

The Cryosphere Discuss., referee comment RC1
<https://doi.org/10.5194/tc-2022-193-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on tc-2022-193

Anonymous Referee #1

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-RC1>, 2022

Review on "Mapping snow depth over lake ice in Canada's sub-arctic using ground-penetrating radar" by Pouw et al.

The snow cover on lake ice is of great significance for the growth and decay of lake ice, lake climatology, limnological hydrology, and lake ecology. It is a positive work to develop a new technology based on the ground penetrating radar to quickly obtain the snow depth over large lake-ice areas. Based on the observation system, the authors carried out observation experiments in four lakes in the Canadian sub-Arctic region, proving the applicability and application value of the observation method, especially proving that the observation ability for the shallow snow layer over the ice surface. Thus, it is a method worth popularizing. The obtained data of large-scale snow observation can be further applied to the numerical simulation of lake ice and limnological hydrological processes, to evaluate the impact of snow and lake ice layers on the ecological environment of frozen lakes, and to evaluate the satellite remote sensing products of snow over the lakes. The paper is well written and structured, the method description is appropriate, the data analysis is basically sufficient, and the conclusion is clear, so it is a research work worth publishing in the TC. However, there are still some problems in the current expressions. It is mainly about the physical analysis of some data statistics results, and the impact of destruction of snowmobile track for natural snow surface on the observation data. Therefore, I recommend that the paper can be considered for publication only after a few minor revisions.

General:

- Some statistical results based on observation data lack the analysis of potential physical mechanisms, for example, the difference of snow depth, density, relevant length in various lakes.
- The author said that snowmobile and sled rolling will increase the snow density and reduce the snow depth to a certain extent. The two impacts can offset each other, so

their impacts are not significant. My suggestion here is whether you can further analyze the difference of the impact on thick and thin snow layers, on new and old snow layers, as well as on the snow accumulated in early December and the snow accumulated in late winter.

- This study presents observation data obtained from one winter. Although the data spatial coverage is relatively large, there is still a lack of data representativeness. Therefore, it is suggested to increase the discussion of data representativeness obtained from the observed winter. How does the snow accumulation on land compare with previous years? What is the difference of the atmospheric precipitation, temperature and other parameters in the winter of the observation related to the climatology? etc. Through such comparison, the application value of observation data can be enhanced.

Special comments:

- Line 15 “~9 cm spatial resolution along transects” 9-cm is the sampling resolution, not the data resolution, because you have not considered the footprint of observation. Therefore, it is recommended to further analyze the observation footprint of single observation.
- 1 Introduction: The application of observation data of snow over the lake ice cannot only focus on the developing of lake ice numerical model, but also be applied to lake ice phenology (e.g., Lei et al., 2012), lake ecology and other fields. The description of research background should be more comprehensive in the introduction.

Ref.: Lei R, Leppäranta M, Cheng B, et al. Changes in ice-season characteristics of a European Arctic lake from 1964 to 2008. *Climatic change*, 2012, 115(3-4): 725-739.

- Line 46 “Daily snow depths are reported across Canada using instruments, such as..” As you mentioned later, the SnowHydro Magnaprobe is a common method for snow depth measurement. Therefore, it should be introduced in introduction, and its advantages and disadvantages should be described, such as manual operation, which is not conducive to obtaining a wide range of snow depth observation data.
- Line 83 “It is expected that the wind fetch and shoreline vegetation affect the snow distribution”, However, in the later data analysis, the impact of these two factors on different lakes has not been discussed enough.
- Table 2: Could you explain why the Long Lake has a relative large snow density compared to other lakes?
- Line 199 “area = 4 ha” ha is not the International Standard Unit.
- Figure 5: In fact, there are multiple intersections in the observation transects for all lakes, which means that there should be two observations at these intersections. In order to explain the stability of the observation and retrieval results, it is necessary to compare the repeated observation results obtained from these measurement

intersections.

- Lines 222, 225 “Long Lake showed the lowest agreement”, “with Vee Lake being the most accurate”: Corresponding to such measurement difference, some physical explanations are required.
- relative error = 11.04 %, and other somewhere: For relative errors, it is not necessary to retain two decimal places, because the accuracy of the evaluation cannot reach this level.
- Line 240 “However, the relative error was improved on Landing-M Lake with a deeper snowpack (5.33 %) than that of Landing-DLake (8.06 %). During the later season, the GPR could derive the minimum snow depths seen on Landing Lake, as opposed to that in the early season, where” Some further explanation is needed here, not only to give the data results.