Hydrology and Earth System Sciences Discussion
HESSD-2010-12

TITLE:
Controls on open water evaporation

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GENERAL COMMENTS

This paper reports results of a field study to measure evaporation from two lakes of different sizes (one small and the other a medium sized lake) in northern Canada using eddy covariance technique. There are only a few studies in literature where the eddy covariance technique is used to estimate evaporation over lakes. Authors have measured meteorological conditions at adjacent land surfaces at both lakes to determine contrasts in land-water environmental conditions as well as boundary layer conditions over both lakes. Authors report that the wind speed is the most significant factor controlling the evaporation from these lakes;; followed by the land-water temperature and vapour pressure contrast. They separate evaporation periods into warming and cooling periods depending on the temperature of water and land surfaces.

The main objective of this study was to demonstrate how the advective boundary layer over a lake is affected by environmental parameters over a small land, medium sized lake. However, authors have not directly shown atmospheric stability and advective processes occurring over these lakes. Much of their key results, such as wind speed is a dominant controls and net radiation is not a key factor in lake evaporation etc has already been reported in literature. Overall I was not impressed with the quality of this manuscript, although I appreciate the author's efforts to collect these data in challenging environments. The manuscript is poorly written and discussion aspects are very weak. The authors should clearly describe and discuss what advances their study has made to further improve our understanding of the evaporation process from lakes or large water bodies of water. They should clearly highlight what is unique in their study as compared to previous work conducted over different sized lakes in the boreal region.

The authors to submit a revised version. The following suggestion would help to improve this manuscript.

Title should be updated to better reflect study content, for example, "Controls on open water evaporation from small and medium size lakes" may be more appropriate.

Atmospheric stability aspects are a major focus in this paper. I would suggest the authors to provide more details and a new figure or figures showing atmospheric stability for the whole study period. Currently they show it for a few days in Figure 2 and do not even describe at what heights the wind and temperature profiles were measured. The authors should show and discuss vertical structure of boundary layer over both lakes and their differences for these two lakes of different sizes? What was their diurnal pattern?

I would suggest to authors to include a wind rose diagram showing wind directions reversals as well as corresponding changes in stability during study periods. Fetch distances should also be shown, in particular for smaller lake.

Authors should present a full range of their measurements over open-water periods. Currently they show 2006 data as scatter plots and 2007 data as cumulative fluxes. It would be better to plots cumulative fluxes for both lakes in one figure for direct comparison, rather in separate figures.

Authors argue that their measurements would be used to develop better models for lake evaporation. A significant portion of their introduction is focused on highlighting weaknesses in existing models such as Priestley-Taylor model. However, they do not use their measurements to propose any improved Lake evaporation models.

Authors should improve the discussion about the significance of this study and how this study would help us to better understand evaporation processes over different size lakes. They should clearly mention what is unique in this study and how these finding differ from our general understanding of lake evaporation. There are a few past studies that compared small and large lakes such as Rouse et al. (2008) and Oswald et al. (2004) etc but these studies are not referred and discussed in this paper, although there is a reference to Blanken et al. (2000).

Specific Comments:

Page2710, Line 1. Replace “initial results” with “results”.

Page2710, Line 8. Replace “eddy covariance equipment” with “eddy covariance technique”

Page2710, Line 15. Delete sentence “The derived relationships will be used to develop a model for estimating the hourly evaporation rates from open water”. It is not appropriate in the middle of text, where you are stating study results.

Page2711, Line 1-2. Authors mention that lake evaporation is still estimated with limited confidence. They should further elaborate on this aspect to improve the significance of their study.

Page2711, Line 25. Authors describe that to parameterize lake evaporation, information about the “lake surface” is required. Do you mean physical properties of lake, including depth, turbidity etc. Mention it clearly with specifics.

Page2712, Line 21. Move all instrumentation details from Study Sites section to following section and change its heading to “Measurements and Data Analysis”.

Page2713, Line 6. Give make and model of sonic anemometer and other key instruments used.

Page2713, Line 12. Give heights of wind and temperature profile measurements.

Page2714, Line 24. May show measured vertical profiles of wind and temperature over both lakes and how they change when reversals of wind direction occur.

Page2715, Line 13. Replace “stability” with “atmospheric stability”.

Page2715, Line 14. Mention evaporation models that use net radiation and give their references.

Page2716, Line 6. Authors state that “Fig 6 shows that the wind speed over water is affected by the stability over the water ….”. However, atmospheric stability is not shown in Figure 6. This statement should be corrected. In fact, a stability indicator is shown for only a few days in Figure 2, while stability aspects are a major point of discussion in this paper. Authors should also include a figure showing wind direction reversals and upwind fetch distances, which are a major factor in evaporation from small lakes. Land-water temperature and land-water vapour pressure contracts are confounding. It should be mentioned.

Page2716, Line 17-24. Show these wind model parameters either in a Table or more appropriately in the text. Also the statement made on line 23-24 to calculate wind speed using eq. 2 and 3 is case specific and applicable to this study, rather than a general statement.

Page2719, Line 19. Authors acknowledge Fluxnet sites. However, they have not mentioned it in the text whether they used data from a Fluxtnet site.

Page 2720, Line 11-13. Granger and Hedstrom, 2010. Modelling hourly rates of lake evaporation, Hydrol. Earth Syst. Sci. Discuss., 7, 2727-2746, doi:10.5194/hessd-7-2727-2010, 2010, is given as a reference but it is not referred to in the text.

There might be an overlap with is paper?

Figure 1. Describe acronyms PANP and NWT in figure caption.

Figure 2. Both lines are not distinguishable in printed B/W figure. Show data for full measurement range rather than only for a few days. See my previous comments about showing wind rose and wind fetch distances as well.

Figure 3 and 4. Used “Lake-water temperature” in Figure 3 and “Tsf(lake) – Tsf(land) in figure 4. Be consistent throughout the ms and figures.

Figure 5. In figure caption replace turbulent heat with “sensible heat”.

Figure 6. Do not start figure caption text with “Landing Lake 2007”.

References

Rouse, W.R., Blanken P.D., Bussieres, N., Oswald, C.J., Schertzer, W.M., Spence, C., 2008. An Investigation of the Thermal and Energy Balance Regimes of Great Slave and Great Bear Lakes.

Journal of Hydrometeorology 9, 1318-1333.

Oswald and Rouse, 2004. Thermal characteristics and energy balance of various-size Canadian shield lakes in the Mackenzie River Basin. *Journal of Hydrometeorology* 5, 129–144.