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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evaluating and improving modeled turbulent heat fluxes across the North American Great Lakes" *by* Umarporn Charusombat et al.

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Paragraphs and comments that were written by the reviewer are indicated by an asterisk (*) at the beginning. Those without an asterisk are responses from the authors.

*General comments *The manuscript focuses on validation of modelled latent and sensible heat fluxes from the surface of the Great Lakes. Five algorithms from three parent models are tested against in situ data from Great Lakes Evaporation Network. It is in general a well written manuscript and a valuable contribution to the research field.

*I would like to start with commenting the understandability of the abstract. I had to read

the full manuscript before understanding the abstract. It is very technical, and I would suggest to refine the language to the extent that a non-expert can understand it. The introduction, however, is very well written and delivers the right message on why this study is of importance. The method section is also easy to follow, although some parts gets very technical, especially page 10-11. I understand that technical details have to be provided, but I would suggest to refine the text to make it more understandable. Furthermore, this part is not my expertise, so I cannot comment on the correctness of the algorithms. The results section is easy to follow, but I think section 3.3 (Error dependence) fits better in Supplementary materials. The discussion section is mostly focused on the limitations of the study. Some parts that are summarized in Conclusion section could have been brought up already in discussions to balance up the discussion on the limitations.

Thanks to the reviewer for the comments overall. Regarding the abstract, modifications have been made to attempt to make it clearer. One key thing based on your comments is that the term "original algorithms" is removed, since this language presupposes the alterations to the algorithms that we experimented with, but which are not mentioned until later.

Regarding the methods section, some small changes have been made to help with clarity. In a nutshell, eqs. (1) and (2) are the most generic form of bulk flux equations and are shared by all of the algorithms. Eqs. (3)-(7) fill in some more detail, but basically are also included in all of the algorithms. At this point, details of the formulation become more subjective in the choice of form of the equations (explaining the difference among the algorithms), which are followed by calibration of parameters. Eqs. (8)-(11) are used by some algorithms and not others, and more details are left to references to the original sources. Eq. (9) is used in COARE and is also essentially the difference between the "original" and "updated" versions of the other four algorithms. We did some work to untangle the disparate notations of the original sources to distill down to the common threads expressed in eqs. (1)-(7).

The authors consider the first paragraph of the Conclusions section as highly positive. Essentially, COARE stood out as giving the best simulation of fluxes, and when one aspect of COARE's formulation was inserted into the other algorithms, their simulations were greatly improved, while there was very low sensitivity to other differences among algorithms. Therefore, we feel that we have identified the main problem and solution. The second paragraph does not speak ill of this study, but does give a caution for the impending scenario when the flux algorithms are put back into the context of the models FVCOM, WRF, and LLTM. "On the other hand" is now removed from the beginning of that paragraph. The third and fourth paragraphs are attempts at explaining the reasons behind certain summertime discrepancies between modeled and observed fluxes. This is necessary, but a more positive spin is added at the beginning of the third paragraph by pointing out that the magnitude of cold-season fluxes is much larger and therefore influential on the annual energy budget. The final paragraph of the Conclusions section is specific to one of the stations, describing some of the problems with its site; we believe that we have done well in validating flux algorithms using the other stations.

*Specific comments *[Page 7, Lines 25-26] Which version of COARE is used in the study – 2.6, 3.0 or 3.5?

"It is equivalent to COARE 3.0" is inserted, because the original code was ported into FVCOM from COARE 2.6, but modifications have been made that are equivalent to COARE 3.0.

*[Page 14, Line 21] Remove the punctuation (.) after "into" *[Page 14, Line 24] Remove on of the "due to" *[Page 15, Line 6] Insert a "f" after "improvements o"

These previous three comments were already implemented in response to another set of comments.

*[Page 17, Line 2] Replace (:) with (.) *[Page 17, Line 4] Insert "section" before "3.3" *[Page 18, Lines 13-14] Remove "were filtered out" at the end of the sentence

These previous three comments were implemented in the manuscript exactly as suggested, and will appear in the final submission.

*[Page 33, Figure caption 1] Monitoring stations are referred to as lighthouse-based monitoring platforms when Fig. 1 is first brought up in the manuscript.

The caption now describes them as "offshore lighthouse-based monitoring stations".

The final submission will also incorporate some clarifications on the types of hardware at the stations, and clean up a few issues of notation.

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