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Hydrology and Earth System Sciences Discussions

Interactive comment on "Assessing the potential hydrological impact of the Gibe III Dam on Lake Turkana water level using multi-source satellite data" *by* N. M. Velpuri and G. B. Senay

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Author's Response to Short Comment by M. Gebremicheal

We thank Dr. M. Gebremichael for his interest in our paper and for providing very useful and insightful comments. Our responses to his comments are listed below:

Comment #1: On Uncertainty: As shown in Fig. 2, the model results are subject to errors, however consecutive figures (Figs 3 – 5) show only deterministic model results (i.e. how does the error shown in Fig. 2 affect the lake level simulations shown in subsequent figures?) Admittedly, how to quantify and show uncertainty is a challenge.

Perhaps you could use different satellite rainfall products as inputs (see references below for high-quality rainfall products in the region) to get ensemble of possible stream flow or lake level simulations. At a very minimum, the uncertainties associated with model results should be acknowledged. Author's response: We agree with the comment and we will add a section in the revised manuscript acknowledging the uncertainty in model parameters and model output.

Comment #2: Figures 3 – 6: the scales of the y-axis (for the lake levels) are different for different figures, and this makes it harder to compare the resulting lake levels. Please use the same scale bar for the lake levels.

Author's response: The scale of the y-axis in Figures 3-6 was chosen to be dynamic depending on the input data such that fine scale difference between the modeled lake levels between 'with Gibe III' and 'without Gibe III'. As per the comment, we agree to make changes in Figure 3 and 6 so that all these figures have same range of lake levels (356-366 m) as shown in Figure 4. However, we would retain Figure 5 (scatterplot figure) as is because the figure does not have any data points below the lake level of 361 m.

Comment # 3: Figure 3: there are a few points (see the hydrograph before 2008) where the flow "with Gibe III" exceeds the flow "without Gibe III". Please explain this.

Author's response: As rightly pointed out, in some rare cases, the hydrograph 'with Gibe III' exceeds the hydrograph 'without Gibe III'. The situation is explained below.

If, heavy rainfall occurs when reservoir is at its full capacity:

With Gibe III: Lake Inflows = Natural flow (Over flow from the reservoir) + Discharges from Gibe III

Without Gibe III: Lake Inflows = Natural flow

Because of the discharges from the Gibe III would add to the natural flow, lake inflows 'with the Gibe III' would exceed the flow 'without Gibe III'. However, this trend would

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only exists as long as Gibe III remains at its full capacity.

We would add the explanation in the revised manuscript to address this comment.

Comment #4: Results and Discussion involving Figure 7. Why is it counter-intuitive to see a smaller impact on the lake level when there is BN rainfall, and a higher impact on the lake level when there is AN rainfall? I think this shows the impact of the elevation-area curve. Would it be better to show the volume as well? I am not convinced the importance of this Figure. If the authors feel this is an important figure, they will then need to justify the results.

Author's response: Yes. The impact of initial lake levels shown in Figure 7 is due to lake elevation-area-volume curve. We see the point made here and we agree that point was not conveyed clearly. We agree to make changes in the revised manuscript to elaborate and clarify the importance of Figure 7. To explain the figure clearly, let us assume two cases as shown below:

Case 1: Lake is at higher initial lake level

Without Gibe III: The lake would receive unregulated inflows (with an average flow of 650 m3/s) that would compensate most of the ET losses and hence lake levels would show little reduction in lake levels.

With Gibe III: The lake would receive regulated minimal inflows (with an average flow of 400 m3/s) especially during the first impoundment period and since at higher lake level (larger surface area), larger volume of inflows are required to compensate the ET losses, the lake levels will decline rapidly when compared to without Gibe III. Hence the impact (different between without and with Gibe III) is higher at higher initial lake level

Case 2: Lake is at lower lake level

Without Gibe III: The lake would receive unregulated inflows (average flow of 650 m3/s) that would compensate ET losses from a smaller surface area and hence lake levels

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would show little reduction in lake levels.

With Gibe III: The lake would receive regulated (minimal) inflows (average flow of 400 m3/s) and since at low lake level, smaller volume of inflows are enough to compensate most of the ET losses, the lake levels will decline at a smaller rate when compared to without dam. Hence the impact (different between without and with dam) is lower at higher initial lake level

Furthermore, we believe that the result from our analysis (Figure 7) could be used to better understanding the hydrologic impact of dam commencement in relation to initial lake levels.

Comment #5: On Sampling Experiments: Both Approach II and Approach III are sampling experiments, so I would recommend combining them in one section (you can have different sub-sections), and giving them more fitting names. I would drop "Knowledge-based scenarios" as this may mean lots of other things.

Author's response: We agree with this comment. We would combine the section on approaches II and III under a section called "Sampling Methods". We would rename 'knowledge-based scenarios' as 'regional climate based scenarios'. We will make these changes in the revised manuscript.

Comment #6: On the model: (1) Explain where or how you would get WHC, (2) What is the time scale of the model simulation?

Author's response: The Digital Soil Map of the World (FAO, 1995) is used to estimate water holding capacity (WHC) for the dominant soil type for each grid cell. The model was run on the daily basis.

Comment #7: On Section 3.7 (NBR): this section goes into further details and distracts reader's attention. I would recommend moving the steps to Annex.

Author's response: Although we understand how this section can be a distraction, we believe section 3.7 is vital and integral part of the manuscript as it highlights application

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of NBR method for generating important hydrologic variables using existing satellite data. We think that it is important to explain, how NBR method can be used to simulate hydrologic variables for the future (equations 8 and 9), and also show how simulated variables can be used for modelling lake or reservoir water levels (Equations 10, 11 and 12). The basic literature on NBR approach provides complex equations and in the manuscript we tried to present NBR using simplified equations that are easy to understand. As equations 8 and 9 are the only equations that are exclusive to NBR and other equations (10, 11 and 12) are integral part of study, we argue that this section would be left as it is. Furthermore, as per the other reviewer's comments, in the revised manuscript, we would add additional basic information on the NBR approach to make it clear and easy to understand for the readers and remove equations 13, 14 and 15 to further improve this section.

Comment #8: On Section 4.1: L 4 what do you mean by "initial comparison"? The whole paragraph is not clear. Which statements do refer to Fig 2 and which statements refer to elsewhere?

Author's response: We agree with the comment that section 4.1 is not clear. Actually, in published Figure 2, we showed only model calibrated vs. observed runoff data and removed un-calibrated runoff data to avoid the clutter. We would add un-calibrated and base flow corrected data to Figure 2 that would demonstrate the underestimation in the modeled runoff data and would also improve the explanation of figure 2 in Section 4.1. Further, we will re-phrase the text in section 4.1 to convey the message clearly. See below for a comparison of new figure and existing Figure 2 in the HESSD manuscript. The new figure shows model un-calibrated (black circles), base flow corrected (red triangles), model calibrated (green plus) and observed runoff data (blue cross).

Comment #9: On Section 4.7: this section should be removed from the results and discussion section. It reads like conclusion or recommendation.

Author's response: We agree with this comment. In the revised manuscript section, we

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will move section 4.7 under separate stand-alone section as 'Recommendations: Opportunities and challenges of using multi-source satellite data for Gibe-III assessment'

Comment #10: On Fig. 4: show legend.

Author's response: Agreed. Information on the black and red lines in Figure 4 was provided in the figure caption. Explicit legend will be added to Figure 4 in the revised manuscript.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/9/C1849/2012/hessd-9-C1849-2012-supplement.pdf

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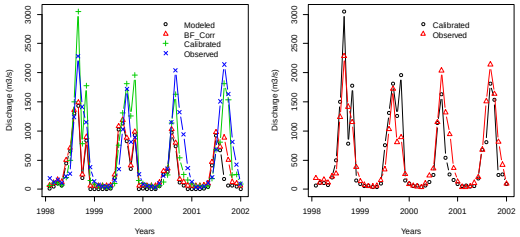

Figure 2. Revised manuscript will be updated with Figure 2 on the left. Right: Existing figure 2 in manuscript

Fig. 1. Figure 2. Revised manuscript will be updated with Figure 2 on the left. Right: Existing figure 2 in manuscript

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