The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC2
https://doi.org/10.5194/tc-2022-193-RC2, 2022

Review of tc-2022-193

Anonymous Referee #2

Referee comment on "Mapping snow depth on Canadian sub-arctic lakes using ground-penetrating radar" by Alicia F. Pouw et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2022-193-RC2, 2022

The manuscript "Mapping snow depth over lake ice in Canada's sub-arctic using ground-penetrating radar" presents a study that takes a commonly used method (GPR) and applies it to snow on lake ice. The study is able to cover great distances with high spatial resolution of observations and compare GPR depth estimates to manual depth measurements with a Magnaprobe. The GPR method resulted in an estimated RMSE of 1.58 cm with a mean bias of -0.01 cm during the early season, and RMSE of 2.86 cm and bias of 0.41 cm later in the season.

Overall, the authors produce a very nice dataset that can be used for modeling efforts and potentially remote sensing validation. However, I do not see anything that justifies this study to be at the level of a "Research Article" in The Cryosphere. Again, this is a great dataset but a more robust analysis of data would need to be presented to be a research article, in my opinion. As it is I think it a great "data paper" or potentially a "technical note" type of manuscript. Unfortunately, The Cryosphere does not publish these types of papers so I recommend either submitting to another journal pretty much as is, or providing further quantitative analysis to bump it up to being a full research article. The variograms are a great start, but I think more information on the spatial variability of the snow on lake ice could be good to include. This could include for example: directional variograms to investigate isotropy, variability or depth as a function of distance to shore or distance to islands, does topography of the shore or presence of trees impact anything. I think that the authors started to go down this route with Figure 9 but it needs to continue for more statistical quantifications, in my opinion.

One reason further analysis would be necessary is because the authors did not develop any new tools advance any of the methods to collect the data. Further minor comments are listed below by line number.

15: 9 cm spatial resolution is the spacing between traces, but after you aggregate the data it is a 1 m raster correct? This is the resolution of the data that should be reported

and also incorporates the footprint of observations.

115: "was" should be "were"

158: How was the Wong et al. algorithm applied? Matlab? Python? Please specify.

184-190: How much variability occurred over the 6 m. It seems to me that by choosing only values that closely match one would underestimate the magnitude of the error/bias. As it is written, I do not see a justification for this current method and think the authors should use all values within the 6 m range to calculate the comparison metrics.

200: what is meant by "closed-off areas"

236: Given such low density values, I am not sure that teh Kovacs equation is appropriate. Kovacs was developed for much denser firn. Di Paolo et al. (2018) and Webb et al. (2021) could be good references for a more appropriate equation.

references:

Di Paolo, F.; Cosciotti, B.; Lauro, S.E.; Mattei, E.; Pettinelli, E. Dry snow permittivity evaluation from density: A critical review. In Proceedings of the 2018 17th International Conference on Ground Penetrating Radar (GPR), Rapperswil, Switzerland, 18–21 June 2018; pp. 1–5

Webb, R.W.; Marziliano, A.; McGrath, D.; Bonnell, R.; Meehan, T.G.; Vuyovich, C.; Marshall, H.-P. In Situ Determination of Dry and Wet Snow Permittivity: Improving Equations for Low Frequency Radar Applications. Remote Sens. 2021, 13, 4617. https://doi.org/10.3390/rs13224617

These comments are meant to be constructive. I think this is an excellent dataset and good work.