

Interactive comment on “Modelling the water balance of Lake Victoria (East Africa), part 2: future projections” by Inne Vanderkelen et al.

Anonymous Referee #1

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GENERAL COMMENTS:

The authors write about impacts of climate change on the Water Balance of the Lake Victoria. The authors are apparently with a climate background and are using terms that for a readership with hydrology/water resources management background are somewhat unusual. The authors use the term “outflow scenario”, however, the outflow is the result of the management/operation of the dams at the outlet. Therefore I recommend to call these scenarios “management OR operation scenarios”. I also suggest replacing “amount(s)” (e.g. “amount of outflow”) by “volume(s)”.

Furthermore, there are some relevant points that need clarification (and I don't find an answer in this neither in the first paper): when following the Agreed Curve in the simulations (using RCM results as input, evaluation and climate scenarios), where are

minimum and maximum water levels set for this curve (1133.5 and 1136.0 (1136.5?) m asl, respectively)? In case the water level is lower there is no outflow (but further reduction of water level due to evaporation possible). What happens if the water level is reaching or surpassing the maximum water level? All water is discharged?

SPECIFIC COMMENTS:

Abstract:

Page 1; Line 4: "Yet, nothing is known about. . ." change to "Yet, little is known about. . ."

1. Introduction:

Page 1; Lines 9, 11, 13: Replace "emission" by "concentration"

Page 1; Line 24: ". . .during the dry season in the Ethiopian highlands (Di Baldassarre et al., 2011)." change to ". . .during the dry season in the Ethiopian highlands, where the second major source is located (Di Baldassarre et al., 2011)."

Page 2; Lines 1, 3, 6 (and whole text): use either "Nile basin" or "Nile Basin"

Page 2; Line 4: ". . .hydropower." change to ". . .hydropower generation."

Page 2; Lines 6/7: "Lake level fluctuations also influence the amount of outflow released..." it is clear that input (precipitation over the lake and inflow by tributaries) affects the lake level, but also the (managed) outflow has a strong influence on the lake level. I would rather see that "The amount of outflow released also influence the lake level fluctuations...".

Page 2; Line 13: ". . .relating the outflow and lake level" would recommend changing to ". . .relating the lake level and outflow" as lake level is the guiding dimension

Page 2; Lines 19/20: "In the last decades, the long rain seasons in East Africa have experienced a series of droughts. . ."; this statement is somewhat ambiguous to me: with "long rain seasons" you mean the annually occurring rain seasons (with peaks in

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March-May and Nov-Dec) – in contrast to the (annual) dry season – that have shown low precipitation volumes (sums) in the last decades? Maybe rephrase to “In the last decades, the usually long and strong rain seasons in East Africa have shown a number of years with precipitation volumes below average...” to make this statement more clear.

Page 3; Line 15: “. . .Climate. . .” change to “. . .Climate. . .”

Page 3; Line 19: Replace “emission” by “concentration”

Page 3; Line 21 (and whole text): "Vanderkelen et al., 2018a" there is only one reference for Vanderkelen et al. in 2018.

Page 3; Line 24: please delete “successfully”

2. Data and methodology

Page 3; Line 31: Change to “. . .the Representative Concentration Pathways (RCP) 2.6,..." AND then change Page 4; Line 2 "...the three Representative Concentration Pathways (RCPs; 2006-2100)." to "...the three RCPs (2006-2100)."

Page 3; Line 31: Replace “emission” by “concentration”

Page 5; Line 6: "...with the observed lake level in 1950” guess you mean “1951”.

Page 5; Line 9: "The evaluation and historical WBM simulations use recorded outflow values." As far as I understand you use the recorded outflow values (shown in Fig. 3 of the first paper) in the historical WBM simulations using the input (precipitation and evaporation over the lake and inflow by tributaries) from the (RCMs) historical climate simulations. As the outflow is depending on the lake level it clearly depends on weather conditions (precipitation, inflow) of the last weeks/months, e.g. rain/dry season with corresponding high/low lake levels. You also stated that there are huge differences in the climate between the years, affecting precipitation over the lake and inflow by tributaries. As a day/month/year in a RCM is representing the general climatic

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characteristics of that period, but not the weather of this specific day/month/year, it is not clear why you do not use the Agreed Curve for calculating the outflow. It is clear to me that the way the simulations are done only by chance you can close the WB of the lake. When a RCM simulates a sequence of wet years (with consequently high outflow volumes) while a sequence of dry years (with consequently low outflow volumes) was observed, using the low observed outflow in the RCM simulation will inevitably lead to problems in closing the WB.

Page 5; Lines 16/17: Here it is explained for the “constant lake level scenario”: “If the water balance is negative, there is no outflow, but the lake level is allowed to decrease. When the water balance is positive again, the lake level is first restored to its predefined constant height.” It is not mentioned how the outflow at very high water levels, i.e. higher than maximum water level of 1136.0 (or 1136.5) m asl, is simulated.

Page 5; Lines 19/20: “In the last defined scenarios, future outflow is kept constant, ensuring a constant supply of hydropower” - as stated by the authors the water level fluctuates up to 2.5 m (e.g. page 13, line 24 of the first paper). The same outflow with a difference in the head of 2.5 m will lead to differences in the generated hydropower. There may be a “constant supply of hydropower” but as this could be mistaken as “monotonic” or “unchanged” I think this should be rephrased (maybe use “continuous”?).

Page 6; Line 9: “. . .of the 7 tested the bias. . .” change to “. . .of the 7 tested bias. . .”

3. Results:

Page 6; Line 26: “Results of the evaluation WBM run are compared. . .” change to “Results of the evaluation WBM runs are compared. . .”

Page 7; Line 1: “Table 1. Table showing the a and b parameters of the linear. . .” change to “Parameters a and b of the linear. . .”

Page 8; Line 2: “. . .lake levels (figure 4a).” change to “. . .lake levels (Fig. 4a).”

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Page 9; Line 9ff: the whole section (3.3), giving the results for water levels and outflow, needs to be revised. According to my understanding water levels above 1136.5 m asl would lead to increasingly high outflows (there is no structure to withhold water) and the water level cannot reach values as given, e.g., in Fig. 8 (=> reaching up to 1180 m asl). It is not clear what (if any) digital elevation model is used. A water level of 1180 m asl would mean (considering the flat shores/wetlands close to the lake) that an enormous area (lake surface area > 100.000 km²?) would be flooded.

Page 9; Line 26: "...relation between outflow and lake level" would recommend changing to "...relation between lake level and outflow" as lake level is the guiding dimension

4. Discussion:

Page 10; Lines 12/13: "...LVB (Fig 3 and Fig. 4)." change to "...LVB (Figs. 3 and 4)."

Page 10; Lines 21/22: "The other CORDEX models have no lake model embedded." – Why this information is only given in the discussion? It would help to understand better the deviations of the other models when giving already in "2. Data and methodology".

Page 10; Line 33: "...Souverijns et al. (2016) (up to 0.5 mm-1 over the lake)." change to "...Souverijns et al. (2016) (up to 0.5 mm day-1) over the lake."

Page 12; Line 20: "Providing a constant hydropower supply, which implies a constant outflow,..." - The same outflow with a difference in the head of 2.5 m will lead to differences in the generated hydropower...

Page 12; Line 22ff: Please check where you are referring to (or citing numbers for) electricity generation/demand and energy demand (energy also includes fuel for cars etc., the energy demand of a region/country therefore is higher than the electricity demand).

Page 13; Lines 6 and 15: "...model uncertainty..." - Here you are referring to CLIMATE model uncertainty?

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5. Conclusion:

Page 13; Line 25: "...a water balance model constructed developed for Lake Victoria..." change to "...a water balance model developed for Lake Victoria..."

Appendix A (pages 23-25):

"...HIRHAM5 driven by EC-EARTH and CRCM5 driven by CanESM2 are not used due to the fact that they exhibit discrepancies between their historical and future simulations..." – please check if during the download, naming of files or at some other point (even check if an error occurred at the CORDEX homepage) an error occurred: According to Fig. A1 for the historical run (HIRHAM5) the precipitation is between 3-5 mm/day, while for scenarios (first years) according to Fig. A2 CRCM5 gives comparable values. According to Fig. A2 for the historical run (CRCM5) the precipitation is between 10-14 mm/day, while for scenarios (first years) according to Fig. A1 HIRHAM5 gives comparable values. Can it be that historical runs or scenarios between these two models were substituted (I see the same for evaporation and to a lesser extend for inflow)?

Appendix B (page 26):

Line 3: "...condition to compared the WBM simulations..." change to "...condition to compare the WBM simulations..."

Line 6: "To account for the missing days, 5 extra days are added for every 72 days in the year, starting after the 36th day." – please describe exactly how this is done; I guess that "1 extra day is added each 72 day, starting at the 36th day." as shown in the table below

day of year (orig.) 36 108 180 252 324 360

day of year (corr.) 37 110 183 256 329 365

Appendix C (pages 26-28):

Line 18: "...compare figs. C1, ..." change to "...compare Figs. C1, ...", also in the titles of Figs. C1, C2, C3 and C4 "As in Fig. ..."

Acknowledgements (page 28):

Line 6: "...through ESGF.Wim Thiery was..." change to "...through ESGF. Wim Thiery was..."

Please check the References, e.g.:

Page 30; Line 2: "Adeyemi, K. O. and Asere, A. A.: a Review..." change to "Adeyemi, K. O. and Asere, A. A.: A Review..."

Page 31; Lines 20/21: "Mayaux, P., Massart, M., Cutsem, C. V., Cabral, a., Nonguierma, a., Diallo, O., Pretorius, C., Thompson, M., Cherlet, M., Defourny, P., Vasconcelos, M., Gregorio, a. D., Grandi, G. D., and Belward, a.:..." change to "Mayaux, P., Massart, M., Cutsem, C. V., Cabral, A., Nonguierma, A., Diallo, O., Pretorius, C., Thompson, M., Cherlet, M., Defourny, P., Vasconcelos, M., Gregorio, A. D., Grandi, G. D., and Belward, A.:..."

Page 32; Lines 23/24: is this a book chapter (editor, publisher?) or a journal article?

Page 33; Lines 1/2: "Vanderkelen, I., Lipzig, N. P. M. V., and Thiery, W.: Modelling the water balance of Lake Victoria (East Africa), part 1 : observational" change to "Vanderkelen, I., Lipzig, N. P. M. V., and Thiery, W.: Modelling the water balance of Lake Victoria (East Africa), part 1: observational" and include full reference (page no. etc.)

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