Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "Simulations of future changes in thermal structure of Lake Erken: Proof of concept for ISIMIP2b lake sector local simulation strategy" *by* Ana I. Ayala et al.

Anonymous Referee #2

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General comments

The article "Simulations of future changes in thermal structure of Lake Erken: Proof of concept for ISIMIP2b lake sector local simulation strategy" presents impacts of changing climate on lake water temperature. The article is of very high interest and very well written, the work is thoroughly executed and discussion is relevant. The authors used a hydrodynamic lake model GOTM with 4 GCM/RCMs, using Generalized Regression Artificial Neural Network to disaggregate daily climate into hourly data. The GOTM model was able to reproduce observed lake temperature data for current time period (8 years). The model was then executed with climate forcing data from 4 GCM/RCMs

form ISIMIP2b. The climate impact was evaluated for a set of thermal indices.

Specific comments

I would recommend expanding on the Methods section to provide more information that is critical in understanding the study, its aims, and results. It is unclear why the authors chose to consider 2006-2099 as the future even though the period begins 13 years ago. It is also unclear why this full period is evaluated without any consideration of the changes that occur from 2006 to 2099 based on the trend analyses also included in the manuscript. It seems that changes that can occur during this "future" period are considered representative of changes that will occur by 2099. The averages from this 94-year period are compared to averages from a 30-year period of 1975-2005. The variability during a 30-year period and during a 94-year period with a significant trend is expected to differ and this affects the projected changes.

A more typical approach in many climate impact studies is to select two 30-year periods, one that represents a current climate (reference period, e.g. 1981-2010) and one that represents a future climate (e.g., mid-century 2041-2010 or late century 2071-2100). Forcing data from the same climate model would then be used as model inputs for both time periods; the difference between these results would represent the projected impact. It is also not clear from the manuscript how were the reference period values calculated for calculation of anomalies from the respective GCM/RCMs during the reference time period.

The results for the mid-century and late century should be added to the manuscript to evaluate how the change progresses; alternatively, the current results can be replaced with the late century period as that seem to be the focus of the "proof of concept" study.

It is also important to include information on the variability of the simulated thermal indices due to the climate model selection, i.e. present information for all 4 GCM/RCMs for the reference time period. That can give indication to the significance of the projected impact.

The information on the GOTM model for Lake Erken is very limited; the methods section should be expanded to include more details on the model structure, e.g. vertical resolution, inflow and outflow from the lake, etc.

Some relevant parts should be moved from Results to Methods (e.g., the beginning of section 3.1 and 3.3. Also, the periods used in the calibration (training) & validation periods for GOTM and GRNN should be put into the context between these two models. It is not readily apparent from the manuscript.

It should be emphasized that training the temperature disaggregation algorithm on the current diurnal patterns means those current patterns will be projected to the future time series and any potential changes in diurnal pattern from the changing climate are ignored.

Technical comments

Increases are given to 0.01 deg.C – what is the accuracy of the measurement and of the simulations? Is this accuracy adequate?

L 68 –dimictic?

L89 Mean sea level(,) pressure(,) relative humidity and precipitation were measured – missing commas?

Section 2.6 It would be useful to include model performance for other thermal indices used for evaluation of change, e.g. duration of thermal stratification

L 162: Schmidts stability – needs a reference/ brief explanation

L 231: this model handicap and any other should be described in section 3.2

L 312-314 However, the dominant wind (is) along . . . missing word?

L 322, 324 When GOTM was forcing with . . . forced?

L 350: it would be good to put the statement into context; what kind of changes can be

expected with these increases in temperature?

Figure 2 heading: figure shows calibration as plots a, c, e, and g, but the caption says these are validations

I would recommend including a similar plot but with model residuals (perhaps in Supplementary materials); that would make any differences much easier to see especially on the timing.

Figure 3: it would be helpful if the scale on y axis with the same units had the same range (a-d)