Hydrology and Earth System Sciences Discussions

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2
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Comment on hess-2022-133

Anonymous Referee #2

Referee comment on "Assessing the influence of lake and watershed attributes on snowmelt bypass at thermokarst lakes" by Evan J. Wilcox et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2022-133-RC2, 2022

This is an interesting manuscript that presents a novel way to estimate the amount of lake water that is replaced by freshet near the end of winter by using isotope analysis. The authors also linked the amount of water replaced by freshet with lake depth. Furthermore, the isotope analysis suggested that the freshet have different sources such as snow or rainwater from the previous fall. I think the results are publishable, and just have a few minor comments about the manuscript that hopefully will help improve it.

- I suggest a slight revision of the title. The authors can delete "Northwest territories, Canada" without loss of clarity. The paper also goes into detail on how the different lake/watershed parameters influence the % of lake water replaced by freshet, but it is not clear from the title.
- The authors can expand on why they chose to look at watershed and lake characteristics and how that affected the magnitude of snowmelt bypass in the introduction. Did any previous studies or preliminary data hint on this? The authors could also expand on the potential impacts of the study on the ecology in the conclusion.
- In figure 7 the schematic ends with the lake being well mixed throughout the water column. However, the authors did not show that the lakes were well mixed post snowmelt. Some arctic lakes (e.g Cortes and Macintyre 2020) experience mixing only in the upper part of the water column at the end of winter and spring. This well-mixed condition was also implicitly assumed in equation 2 when the authors estimate the % of lake water replaced. I realize that these lakes are significantly shallower than the one presented in Cortes and Macintyre (2020), but the formula might need to be adjusted in the case of incomplete mixing. If this is possible, then the methods in this paper could be extended to a wider class of lakes.
- Line 14: If the lake freezes all the way to the bottom in winter, then this condition does not exist.
- There is a colourbar for the schematic in figure 1 but I do not see the colours. It could

be worthwhile to put the same colourbar in figure 7. In figure 7 the authors can label what the brown arrows are, as figure 1 did.

- The authors should define in Figure 5
- Line 200: Not sure how the presence of a layer of freshet explains the relationship between lake depth and the amount of water replaced by runoff, please explain.
- Line 204: "Shallower lakes likely had colder lakebed temperatures". Does this only apply to thermokarst lakes? In some mid-latitude seasonally ice-covered lakes the bottom can be very close to 4^{o}C because of heat stored in the shallow sediments over summer that flows down via gravity currents. Figure 7a should also be modified.
- Line 249: Authors should explain what the typical thermal structure is. A recent analysis by Yang et al. (2021) suggests that there can be many typical thermal structures across different ice-covered lakes.
- Line 465: Not sure if a software needs to be cited here.
- Table 1: Is the snow depth uniform across the lakes?
- Table 3: The caption says that the p-values are shown for each isotope but there is only 1 value.
- Table 3: The authors can reorder the variables such that the lake parameters come first, then the other variables after.
- HESS requires a data availability section at the end of the manuscript on how the data used in this paper can be accessed.
- I suggest the authors change the notation for the fraction of total lake volume, as V_{Lake} looks a lot like the volume of the lake.

References:

Cortés, A., & MacIntyre, S. (2020). Mixing processes in small arctic lakes during spring. *Limnology and Oceanography*, *65*(2), 260-288.

Yang, B., Wells, M. G., McMeans, B. C., Dugan, H. A., Rusak, J. A., Weyhenmeyer, G. A., ... & Young, J. D. (2021). A new thermal categorization of iceâ□□covered lakes. *Geophysical Research Letters*, *48*(3), e2020GL091374.