Review of tc-2023-4
Recent Evolution of Supraglacial Lakes on ice shelves in Dronning Maud Land, East Antarctica. Mahagaonkar et al. (2023)

This paper uses a band thresholding approach to map surface meltwater over several ice shelves in Dronning Maud Land between 2014 and 2021. It is the first study to look at inter- **and** intra- annual variations in ponded water extent across several ice shelves in this region.

Overall, this paper is fairly well written, and adds some detail to our understanding of surface meltwater across Dronning Maud Land. However, in my opinion, the paper requires some major and minor edits prior to being ready for publication, which I have outlined below.

Major Comments

The authors use relatively new methods from Moussavi et al. (2020) to mask for clouds, rocks, and ocean prior to classifying water pixels. However, Moussavi et al. (2020) also provide a multi-band threshold approach for mapping surface meltwater, but the authors opt to just use an $NDWI_{ice}$ approach, with no justification for this decision. This is an odd decision to make, given the success of the methods provided by Moussavi et al. (2020), and given that the methodological approaches are now mixed. I would recommend mapping the meltwater using the methods provided by Moussavi et al. (2020), or giving a strong justification as to why this is not done.

In addition to this, please can I request that the authors provide the exact equations used for all methodological steps in their work. At times I find the methodological descriptions very vague.

Throughout the text, there is a significant lack of references to the relevant papers. Please can the authors comb through their work and make sure any idea that is not their own is referenced. This is particularly true for the discussion.

At present, there are a lot of interpretative and discursive statements in the results section, which need to be removed and placed into the discussion of the paper. The results should simply state the results presented by the study, and nothing more. Examples of this are parts (or all) of lines 292-293, 321-322, 336, 340-341.

The authors state numerous times that they see the transfer of water across the ice-shelf surface. However, I would argue that they present no evidence for this. The data collected here simply maps surface meltwater extent and does not prove flow or transfer of water in any dimension. It is not implausible that water is flowing across the ice-shelf surface along topographic gradients, but without evidence and analysis showing this, I think these inferences should be removed from the paper.

The discussion currently includes numerous claims that are neither supported by references from the literature nor from evidence in the paper. This discussion should build on phenomenon that the analysis finds and embed this in previously published literature.

Minor Comments

L8 (and elsewhere): The phrase ice sheet – ice shelf stability regime is a bit odd, perhaps rephrase to 'severe impacts on the stability of an ice shelf' and then weave in the subsequent implications for the ice sheets because of this.

L12: Change 'Antarctic ice sheet' to 'Antarctic Ice Sheet'. Check for this elsewhere too & check other nouns.

L27/28: This sentence is vague, try to add detail.

L30: If the water isn't being exported as run off, but surface melt is occurring, then tell the reader what the fate of that surface melt is.

L37: In this paragraph you start by talking about meltwater on ice shelves, but on this line you say meltwater can drain and cause glacier speed-up, which is something that would occur on grounded ice rather than an ice shelf. Please read through your paper again thoroughly and make sure you clearly separate out ideas pertaining to ice shelves vs. grounded ice.

L42: There are so many more references you could use here. If you just want to use a couple, then please write this as '(e.g. Kingslake et al., 2017; Stokes et al., 2019)'. This concept should be applied elsewhere throughout the paper too.

L46-48: The evolution of supraglacial lakes has also been observed on the Nivlisen Ice Shelf (Dell et al., 2020), and Roi Baudouin Ice Shelf (Dell et al., 2022). Both of these are in Dronning Maud Land.

L59: What do you mean by 'simple configuration', perhaps reword.

L66: The two papers you reference here actually use different methods, so which did you use?

L72: 'houses' is an odd choice of word, perhaps change.

L73: Change 'kms' to 'km'

L77: The periphery of what? This isn't very clear. Where exactly on the ice shelf are you referring to?

L80-83: Could you show this in a figure? Which glaciers feed which ice shelves?

L87: These papers aren't really Antarctic-wide. Find alterantives, depending on how you want to define Antarctic-wide.

L88-89: This study by Dell et al. (2020) should have been referenced much earlier on before you justify your study and your work. Also you should reference Dell et al. (2022) and Kinglake et al. (2015).

L92: Change 'Landsat-8' to Landsat 8

L104: Here and elsewhere, where did you download all your datasets from?

105: What is the common pixel size?

L104-105: Could this information be weaved into a different paragraph; it seems odd to have it structured in this way.

L109: It might be better to say that you use Collection 2 Landsat data before this point.

L111: Did you pick these bands because they were the bands used by Moussavi et al. (2020), if so then perhaps say this.

L114: Did you get a script for the per-pixel corrections from somewhere? If so perhaps reference it.

L146-147: What are the 'other outliers'?

L148: How much manual post processing was required? You could perhaps give an example of an image before and after manual post-processing as a supplementary figure.

L168: Reference needed.

L173: And Dell et al. (2020)

L182: What do you mean by ice-shelf region?

L191: What do you mean by 'Larger areas having such pixels were manually removed'? You removed lake edges found in Sentinel but not Landsat? Clarify.

L200: change 'temperature' to 'temperatures' (in two places). Change 'was' to 'were'.

L206: Change 'seasons' to 'season'.

L209: So do you chose to refer to areas or volumes?

L220: Do you have a figure showing what areas were randomly sampled? Did you randomly sample homogeneous features separately to homogenous features? Or did both types of features just get selected in the same random sample?

L225-227: What was the maximum difference, minimum difference etc? Does this justify your selection of a 1% relative uncertainty?

L232: Give the seasons in brackets after 'several seasons'

L256: This should probably be made clearer earlier in the text too, but did you look at every ice shelf in DML to start with, and then only find melt on five ice shelves? OR did you only look at these five ice shelves in the first place?

265: Here and elsewhere: What does 'viz' mean? Rewrite/ reword.

L272: Give examples of the years of low and high melt.

L285: remove '(within a particular melt season)'

L286: remove '(multiple melt seasons from different years)'

L339: I think you mean Fig 7.

L392-395: What are you trying to say here? It doesn't make much sense to me.

L396: Again, missing references, if you are just giving some then use (e.g. refs).

L423: Put these refs immediately after the ideas they are relevant for.

L440: Clarify what you mean by 'Direct surface drainage into the ocean'. I think you mean water flow off the ice shelf edge into the ocean, but this could also mean hydrofracture. Check this elsewhere too.

L451: Change 'Shackleton ice shelf' to 'Shackleton Ice Shelf'.

Figures

Figure 1: What dataset in Quantarctica did you use? It should have a reference as it would have come from somewhere.

Figure 3: Does the 10 Km scale apply to all the individual ice shelf maps? Give the inset map a scale.

Figure 6: For the 'b' figures, consider changing the Y axis to %'s, as this is how you present the data in the text . This Y axis also needs a label! X axis labels needed for both a and b!

Figure 7: Add X axis labels.

Table 2: Caption: correct 'ices helves'

Supplementary

Figure S3: Give the actual image information for imagery used. Apply this where appropriate elsewhere too.

Figure S6: Legend needed. If you are using REMA data it needs to be detailed in the methods of your paper.

Figure S7: Not referred to in the text? Also this builds heavily on the work of Moussavi et al. (2020), correct? This should be acknowledged. The figure also provides no info on the threshold values used.

A table of the satellite data used and data availability should be included as supplementary info.

References

Dell, R., Arnold, N., Willis, I., Banwell, A., Williamson, A., Pritchard, H. and Orr, A.: Lateral meltwater transfer across an Antarctic ice shelf, Cryosph., 14(7), 2313–2330, doi:10.5194/tc-14-2313-2020, 2020.

Dell, R. L., Banwell, A. F., Willis, I. C., Arnold, N. S., Halberstadt, A. R. W., Chudley, T. R. and Pritchard, H. D.: Supervised classification of slush and ponded water on Antarctic ice shelves using Landsat 8 imagery, J. Glaciol., 1–14, doi:10.1017/jog.2021.114, 2022.

Kingslake, J., Ng, F. and Sole, A.: Modelling channelized surface drainage of supraglacial lakes, J. Glaciol., 61(225), 185–199, doi:10.3189/2015JoG14J158, 2015.

Kingslake, J., Ely, J. C., Das, I. and Bell, R. E.: Widespread movement of meltwater onto and across Antarctic ice shelves, Nature, 544(7650), 349–352, doi:10.1038/nature22049, 2017.

Moussavi, M., Pope, A., Halberstadt, A. R. W., Trusel, L. D., Cioffi, L. and Abdalati, W.: Antarctic Supraglacial Lake Detection Using Landsat 8 and Sentinel-2 Imagery: Towards Continental Generation of Lake Volumes, Remote Sens., 12(1), 134, doi:10.3390/rs12010134, 2020.

Stokes, C. R., Sanderson, J. E., Miles, B. W. J., Jamieson, S. S. R. and Leeson, A. A.: Widespread distribution of supraglacial lakes around the margin of the East Antarctic Ice Sheet, Sci. Rep., 9(1), doi:10.1038/s41598-019-50343-5, 2019.