

The Cryosphere Discuss., referee comment RC1
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Review of manuscript by Dunmire et al.

Anonymous Referee #1

Referee comment on "Contrasting regional variability of buried meltwater extent over 2 years across the Greenland Ice Sheet" by Devon Dunmire et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-3-RC1>, 2021

Review of "Contrasting regional variability of buried meltwater extent over two years across the Greenland Ice Sheet", by Devon Dunmire et al., a manuscript submitted for publication to The Cryosphere.

GENERAL

This paper presents a deep-learning application for the automated detection of buried lakes over the Greenland Ice Sheet. Subsequently, the statistics and regional differences in buried-lake presence are analyzed to infer different physical processes behind the formation of these buried lakes.

The manuscript is already in really good shape, both scientifically, methodologically, and in terms of language and presentation quality. It reads like a breeze.

I would like to suggest two points of further improvement to the paper.

(1) The temperature and melt history prior to the buried lake detection is now presented in figure 7 and tables B3 and B4. However, it would be really nice and more direct to include, for example, simulations of subsurface temperature from RACMO2, a simplified firn model, a very simple thermodynamical model, or from observations of subsurface temperature close to a buried lake (if these exist) to corroborate the link between climate and lake survival in fall. The present analysis isn't wrong but it is somewhat circumstantial.

(2) I think section 4.2 could be written even more clearly, by really separating the regimes in the SW, NW and SE even more rigorously. Also, what is the role of burial rate (i.e. snowfall rates) in each of these areas on buried-lake formation and detection? And what is the role of the near-surface density (porosity) in sustaining lakes in each of these areas?

Finally, could you elaborate on the potential to extend the time series of buried lakes back in time, as mentioned in the last sentence? What sensors are available? How far back in time?

SPECIFIC

Line 45: How can C-band and your method discriminate between buried lakes and firn aquifers?

Line 59: prior to buried lake detection: prior to the date of the buried-lake detection imagery.

Line 76: explain HV band

Line 134: was -> were

Line 154: calculated -> calculating

Line 211: I guess this means surface lake water presence?

Section 4.4: given a rough estimate of buried-lake depth (1m? 5m? 10m?), is it possible to mention a range of the amount of water potentially stored in the lakes? For 1 m depth and 376 km² this means 0.376 Gt, for 10 m it is 3.76 Gt (please check!). On an ice-sheet scale, these numbers are small. Are the effects mainly on a local scale? It would be good to elaborate here a bit more.

Figures 4, 6 and 9: in the captions, please refer back to the overview map in Figure 3 for the locations of the images. This was at first unclear to me.

