

Review for Parameterization of lakes water dynamics in the ISBA-CTrip land surface system by Guinaldo et al.

Paper summary:

The paper describes new lake mass balance model component called MLake and how the new module is integrated into the river routing model (CTrip) coupled to ISBA land surface model. The paper also evaluated the developed model at 4 river basins across the globes and shows improvement of downstream discharges and lake level simulations compared to the observations.

Overall comments:

The descriptions of lake water balance model implementation into a river model for ESM fits very well in the GMD, model description paper. The lake water balance computation used in this paper seems to be more precise (account for lake-ground water interaction, separate treatment for surface runoff inflow and baseflow inflow) than other lake models even used for global hydrologic models. So, particularly for the ESM, I think it is substantial advancement of model process representations.

Simulated impacts of lake parameter (i.e., outlet structure parameter) on the lake level and downstream discharge seems to be reasonable and discussed well. Figures showing results are also clear overall.

My main concern is a lack of conciseness: the paper can be shortened by textural editing as well as by cutting some materials. More importantly, I feel the authors need to polish the descriptions throughout the paper. I put a few science related comments following numerous minor editorial comments I found as I read.

Specific comments:

- P29-L920: This might be typo, but KGE expression seems to be incorrect. Standard KGE (Gupta et al., 2009) is a distance based on correlation (r), ratio of standard deviation (α) and mean ratio (β). Modified KGE (from Kling et al. 2012) uses ratio of coefficient of variation (γ) instead of ratio of standard deviation (α).

In my opinion, KGE is convenient for model calibration since KGE aggregates three metrics into one, which allow modelers to use a single objective (target metric) to optimize the model, rather than multi-objectives, but for just model evaluation, KGE (aggregated metric) itself does not mean much (what aspects of time series the model simulate better or worse). Since table 6 compare Q_s/Q_o and σ_s/σ_o , I would suggest adding correlation and removing KGE.

- Section 2.3.2 and 2.3.3 seems be a crux of the paper (descriptions of lake implementation strategy), and therefore need to be clear so reader can understand how exactly the lake are implemented in the network. Unfortunately, I am having hard time following section 2.3.2 after I read through several times. So, I feel I need to request the author revise this section drastically. Section 2.3.3 is described well.
- P22, L717: I found this (sub-grid variability of lake levels for a large lake) is interesting discussion and may be important. Impact of such lake sub-grid variability on downstream discharge is described in L725, but not clear and would be nice to see a little more elaboration on this. For even larger lakes

(e.g., Great Lakes), the lakes should be represented by a number of grid boxes, and make individual grided lake interact each other?

Editorial comments:

- Throughout the paper: The authors use “resolution”, instead of “solution”, which I would suggest using (e.g., numerical solution, not numerical resolution). Using “resolution” to mean “solve an equation or something” be confusing since “resolution” is also used for grid box sizes and vertical resolution of soil layer, snow layers.
- Throughout the paper: I know this may not be critical issue...but I feel the paper uses “scale” carelessly. “scale” is the characteristic length (space and time) of processes, modeling and observations (see Blöschl et al., 1995: <https://onlinelibrary.wiley.com/doi/abs/10.1002/hyp.3360090305>). For example, “global scale model” used throughout the paper means globe is the characteristic length of modeling, but it really means global domain model and scale used for model should be smaller.
- Title: SURFEX v8.1 is the name of land surface model platform, but here, should lake model component name and version be in title. Here, is MLake name?
- P2, L44-46: I feel this sentence is really opening sentence. Descriptions priors to this sentence seem to be little related to the topic in this paper.
- P3, L65: Suggest adding references. Climate change impact on Lake Chad has been reported in publication (<https://www.nature.com/articles/s41598-020-62417-w>)
- P3, L70: Suggest changing runoff -> discharge. e.g., lowering inter-annual and seasonal variability of downstream discharge?
- P3, L95: “General Hydrological Model” -> Global Hydrological Model?? If not, what does General Hydrologic model mean?
- P5, L136: Awkward description. Suggest removing this.
- P7, L214: main driver -> main motivation?
- P8, L258: what does “component” mean here? I believe it is lake, but please be specific.
- P8, L272: “dynamic close to a lake”. Not clear to me.
- P8, L273: “lake hydrological dynamic”. Sounds awkward to me.
- section 2.2: this section provides brief description of Flake model, which simulates energy balance in lake (my understanding), and lake evaporation is a part of the energy balance. I feel header should be “Flake model: lake energy balance model”. This way, consistent with the following section (MLake)

- Section 2.3.4: I am not sure about importance of this section. Figure 7 could follow more convention of flowchart (<https://en.wikipedia.org/wiki/Flowchart>). I wonder if this section (after shortened) could be moved to very beginning of section 2.
- P22, L719: “uni-dimensional” -> one-dimensional.
- P22, L724: “fast time variations of the river discharge”. Not clear phrase. Please consider describing different way.
- P25, L798: “a unique composite energy budget for soil and vegetation”. Does this mean control volume for energy budget computation is combined of soil and vegetation (not separate)?
- P26, L834-836: this paragraph sounds out of place in this section (simulation sensitivity to lake outlet width)
- P27, L842: “has been conducted” -> use past tense?
- P27, L842: “four river networks” -> four river basins?
- P27, L865: “monitoring” -> monitor.
- P27, L867-869: I would suggest moving this sentence to the end of the paragraph (replace the last sentence with this). Eventually we would like to see the effect of lake bathymetries on lake levels, downstream discharge across the globes.
- P28, L878-L879: I would suggest adding references. Some groups have done some work on reservoir operation schemes, e.g., Hanasaki et al., 2006 JH, Shin et al., 2020 WRR.
- P28: Appendix header is missing?
- Figure 11. Add y-axis labels.
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