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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Trends and abrupt changes in 104-years of ice cover and water temperature in a dimictic lake in response to air temperature, wind speed, and water clarity drivers" *by* M. R. Magee et al.

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Reviewer 1: Dr. Renjie Xia The authors would like to offer sincere thanks to Dr, Renjie Xia for taking time to carefully review this manuscript and provide insightful comments to improve the quality of the manuscript. Below is a point-by-point response to issues raised in the manuscript.

General Comments This article is well written, and the topic is interested. Authors did an extensive literature review, and provided a large number of references to validate their work. The conclusions presented in this article are useful. We greatly thank

the reviewer for the compliment. Specific Comments (1) Both DYRESM (Dynamics Reservoir Simulation Model) and DYRESM-WQ (Dynamic Reservoir Simulation Model – Water Quality) developed by the Center for Water Research at the University of Western Australia have been extensively calibrated and verified through field work. These models are reliable to use. Authors added an ice and snow model to the DYRESM-WQ, and developed a new model called as DYRESM-WQ-I.

Authors wrote that this resulting model was validated and employed (validated using a long-term (1911-2014) observational dataset, then employed to simulate long-term (1911-2014) ice cover and water temperature in the lake). One question has arisen what is the meaning of "validated" or "employed"? In general, "calibrated" and "verified" are common used in scientific articles. Authors should explain why using "validated" and "employed"? In addition, seems this new model was validated and employed just once by using the same observational dataset. Therefore, another question has arisen that the results obtained from this new model (validated and employed just once) is reliable?

The authors thank the reviewer for pointing out this oversight and confusion in the manuscript. DYRESM-WQ-I was calibrated for Lake Mendota by setting the minimum layer thickness in the model. Other parameters for the hydrodynamic and ice models were chosen from previous literatures. Specifically, for the ice model, it is based heavily on the previously calibrated and validated Mixed Lake with Ice (MLI) model developed by Rogers et al (1995). Alterations to the model are for two-way coupling of the water-column dynamics to the ice model (MLI has only one-way coupling) and the addition of a time-varying sediment heat flux for all horizontal layers wherein the heat flux is dependent on both time-varying sediment temperatures and time-varying lake water temperatures. As the Rogers et al (1995) model has been previously validated through extensive field effort, we did not conduct further field-validation for this study. However, we calibrated the model for the period of 1995-2014. We add a new section, "2.2 Model calibration" and validated compared to observed data for the full simula-

tion period 1911-2014. We have added the following text to improve clarity on model development, calibration, and validation.

P 5, L18-20: " The ice model is based upon the MLI model of Rogers et al., (1995) with alterations to two-way coupling of the water-column dynamics to the ice model and the addition of time-dependent sediment heat flux for all horizontal layers."

P7, L21 – P8, L2: "The model was calibrated for the period 1995-2014 by varying the minimum layer thickness over values ranging from 0.05 m to 0.5 m at 0.025 m intervals. Layer thickness values were evaluated for the least amount of deviation between predicted and observed temperature values for Lake Mendota over the period. Based on this analysis, a minimum layer thickness of 0.125 m was chosen as the best setting to predict water temperature at all depths. Other parameter values in the hydrodynamic and ice cover models were obtained from literature values (Table 1). To evaluate the performance of the model, root-mean square error (RMSE) was used to compare simulated and observed ice cover and water temperature values for the full model period (1911-2014; see Sect. 4.2). Simulated and observed values are compared directly, with the exception of aggregation of water temperature measurements to daily intervals where sub-daily intervals were available."

Additionally, a new table, Table 1, has been added to the manuscript to provide parameter values used in the hydrodynamic and ice model portions of DYRESM-WQ-I.

(2) One suggestion: dividing the long-term observational dataset to two groups, then using one for the “validated” purpose, and using another for the “employed” purpose. Please see the response to comment 1. Specifically, we calibrated the model for the period of 1995-2014. Afterwards, we validated the model for the full simulation period 1911-2014.

(3) Readers might be interested in the long-term 104-year continuous dataset and want to know how many variables observed are included in this dataset. Summarizing a table to show all the observational variables in the dataset will be grateful to these

readers.

The authors agree that the observation datasets used for model input and calibration/validation are valuable to readers. Indeed the variables are listed in the subtitles of section 3. Including another table listing datasets in addition to what is included within the text may be repetitive. Instead, we have revised sections of the text to further detail where raw datasets are available and where data adjustments were made to improves the clarity of datasets.

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