

## ***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 #1**

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#### General comments

The manuscript entitled “Simulations of future changes in thermal structure of Lake Erken: Proof of concept for ISIMIP2b lake sector local simulation strategy” aims to assess the impacts global warming on the thermal characteristics of Lake Erken. Since future projections of global warming are at a daily time step, the authors first analyse the need to disaggregate the input variables to the hourly time step. The manuscript is well written. The topic is scientifically relevant.

#### Specific comments

Line 70-71: “It is the lake’s relatively shallow depth and large surface area, which leads  
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to large inter-annual variability in the timing and patterns of thermal stratification.” Why is this? Perhaps explain in one or two sentences how this works and why this is different for relatively deep lakes or lakes with a small surface area.

Line 138-139: “More detailed description of the GRNN methods and models are given in the supplementary material to this paper.” I was hoping to find equations on how the GRNN model calculates hourly estimations based on daily input, however, I could not find a detailed description of the GRNN methods in the supplementary materials.

Line 158: “Schmidt stability”, perhaps give a definition or equation of the Schmidt stability

Line 170-174: “Air temperature, short-wave radiation, relative humidity and wind speed were temporarily disaggregated into hourly values from mean daily data, using the GRNN models. A database was constructed using 8 years of measurements. From this whole set of data, the first 5-years of data, that is, from 2008 to 2012, were used for training, and 3-years of data from 2013 to 2015 were used for validating the results obtained.” This sentence was confusing. After reading the methods section I first assumed this was about the calibration/validation of GOTM. However, later I realized it was about the calibration/validation of GRNN. I would expect these sentences in the methods section. Moreover, it would be good to mention clearly that there are two types of calibration/validation: that of GOTM and that of GRNN.

Line 192-193: “Temperature simulations for the validation period were more accurate (average RMSE of 0.66 ÅC and NSE of 0.97) than for the calibration period (average RMSE of 0.95 ÅC and NSE of 0.94), but in both periods the model performance was considered acceptable.” I would expect that the validation period would be less accurate than the calibration period. Therefore, my first thought was then that perhaps the legend was swapped between calibration and validation. Yet, the authors later mention that this is “due the higher variability in observed water temperature during the long calibration period.” (Line 284-285). Then the question raises, which data set

is more representative? Was the high variability during the calibration period actually quite normal and the validation period exceptionally uniform? And what does this mean for the validity of the output?

Line 202: "As would be expected the simulations of bottom temperature were slightly less accurate" Why would this be expected?

Line 349-351: "Combined these results suggest important changes in the factors affecting lake biogeochemistry directly through changes in temperature and indirectly by influencing the availability of light and nutrients." The presented results only indicate an increase in temperature and stratification period. Since the presented data does not show how this affects biogeochemistry and the availability of light and nutrients, could the authors be a bit more specific on this in the conclusion? How do the authors think/speculate it will change (perhaps refer to the introduction where a short explanation is already given)?

#### Technical corrections

Figures in general; 1) it would be good to have comparable axes per figure. For example, figure 3a has a y-axis going from 0-1.2 oC, while figure 3b goes from 0-0.8 oC. I suggest that the authors uniform the axis and perhaps use the normalized RMSE to compare the different subfigures 2) From the figures caption, it is not always clear if the predicted output is with GOTM or with GRNN. Perhaps include this information in the figure's caption. General: sometimes I read "wind\_factor" and sometimes "wind factor" without "\_". Is there a difference in meaning?

Line 246-247: "Simulated changes were generally slight less for the simulations driven by daily forcing data as shown by the figures in parentheses". Put a dot after parentheses and change "slight" to "slightly"

Line 284: "were more accurate than for the calibration period (2006-2014) due the higher variability in observed water temperature" add "to" after "due"

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Figure 2: 1) the caption says that validation is figure 2a, 2c, 2e and 2g, however, the title of the figures suggest that validation is figure 2b, 2d, 2f and 2h. This is confusing. 2) Perhaps include the words "observations", "daily data", "hourly data", "synthetic hourly data" on the left side of/ or under the figure. It is now quite a puzzle to find which subfigure tells what. 3) Perhaps also include a difference graph where the difference between "observations" and respectively "daily data", "hourly data", "synthetic hourly data" is shown. From figure 2, it is now hard to see the differences. (The same holds for figure 4, where it is hard to see the differences between historical and the rcp's)

Figure 5 and 6: In figure 5i, the authors indicate the words "deeper" and "shallower" with arrows. This really increases the readability of that specific subfigure and the same would help the reader in all other subfigures.

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