

Geosci. Model Dev. Discuss., referee comment RC3
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Comment on gmd-2021-433

Willem van Verseveld (Referee)

Referee comment on "A framework for ensemble modelling of climate change impacts on lakes worldwide: the ISIMIP Lake Sector" by Malgorzata Golub et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-433-RC3>, 2022

General

This paper by Golub et al. presents the simulation protocol by the Lake Sector of the ISIMIP to model the impact of climate change using an ensemble of lake models, a large and important effort. The paper is well written and structured and the topic is interesting for the journal audience. Please find below some questions and comments that require mostly minor modifications for further improvement of the paper:

- While there is some overlap between lake models (ALBM, GOTM and Simstrat) for local and global simulations, it is not clear to me why not all 6 global lake impact models were also applied to the local domain and calibrated in this setting. This should be clarified in the paper. In fact, you could use the same model sets for both applications. This approach can also give useful information about the value of default/a-priori model parameters at the global scale when compared to local domain calibrated parameters and simulation results. In the Conclusions lines 9-12 states that reasonable parameter and coefficient values from the local domain were used in the global domain. How was this exactly done (it seems this is only described for GOTM)?
- The water balance is not considered as part of the lake modelling efforts (paragraph 3.5.3). In lines 20-23 of paragraph 3.5.3 the explanation is that one should use caution for (only) seven lakes or reservoirs with large water level fluctuations (Table 1). If think the wrong Table is referenced here? Seven lakes or reservoirs are part of the local domain, what about the global domain? And what are large water level fluctuations (definition)? But even without large water level fluctuations, large input-output changes (inflow, outflow, precipitation, evaporation) because of climate change can have a significant impact on lake temperature (e.g. changes in residence time)? This part in the paper requires more explanation, either including appropriate references that confirm that the omission of water balance components has only a significant impact on lakes with large water level fluctuations, or rewrite this to a more cautious statement (this omission can have a broader impact).
- It is stated that the global lake models were not calibrated because of lack of a global-scale data set of measured lake water temperatures. What about using other datasets

like satellite based datasets for example for surface water temperature? Or are there any (planned) efforts to setup a central data repository to collect measured lake water temperature (and other variables) data, for example similar to the Global Runoff Data Centre (discharge data for hydrological applications)? Also, when the water balance is considered, additional data like water level, surface area dynamics etc. (for example from satellite data) could be considered for calibration/validation purposes. Would be good to add a section/line to the paper that considers some of the solutions/ideas from the authors for a lack of a global-scale data set.

- Generally a calibration strategy also includes the validation of the calibrated model. It is not clear if this was done, please describe this in more detail or explain why a validation was not carried out.
- An extra section to describe future work (ongoing ISIMIP 3, possible solutions lack global dataset?) would be useful (see also the last specific comment below).
- And, finally, briefly some differences between models (P26, lines 24-27) are mentioned. Are there more examples from his study? I think it could be useful to include this kind of information more extensively in the paper.

Specific comments:

- P22 line 6-7: different objective functions were used by the different models. Why was not the same objective function used for each model? I think using the same objective function is an important aspect of an ensemble modelling protocol.
- Table S2 and S3 seem to have missing information in some table cells (empty)
- P22 line 25: spinup periods were different. Bit similar to objective function, please state clearly why not the same spinup period was used (if applicable) for each model.
- P25 line 17: Gao reference is missing.
- Paragraph 4.1.2 Better move this part to an "Outlook or further work" section, this is not really a result, but part of possible further study.