

The Cryosphere Discuss., author comment AC2
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Reply on RC2

Jenny V. Turton et al.

Author comment on "The distribution and evolution of supraglacial lakes on 79°N Glacier (north-eastern Greenland) and interannual climatic controls" by Jenny V. Turton et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2021-45-AC2>, 2021

Dear Reviewer,

In this response, we outline the larger changes that we will make to the manuscript in response to your specific comments. Then, following a decision by the editor, we will then upload a revised manuscript and point-by-point response to all critiques.

Firstly, thank you for providing your time and expertise to review our manuscript. We greatly appreciate your comments and hope to improve the manuscript by incorporating the changes. In general, we aim to improve the manuscript's structure for better understanding, especially in section 3.3, and improve the communication of the results by amending the figures. Furthermore, we will extend the description for the lake detection algorithm and include more discussion of lake drainage. We summarise your main concerns and address your key comments below:

Comment: I would like to see more explanation and justification of the lake identification method including motivation over NDWI method, how to distinguish slush, key limitations and lower lake-area limit.

Response: The mentioned aspects are critical aspects of the lake detection methodology and are discussed in length in the method paper by Hochreuther et al. (2021), including the paper you suggested (Williamson et al. 2017). The goal of this study is centred around the linkages between atmosphere, cryosphere and hydrosphere, thus we initially thought an in-depth discussion of the lake detection method would not only extend the page volume of the manuscript significantly, but also shift the balance of its aspects quite heavily towards methods. Nonetheless, as we agree these are key aspects of the lake detection method and thus the curiosity is well justified, we will extend the paragraph to include information on the bandratio method, including its limitations (the minimum lake size is one of these). Lake depth could not be calculated, as, due to missing ground truth data, no relationship could be built between the MSI-detected spectra and actual lake depth. Though numerous studies from West Greenland exist (including measurements from there), these values cannot simply be applied due to a number of reasons (different solar angle and azimuth, different lake bottom properties etc.). We will also include this.

Comment: More Greenlandic studies are required in the discussion.

Response: We will include more Greenlandic supraglacial lake studies in the introduction and discussion, this is a clear oversight. Both reviewers suggested literature that we will read and incorporate where possible.

Comment: More information required on lake drainage.

Response: Both reviewers requested more information about lake drainage results. As the aim of this study was to link climate conditions with lake characteristics, and there is likely little relationship between climate indicators and drainage, we did not include this information initially. Furthermore, given the very cloudy conditions in northeast Greenland, it can often be difficult to quantify whether lakes have drained or are covered with clouds, especially when clouds persist for a number of days and lake drainage may have been missed. However, we will include some discussion of one or two lake drainage events in the form of case studies, so that we may infer the likely drainage mode in this region. Neckel et al. (2020) observed a lake drainage event in our study region and we will analyse this particular event, as we have observations to prove that the lake drained as opposed to being covered by clouds or froze over. Following this, we will assess a number of other lakes, to see whether individual lakes or a number of lakes drain in a similar fashion.

Comment: A few figures need substantial work.

Response: A number of figure changes were also suggested by Reviewer 1, so we will modify all figures in the manuscript to better represent the results, synthesise the data and aid in understanding. Specifically: Figure 1 will now include a larger map of Greenland with labels for NEGIS and the grounding line. Figure 2 will include the absolute lake area values (as a line plot) as well as percentage change, with some alteration to the colour bar. Figures 3 and 5 will be split into 4 panels to represent each year, and table data will be included on figure 5. Figures 6 and 7 will be combined into one panelled figure. An additional figure is likely to be included to accompany a short discussion on the lake drainage characteristics- as mentioned by both reviewers.

Comment: Structure of some paragraphs needs revision, including the discussion and conclusion.

Response: We will ensure that some sections of the discussion are moved into the introduction, and that the conclusion does not bring any new results to light but includes the wider implications of the findings. Furthermore, we will adapt section 3.3 of the results following suggestions from reviewer 1.

Suggestion: To include looking at the role of atmospheric rivers.

Response: The first author of the paper is currently working with a number of collaborators (including the author of the suggested paper you referenced) to look at the role of atmospheric rivers on the whole surface mass balance and melt production in this region. As this is quite a substantial amount of work and results, we will not include it in this manuscript. However, it is likely that the high snowfall amounts in 2018 were related to a high frequency of strong atmospheric rivers, and we could include this in the discussion, and as a pointer to future areas of research.

The line-by-line comments and a more thorough description of the changes made will be provided in a point-by-point response to reviewers, once the editor has provided guidance on whether we are to upload a revised manuscript.

Once again, thank you for taking your time and providing your expert opinion on our research. We are hopeful that the editor invites us to provide a revised manuscript.

Best wishes,

Dr Jenny Turton, on behalf of all authors.