The Cryosphere Discussions

The Cryosphere Discuss., referee comment RC2
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# Comment on tc-2021-203

Anonymous Referee #2

Referee comment on "Seasonal evolution of Antarctic supraglacial lakes in 2015–2021 and links to environmental controls" by Mariel C. Dirscherl et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-203-RC2, 2021

## General Comment

Dirscherl et al. present a study on the evolution of supraglacial lakes on six Antarctic ice shelves between 2015-2021 based on a comprehensive and newly generated data set of lake extents and investigate the main environmental drivers of the meltwater ponding. The primary source data for generating high-resolution time series of supraglacial lake extents are Sentinel-1 (S1) SAR and Sentinel-2 (S2) optical satellite imagery, which are processed building on previously developed machine learning methods. The resulting supraglacial lake extent maps are merged and converted to fractional water coverage time series for further statistical analysis. For the analysis of climatological controls a number of variables derived from the ERA5-Land reanalysis data set are used as well as large scale atmospheric indices.

In the Antarctic Peninsula the authors find anomalous high lake coverage in the last two melt seasons and low lake coverage in preceding years, while in East Antarctica this seemed to be reversed and also generally more variable. The correlation analysis showed that climatological controls (temperature, solar radiation, snow melt, wind) varied for each iceshelf both spatially as well as temporally, illustrating the complex interplay between different climate variables at different time lags. Also the Southern Annular Mode and the local glaciological setting was found to exert a strong control on supraglacial lake formation.

The topic of this paper, supraglacial lake evolution in Antarctica and its main climatological controls, is very interesting and relevant, in particular thanks also to recent advances in modern computing technology and increasing availability of satellite EO data. This paper by Dirscherl et al. is a well written, illustrated and referenced manuscript and a valuable and original contribution of interest for the glaciology community. The authors give a good motivation for their work, a detailed description of their methods and results and provide a thorough discussion. The outcome provides new insights on present-day Antarctic surface hydrology and main environmental drivers in particular relevant for ice sheet and climate modelers.

That said, I do think there is some room for improvement, in particular with respect to the readability, as at times the amount of information in (particular in) the results and discussion section is somewhat overwhelming. Maybe it is better here to not describe and discuss each and every detail but focus on the key points and let the figures/tables tell the rest. Further comments and suggestions for improvements are provided below.

**Specific Comments**

Pg 2 – Ln 34-36: With… Antarctic: I think the wording in this sentence is a bit too strong or not clear. In particular the notion that surface hydrological features will become the dominant driver for Antarctic ice mass loss. This is currently overshadowed by basal melting and iceberg calving.

Pg 3 – Ln 65: (v): should be (iv)

Pg 5 – Ln 137: through Wohlthat mountains: through the Wohlthat Mountains

Pg 5 – Ln 146-148: The AOI outlines look a bit random to me. Does this mean that no lakes occurred in the other areas? Why not investigate the entire ice shelf?

Pg 5 – Ln 156: Sentinel-1: I assume you have used the GRD product?

Pg 5 – Ln 163: Sentinel-2: Did you use any particular spectral band/combination? What resolution?

Pg 8 – Ln 231-232: The ... regions: This needs some more elaboration on how the test data sets was generated.

Pg 8 – 251-252: This also needs some elaboration on to what extent do the Sentinel-1 and Sentinel-2 datasets agree? Can some of the intra- and inter-annual variability be explained by differences between the sensors, in particular since you mention that S1 can also observe buried lakes, not visible with S2?

Pg 8 – Ln 252: interpolate: do you mean spatial or temporal interpolation?

Pg 8 – Ln 255: fractional water coverage: elsewhere this is referred to as fractional lake extent, do you mean the same?

Pg 9 – Ln 285: The results section starts with a graph/description on supraglacial lake extent dynamics, what I miss are actually some (examples of) high-resolution supraglacial lake extent maps generated in 3.2.2.

Pg 14 – Ln 447: 0-1, 2-4 and 0-1, respectively
Pg 14 – Ln 452: Wind: Do you mean wind magnitude?

Pg 20 – Ln 638: How does firn air depletion lead to facilitate melt? Seems like a step is missing here.

Pg 21 – Ln 665: latitudinal: do you mean longitudinal?

Pg 21 -Ln 673: is among: are among

Pg 21 – Ln 678: ice shelf geometry: In what way does the ice shelf geometry play a role for supraglacial lake evolution?

Pg 23 – Ln 717-718: How does prevailing low wind speeds following periods of anomalous high wind speeds dictate lake formation, what mechanics are at play here?

Pg 23 – Ln 732: near the Wohlthat Mountains

Pg 25 – Ln 800: As before, where can we see an example of this product at unprecedented 10 m spatial resolution?

Pg 25 – Ln 801: surface hydrological features -> supraglacial lake extent

Pg 26 – Ln 802: buried lakes: Can you elaborate on how deep buried lakes can be detected

Pg 27 – Ln 842: Data availability: Are the generated products going to be made publicly available?

**Figures**

Fig 5: This is a nice plot showing fine-scaled details, but unfortunately it is hard to distinguish the different colours.

Fig 5: I would suggest switching the labels b & a to a & b, same for h/g, f/e