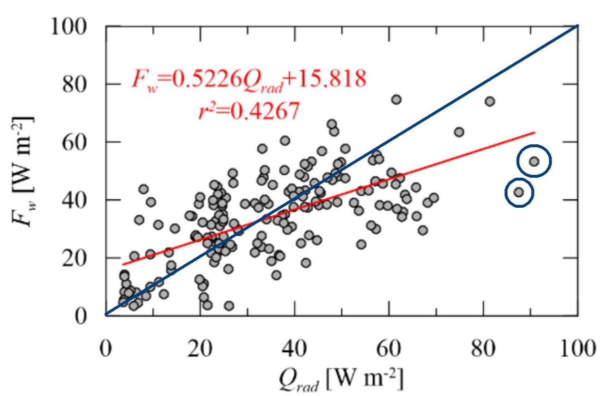
The study is dedicated to the heat budget of ice-covered waters in Central Asia. This is a weakly investigated topic important for understanding the seasonal ice balance in large arid endorheic regions of strongly continental climates.The authors used four years long observations of temperature and radiation in a large shallow lake of Inner Mongolia. High temporal and vertical resolution of observations allowed estimation of the boundary fluxes in the ice-water-sediment system and their relationship to solar irradiance, and ice and snow thicknesses. Data from the ice-covered seasons from 2015 to 2019 provided estimates of inter-annual variability in the winter heat budget. The methods are generally correct and adequate to the posed research questions. The results are of interest for the ice research community and are suitable for publication in "The Cryosphere". The manuscript is well-organized. The presentation can be however improved by language and style editing.

I have some remarks and questions on the analysis of the results. In particular, the concluding part of Discussion, including Eq. 6 and Figure 9, is rather confusing. Why apply a least-square linear model to approximate the water-ice heat flux $F_w$ as a function of solar radiation $Q_{rad}$? It directly follows from your data that $F_w \approx Q_{rad}$ (see the last sentence before Eq. 6). Hence, the coefficients $a$ and $b$ in your linear model have no physical meaning, unless you propose their interpretation. Moreover, looking at Fig. 9, one could suggest that a straight line $F_w = Q_{rad}$ would explain approximately the same amount of variance in the observations (see the blue line in the drawing below), especially if the outliers at very high under-ice radiation levels (blue circles in the drawing) are removed. Herewith, apart from being unjustified physically, the coefficients $a$ and $b$ introduce only additional uncertainty without any additional predictive power. This part of the analysis requires essential revising.




Below are remaining comments and questions arranged along the text flow.

- Line 104: Figure 1a needs some edits and(or) explanations. What do the colored areas mean? They are subscribed in Chinese only. If it is a classification of climatic zones, where it comes from? A reference to the source is needed.

- Lines 115-117: I have not found any information on water depths where the irradiance sensors were installed in the water column.

- Line 137: Eq. 1 is valid if $T_w$ is the water temperature averaged across the water column. It should be explicitly stated in the text.
- Line 145: How the extinction coefficient was measured?
- Lines 152-158: Can you provide details on the "optimal control model"? How deep the temperature loggers were buried in the sediments? How the thermal conductivity of the sediment was estimated?
- Lines 163-165: Replace "first" with "second" and vice versa.
- Lines 176-177: Why these certain thresholds were chosen for the irradiance? Can you compare them to typical seasonal radiation values under ice?
- Line 192: Did absolute humidity change in the diurnal cycle, or was it just an effect of the air temperature variations?
- Line 218: Replace "persist" with "persistent"
- Lines 223-225: It would be more consistent to describe the phenomenon as a local temperature *minimum* created by vertical salinity gradient preventing downward heat transport from the upper waters. Cf. Mironov et al. [2002, Section 6 "Effect of salinity"].
- Lines 242-243: The temperature-salinity distribution described here inevitably suggest development of double-diffusive convection [Schmitt, 1994]. While the existing data do probably not allow direct estimations of double diffusion, its potential role in the vertical heat transport is worth mentioning here or in Discussion.
- Lines 269-271: How the relative contribution of convection to $F_w$ was estimated?
- Lines 359-361: Eq. 3 requires temperature profiles within the ice cover and knowledge of the heat conduction coefficient. Neither of them are "routinely observed".

# References

D. Mironov, A. Terzhevik, G. Kirillin, T. Jonas, J. Malm, and D. Farmer. Radiatively-driven convection in ice-covered lakes: Observations, scaling and mixed-layer model. *Journal of Geophysical Research*, 107(C4):7–1–7–16, 2002. doi: 10.1029/2001JC000892.

R. W. Schmitt. Double diffusion in oceanography. *Annual Review of Fluid Mechanics*, 26(1):255–285, 1994.