_{mod}$  is not present in the Strickler formula (there is  $A$  and  $R$ ). What is the relation to  $d$ ? It should be written explicitly. What is the relation between the Strickler formula and  $Q = a(h - h_0)^b$ ? What is the value of  $b$ ? If I understand well, the observed and modelled water discharge are obtained using the same formula with the same parameters. Why is then  $Q_{rec}$  needed? Trying to explain 3 essential things (model calibration, evaluation and evaluation of rating curves) in the same paragraph does not work.

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215. Does the model provide simultaneously the output at the 3 stations? Was it calibrated simultaneously to the 3 gauging stations? Or was it calibrated individually to each station? If it was calibrated individually to each station, shouldn't the parameters of the same HRU in different catchment be the same? How was this ensured?

230. It appears that the model was calibrated using FDCs. But the objective is to simulate streamflow. Are FDCs sufficient to represent streamflow time series? E.g. I can imagine that information about seasonality as well as timing of peaks is lost when calibrating to FDCs. How were these problems addressed?

230. I don't think you need caption for equations. The explanation should be in the main text.

230. Was it multi objective calibration leading to a Pareto-front? Needs to be clarified.

As the methodology was very unclear, it is difficult to understand and judge the value of the results. I guess major clarifications are needed, before a fair assessment can be made

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