Response to Reviewer #1

This paper presents an annual ice-marginal lake inventory from 2016 to 2023, classified using an established remote sensing approach. The paper is short. Figures and Tables are nicely drafted. The dataset is certainly valuable, but the authors also report that their automated processing are underdetecting the lakes but apparently do not take any means to improve it. I miss more information on validation and more discussion on how improvements could be made. I also question why there are so many authors (I counted 12 incl 3 'managers') on this rather short paper not involving any field investigations.

Thank you for your feedback. This publication and the associated dataset are the culmination of a long-term effort across different projects, incorporating in situ data (and thus fieldwork) that has been collected by many contributors. We greatly appreciate your feedback and will respond to your major comments subsequently, followed by outlining our responses to your minor comments.

We appreciate your feedback on the automated classification method. The automated classification approach prioritizes consistency and reproducibility across large spatial and temporal scales. Incorporating manual delineations, while potentially improving detection in localized cases, would introduce subjectivity and limit the reproducibility and scalability of the dataset. That said, we recognize the potential for improving the classification methods in future work, including exploring hybrid approaches or enhanced algorithms that could reduce omission errors while maintaining automation and consistency. In Section 6.2 (The future of the ice-marginal lake inventory series), we have now elaborated on how the automated classification method could be improved upon with examples from other publications, and how the overall product could be developed to address the under-detection of lakes.

With regards to the validation, we had included error analysis for lake abundance and surface lake temperature, and data quality control as reflected in the methodology performance at the time of submission. In light of your feedback, we have now included an extra section that performs error analysis for lake size (this was also requested by Reviewer #2), therefore providing a more complete error analysis of each aspect of the dataset and the underlying methods. This error analysis can be found in Section 5.3 (Lake size error estimation). The discussion and other relevant sections have also been updated accordingly.

Minor comments

I have checked the readme.txt, and downloaded one of the lake files. Seems fine

Great to hear. Thank you for checking the dataset.

7 'The dataset catalogs 2918 automatically classified ice-marginal lakes and reveals their evolving conditions over time.' Does not the number of lakes vary through time?

Yes, the number of lakes varies through time as elaborated on in Section 4.1 (Lake abundance). The sentence is merely providing an overview of the number of unique lakes identified across all years. To make this clearer, we have edited this sentence: "Here, we present an eight-year (2016–2023) inventory of 2918 automatically classified ice-marginal lakes (>=0.05 km^2) across Greenland, tracking changes in lake abundance, surface extent, and summer surface temperature over time." (Line 5-7)

26 do you have a reference for this sentence?

There are many broad references we could add here related to the study (and naming) of GLOFs/Jökulhlaups, as they are well-studied phenomena. References to examples where the terminology are used (Taylor et al., 2023; Elbi et al., 2023) have been added accordingly. With regards to a reference for the Greenlandic naming, this is based on direct consultation with Oqaasleriffik (the Language Secretariat of Greenland) as we had not come across a Greenlandic term for this previously. This information has now been added:

"For example, many ice-marginal lakes are prone to sudden and short-lived drainage events, thereby producing GLOFs (Glacial Lake Outburst Flood events) (e.g., Taylor et al., 2023) which are also referred to as jökulhlaups (Icelandic) (e.g., Eibl et al., 2023) or sermimit supinerit (direct translation into Kalaallisut, West Greenlandic; in singular sermimit supineq) (Oqaasileriffik, personal communication, November 2024)." (Line 28-31).

30-41 I found this a bit detailed, is all needed? I suggest shortening this part, do it a bit wider in terms of authors cited and more general before zooming in on Greenland.

We have removed the Russell Lake example to present a more general picture of ice-marginal lakes. The paragraph is more concise now.

55 I am not sure that you in your paper defend the statement 'and assess the impact of these changes on future sea level projections.' There is no reference for the statement and I would be careful with it.

Agreed. We have changed this statement to address this concern: "Given that ice-marginal lakes are projected to increase in size and abundance over time (Shugar et al., 2020; Zhang et al., 2024), it is of utmost importance to generate time-series that adequately capture ice-marginal lake change and could potentially contribute to future sea level assessments." (Line 56-58).

63-65 here you use both ice-marginal and ice-contact lakes- you define ice-contact lakes, but not the other. I suggest you define both and check the use throughout.

Noted. We decided to drop the use of the term "ice-contact lake" and only use "ice-marginal lake". This has been checked and revised throughout the manuscript.

68./103/ can you here or elsewhere mention if there are any previous lake inventories based on Landsat that you use for reference or if this is the first?

Carrivick and Quincey (2014) presented an ice-marginal lake inventory using Landsat image classification which was multi-temporal, however, this was limited to the southwest Ice Sheet margin. How et al. (2021) provided the first Greenland-wide inventory, but this was a static dataset. Therefore, as far as we are aware, this is the first multi-temporal ice-marginal lake inventory series that covers all of Greenland's Ice Sheet and PGIC margins. The inventory series presented builds upon the static 2017 inventory presented in How et al. (2021), which is already noted in this section (Line 65-66). We have now added this additional information on Lines 66-68: "How et al. (2021) provided the first Greenland-wide ice-marginal lake inventory as a static dataset, building upon regional multi-temporal efforts, such as the southwest inventory classified from Landsat imagery (Carrivick and Quincey, 2014)."

Can you specify that 2016 is the first year due to launch of Sentinel. It is implicit but not explicitly stated.

Done - "Thus far, there are 8 annual inventories, covering the Sentinel satellite era from 2016 to 2023, where one inventory represents one year." (Line 72-73)

105 remove –?

The Gillies et al. reference has a dash included at the end of the date, as specified by the authors (see here - https://github.com/rasterio/rasterio/blob/main/CITATION.txt). This is often the case when referencing software, to signify that updates and development of the software remain ongoing. We respect the wishes of the software authors and will not alter the reference as part of this review.

3.1.1./3.1.2./3.1.3/3.2/5.1/throughout where your work are described. Usually work done in methods are written using past tense. If you did the work, use past tense. This makes it easier differencing published work (present tense) from what has been done for this paper/dataset.'

Done.

163+ will this number of lakes sharing margin not differ with time, this can change for year to year, which year of the dataset are you referring to? Suggest to rewrite this. You mention below that lake number vary from year to year, so how come one number is static while other differs.

As previously explained, this statement is merely providing an overview of the number of unique lakes identified across all years. We have re-worded the statement to better convey this: "In total, the dataset identifies 2918 automatically delineated ice-marginal lakes across all inventory years". (Line 172).

209 past tense, was?

Done.

243 can you elaborate a bit more on how this was done and explain this better, it is a huge difference. Were lakes then included annually based on this effort? What was the follow up from the results you found. Did you try to improve the mapping method or include manual digitisation? Not clear to me. The last sentence ' ..no manual lake delineations are included' seems to be a strange follow up if the underdetection is so substantial. I am not sure if any of the statements in 6.1 is valid if the dataset is missing so many lakes. Could the methods have been improved? Or could manual updated help?

See major comments.

The result of the validation is completely missing from conclusion and abstract, data uncertainty and accuracy is important part of an ESSD paper. I would rewrite the abstract to be less general and more direct on results and uncertainties. same with conclusion.

Done. The Conclusions and Abstract have been written to focus more on the dataset results and validation.

I miss a figure showing validation of the method from one of the newer years that is previously not published.

We are unsure exactly what kind of figure is being requested here. Given a new validation section has been added to the manuscript (Section 5.3 Lake size error estimation), we have decided to take no further action on this comment.

Response to Reviewer #2

The manuscript provides an overview of the multi-temporal high resolution (spatial and thermal) development of ice marginal lake inventories of Greenland from 2016 to 2023. This represents a substantial advance in the science of ice marginal lake evolution at the regional scale across very remote. However, I do have some concerns over some of the parameters and lack of boundary error estimation within the manuscript. These could all be relatively easily address to provide a high quality inventory that will provide a substantial advancement in the study of ice-marginal lakes relationship with climate change in order to understand their role as a resource but also a hazard in some areas.

The combination of the multi-sensor remote sensing approach for lake detection following How et al., (2021) provides a relatively robust approach for a complex dynamic problem over a very large and mostly very remote area. The accurate detection of water bodies at these locations are not only important glaciologically, but also for hydrology and ecology downstream. With this in mind I would highly recommend that lakes are not eliminated from the inventory once they lose contact with the ice front, but instead are classed as 'non-contact' or perhaps archived in a sub-inventory. The presence of these lakes will further modify any glacial meltwater, as they can be a substantial sediment sink (Vowels et al., 2025) as well as thermal modification and also implications for passage of GLOFs. All of which have substantial importance downstream.

The detection of water bodies at these ice marginal lake sites across Greenland is an unenviable task – given the presence of snow and ice as well as frequent cloud cover. The *detection of 'lake margins' becomes a critical problem in analysing the spatial evolution. Some of these lake margins will have substantial snow and ice banks throughout most years. Consequently uncertainty assessment of lake margin boundaries becomes complicated, but still important – yet this does not appear in the manuscript? The combined areal uncertainty from How et al., (2021) could be referred to. This could be dealt with through standard remote sensing approaches to lake boundary errors or there is potential for classifying or flagging lake margins that have substantial snow/ice cover. This will effect the thermal conditions in the lake. It is also important for understanding some of the large lake decreases that your report – are these from increased snow/ice cover? Drainage/lowering? Or glacier terminus 'advance' from increased glacier velocities? If the latter then they are very important to examine further (King et al., 2018).*

Unfortunately the Landsat Level 2 thermal product is resampled to 30m, which creates problems for eliminating the original 100m pixels that would be a combination of water and non-water. As well as the added uncertainty with defining lake boundaries and also any uncertainty with the alignment/correlation between the Landsat thermal sensor and infrared/visible sensors. In order to reduce pixels with thermal contamination in the dataset from boundary issues I would strongly recommend setting a buffer of 100m minimum around the lake margins. I think this will reduce some of the noise in the dataset, particularly for smaller lakes and those with peninsulas/rock islands etc.

This is a huge body of work that will have a transformative impact on glacial lake science (after a few modifications)!

Thank you for your feedback, Adrian. The thought and time taken to provide this detailed review is greatly appreciated. Responses to your major comments are provided below, followed by comments from your line-by-line feedback.

Based on your feedback, the dataset has now been updated with:

1. Centroid positions added as an attribute ("*centroid*"). These are XY central coordinates for each lake, derived from all classifications across the inventory series. Coordinates are provided in the WGS NSIDC Sea Ice Polar Stereographic North (EPSG:3413) projected coordinate system
2. Landsat image acquisition periods have been added (attribute: "*temp_date*"), with acquisition datetimes formatted as "YYYY-MM-DD HH:MM". In the case that averages are composed of multiple Landsat images, each datetime is listed with a ", " break
3. A new data file has been added which holds all classified ice-marginal lakes across the inventory series ("*ALL-ESA-GRIML-IML-<version>.gpkg*"). This version is an

aggregate of all polygons, merged based on corresponding lake identification numbers. In other words, one polygon vector feature signifies the maximum extent of one classified lake.

The revised dataset can be found at https://doi.org/10.22008/FK2/MBKW9N (version 2).

We have decided not to include ice-contact and non-contact water bodies (and a corresponding classification criterion in the metadata) primarily because this changes the inherent definition of the dataset and would be a substantial undertaking that would culminate in the production of a different dataset. Ice-marginal lakes are defined specifically as water bodies that share a boundary with an ice margin, and their presence has a direct impact on ice margin conditions. The term "glacial lake" is a broader term for ice-contact and non-contact lakes, including those that once shared a boundary with an ice margin (i.e. "detached") (Shugar et al., 2020). Broadening the dataset to include all glacial lakes would throw into question exactly what can be defined as a glacial lake, given that all lakes in Greenland were at some point connected to the Ice Sheet or PGIC and therefore could be defined as a glacial lake. In addition, it is expected that a high majority of non-contact lakes are stable and therefore there is no inherent need for an annual time-series of lake change in these cases, compared to ice-marginal lakes which are more changeable and dynamic. We believe the ice-marginal lake inventory series could form a component of a future glacial lake inventory though, which would be a separate dataset to the inventory series presented here. We have therefore included this idea as a future opportunity in Section 6.1 (Uses for the ice-marginal lake inventory series) (Line 301-304).

With regards to the issues with classified lake boundaries, an uncertainty assessment and error estimation is now included for the lake boundary/size. Reviewer #1 made a similar comment regarding the validation also. We have added this to the manuscript in Section 5.3 (Lake size error estimation). The lake boundary/footprint size is evaluated by comparing the multi-spectral and backscatter threshold classifications within the inventory series itself, and in turn assessing the differences in classification. This produced an error estimate of ±0.77 km^2.

Finally, thank you for highlighting the resampling of the Landsat 8/9 Level 2 surface temperature data product. As a result, surface temperature estimates for each ice-marginal lake have been re-processed, using a 100 m pixel buffer to remove thermal contamination. The dataset, results and corresponding figures have been updated to reflect this. An interesting note is that the trends in surface temperature estimates remain unchanged, but generally lake surface temperatures were colder. In addition, we understand that results regarding the lake surface temperature estimates appear under reported compared to the other results sections. This was originally because we intended for these results to be reported and explored more thoroughly in a corresponding analysis publication. However, it is appreciated that more details are needed here to balance the rest of the results section. To rectify this, an additional figure exploring spatial and temporal trends in lake temperature has been added (Figure 7), along with an expansion to Section 4.3 (Line 225-237). In all, this demonstrates a clear latitudinal trend in lake temperature as expected, and interesting links between lake size and temperature evolution.

Minor comments

Abstract – it may be beyond the scope of this style of paper but it could have more results in it? Some of the big lake decreases? Thermal results? Currently reads more like a short research proposal/rationale. Also would like to see '1km buffer' and 0.05 km2 in the abstract.

This was also a comment from Reviewer #1, so we have added more of the results/discussion to the abstract and removed some of the technical details.

20 – Greenland 'glacial' lakes were 21% of Zhang et al., (2024) global inventory…

The Zhang et al. (2024) global inventory only includes PGIC glacial lakes, not those associated with the Greenland Ice Sheet. Therefore, whilst this is a good piece of information, we will not include this in the manuscript.

20- St Pierre et al. (2019) argued proglacial lakes could be substantial CO2 sink – this inventory provides a big step to monitoring suspended sediment concentrations of them (contact and non-contact)

21 – as well as hydrological modification (higher temperature and lower SSC).

These are great additions that we are happy to add. The sentence is now updated: "The delayed release of meltwater at the ice margin is a significant, dynamic component of terrestrial storage, as well as a substantial CO_2 sink and part of the hydrological system (St. Pierre et al., 2019)" (Line 24-25)

31 – Warren and Kirkbride (2003) needs to be cited here. Haresign and Warren (2005) and Roehl (2006) should be really as well.

Warren and Kirkbride (2003) and Röhl (2006) have been added to the references here (Line 35-36).

40 – and hydrological modification – key to know characteristics of water feeding into one of the most delicate parts of the thermohaline circulation…

Noted. Changes in hydrological conditions has now been added to this sentence: "This assumption overlooks the role of ice-marginal lakes as intermediary storage, and changes in lacustrine and hydrological conditions, caused for instance when glaciers retreat onto land." (Line 43-44).

53 – Can these be reclassified rather than retired? They're still important (see above).

See response to major comments.

60 – And glacial lake response to climate?

Yes, this has now been added to the sentence: "These inventories reveal evolving lake conditions that support future assessments of sea level contribution, lake response to climate change, ecosystem productivity, and biological activity associated with the Greenland Ice Sheet and the PGICs." (Line 61-63).

Table 1 - Landsat 8/9 – filter – It should be 20% rather than 30%?

Yes correct, thanks for catching this. It has now been changed to 20%.

Table 2 – Could you also add the following to improve useability further; i. centroid (could be from 2017) ii. Contact or non-contact iii. Temp_time – time of Landsat image -> images in PM will likely capture daytime surface warming of very near surface layers (especially with high SSC)

Centroid positions have been added as the attribute "centroid". These are XY central coordinates for each lake, derived from all classifications across the inventory series. Coordinates are provided in the WGS NSIDC Sea Ice Polar Stereographic North (EPSG:3413) projected coordinate system.

Landsat image acquisition times have been added as the attribute "temp_date", with acquisition datetimes formatted as "YYYY-MM-DD HH:MM". In the case that averages are composed of multiple Landsat images, each datetime is listed with a ", " break.

Contact and non-contact attributes have not been added, as outlined in the response to the major comments.

Adding dam type into the inventory would be desirable but not essential and clearly a huge amount of work that would be a whole different project in itself – probably requiring citizen science ground validation?

Dam type would be a valuable asset to the dataset, but like you say, would take a tremendous amount of work. In addition, dam type classifications may not be possible in scenarios such as consistent snow/ice cover, or in cases where high spatial resolution satellite imagery is needed to make a confident classification. Citizen science ground validation could aid in a small proportion of dam type classifications, as many ice-marginal lakes exist in unpopulated areas where this would not be possible (as reflected in the fact that most lakes do not have a corresponding placename).

103 – I would like to see '1km buffer' and '0.05km2' in the text here and also in the Abstract as they are key defining parameters of the inventory.

This information is defined in Section 5.1 (Data quality control); however, we understand the need for this to be defined earlier in the methodology section. The beginning of the methodology section has been updated to reflect this:

"Lake classifications (>=0.05 km^2) were based on those adopted..." (Line 109)

In addition, this information has been added to the abstract (Line 6). We have chosen not to include the 1 km buffer as this is not a strict classification criterion. The 1 km ice margin buffer is an intermediary filtering step, after which lakes that do not share an ice margin are manually removed. This is described in Section 5.1 (Line 241-248).

128 – Nice strategy – this has been a key problem for a while especially with differing geology and consequently reflectance spectral signature from the lake SSC

Thanks very much.

130 – 'best quality' – is this user defined? Or a class of product?

The ArcticDEM mosaic version 3 was composed of the best quality strip data, which was manually defined. It appears this has changed for the version 4 release, where all strip data is used in the compiling of the mosaic product. A reference to the version 3 mosaic product (Porter et al., 2018) has now been added to indicate where this information is sourced from: "Water bodies were classified from the ArcticDEM 2-metre mosaic (version 3), which is compiled from the best quality ArcticDEM strip files and manually adjusted to form a static data product (Porter et al., 2018)." (Line 138-139).

140 – 30 metre spatial resolution is incorrect – the original thermal pixels are 100m – so some pixels could easily be a combination of land (10 to 20 C) and lake water (4 C) with substantial thermal contamination. Either more needs explaining regarding the resampling method or stick with 100m to be on the safe side – there is plenty of data so can afford to lose some pixels.

As outlined in the response to the major comments, we have re-processed all lake temperature estimates with a buffer of 100 m and therefore this is reflected here, sticking to describing the 100 m resolution (Line 147) and modifying the border pixel description:

"Lake extents were cropped by a border pixel (i.e. 30 metres)..." >> "Lake extents were cropped by a border pixel (i.e. 100 metres)..." (Line 168-169).

142 – There needs to be more detail (Is it the NCEP reanalysis? 6 hour? 1 degree?) on the atmospheric data and correction used in this product given the nature of the study area and the Landsat L2 thermal product struggles in coastal zones (Dyba et al., 2022). I would imagine it handles the lower topography/stabler climate of SW Greenland better than the higher topography and dynamic climate and microclimates of E Greenland… (although I would still like to see how the regional average LSWT compared – see below)

According to the Landsat Atmospheric Auxiliary Data Format Control Book (2023), MODIS atmospheric auxiliary data and VIIRS atmospheric auxiliary data are used for Landsat 8/9 collection processing, with a geographic projection with 0.05 degree pixels (NCEP reanalysis is used for Landsat 4-7). Whilst Dyba et al. state that errors are larger in coastal zones, they also conclude that these can be corrected and the quality of temperature estimations for these zones can be improved. By validating and comparing in situ temperature data from Greenland (Section 5.4. Lake surface temperature error estimation), we present promising results that support this statement. In light of this, further information regarding the atmospheric auxilary data has been added to the corresponding methodology section, including a reference to the Landsat data format control book:

" along with ASTER datasets (global emissivity and normalised difference vegetation index) and MODIS and VIIRS atmospheric auxiliary data (geopotential height, specific humidity and air temperature) (Earth Resources Observation and Science (EROS) Center, 2020; Malakar et al., 2018; U.S. Geological Survey, 2023).” (Line 149-152).

Did you eliminate temperatures below 0oC ? Needs adding in Methods.

Yes, all estimates below freezing point (i.e < 0°C) were removed. This is now added to the methods section:

“Lake extents are cropped by a border pixel (i.e. 30 metres) to reduce the impact of edge effects.” >> “Lakes extents were cropped by a border pixel (i.e. 100 metres) to reduce the impact of edge effects, and all unrealistic estimates below freezing (i.e. < 0 °C) were removed.” (Line 168-169).

In addition, this information was added to the corresponding figure captions (Figure 6 and 7).

145 – Lakes in Poland are very different to glacial lakes in Greenland… (More stable atmosphere and less water input as well as lower SSC) So the comments on developing a calibration factor for Greenland in the Discussion are well founded. Using the GEE script from Ermida et al. 2020 would be more robust though? The validation data for SW Greenland does look very good though – which I think proves sufficient robustness.

Yes, lakes in Poland have differences to those in Greenland; however, this is the only study we found that convincingly derived water surface temperature estimations. They present several approaches to estimate water surface temperature, one of them being the application of a correction factor to the Landsat 8/9 reprocessed surface temperature science product. We compared in situ temperature measurements in Greenland to demonstrate a high confidence in applying this known correction factor. As stated though, we view this as the first step to defining a Greenland-specific lake correction factor – this endeavour will likely form a whole body of work in itself and is already yielding some interesting findings.

We had not come across the Ermida et al. publication and processing routines before, so thank you for making us aware of this. From reading the paper, it appears this is merely a land surface temperature estimation, rather than a water surface temperature estimation. However, we have cited the Ermida et al. work in the manuscript as we think it is valuable for readers to refer to:

"...in degrees Celsius (NASA Applied Remote Sensing Training (ARSET) program, 2022; Dyba et al., 2022)." >> "...in degrees Celsius (Ermida et al., 2020; NASA Applied Remote Sensing Training (ARSET) program, 2022; Dyba et al., 2022)." (Line 159-160).

159 – I think the simplest way to deal with the thermal contamination at lake boundaries is to increase the buffer to 100m

Agreed. Lake temperatures have been reprocessed with a 100 m buffer now.

163 – Add '... that have existed between 2016 and 2023' ?

Done. This was also highlighted by Reviewer #1. The sentence now reads as: "In total, the dataset identifies 2918 automatically delineated ice-marginal lakes across all inventory years (2016-2023) (Figure 1)." (Line 172).

173 – Yes I think the variability in abundance is impossible to study further at this scale – could be variations in meltwater flux, permeability of substrate (a large number may be permafrost underlain/ground ice – could potentially develop taliks...) dam porosity etc.

Agreed. We think that the change in the number of ice-marginal lakes needs to be studied on a decadal scale in order to identify meaningful trends. Given this is a living dataset that will continue to be added to year on year (and with a possibility of including prior years to the Sentinel era), it is hoped this will be possible in the future.

192 – CE looks to be low variability in area in Fig. 3a? NO looks to be second largest variability in area on those results.

Indeed, change in average lake area over the ice sheet margin is smallest at the CE ice sheet margin (0.30 km^2). The largest change is experienced at the NO ice sheet margin (1.31 km^2). Fluctuations in the average lake area at the PGIC margins are generally much smaller, apart from in the CE (2.20 km^2) and NE (1.76 km^2) regions. We have more clearly defined in the text when we are described Figure 3a (Ice Sheet lake change) and Figure 3b (PGIC lake change) (Line 177-186).

195 – I think these declines in area are an important result. This should either be explored a bit further (maybe not appropriate in this paper) or flagged for future research etc (see comments above)

Yes, as well as the many scenarios where lake size remains relatively consistent. We have added this to the section on future research:

"Tentative findings have been outlined, yet further analysis and evaluation against other datasets is needed to investigate causal links. For example, the inventory series could be used to address the drivers of change in lake area with comparison to potential influences such as meltwater flux, sedimentation rates, bedrock type, and GLOF magnitude and frequency (e.g. Veh et al., 2025)." (Line 299-302).

201 – Yes I can see the glacier remnant on the NW side of the terminus. Some of the 'margin lines' on the South side look to be possibly from lake ice?

We visually inspected the corresponding satellite imagery and it does appear that lake ice may be influencing the classified lake form in Figure 5a. In fact, this is an example of a lake with persistent ice cover throughout the summer (and for all inventory years). This has been noted in the figure caption:

"It is noted that the example from (a) is a lake with persistent ice cover throughout the summer season." (Figure 5 caption).

203 – Important observations for 5c and 5d – worth flagging I think – are these a topic of ongoing research?

Lacustrine terminus retreat dynamics at Greenland's ice margins is a topic that we think the ice-marginal lake inventory series could aid in investigating further. It has been investigated elsewhere, for example in Sweden (through your own work, Dye et al. 2021, 2022), in Patagonia (Minowa et al., 2017), and at the Cordillera Darwin (Langhamer et al., 2024). Lacustrine terminus dynamics have been examined in Greenland, but largely limited to the Kangerlussuaq (SW Greenland) region (e.g. Mallalieu et al., 2021). Consequently, the inventory series could support the study of lacustrine terminus retreat dynamics more widely across Greenland, perhaps on a regional scale, or more ambitiously on a national scale. We, ourselves, are not currently looking into this as a follow-on from the Greenland inventory series; however, we have added this to Section 6.1 (Uses for the ice-marginal lake inventory series):

"Additionally, the inventory series would be a valuable dataset for examining lacustrine terminus retreat dynamics, expanding investigations from a case study basis (e.g. Mallalieu et al., 2021; Langhamer et al., 2024) to a regional and/or national scale (e.g. Dye et al., 2022)." (Line 304-306).

Section 4.3 – This section currently is under explored/reported.

As noted in the response to major comments, we have recitfied this by including a figure (Figure 7) exploring spatial and temporal trends in lake temperature has been added, along with an accompanying expansion of Section 4.3 (Lake surface temperature) (Line 225-237). In all, this demonstrates a clear latitudinal trend in lake temperature, and interesting links between lake size and temperature evolution.

209 – Is this the average for all pixels? Or Sum of all lake averages divided by number of lakes? (some of the large lakes could skew this)

211 – of all pixels?

These values represent the sum of all lake averages divided by the number of lakes. This has been clarified in the text (Line 222-223) and caption for Figure 6:

"Examining the average lake surface temperature estimate across all lakes, the average lake..." >> "Examining the average lake surface temperature estimate across all lakes (i.e. the sum of all lake averages divided by the number of lakes), the average lake..." (Line 222-223).

As said above, this is the sum of all lake averages divided by the number of lakes. This is added to the text and corresponding figure caption.

212 – Replace 'falling' with 'being lower' as these are snapshots

Done.

214 – Replace 'rising' with 'being higher'

Done.

There is more room for exploration of the thermal results – either here or signposted to a future publication. If the thermal contamination issues are resolved, the average lake temperature by region should be shown. Also potential for average temperature by different lake size classes etc. With higher confidence in the data the lower temperatures in 2018 could be explored further too. At the moment the thermal data feels a bit like a 'bolt on' component.

See response to major comments (also detailed in the feedback for Section 4.3) as to how the thermal results have been expanded upon with, for instance, lake size compared to average surface temperature.

224 – Again can these detach lakes be reclassed as non-contact or put in a separate archive?

See response to major comments.

247 – Boundary error/uncertainty estimations of some kind need including here.

Agreed. This was also noted by Reviewer #1. In response, we have added a section on the lake size error estimation (Section 5.3). Lake boundary/footprint size is evaluated by comparing the multi-spectral and backscatter threshold classifications, producing an error estimate of ±0.77 km^2.

258 – Agreed estimates are reliable. The validation data has an interesting cluster of points around the lake sensor temperature of 4 oC – could be afternoon warming of surface water? Time of day of image capture is important.

Yes, this is an interesting cluster that we would like to explore further (possibly as a designated project on lake temperatures in Greenland). This cluster originates from two specific lakes - Qamanersuaq and ST924. In both these instances, all measurements and coinciding remote sensing estimates are from afternoon acquisitions (between 13.00-15.00). However, this is the case for all of the validation dataset presented here – all measurements coincide with afternoon Landsat satellite passes. Therefore, it is likely that this clustering is associated with another influencing factor, such as lake depth/morphology or suspended sediment concentration. We have added this information to figure caption (Figure 9) and the manuscript to clarify this:

"All observations are fro afternoon acquisitions (between 13.00-15.00 UTC)." (Figure 9 caption).

“An interesting cluster of data points is evident, originating from measurements taken at Qamanersuaq and Asiaq station 924 which could be related to specific lake characteristics, such as lake depth/morphology or suspended sediment concentration.” (Line 289-291).

265 – Yes this is a really important inventory for assessing how glacial lakes form part of a deglaciating land system and how their response to climate affects hydrology and ecology downstream. At the moment this section reads too glaciology focused – there is much wider scope for assessing the glacial lake evolution. How will lake development affect downstream sediment budgets? How will temperature changes affect ecology? (Fellman et al., 2014)

Remarks on wider applications of the dataset have been added to Section 6.1 now. See comment from Line 203 for full details.

292 – Are there any TanDEMX products that would help? (Is access through ESA possible?)

TanDEM-X could be an option, however, Lutz et al. (2024) stated that coverage over Greenland is sporadic due to the acquisitions being campaign-based. We would need to ensure that coverage could at least yield an annual Greenland-wide DEM for sink detection classifications, however, we have not looked further into the feasibility of this. TanDEM-X has been added alongside the ArcticDEM strip data as a potential DEM dataset to use in the future:

“For the DEM classification, an alternative would be SAR-derived DEMs from the TanDEM-X mission or the ArcticDEM strip data product, which are both time variant, but data coverage is lacking currently and scenes covering all Greenland may not be possible from year to year (e.g. Lutz et al., 2024).” (Line 332-334).

Figure 1 – More thermal results need to be added

Average surface temperature for each region is now provided in the regional table statistics, replacing the largest lake size (as this is provided in the annotations on the map identifying the largest lakes for each region).

Figure 3 – NE lake area was high for 2018

Yes, it is markedly high. This has now been noted in the corresponding text (in Section 4.2):

"Average lake size is highest in the NE region in 2018 and 2022, with an average size of 2.71 km^2 and 2.77 km^2, respectively..." Line 200-201).

Figure 4 – Currently difficult to distinguish between the ocean and ice sheet. I suggest having ocean in a shade of blue.

Done.

Figure 5a – See above. I would like to query the lake margin for 2017 in Figure 5a – which looks to have a pattern suggesting lake ice at the margins?

Done, the ocean area in the overview map has been changed to a shade of blue. We visually inspected the imagery from 2017 and it does appear that lake ice may be influencing the classified lake form in this case. In fact, this is an example of a lake with persistent ice cover throughout the summer (and for all inventory years). This is now noted in the figure caption:

"It is noted that the example from (a) is a lake with persistent ice cover throughout the summer season." (Figure 5 caption).

Figure 6 – data filtered below 0C? (If so please add this in the caption) Looks like lots of noise > 8 C

Yes, all estimates below 0°C are filtered out. This has now been added to the figure caption:

"Averages are calculated from all available scenes acquired from the month of August to limit the risk of mis-estimates due to ice-covered conditions, with all estimates below 0°C removed." (Figure 6 caption).