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Geoscientific Model Development Discussions

Interactive comment on "Incorporating Wind Sheltering and Sediment Heat Flux into 1-D Models of Small Boreal Lakes: A Case Study with the Canadian Small Lake Model V2.0" *by* Murray D. MacKay

Anonymous Referee #2

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A paper "Incorporating wind sheltering ..." by Murray D. MacKay presents two improvements of a 1D Canadian Small Lake Model v2.0, namely, a correction to surface drag coefficient, representing effects of sharp roughness discontinuity at the lake-shore interface; and modification of radiation scheme simulating integral effect of shortwave radiation absorption at variable lake depth. The approaches and hypotheses involved are clearly described and are mathematically elegant. Although the observational data used to validate new parameterizations is limited, both parameterizations are worth publishing and are highly relevant to the journal scope. However, I feel the manuscript

could be hopefully improved by considering the following comments:

1) The wind-sheltering effect is parameterized using analytical models for internal boundary development over roughness boundaries, published in previous century. Since then, there have been new studies performed elucidating turbulent flow dynamics (including surface stress) over such surfaces, e.g. Large Eddy Simulation (Glazunov and Stepanenko, 2015; Kenny et al., 2017), wind tunnel experiments (Markfort et al., 2010; Markfort et al., 2014) and eddy covariance measurements (Queck et al., 2016; Barskov et al., 2017). Though, the author briefly mentions Markfort et al., 2010, I would expect more discussion on the subject.

2) The author assumes water surface momentum roughness to be of O(10^{-3}) m. However, from my experience this likely to be an overestimation of typical values. Could you provide more grounds on choosing this value, or check the sensitivity of the model to this parameter? The other option would be simulating z_0 by Charnock formula modified with fetch-dependence, like it is done in FLake model.

3) Fig. 3, bottom panel. Do you have observation data for the mixed-layer depth, derived from temperature measurements?

Literature

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