RESPONSES to REVIEWER 1

Second review for Carrea et al. "Factors influencing lake surface water temperature variability in West Greenland and the role of the ice-sheet"

After partaking in the first round of reviews, the authors of the manuscript ("Factors influencing lake surface water temperature variability in West Greenland and the role of the ice-sheet") have amended and upheld all of the suggested changes. These changes included manuscript re-structuring and introducing Greenlandic lake naming conventions. The manuscript now reads much more clearly, with a distinct structure that guides the reader through the multiple datasets and findings presented.

Response: the authors thank the reviewer for the very constructive comments which have contributed greatly to improve the paper.

I only have a three minor comments, but essentially I think this manuscript can be accepted once these changes are implemented.

1. Lengthy sections/paragraphs

I agree with the other first reviewer of this paper that some of the sections/paragraphs are lengthy. This is still the case in this revised version. I don't think this needs much altering other than splitting the following sections into paragraphs:
- 1. Introduction
- 2.1. Study region
- 2.9.1. Characterisation of lakes in the study region
- 3.1. Physical characterisation of the study region (third paragraph)
- 3.2. Characterisation of the six studied lakes (second paragraph)
- 5. Conclusions

To give an example, I think Section 2.1 (Study region) could be split into paragraphs at Lines 82 and 92 to form paragraphs on a) the general region; b) the regional climate; and c) specific lake details.

Response: We have split the suggested sections in paragraphs.

2. Revisions to lake names

Thank you for including the Greenlandic lake names in the paper. With regards to how they are referenced throughout the paper; generally, the Greenlandic name references that the placename is associated with a lake (e.g. "Tasia", "Tasersua"), so referring to them as, for example, "Lake Tasersuaq Aallaartagaq (D)" is incorrect. Please amend these like so: "<Greenlandic placename> (Lake <X>)".

For example: "Lake Tasersuaq Aallaartagaq (D)" >> "Tasersuaq Aallaartagaq (Lake D)"

For instances where multiple lakes are referenced, it is fine to write, for example, "The lakes Eqalussuit Tasiat (Lake A), Nassuttuutaata Tasia (B) and Itinnerup Tasersua (C)..." (Line 297-298).
R: We have followed the structure "<Greenlandic placename> (Lake <X>)", except in list "Eqalussuit Tasiat (Lake A), Nassuttuutaata Tasia (B) and Itinnerup Tasersua (C)..." where we have removed the word 'Lake' in the bracket before the capital letter.

3. Grammatical errors and typos

There are quite a few grammatical errors and typos remaining, even after a first round of reviews and revisions. I have highlighted those below which I saw, but I also expect all authors to do a final read-through for grammar and spell checking after this round of revisions. For reference, all line suggestions are based on line numbering from the tracked changes version of the revised manuscript.

Line 20: "...such as instance calving..." >> "...such as calving..."
R: Done

Line 33-34: "None of the lakes was connected..." >> "None of these lakes are connected..."
R: Done

Line 28-40: I would suggest re-structuring this to better convey that actually measurements have been collected as part of three main efforts - 1) the southwest campaign between 2011-2022; 2) the 1998-2000 transect near Kangerlussuaq; and 3) the active, seasonal monitoring of the GEM lakes (I understand that data is only available up until 2019, but they have remained monitoring this lake each summer season and there are plans to publish the 2019-2024 data shortly). As it stands in the current structuring it appears that there are two main campaigns, and the GEM lake monitoring is not a major monitoring effort.
R: Done. We have created a list of the 3 efforts.

Line 107: Please add this DOI as a reference, or include the DOI in brackets, rather than as part of the main text.
R: added the brackets

Line 118: Again, either add the DOI as a reference, or place it in brackets.
R: added the brackets

Line 125-127: I think this sentence needs to be re-ordered, or you can remove "where to discover how to search and download all Landsat products from United States Geological Survey (USGS) data portals)" and move the USGS acronym definition to the next sentence
R: We have changed the sentence:

The Landsat 8 data are available at the Landsat Data Access web page (https://www.usgs.gov/landsat-missions/landsat-data-access) where to discover how to search and download all Landsat products from United States Geological Survey (USGS) data portals. The USGS Landsat no-cost open access data policy remains intact since its inception in 2008.
into:
The Landsat 8 data are available at the Landsat Data Access web page (https://www.usgs.gov/landsat-missions/landsat-data-access) within the United States Geological Survey (USGS) data portal. The Landsat no-cost open access data policy of the USGS remains intact since its inception in 2008.

Line 138: MacCallum and Merchant reference should be inline with the text rather than in brackets, i.e. "(MacCallum and Merchant, 2012)" >> "MacCallum and Merchant (2012)"
R: Done

Line 139: "...(Carrea et al., 2023) which was..." >> "...(Carrea et al., 2023), which was..."
R: Done

Line 180: DOI as reference or in brackets
R: added the brackets

Line 237: "Two domains are addressed: (i) northern domain..." >> "Two domains are addressed: (i) the northern domain..."
R: Done

Line 239: "Figure1(b)" >> "Figure 1(b)"
R: Done

Figure 2 caption: I think you can remove the "(a), (c)" definitions at the beginning and just have them defined at the end of the sentence. This is the same for the last sentence in the caption defining subsets (b) and (d).
R: Done, but we have replaced "(a), (c)" with "On the left hand side,…." , and "(b), (d)" with "On the right hand side,…."

Table 1: Please can the lake names caption be amended to acknowledge that lake names are sourced from Oqaasileriffik placename database, which is distributed with QGreenland. I.e. "a. Oqaasilerffik (the Language Secretariat of Greenland) placename dataset, distributed with the QGreenland spatial dataset suite (https://qgreenland.org/) (Moon et al., 2023)
R: Done but we have removed (the Language Secretariat of Greenland) because of space

Table 1: "Landsat8" >> "Landsat 8" for captions d and e
R: Done

Line 397: Change "lake A" to respective placename

R: Done

Line 451-458: Given the manuscript is already lengthy, I don't think this summary passage is needed. I would suggest removing this and going straight into Section 4.1.
R: Removed the full summary

Line 550: "...we presented new long-term consistent..." >> "...we presented new, long-term and consistent..."
R: Done

Line 589: Initial in reference should be capitalised, i.e. "o." >> "O."
R: Done

RESPONSES to REVIEWER 2

This is my second review of this paper. The authors have addressed my comments from the previous review, and most issues have been satisfactorily resolved. Even in cases where certain aspects have not been altered, sufficient justifications and corresponding explanations have been provided in the manuscript. Overall, the authors have made significant improvements, and the paper now meets the publication requirements.

<u>Response</u>: **The authors thank the reviewer for the useful suggestions that have definitely improved the paper.**

I still have a few minor suggestions for further enhancement:

1） The authors are commended for citing a large number of relevant references in the introduction. I suggest that these references be appropriately summarized and synthesized, particularly highlighting the research gaps in the related studies to further emphasize the advantages of the current work.

<u>Response</u>: **We have highlighted the current studies that characterise lakes, highlighting their limitations and the need of consistent spatially distributed and long-term measurements to characterise lakes in such a remote area like Greenland. In our opinion, this paper is an important starting point which will allow a better understanding of thermal behaviour of lakes in the region which will allow a better modelling and possibly guide for the selection of crucial area to be monitored.**
We have also added a paragraph at the end of the Introduction:
"In summary, this work aims to provide a substantial initial contribution to understanding lake thermal dynamics in this critical region, with the potential to enhance predictive modelling and support the strategic selection of monitoring locations. Lakes are important sentinels of climate change, as their thermal regimes respond rapidly to atmospheric forcing and reflect broader environmental shifts—particularly in this region. However, consistent in situ observations in this

area remain limited. Remote sensing offers a powerful tool for capturing spatio-temporal patterns in surface water temperature at otherwise unattainable scales. By addressing this gap and leveraging satellite-based observations, this study also intends to demonstrate the value of remote sensing in supporting climate-related assessments of freshwater systems. Our findings contribute to ongoing efforts to develop robust, observation-driven frameworks for monitoring lake responses to climatic shifts and offer valuable insights for enhancing lake modelling in the region."

2) The paper utilizes a substantial amount of data and describes the data usage process. Would it be possible to include a flowchart to help readers better understand how these data are utilized?

Response: Given the complexity, rather than a flowchart we have included a table where for each task we have listed the data and task that have been used for. We hope that this table clarifies the data usage.

3) For the statistical analyses concerning trends and correlations in temperature variations, I recommend including information on confidence levels and related metrics. In particular, how were data gaps in the long-term time series handled?

Response: Trends are provided with standard uncertainty, and the p-values are used to identify which correlations are significant. We have chosen this approach since, in our opinion, it provides enough information without overcomplicating the matter, given that the paper is already quite dense.
The presence of gaps has been handled using anomalies when averaging, which reduces the range of variability of the data. In this way, the averages of data with gaps can be considered representative of the true average when the climatology is added back to the anomalies.

4) The current method for determining lake stratification employs a fixed temperature threshold. I suggest the authors discuss the rationale behind the choice of this threshold and analyze the sensitivity of the results to its value.

Response: The temperature of 3.98 °C is the minimum density temperature threshold for freshwater. Deep lakes with temperature seasonally greater than this value are likely stratified for fundamental stability reasons. We have also referenced other studies on lake stratification phenology.

5) Much of the manuscript is devoted to describing the observed changes, while the underlying mechanisms are less explored. I recommend that the authors, in conjunction with existing literature and theoretical models, delve into the mechanisms driving the changes in lake temperature and other related variables. I know this is not easy, but it's worth trying.

Response: We thank the author for the comment, and this is something that we are planning to attempt but we also think that this constitutes a separate paper.

6）I advise standardizing the symbols, units, and legends throughout the paper.

Response: We have standardized symbols, units and legends.

7）The language throughout the manuscript should be more concise, avoiding overly long sentences (e.g., Section Introduction). I suggest breaking up some lengthy paragraphs to better highlight the core conclusions and areas for improvement.

Response: We have followed the suggestion of the reviewers to break up lengthy paragraphs and in particular we have separated into paragraphs the text in the following sections:
- 1. Introduction
- 2.1. Study region
- 2.9.1. Characterisation of lakes in the study region
- 3.1. Physical characterisation of the study region
- 3.2. Characterisation of the six studied lakes
- 5. Conclusions