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Hydrology and Earth System Sciences Discussions

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 #2

General comments: The content of the manuscript by Rientjes et al. fits most certainly within the scope of HESS. Ways to estimate the water balances of ungauged catchments based on similarities with gauged catchments are highly relevant. The aim of the paper was to improve the water balance of Lake Tana using two critera for calibration. The paper is overall well written, though the grammar can be improved. The novelty value of the concepts and methods used, are however, limited. The paper

presents an improvement of the earlier regonalisation done by Kebebe et al. 2006, SMEC (2008) and Wale et al. (2009). In comparison with the paper byWale et al. 2009, the novelty of this paper consists mainly of using another method to estimate lake water evaporation (by the method developed by Su (2002) to estimate albedo Su) and by using longer time series. Doing so, the authors improved the closure of water balance from 5 to 2 %. This is a major improvement, as these last percentages are hard to gain, but otherwise the paper has limited contribution to development of new methods.

Reply: We thank the reviewer for the comments on the closure term of the water balance. Indeed, the smaller the error (already) is, the more difficult it often proves to be to further reduce the error. Further, the reviewer makes a comment on the novelty of the paper claiming that only the procedure to estimate lake evaporation has changed. Unfortunately we have to disagree to this comment since, compared to the paper by Wale et al., (2009,) we applied a very different, much more advanced procedure (i.e., Monte Carlo simulation) to calibrate the hydrological model. Obviously the outcome of such procedure directly propagates into regional model and thus affects the overall outcome of this regionalization study. Also non-effective PCCs in Wale et al. (2009) have been replaced by other PCCs. Further we estimated lake evaporation by a more comprehensive remote sensing based procedure.

I would like to make three strong recommendations for improving the manuscript:

1) Improving the description of method to estimate lake evapopration from albedo estimated by remote sensing and its results

Reply : Following the comment a more extensive description is added.

2) Adding a clear description of the methods used for validation (the word validation appears for the first time in result section)

Reply : Following the comment a more extensive description is added to a new para-

graph 5.7 'Validation of the regional model'.

3) Adding an overview how well the physical characteristics of the gauged catchments resembled the ones of the ungauged catchment as the later ones were found in NW corner of the basin, they might be different from the others. The overview could be achieved by adding a table with the values used of the physical characteristics for each catchment and an area-normalized value for the whole basin. The area-normalized value would provide an important insight in the abundance of a certain physical property.

Reply: We partially agree to the remarks by the reviewer. We note that the gauged catchments are fairly well distributed over the Lake Tana basin area and not located in the NW corner as suggested by the reviewer. We note that we modified Figure 1 to better visualize between gauged and ungauged catchments. We also have added a sentence that explicitly refers to the figure. We evaluated normalized values of PCC as suggested by the reviewer and added descriptions to the manuscript. We did not add the table for reasons of brevity and to save space (the table stretches over 2 pages).

Specific comments: Title: Suggestion for title: Improved regionalization for lake level simulation of Lake Tana in the Upper Blue Nile, Ethiopia. Multi suggests more than two. Here two criteria are used for calibration

Reply: We agree to the comment that also was made by reviewer 3 and have changed the title.

Abstract: The objective given in abstract P7342 L1 is not the same as in Introduction

Reply ; We modified the first sentence and have added the objective at the end of the first paragraph.

P7344 L13-14; Mention the methods used for calibration (for instance the two criteria for calibration) and validation in this study rather than discussing other studies in abstract L7-L10, L18

Reply ; This comment is not entirely clear to the authors since sections are mixed. We note that the Monte Carlo procedure already is mentioned in the Abstract. We now have added a short description on Monte Carlo simulation in the Introduction following the suggestion. We disagree to the comment that previous work should not be discussed since such description serves as the bench mark to the work and approaches presented in the current manuscript.

P7345 L9-L12; Add a references for the source of runoff data. Where are the gauged catchments found?

Reply : The requested references are added. We note that in Figure 1 all gauged and ungauged systems are indicated. We have added a sentence that explicitly states that the distribution of gauged and ungauged catchments is shown in Figure 1.

P7346 L8:-9; Please clarify how consistency was analyzed.

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

P7346 L20; Reference WRB, 2007 missing in reference list

Reply : The reference was redundant and is removed.

P7356 L6-L11; see comment on P7346 L8:-9, maybe add results in an appendix

Reply : We hesitate to add the outcomes of the time series correction since many time series need to be shown then but also since the procedure to correct the time series is described. As such we have denied adding the results.

P7358 L19-L20; Normalized whiskers per definition 0-1? Why not for alpha

Reply: We thank the reviewer since we overlooked the error. A correction has been made and alpha is rescaled between 0 and 1.

P7359, L4; move to material and methods.

Reply: We thank the reviewer and have followed the suggestion. A sentence has been

added to section 5.0

P7360, L7-L8; 'Therefore' not clear as relationship to VER is strongest?

Reply. A description has been added to the manuscript.

Table 5 is redundant as same information is given in table 6.

Reply: We thank the reviewer for the comment and we removed Table 5.

Table 4 and 6; BETA and CFLUX are modeled with parameters with very low correlation, HI and PET, respectively, Isn't that worth discussing?

Reply : We believe that the reviewer means PCCs instead of parameters. The phenomenon the reviewer refers to is not uncommon in regionalization studies. For instance in Deckers et al., (2010) in a regionalization study in the UK and in Wale et al., (2009) MPs are also correlated to PCC with very low correlation. A discussion on plausibility of statistically most significant relationships of a regional model when poorly correlated PCC are added. We note that many cases can be shown that the use of PCCs with high correlation does not improve the regional model.

Figure 3; X-axis and figure text not clear. *Reply: We have increased the size of the font.*

Detailed comments:

P7344, L10; the study -> this study *Reply :Done*

P7345; add 'of Ethiopia' -> highlands of Ethiopia *Reply :Done*

P7346, L5; year missing: was updated in ? *Reply :Clarification is added*

P7358, L6 do you mean 'calibration' or 'validation' here? *Calibration since the procedure is repeated for the narrowed parameter space.*

L27; Tthe->The *Reply :Done*

P7347- P7349; Add units to all model parameters and equations *Reply: We note that units of all parameters are already added to table 1 and 4.*

P7350 L22-L25; Not clear, please reformulate *Reply :Done*

P7351 L16-L17; move to line L11 where Qsim is used first time. *Reply :Done*

P7353 L17; Land use ->Land Use; *Reply :Done*

L19 NMS-> NMA; *Reply :Done*

L26; reformulate 'that also is selected for this study' *Reply : Done*

P7346 L24; Replace 'in' with 'by' Wale et al. *Reply :Done*

P7347; Equations 1 and 2 concern snow, not relevant for this study *Reply : The section on the snow meld has been removed.*

Table 1 Maximum for CFLUX should be at least 2 *Reply : Done*

Table 3 and 4 replace 'KF' with 'Kq' *Reply :Done*

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