Response letter

Preprint title (ESSD-2022-457): A long-term dataset of simulated epilimnion and hypolimnion temperatures in 401 French lakes (1959-2020).

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Reviewers comments are in *italic* and authors comments are in **bold**.

On behalf of my co-authors, I would like to thank the reviewers for taking the time to review our manuscript for the second time. We carefully considered all their suggestions and made the necessary revisions to the manuscript. In the sections below, we provide responses to each of the issues raised by the reviewers.

Reviewer 1

The manuscript presents a dataset of simulated lake water temperature of 401 French lakes using a modelling approach. The manuscript was already in a good shape but I feel that after this round of revision the description of calibrated or not versions (and their comparison) greatly improved.
I think that the presented dataset is relevant to leverage lake research in the context of climate change.
The manuscript it is overall well written so I only have some minor issues listed below.

Minor issues:

- *L194 – "surface temperature" should be "mean surface temperature" right? Because potentially Landsat give the spatially distributed information.*
  - **Yes, Landsat infrared data (skin temperatures) were used to estimate mean surface temperatures according to (Prats et al., 2018).**
  - **Within a Landsat image, skin temperatures were averaged spatially over water pixels. According to Prats and Danis, (2019), median skin temperatures were used as an estimation of mean surface temperatures.**
  - **We reformulated the sentence as follows (L193-195): These equations were determined using robust regressions and Landsat infrared data (median skin temperatures) from 1999 to 2016 of French lakes to estimate mean surface temperatures (Prats et al., 2018).**
- *Figure 1 – The legend report: Reservoirs, natural, artificial (others) and gravel pit. I am curious what kind or lakes have been grouped under artificial, could you please add an example in the text where you mention this distinction for the first time? That would be useful to understand.*
  - **The category of 'other' artificial lakes (n = 38) primarily comprises ponds and quarry lakes. This information has already been included in section 3.4 "Lake simulations" (L243) and section 8 "Data usage" (L483). For this revision, we added the same information in the legend of Figure 1 and the rest of the figures where the category "Artificial (other)" is mentioned (Figures 3, 5, A3, A4, A5, A6, A7, & A8).**

- **We specifically added the following sentence to the legends: The "other" artificial lakes consist of ponds and quarry lakes.**
- **In Figure A8 (Appendix A) we modified the legend as follows: "Distribution of initial filling years for lakes (e.g., reservoirs, gravel pits, ponds and quarry lakes) of the LakeTSim dataset."**

- *L367 – add a space before parenthesis.*
  - **Space added (L389).**
- *L462 – I suggest modifying the sentence by adding: "We compiled the initial temporal gap filling for 282 of…."*
  - **We modified the sentence as follows (L489): "We compiled the initial temporal gap filling related to the initial filling years for 282 of these 347 non-natural lakes (269 reservoirs and 13 artificial lakes, Figure A8 in Appendix A) in Table S1 (see Supplement) to be used as a companion dataset to LakeTSim."**

Reviewer 2

I appreciate the changes included into the manuscript, especially concerning the uncertainty analysis (both methods and results).
Please, find below a couple of specific comments.

- *As for the authors' reply to the first main comment: please note that the 8-, 6-, and 4-parameter versions of the air2water model were already presented in Piccolroaz et al (2013), while Toffolon et al (2014) and Piccolroaz (2016) revised the definition of the parameters. Please, specify that you used the 4-parameter version of the model.*
  - **We specified the use of the 4-parameter version of the air2water model in section 4 "Model performance", L320.**
- *Note that the parameters that you used were those obtained in Toffolon et al (2014) and recalled in Piccolroaz (2016) after having applied the model to 14 temperate lakes around the globe. In this respect, I do not think that it is fair to compare the OKPLM model run with the "default" parameter values given by the parameterization in Prats & Danis (2019) with air2water run with the parameters in Toffolon et al (2014) and Piccolroaz (2016). In fact: in the first case, the parameters have been obtained for the same/a similar dataset (French lakes) while in the second case they refer to lakes from around the globe. Being the air2water model data-driven, one cannot assume the parameters in Toffolon et al (2014) and Piccolroaz (2016) as "default parameters" and use these parameters for other applications, especially if the air temperature (the forcing) comes from a different source.*
  - **According to (Piccolroaz, 2016), the 4-parameter version of the air2water model (with calibrated parameters) shows acceptable performance until the percentage of missing data reaches about 97% (i.e., when data are available at about monthly resolution, on average) which is the case for most water bodies in the LakeSST dataset used in Prats and Danis, (2019). Hence the choice to apply the 4-parameter version of the air2water model in Prats and Danis, (2019) using the parametrization presented in Toffolon et al. (2014) and derived from a set of 14 temperate lakes with different geomorphological characteristics.**
  - **In order to clarify this we added the following in section 4 "Model performance" (L331-336): The air2water parameter values were obtained as a function of lake depth from the parametrization presented in Toffolon et al. (2014), based on data from 14 lakes around the globe. In this case, the air2water model parameters were**

not calibrated due to the fact that the percentage of missing data within the LakeSST dataset employed in Prats & Danis (2019) exceeded 97% for most lakes. Beyond this threshold of 97% missing data, the performance of the calibrated 4-parameter version of the air2water model was found to be unsatisfactory (Piccolroaz, 2016).

- *Equation(14): please, explain how the weights w_i are assigned.*
  - **The weights (w_i) are calculated based on the inverse of the variance-covariance matrix of the observation errors.**
  - **We added this information on L289, section 3.5 "Calibration, uncertainty and sensitivity analysis".**
- *According to the authors' response, I would stress that they "included the drivers along with the parameters in the sensitivity analysis to emphasize the potential biases and that they should be taken into account".*
  - **Thank you for highlighting our response in regards to the inclusion of forcing parameters in the sensitivity analysis, we still maintain this perspective. We think that this indeed underscores the importance of considering potential forcing biases in our analysis.**
  - **We added this information to the manuscript, Section 3.5 "Calibration, uncertainty and sensitivity analysis", as follows (L271-274): "In addition to model parameters, sensitivity analysis was extended to encompass forcing parameters (*MAAT, at_factor, sw_factor*) as they provide information about the degree of sensitivity exhibited by model parameters in response to biases in the forcing data."**

Additional author comments

- **We added some minor modifications to the manuscript (highlighted in the marked version of the submitted manuscript).**
- **We added some details to the section 3.4 "Lake simulations" to clarify more the difference between the usage of "default" and "calibrated" model parameters (L247-255).**

References

Piccolroaz, S.: Prediction of lake surface temperature using the air2water model: Guidelines, challenges, and future perspectives, Adv. Oceanogr. Limnol., 7, 36–50, https://doi.org/10.4081/aiol.2016.5791, 2016.

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