Overview

We would like to thank the reviewers for their careful review and constructive comments, which really helped improve the quality of the manuscript, as well as thank the editor for giving us the opportunity to address these comments in a revised version. In response to these comments we have substantially revised the paper:

-We have improved the overall writing style.

-We have updated all figures and tables and rewritten the captions.

-We have heavily edited and rewritten section 3 (Methods and data) with a specific focus on section 3.1 and 3.2, to 1) accommodate any technical confusion about the UAV GNSS system, 2) elaborate on the GNSS data processing, 3) provide reflections on the variations in the SfM RMSE values. Finally, we have applied an additional method for assessing the uncertainty of our produced DEMs, as suggested by reviewer #1

We have also made many smaller edits, explained in details below.

Mads Dømgaard and the co-authors

Referee comments 1 (RC1)

We thank Nathaniel for his detailed and constructive feedback on our manuscript, which particularly helped improve the figures, the method section and the overall presentation. Below we copy Nathaniel's comments in red and write our responses in blue

General Comments

ABSTRACT

Needs a bit of work in terms of writing style, sentence structure and clarity, but mostly good. It gives an overview of your research, from initial background, through your methods and into the key findings and interpretations.

INTRODUCTION (and STUDY SITE)

This is a really nice concise, yet informative introduction to your study. From reading it I am able to understand the problem that you're trying to investigate, why it's important, and where your study fits within the wider picture. It reads very well, with only a few minor issues with spelling/grammar and sentence structure (which is a shame considering the opposite is the case when it comes to your methods).

Study Site section is also good, again informative and overall well written. I've made a few minor comments but again, nothing major.

METHODS

Although this section is fairly informative and concise in places, there are some fairly significant issues within some of your sub-sections, particularly related to the UAV analysis, which limits my confidence in the DEMs and orthos that you've produced. These issues are discussed below. I also agree with the Editor that Sections 3.3 through to 3.6 need a bit more information – not too much, but enough so that the reader fully understands what you have done.

More broadly, your writing needs a fair bit of work. You switch between past and present tense regularly, particularly in the second half of your Methods (e.g. 3.3, 3.4). All your writing in this Section should be in the past tense (i.e. it's what you DID, not what you're doing).

Also in places, your sentence structure, and your writing style more generally, is not "academic enough", and there are several grammatical errors. I've highlighted many of the most pressing issues below but please make sure you're proofing your work sufficiently!

RESULTS

Good overall. They are described well, in sufficient detail but still concise. Writing and style is much improved from the Methods, but still some small issues with structure and grammar etc. Figures and Tables in this section are mostly OK, but all could be presented better, while captions need significant work. See comments below.

DISCUSSION

This is a really nice section. Very informative, well referenced, mostly well written and it really sells the importance of your work and its wider relevance. Again, your writing style and sentence structure does need a little bit of work, but it is improved on your Results, and vast improvement on your Methods.

CONCLUSIONS

This is a good conclusion – it summarises your research really nicely, and highlights the key findings. Your writing is again mostly OK, but once again there are several small issues with writing style and/or sentence structure.

We are thankful to Nathaniel the careful and thoughtful review, and we agree with the vast majority of the raised points. Below, we go through the comments in detail.

Specific Questions

Line 84 (and whole paragraph) – I think there's been a bit of technical confusion here, which may be an honest mistake on your part, so I've given you the benefit of the doubt.

Basically, your UAVs don't have "onboard post-processed kinematic (PPK) GNSS receiver logging position data" as you've put it. Your UAVs have "*direct georeferencing capabilities provided by an on-board GNSS receiver* (I don't know which/what GNSS module – mention), *which records the positional data of each image as its captured"*. This imagery can then be post-processed EITHER by Real-Time Kinematic (RTK), or post-processed kinematic (PPK) processing. Basically – RTK you do in the field, PPK you do away from the field, such as back at camp, back home etc.

You've stated that you've used PPK, which is sensible, it's the most accurate form of post-processing (e.g. see Chudley et al., 2019; Jouvet et al. (2019)), but you don't explain any of this in this paragraph. From my point of view, it sounds like you don't really understand how your UAV imagery was processed, which limits my confidence in the rest of your Methods and Results. However, by cleaning up this paragraph and adding a bit more contextual information I think you'd go a long way to addressing this (e.g. by looking at those references above).

Thank you for the comments on this section, which we fully agree with. We have completely rewritten the section to avoid any technical confusion and to improve the general understanding. It now reads:

"Both UAVs have direct georeferencing capabilities provided by an on-board GNSS receiver (Table 1), which records the positional data of each image as it is captured. To achieve centimetre-level accuracy in both the vertical and horizontal direction of the camera positions, we kinematically post-processed the positional data from the UAV GNSS receivers. Compared to real-time kinematic (RTK) correction, post-processed kinematic (PPK) positioning is considered more accurate and does not depend on a reliable real-time connection to a GNSS base station (Chudley et al., 2019). The UAV GNSS data was post-processed using WingtraHub (v. 2.2.0) and KlauPPK (v. 7.17) software relative to the fixed Greenland GNSS Network (GNET) base station, located in Kangerlussuaq (KLSQ) approx. 30 km from the field site (Bevis et al., 2012). The processed camera position for both UAV surveys have a vertical and horizontal accuracy of c. 0.09 m and 0.06 m, respectively (Table 1).

For the purpose of validating the accuracy of the produced DEMs we placed a combined total of 33, 0.3 x 0.3 m black and white, ground control points (GCPs) and measured their position using an Emlid Reach RS2 GNSS receiver (Table 1). We post-processed the log files from the Emlid rover using Emlid Studio (v. 1.3) software and the KLSQ base station data. Due to poor satellite reception and cycle slips we were only able to retrieve reliable fix solution position results for 0/20 and 2/13 GCPs in Mission I and Mission II, respectively (Table 1, Figure 1)."

Section 3.2 (first paragraph in particular) – I'm a little surprised by 1) the errors you've obtained across the two surveys, 2) your method of accuracy assessment (using GCPs), and 3) that you didn't think to include a different form of accuracy assessment.

1) Even though you undertook your surveys using two different UAVs, the fact you have vastly different RMSEs for the two surveys seems odd to me – I assume these are the RMSEs that are reported in Metashape? Although issues with satellite geometry can influence accuracy of GPS (as you found with your GCPs), I can't see how they'd result in such differences. It would be good to see some mention of this, or some sort of reflection as to why the errors may be different to give more confidence in how you processed your data, as well as your final results.

Yes, the RMSE values are the ones reported in Metashape. We have added a paragraph in the manuscript with reflections on why we might observe the large variations in RMSE between the two Mission. The paragraph reads:

"The RMSE of the X, Y and Z camera location, as reported in Agisoft Metashape after model generation, is 0.01, 0.01, and 0.02 m for Mission I and 0.28, 0.32, and 0.14 m for Mission II (Table 1). The large RMSE values of Mission II, likely originates from strong wind conditions at the time of surveying, which may have caused the UAV to tilt or move slightly during image acquisition. In combination with the manual flight mode, this may have resulted in a lowered image quality and a poor image overlap in specific regions, such as at the western part of the lake (Figure 1). Furthermore, the majority of the acquired images have an oblique view angle, which makes them computationally challenging compared to nadir images, due to geometric and photometric deformations caused by varying perspective and illumination (Jiang et al., 2020).

2) You are incredibly light on details as to how you used your two GCPs to assess model accuracy. How did you do it? If you're wanting to keep these results in the Methods, then you'll need to explain exactly what you did and why (why is it a good form or assessing accuracy of UAV models? Has it been used in previous studies?)

Personally, I'd remove it and assess accuracy a different way (see point 3, below), as you don't have enough GCPs to provide a robust enough assessment. I've been in a similar situation where issues with satellite geometry and signal have meant I've been unable to accurately record the positions of

my GCPs - it's frustrating – but there are other ways of assessing model accuracy. Ask yourself the question – is your method of assessment honestly robust enough?

3) A better way of assessing model error would be an assessment of stable ground locations. In theory, these regions should be stable between surveys, and therefore any variations are indicative of the uncertainty in the system. For this you'll obviously need areas of stable ground that are free of ice, or the lake, and which are encompassed by both surveys. I can see from Figure 1 that there are two such regions, and therefore I think this would be sensible method to undertake.

One way you can do this is by a cloud-to-cloud comparison of the dense point clouds you've produced during the SfM workflow. If you export these from Metashape, and import them into Cloud Compare software (which is free), then you'll be able to do this. Basically you want to extract the two areas of stable ground from both point clouds (at the same time), and then subtract each one from the other. You can then look at the mean, Std Dev and distribution of errors in these regions, providing a much more robust assessment of the accuracy of your produced UAV products.

Another method you could also employ is measuring displacements across these same stable ground locations, a method commonly done in remote sensing studies, as well as in UAV studies (e.g. see Chudley et al., 2019; Jouvet et al. (2019)).

Either way, I strongly suggest you choose one of these new methods of assessment and include it in your analysis. In its current form, this section of your methods is not robust enough, it is not aware of the potential limitations of the UAV method, and ultimately, I'm not convinced by the accuracies you have reported, which filters through to my belief in your results. It's also worth noting, that if you go away and do this, the errors you report will still be well below the change that you're attempting to detect (which is obviously good), but without a robust accuracy assessment to support this, such a statement has no real standing. This is a (relatively) easy fix, however.

We fully agree about the need for a better measure of uncertainty to build trust in our results. First of all, we have provided an improved explanation on how we use the GCPs to measure the model accuracy. Secondly, we have applied an additional method for uncertainty estimation and, as suggested, based this estimate on the relative offset between the DEMs over stable bedrock. However, instead of a cloud-to-cloud comparison, we compare the DEMs by applying the Co-registration framework developed by Nuth and Kääb and adopt the results as our main measure of uncertainty. We have added a paragraph in the manuscript describing this:

"Previous studies, using a similar setup and approach (Chudley et al., 2019; Jouvet et al., 2019), reported horizontal and vertical uncertainties in the range of 0.1 – 0.4 m, without the use of GCPs. By measuring the horizontal and vertical displacement between the fix solution GCPs and their observed location in the Mission II orthomosaic and DEM, we estimated the accuracy to be 0.14 m and 0.35 m, respectively. Due to a lack of reliable GCPs, we applied an additional method for determining the uncertainty. Inspired by similar studies (Chudley et al., 2019; Jouvet et al., 2019), we estimated the uncertainty by calculating the relative offset between the Mission I and Mission II DEM over stable bedrock, assuming no change in the topography. We applied the python module PyBob (McNabb, 2019) based on the co-registration method developed by Nuth and Kääb (2011), which determines the X,Y and Z offset from elevation difference residuals as well as the terrain's aspect and slope. The co-registration was based on >8 M pixels extracted from two areas of overlapping bedrock located on both the western and eastern part of lake. Using the Mission I DEM as the reference, we found a relative offset of X = -0.43 m, Y = 0.11 m and Z = 0.53 m and adopted this as our main measure of uncertainty. By applying this offset to the Mission II DEM, we were able to reduce the mean elevation difference and RMSE over stable bedrock from 0.39 m to 0.00 m and 0.42 m to 0.17 m, respectively. Following co-registration, we mosaicked the Mission I and Mission II DEM."

Figures and Tables – Mostly OK, however, there are a few issues. Minor points I've put in the "technical corrections" section below, but more pressing points I've put here:

Figure 1 – Make some of your markers a little bigger (or the whole figure) as currently they're difficult to see, e.g. the GCPs. Caption also needs to be more descriptive, consistent, and needs to include direct reference to inset map. Perhaps might be better off labelling each of your panels (a), (b) and (c) for example.

Figure edited to accommodate reviewer #1 and #2. Increased size of point markers. Labels, north arrow and panel numbering (a,b,c) are added. Caption changed and now reads: "*Figure 1. A) Study site location in Greenland. B) Zoom in on study site with location of hydrograph and Promice weather station. C) UAV mission area I and II with location of GCPs overlaid on a four band Planet (2017) acquisition from 23/8-2021. The yellow triangles illustrate the only two reliable fix solution GCPs. Due to image gaps at the western part of the lake the produced UAV DEM is filled with elevation data from two ArcticDEMs acquired on the 19/9-2014 and 2/8-2015.*"

Figure 2 – Did you make this graph in python (or similar graph-making software?) As this looks more like a graph made in Microsoft Excel. That's fine if so (although you could make the graph wider), but have you tried making graphs in Python? Or know someone who can? It can take a bit of time to learn but it's well worth it for the publication-style figures that it produces. Just a thought. If this is made in python, then it needs to be improved visually.

Also – you state relationship in your caption but don't show any sort of relationship on the graph. What's the r2 value? Could quite easily plot this too for both sets of data.

Figure has been replotted in python and cleaned. Caption has been edited and now reads:
"*Figure 2. Lake area (km2) and lake volume (M m3) with changing water level (m), calculated for every second meter, based on the 2021 post-drainage DEM. The lake has a theoretical maximum water level of 433 m after which it overspills the damming glacier. The sharp increase in lake area from ~420 m – 422 m is due to a plateau at the north eastern part of the lake (Figure A1).*"

Table 2 – Extremely hard to read at current size and orientation. Have you considered putting the page orientation to landscape? As that would make the table bigger, and consequently much clearer, and thus easier to read. You are also missing the top outside table border, and the caption needs a bit of work to make it clearer and improve sentence structure.

Thanks for the great suggestions. Page orientation changed, figure enlarged and top border added. Caption changed and now reads:

"*Drainage dates, pre- and post-drainage water levels, lake areas, and volumes for 15 GLOFs spanning 1987 to 2021. The 1987 estimates are adopted from Russell et al., 2011. The 2007 to 2021 estimates are reconstructed using the 2021 post-drainage DEM in combination with selected optical satellite images as well as from downstream hydrograph observations. Table includes references to previous studies of the lake, including estimated drainage volumes*."

Figure 3 – See, this looks like a graph made in Python (or similar), but it's still difficult to discern what it's trying to show (which is not helped by the caption). If all your graphs are made this way, then I apologise, but I think they all need a bit of work to be of publication quality.

Figure edited according to comments from reviewer #1 and #2. Size increased, ticks added to x-axis

and labels rotated, improved y-axis labels. Caption changed and now reads:

"*Figure 3. Pre-drainage water level, drainage volume and drainage day of year (DOY) for 14 GLOFs spanning 2007 to 2021. Pre-drainage water levels (blue circle) are estimated using the 2021 post-drainage DEM. Drainage volumes are estimated using both the 2021 post-drainage DEM (red triangle) and downstream hydrograph observations (green square). The grey bars indicate the day of year (DOY) of the drainage and refers to the leftmost Y-axis. No hydrograph data for the 2018 event*."

Figure 4 – There's a LOT going on in this figure, and you've done your best to try and show it all clearly - but it's still not easy to understand. However, changes in the position of some elements, and a better caption would greatly improve it.

For example, Panel (a) needs to be moved so its flush with the top left edges of the figure. You could also put a (b) next to the box in panel (a) to more clearly show that the region is the same as the one shown in panel (b) (like you've done in panel b already).

Panel (b) needs to have the legend moved to a corner of the panel (I'd say bottom right), given a light, semi-transparent background (so that the legend items etc. are easier to see), and the scale bar and north arrow moved to the bottom left and made bigger. Your colour ramp for the DEM is also squashed (make it bigger) and you can remove the "high" and "low" labels. By moving panel (a) into the corner, it'll allow you to move the region of interest shown in Panel (b) to the left, which will allow you to make the legend bigger. More generally, I think your DEM is fine, and is showing some transparency, but could you make it slightly more transparent? Also, I think some of your labels in the panel are not corresponding to the right panels below. For example, you have no "c" label, but you have two "e" labels, and they're not showing the same area. You also need to put a space between the elevation value of each point, and the "m".

Panels (c) – (h) are fine. I would suggest making your panel labels (i.e. b, c, etc.) slightly smaller, and putting them into a text box with a black background and white border. That way they won't be obscured by the underlying image, and you can always shift the view slightly if it's covering a small feature of interest.

Caption – lots to work on here. For your benefit, I'll suggest writing something like; "A) Overview of drainage routes I and II overlaid on a hillshade of the ArcticDEM from 2nd August 2015. Box indicates the region illustrated in panel b). B) Hillshade of the post drainage terrain, produced from the Mission I DEM, highlighting where the water exits the glacial drainage outlet. The drainage thresholds indicate the highest elevation points along the drainage routes. The 2015 and 2021 ice margins are digitized based on the ArcticDEM and Mission I DEM, respectively. C) and D) Ice blocks deposited along the two drainage routes, up to 5 m in length. E) Likely collapsed en- or subglacial cavity, ~10 m in diameter, with a total of five such features observed at the ice margin. F) Fractured ice due to supraglacial water flow. G) and H) Crevasses on the ice surface, reaching several hundred metres in length."

Thank you for the great suggestions! The figure has been edited accordingly.

Caption edited and now reads: "*Figure 4. A) Overview of drainage route I and II overlaid on a hillshade of the ArcticDEM from 2/8-2015. Box indicates the region illustrated in panel b). B) Hillshade of the post drainage terrain, produced from the Mission I DEM, highlighting where the water exits the glacial drainage outlet. The drainage thresholds indicate the highest elevation points along the drainage routes. The 2015 and 2021 ice margins are digitized based on the ArcticDEM and Mission I DEM, respectively. C) and D) Ice blocks deposited along the two drainage routes, up to 5 m in length. E) Roughly circular and nearly vertical holes, ~10 m in diameter, with a total of five such*

features observed at the ice margin. F) Fractured ice due to supraglacial water flow. G) and H) Parallel fractures, reaching several hundred metres in length."

Figure 5 – A few minor points here. Key thing is that it could be laid out better and axis headings could be formatted slightly differently. I'd suggest increasing the space around each figure to ensure that no part of one overlaps with a part of another. A consistent spacing around each figure would fix this. You also need to add axis tick marks to both your X and Y axis labels.

If space becomes an issue though, you could remove the Y axis labels from the middle and right plots, and just keep it on the left-most plots. Because all your plots have the same temperature scale, its not particularly difficult to read off the scale on the left for a plot in the middle, or right. This would free up a bit of space and improve the overall presentation. You'd just have to ensure that you state in the caption that all plots share the same Y axis range.

The other thing that needs addressing is your formatting of the X axis dates. Rather than displaying in the current format, you could show them as 03/09/10 for example (for 3rd September 2010), or even just 03/09 because you've placed the year above each plot. Doing so should allow you to avoid having to use diagonal labels, and again would improve overall presentation.

Great suggestions. The figure has been edited accordingly. Caption edited to indicate that all plots share the same y axis range. It now reads:

"Figure 5. Plot of hourly temperature measurements from 10 days prior to the drainage event from KAN_L. Green line shows the mean air temperature (MAT) 41-10 days prior to the drainage, red line shows MAT 10-0 days prior, and orange line MAT 5-0 days prior to drainage. Red circle denotes the start of the GLOF and for the 2018 event the circle is larger due to uncertainty about the timing. All plots share the same Y axis range."

Figure A1 and A2 – Five things here, shared by both figures. 1) Move the scale bar and legend into the corner, or put the scale bar bottom left, legend bottom right. 2) Where's the north arrow? 3) If you're not going to make the extent of both figures the same, then make sure their scales bars are different. 4) The coordinate grids on your figures are inconsistent – on A1 you have them on the top and right, but show the tick marks on the left and bottom, and on A2 you don't show any. Make it consistent! 5) Caption – you're incorrectly referencing the Planet imagery. Should be something like "background is a three (or four) band Planetscope acquisition from XYZ" (XYZ being the date e.g. 16th June 2017).

The figures have been edited accordingly. Captions are edited and now reads:
"*Figure A1. Contour map with 5 m intervals based on the 2021 post-drainage DEM. Background is a four band Planet (2017) acquisition from 23/8-2021.*"

"*Figure A2. Position of ice margin digitized from satellite images. Background is a four band Planet (2017) acquisition from 23/8-2021.*"

Technical Corrections

ABSTRACT

Line 12 – "…influence local ice dynamics, bedrock displacement, the surrounding geomorphology as well as pose flooding hazards".

Corrected to compromise between reviewer #1 and #2:

The sentence now reads: *"… influence local ice dynamics and cause bedrock displacement and geomorphological changes as well as pose flooding hazards."*

Line 13 – "Multidecadal time series of lake drainage dates, volumes and flood outlets are rare, but are essential for understanding the impact on, as well as the interactions with, the surrounding landscape, identifying drainage mechanisms, and for mitigating downstream flood effects."

Corrected

Line 15 – "In this study, we use high-resolution digital elevation models (DEM) and orthophotos generated from uncrewed aerial vehicle (UAV) field surveys, in combination with optical satellite imagery to reconstruct robust lake volume changes associated with 14 GLOFs between 2007 and 2021 at Russell Glacier, West Greenland".

Corrected

Line 17 – "As a result, this is one of the most comprehensive and longest records of ice-dammed lake drainages in Greenland to date."

Corrected

Line 18 – "Importantly, we find a mean difference of ~10% between our lake drainage volumes when compared with estimates derived from a gauged hydrograph 27 km downstream."

Corrected

Line 19 – "Due to thinning of the local ice dam, the potential maximum drainage volume in 2021 is c. 60 % smaller than that estimated to have drained in 2007."

Corrected

Line 20 – "Our time series also reveals…"

Corrected

Line 23 – This" not "The".

Corrected

Line 24 – "late-seasonal drainage" not "late-seasonal drainages".

Corrected

Line 26 – Comma after "GLOF", and "…with a sub- or en-glacial flow pathway, as well as supraglacial flow across the ice margin".

Corrected

INTRODUCTION and STUDY SITE

Line 34 – "In both number and size".

Corrected

Line 35 – good sentence, but change beginning slightly: "Currently, there are >3300 ice-marginal lakes in Greenland, with these predominately found around peripheral mountain glaciers and ice caps (PGICs), but there is also a relatively high density of ice-dammed lakes along the southwest Greenland ice sheet (GrIS) margin."

Corrected

Line 40 – "occur" not "be".

Corrected

Line 41 – "for", not "on".

Corrected

Line 46 – observations (plural).

Corrected

Line 48 – "…lake drainage and the timing and magnitude of flood events."

Corrected

Line 49 – "aid" not "helps".

Corrected to accommodate both reviewer #1 and #2. The sentence now reads:

"*Furthermore, long-term data improve our understanding of drainage triggers and mechanisms, provide important context for the scale and frequency of current and future GLOFs as well as aid in the mitigation of downstream effects.*"

Line 50 – don't need to have lake water level AND lake drainage volume – remove the second "lake".

Corrected

Line 52 – 22nd, not just 22.

Changed to 22nd August 2021

Line 54 – I'd argue that you don't need both "monitored" and "studied" – however, if you want to keep both (as I don't know how much it's monitored), you could say "intensively monitored and well/widely studied".

Corrected.

Line 56 – "GLOF behaviour", perhaps?

Yes, good point. Corrected

Line 57 – "…into two nearby outlet lakes and further afield into…"

Corrected

Line 60 – "up until 1987 where it entered a 20-year period of stable water levels."

Corrected

Line 62 – "Annually" sounds better than "yearly".

Corrected

Line 63 – start sentence something like "Previous lake drainage events have been estimated using a variety…"

Corrected

Line 65 – I'd argue that most people will know what GPS/dGPS means. However – if you want to

keep it in, the change end of this sentence to something like "…time-lapse cameras and differential Global Positioning System (dGPS) techniques to monitor the elevation of the water surface."

Simplified to "..dGPS techniques"

METHODS

Line 70 – "undertaken", not "conducted".

Corrected

Line 71 – change to "As the lake did not fully drain we were unable to survey the entire lake topography, however, a minimum water level of 408.8 m was surveyed, which is almost identical to the minimum lake level observed after other previous GLOF events". (Got any references to support this point?)

Corrected, but 'minimum water level' changed to 'standing water level' to accommodate reviewer #2. Reference added, Russell et al., 2011

Line 73 – Remove "made".

Corrected

Line 74 – put in "finding a minimum elevation of…"

Corrected

Line 75 – your UAV imagery cannot be called "ultra-high resolution" as the resolution of your orthos and DEMs is 0.04 and 0.1 m, respectively. Typically, anything 0.01 m or below can be considered "ultra-high resolution", which is possible by either flying the UAV very low, or using a method such as TLS. In your case, you've produced high resolution models, at best very-high resolution, although I'd even query the latter based on the resolution of your DEMs – please change.

Also, change "UAV mission" to "UAV surveys".

You are right. Corrected and changed to high-resolution

Line 76 – Assume the refined DEM is just the UAV-derived DEM? In which case remove "refined" and change to "From this DEM, we are able to precisely estimate the pre- and post-GLOF water level, the lake area and the likely drainage volume of both historical and future events."

It is - corrected

Table 1 – Please keep your number of decimal places consistent, or at least sensible – i.e., why have you quoted the accuracy of your models to 2 d.p., but the resolution of your Mission 1 ortho to 3 d.p.?

Cont. You're also missing a full stop at the end of the caption for Table 1.

Good point! Corrected

Line 98 – remove "are".

Corrected

Line 99 – what did you use the post-processed geotagged images for? I know, as I'm familiar with SfM workflows, but other may not be. You used them to georeference the point clouds, right? So it's worth saying that.

Good point – added. The sentence now reads:

"Instead of GCPs, we used the post-processed, geolocated camera positions to georeference the point cloud.

Line 100 – this is a bit messy – did you not build a mesh, or texture? Anyway, change this sentence to something like "DEMs and orthomosaics for Mission I were then exported at resolutions of 0.1 and 0.04 m, respectively, while for Mission II both were exported at a resolution of 0.1 m.

No mesh or texture was build. DEM was constructed from dense point cloud.

Sentence corrected

Line 102 – Not capitalising "Table", here and throughout – change.

Corrected

Line 105 and whole paragraph – Sometimes you refer to it as *Arctic DEM* and other times as *ArcticDEM* – it's the latter, so be consistent throughout.

Corrected

Line 106 – "regions" not "parts", "data" not "measurements" and "acquired" not "captured".

Corrected

Line 107 – surely it makes more sense to state the earlier DEM first, no?

Also, remove this sentence "At the time of acquisition, both Arctic DEMs had a water level of approx. 407 m." and put after the next sentence (i.e. after the Noh and Howat reference).

You are right. Corrected

Line 109 – "predominately" not "mainly".

Edit these sentences to something like "We predominately utilised the 2015 DEM as it was produced using images acquired only five days after the 2015 drainage event, however, it also contained several data gaps. Consequently, we filled these using the 2014 DEM, which was produced using images acquired 47 days after the 2014 drainage event.

Corrected

Line 114 and elsewhere – You switch between "Mission I/II derived DEM" and "Mission I/II DEM" quite often throughout – choose one and stick to it – the reader knows "Mission" refers to the UAV DEMs, so I'd use the latter.

You are right. Corrected to Mission I/II DEM throughout the manuscript.

Also Line 114 – This sentence doesn't read very well – change to something like "Using the Mission II and ArcticDEM mosaic, as well as the Mission II orthomosaic, we digitised lake area and extracted elevation points every 5 m along the digitised eastern lake margin to estimate a water level of ~XYZ on the 6th September 2021."

Corrected

Line 117 – Start sentence with "From herein the final…"

Corrected

Line 123 – use "temporal intervals" rather than "timestamps."

Also same line – it's "used" (or utilised), not "use" – remember past tense (this section seems predominately written in present tense which is incorrect).

You are right. Corrected + the entire manuscript edited to be written past tense

Line 124 – so you manually georeferenced your satellite data to your UAV orthos, which you were unable to carry out any sort of robust accuracy assessment on…hmm…

Section 3.2, now contains a new and robust method for uncertainty estimation.

Since the UAV ortho is constructed based on the UAV-DEM, and we are aiming for a good fit between the satellite images and the UAV-DEM to extract elevation points along the lake margin, we will argue this is the optimal way to go about it. Furthermore, all utilised satellites image have a much coarser resolution (3-15 m) than the UAV ortho, as well as an inconsistent initial geolocation.

Line 125 – e.g. Carrivick and Tweed, 2019.

Corrected

Line 126 – what criteria did you use for placing these points? Was it random? Was there a placement method? Why 30? Why not 40? Or 20? A bit more detail would perhaps be welcome as for all I know you may have clustered these points together in one part of the eastern region...

New lines added elaborating on the placement of the points. The sections now reads:

"*…..the pre- and post-drainage water level was determined by manually placing 30 points along the ~600 m waterline on the eastern part of the lake as observed on the satellite images. The points were placed with an approximate spacing of 20 m, however, varying depending on the visibility of the waterline as well as from avoiding areas with apparent morphological changes. The eastern part was chosen as it only contains high-resolution (0.1 x 0.1 m) UAV-derived elevation pixels as well as having a flat slope compared to the steep terrain in the west (Figure A1). For each of the 30 points, we extracted the elevation from the 2021 post-drainage DEM and calculated the mean water level as well as the standard deviation indicating the uncertainty of the elevation estimate (Table 2).*"

Line 137 – remove "simply".

Corrected

Line 139 and 149 – Change entire sentence to "From 2007 to 2011 we observed a gradual advance of the ice margin, while from 2011 onwards it remained relatively stable with only slight changes in frontal position observed".

Corrected

Line 140 to 142 – this sentence doesn't make much sense – re write to make clearer.

Sentence rewritten to: "*For each year, we manually adjusted the lake area to match with the position of the ice margin, as observed in the respective satellite image, and then recalculated the volume change of the adjusted lake area based to the estimated pre- and post-drainage level.*"

Line 145 – change “low” to “relatively coarse”.

Corrected

Line 146 – change “better” to “finer”.

Corrected

Line 147 – “sudden changes” is probably OK, but I would personally use “short-term” changes/variations.

Corrected to short-term changes

Line 149 – change “main surface drainage routes for the GLOF drainage water running” to “main surface drainage routes for each GLOF event from the glacial drainage outlet…”

Corrected

Line 151 – change “destinations” to “locations (i) and (ii)”.

Corrected

Line 153 – change “even out” to “remove/limit (the influence of)”, “locale” to “local”, and “potentially hinders water flow” to “that could potentially influence water flow”.

Corrected

Line 155 – change to “to determine the maximum elevation of each route”.

Corrected

Line 159 – “before being converted”. I also assume water stage is water level, as a means for estimating discharge? In that case, why don’t you change “water stage” to “water level” as it sounds better?

Also same line – “Water discharge was THEN obtained using A rating curve”

Corrected

Line 160 – “…and is associated with…”

Corrected

Line 161 – I would strongly argue that anyone reading this will have enough knowledge to know that diurnal discharge fluctuations are due to ice melt. However, I leave it to you whether you keep that bit in or not, although I would definitely change it to “induced by ice melt within the glacier catchment”

Sentence removed.

Line 162 – remove the comma.

Corrected

Line 164 – add “to be made” to the end.

Corrected

Line 166 and 167 – Change to “Air temperature data was obtained from the KAN_L automatic weather station (don’t think AWS needs capitalising), part of the PROMICE AWS network, which is located on the ice sheet at 670 m asl, X m/km from the study site”. (Replace X with the distance

from the AWS to your site).

Corrected

RESULTS

Line 171 – "Figure 2 illustrates how lake volume and area change with variations in water level, as calculated based on the 2021 post-drainage DEM".

Corrected

Line 173 – "To accommodate for the higher water level observed in 2007, we manually adjust the…"

The sentence is deleted as the entire section is edited following the comment regarding line 177.

Line 176 - for my own understanding more than anything, is the maximum depth of the lake (433 m in your UAV DEM) the same thickness as the ice? Is that what you're saying here?

Not the thickness of the ice, but the elevation of the damming glacier. This is now reflected in the manuscript. See comment below.

Line 177 – This last sentence seems a bit out of place. Your narrative seems to be going in one direction, where we're talking about the 2021 level related to the 2007 level, and how this can be used as a proxy for ice thickness, and then suddenly we're on to the 2015 lake level and then nothing else? The paragraph ends so abruptly that I'm not sure something else should be added to it?

Regardless – you could start this last sentence with something like "In comparison, we are able to determine a theoretical maximum water level of 450 m from the 2015 ArcticDEM (strip), which is ~17 m higher than the 2021 lake level.

You are right. The section has been rewritten and now reads:
"*The lake has a theoretical maximum water level of 433 m, after which water overspills the ice dam, hereby indicating the elevation of the damming glacier. The 2021 theoretical water level maximum produces a lake surface area of 0.79 km2 and a maximum drainage volume of 14.3 M m3, which is a 63 % decrease compared to the actual estimated drainage volume of the 2007 GLOF (Table 2). Moreover, we compared the theoretical maximum water level to the estimated 2007 pre-drainage water level of 453.1 m, and found an ice dam lowering of at least 20.1 m. We were able to determine a theoretical maximum water level of 450 m from the 2015 ArcticDEM, which was 17 m higher than the 2021 level. Based on the present configuration of the lake and ice margin, the lake is not able to reach the 2007 maximum level as it would drain through the glacial conduit at a lower level.*"

Line 181 – "annually", not "yearly".

Corrected

Line 182 – Combine with following sentence and edit to something like "The 2007 GLOF had the largest observed drainage volume, with a value of 37.73 ± 1.08 M m3 recorded (Table 2 and Figure 3), yet a year later in 2008 the volume was four times lower, at ~9.4 ± 1.46 M m3."

Corrected

Line 183 – Remove first half of sentence about no drainage in 2009 (already mentioned at start of

paragraph). Edit second half to something like "In contrast, in 2010 the drainage volume had once again returned to a higher level, with XYZ recorded."

Corrected

Line 184 – Edit to something like "Over the following three years (2011 to 2013) the drainage volume remained relatively stable at between 7 and 9 M m3, before decreasing to ~4 M m3 in both 2014 and 2015, after which a threefold increase to 12.5 M m3 was observed in 2016".

Corrected

Line 187 – Edit slightly to "…in comparison to previous drainage events, with the 2020 event occurring by 31st May."
Corrected

Line 188 – "In the years following the occurrence of these partial drainages, i.e. in 2018 and 2021, the observed GLOFs occurred relatively late in the melt season, with volumes of X and Y recorded, respectively."

Corrected

Line 191 – "occurring", not "happening" and then edit last sentence to something like "However, the later occurrence of these drainage events is not always equivalent to a larger drainage volume, as evidenced in both 2018 and 2019"
Corrected

4.3. Heading – change to something like "Geomorphology of the drainage area/region".

Corrected

Line 203 – "Figure 4A and 4B illustrates/highlights (not shows) the two main routes of drainage for each GLOF event to exit the drainage outlet"

Corrected

Line 204 – correct me if I'm wrong, but isn't a "proglacial passage" just a river? Or in this case, it would be a dry river channel? Basically, the water is channelled into an ephemeral river channel that transports it into the two main outlet lakes and into the wider downstream river network.

Yes. The sentence now reads: "*Drainage route I channels the water into an ephemeral river channel and into two outlet lakes connected to the downstream river network.*"

Line 205 – "In contrast, in drainage route II the water flows across the ice margin…"

Corrected

Line 208 – Don't think you really need this sentence as it's self-explanatory from the Figure? Instead edit the following sentence to be something like "Furthermore, the high resolution of the orthomosaics and DEMs produced through UAV Mission I, as well as the ArcticDEM, have enabled us to observe a number of important geomorphologic features across the drainage region which are not visible in the 3 m resolution Planet imagery". (Remember your UAV imagery is not ultra-high resolution…)
Line 208 has been deleted and the following sentence rewritten: "*The high resolution of the orthomosaic and DEM produced through UAV Mission I, have enabled us to observe a number of important geomorphologic features across the drainage region which are not visible in the 3m resolution Planet imagery*."

Line 210 – "For example", not "as evident". Also I think you can just say "up to 5 m in length" as 5 x 5 m suggests 25 m^2 in area and I would be surprised if you measured the area of all these blocks.

Corrected

Line 211 – "across" not "along". Also just reference Figure 4C and 4D, as 4B is your areal overview which shows no blocks.
Corrected

Line 212 to 213 – Unless I'm mistaken, the features you're showing in panels 4G and 4H are not circular. They are, however, parallel, and as you say, cracks. Surely these are crevasses, no? In which case just say they are (or call them fractures). Again, remove the reference to Figure 4B in-text.

Also, these water escape holes you mention – there's definitely a more glaciological term for these, although in terms of description, yes, you're right in that water would flow into these holes. They could be moulins, but unless you've seen water flowing into them directly, I'd be reluctant to call them that. Instead, and considering the close proximity to the margin, I'd suggest that they're probably areas where the ice surface has collapsed over an en- or sub-glacial cavity – I'd suggest changing the end of this sentence to reflect this.

You are right that the features shown in panel 4G and 4H are not circular, however, if you trace the fractures in figure 4B you see that they run in an interrupted, circular pattern. This was poorly reflected in the manuscript and the sentence now reads: "*The ice margin also contains 0.5 m to 3 m wide, parallel fractures (Figure 4G and 4H) that run up to several hundred meters in an interrupted, circular pattern (Figure 4B), as well as five roughly circular and nearly vertical holes with a diameter of c. 10 m (Figure 4E).*"

We did not use the term crevasse as we hypothesize that the fractures did not form due extensive stress originating from glacier flow, but rather due to a sudden drop in elevation by sub- or –englacial water undermining the surface structure of the glacier. However, we changed the wording to fractures.

We used the term water escape holes instead of moulins as they could be blowholes created by pressurized englacial water. However, I fully agree that they could also be a product of a collapsed englacial cavity (a reflection on this is added to the discussion, line 294), and we have changed the wording from "water escape holes" to "*roughly circular and nearly vertical*".

Line 214 – I'd say something like "Finally, observations of the ice margin and drainage outlet position in both 2015 and 2021 indicate a retreat of 30 m and 60 m in this period, respectively".
Corrected

DISCUSSION

Line 220 – "that are within" not "located within".

Corrected

Line 221 - Remove the space between "10" and the % sign, and the "excluding the 2014 event" as you've already mentioned that it isn't included.

Corrected

Line 222 – "This indicates that the two methods used to obtain drainage volumes can serve as independent validation for one another".

Line 223 - reorder slightly: This could partly be because the cloud-free Landsat 8 images captured closest to the drainage date on 3rd August (2014) * were acquired 13 days prior to the GLOF event, on the 21st July".

*Arguably you don't need to state 2014 as in the previous sentence you already mention it.

Corrected

Line 230 – this is less of a specific point and more of something to consider – have you considered the fact that the hydrograph is 27 km downstream of your site, and looking at Figure 1, the river in which it gauges receives inflow from multiple areas of the glacier, and not just your site (as well as areas of ponded water in the proglacial region) – could this be a potential reason for the large variation, perhaps an outburst flood from one of the other lakes in the system (i.e. not the ones around your site?). Even if it remains unquantified, it would perhaps be useful to state that this could be a possibility, no?

This has been considered and is reflected on in the following sentence, which is now corrected according to your comment below.

Line 231 – I think "Moreover, we find no evidence that any of the other proglacial lakes in the system have undergone a change in their area, which would indicate changes in water storage, and therefore the 2014 event remains unquantified" reads better.

Corrected

Line 238 – remove space between "4" and the % sign.

Corrected

Line 240 and 241 – watch your scientific notation – m^3 not m3.

Corrected

Line 243 – "in" not "across", and "as well as when compared to the reconstructed volumes presented in this study".

Corrected

Line 244 – "highlights" not "shows", put a comma after "volumes"

Corrected

Line 245 – "…estimates to allow for better comparisons of annual variations to be made."

Corrected

Line 247 – comma after "new". Swap "a" for "the". Put in "…GLOFs which show variations in…"

Corrected

Line 248 – "the proposed drainage trigger mechanisms".

Corrected

Line 249 – "Previous studies have suggested several different mechanisms that control GLOFs at Russell Glacier, …"

Corrected

Line 250 – is there a reference for the incomplete resealing mechanism? Or is it also Russel et al. (2011)?

Additional reference added.

Line 251 – "Recent data from ground penetrating radar surveys, however, revealed no evidence of a Nye channel incised into the bedrock, but instead found evidence of at least one englacial tunnel running parallel to the ice margin (REF)."

Corrected

Line 256 – "…but the lake is still able to drain at both similar and higher water levels…"

Corrected

Line 257 – "…both occurred following a year of no drainage, and indicate that in order for the lake the reach such a high-water level an additional (or multiple) melt season is required".

Corrected

Line 258 – Minor point for clarification – you wouldn't need additional or multiple melt seasons, you'd need a longer melt season, that starts earlier in the year.

A longer melt season would likely also be enough, but as indicated by the observations both the 2007 and 2010 GLOF had multiple melt seasons to fill up.

Line 259 – I think cut this sentence into two as it doesn't flow well in its current format: "However, due to thinning of the damming glacier the lake is unable to reach its previous peak drainage water level and volume that was observed in 2007 or 2010." "As a result, and based on its current configuration, the lake can only reach a maximum water level of 433 m, at which point it overspills the ice dam.

Corrected

Line 262 – "suggested" not "pointed to", put a comma after "Glacier", and change "of" to "in".

Corrected

Line 263 – put 1984 first, then 1987. Also change "fits well" to "closely aligns".

Corrected

Line 265 – comma after "season", and then edit end of sentence to "…or an additional means by which to lower the water pressure".

Corrected

Line 266 – Imagine there must be plenty of references to show this, and not just Tweed and Russel.

Additional reference added.

Line 268 – "that occurred between".

Corrected

Line 274 – remove "and" and put a comma after "ablation". Also change "The" to "This" at the start of the next sentence.

Corrected

Line 280 – "Annually" not "yearly".

Corrected

Line 281 "… , suggests other factors may influence the triggering threshold". Also put a space

between 0.3 and m.

Corrected

Line 282 – put a space between 11 and M.

Corrected

Line 284 – "earlier" not "already". Remove comma after "hypothesize".

Corrected

Line 286 – "as an explanation".

Corrected

Line 287 – "After a number of such small events the drainage system likely undergoes a change in configuration, resulting in the closure of the drainage outlet and allowing for the occurrence of a larger GLOF the following year."

Corrected

Line 292 – "…coincides with the estimated location of drainage route I".

Corrected

Line 293 – You've done this before in the manuscript and in this paragraph – but basically you don't need to reference Fig 4B as its just your overview. Panels 4C onwards are the only ones you should be making reference to here. Also it should be written as "Figure 4C, 4D etc).

Also, "…scattered ice blocks and fractured ice surface…", and "…along drainage route I, as well as the new route II during the 2021 GLOF."

Corrected

Line 294 – I'm really unsure why you persist in calling these surface cracks "circular"? From your Figure 4 these features clearly aren't circular? As I've mentioned before, their parallel nature, and considerable length, suggests they are most likely fractures or crevasses. Potentially they may have been formed by a sudden drop in elevation, linked to the flow of water beneath them.
Linked to this, they could have instead been caused by the temporary UPLIFT and subsequent falling of the ice surface in response to the flow of water underneath. The volumes you put forward in this study are sizable, and would I imagine be able to cause local uplift.

They could also, in theory, be formed from below, with the movement and pressure of the water causing basal crevasses to form which propagate up to the surface (ice is quite thin here I imagine, and with plenty of lines of weakness for the water to take advantage of).

The water could also be sufficient to cause slight speeds up in this locality, which would stretch the ice surface and also cause crevasses to form…basically there's multiple explanations, of which you should probably be aware of and make reference to.

Regarding the circular pattern, see our earlier comment.

Yes, we agree that there are many potential explanations for these fractures. We certainly consider the uplift and subsequent falling to be a plausible theory. The sentence has been rewritten to reflect the multiple potential explanations:

"*There are multiple potential explanations for the parallel fractures observed on the ice margin, (Figure 4G and 4H) such as a propagation of basal crevasses towards the surface, stretching of the ice surface from increased basal sliding, as well as a temporary uplift and/or (subsequent) falling of the ice surface. In combination with the additional observed surface features, we consider the latter*

theory the most plausible, however, all explanations can be linked to a sub- or englacial flow of drainage water."

Line 296 – "Figure" not "figure".

Also, as mentioned previously these shouldn't be called "escape holes", and definitely not "blowholes". So rearrange this sentence to be something like: "The several collapsed surface regions observed in Figure 4E are likely created by the collapse of the ice surface above an empty en- or subglacial cavity, or they may potentially be a result of pressurised en- or subglacial water flow being forced upwards and breaching the ice surface, causing localised collapse."

Corrected. Sentence now reads: "*The roughly circular and nearly vertical holes, exemplified in Figure 4E, are likely created by the collapse of the ice surface above an empty en- or subglacial cavity, or they may potentially be a result of pressurised en- or subglacial water flow being forced upwards and breaching the ice surface, causing a localised collapse.*"

Line 299 – "From the 3m-reoslution Planet imagery…"

Corrected

Line 301 – "As a result of this observation we reanalysed those previous events, and although we found no evidence of geomorphic change along the ice-marginal meltwater drainage system after the 2019 and 2020 events, we did observe standing water on the ice margin and changes in the ice colour (black to white) after the 2019 drainage, indicating water flow on the ice surface."

Corrected

Line 305 – "On the basis of these observations, we hypothesize that the new drainage pattern is predominately caused by the thinning and retreat of the ice margin in the vicinity of the outlet, allowing floodwater to more easily flow over and into the ice margin."

Corrected

Line 307 - I note threshold is probably OK, but as its an elevation difference between the two routes, you could probably just change it to "…difference between drainage route I and II (Figure 4B) suggests that route I is still the primary path."

Corrected

Line 308 – "However, as the ice margin gradually thins drainage route II will likely become the dominant path taken."

Corrected

Line 309 – "act as a buffer" and "slow the downstream flow of water".

Corrected

Line 310 – Thus, this shift will affect downstream geomorphology and potentially cause hazards (to who???). Therefore, we strongly suggest that a comprehensive investigation of the potential downstream consequences of GLOFs along this new route is undertaken as a matter of urgency."

Sentence now reads:

"*Thus, this shift will affect downstream geomorphology and potentially cause hazards to local infrastructure. Therefore, we strongly suggest that a comprehensive investigation of the potential downstream consequences of GLOFs along the new route is undertaken.*"

CONCLUSIONS

Line 314 – "spanning 2007 to 2021 to provide a new evaluation and a greater understanding of the…"

Corrected

Line 316 – "Our time series reveal annually reoccurring GLOFs, with the exception of 2009, and considerable variations in both the date of drainage, ranging from 31st May to 15th September, as well as the overall volume, ranging from 0.9 to 37.7 M m^3."

Corrected

Line 317 – "we compare our estimates of drained lake volume produced though DEM analyses with…"

Corrected

Line 319 – same comment about the 10%.

Not exactly sure about what this comment refers to.

Line 320 – not exactly unresolved, as see earlier comment – there are definitely some potential reasons why.

Sentence now reads:

"That difference is excluding the 2014 GLOF where the hydrograph estimate is double the DEM-derived volume, which cannot be resolved with the available data."

Line 322 – "We illustrate that the 2021 theoretical maximum drainage volume is 14.3 M m3, which is a 63 % decrease compared to the 37.7 M m3 volume estimate for the 2007 GLOF. This decrease can be likely be explained as a result of the continual observed thinning of the ice dam."

Corrected

Line 326 – "In contrast, the ensuing annual drainages are likely caused…"

Corrected

Line 327 – "This" not "The", "late-seasonal drainage" not "late-season drainages".

Corrected

Line 328 – "…as well as annual variations in the configuration of the drainage system of the damming glacier".

Corrected

Line 333 – "…with a new sub- or en-glacial flow pathway, as well as the supraglacial flow of drainage water across the ice margin".

Line 334 – "as a result of", not "due to a", and "…ice margin, and that further thinning…".

Corrected

Line 336 – "…significant consequences for the surrounding geomorphology and the potential risk of flooding hazards".

Corrected

Referee comments 2 (RC2)

We thank reviewer #2 for their detailed and constructive feedback on our manuscript and believe that the comments have help improve the manuscript significantly. Below we copy the referee comments in red and write our responses in blue

Line 12: "and cause bedrock displacement...."

Corrected to compromise between reviewer #1 and #2:

The sentence now reads: *"… influence local ice dynamics and cause bedrock displacement and geomorphological changes as well as pose flooding hazards."*

Line 15: Give approx. resolution here to emphasise the point
We have added the DEM and ortho resolution in parentheses

Line 17: Remove ","
Sentence rewritten and now reads: "*As a result, this is one of the most comprehensive and longest records of ice-dammed lake drainages in Greenland to date*."

Line 25: air and/or lake temperature?
Added 'air temperature'

Line 49: Could also add a sentence here about them providing important context for the scale and frequency of GLOFs we get now and may get in the future, with climate warming.
Sentence added. It now reads:
"*Furthermore, long-term data improve our understanding of drainage triggers and mechanisms, provide important context for the scale and frequency of current and future GLOFs as well as aid in the mitigation of downstream effects.*"

Figure 1: Would be helpful to add some labels to this figure, in all sections, e.g. labeling the glaciers and adding a north arrow.
Figure edited to accommodate reviewer #1 and #2. Increased size of point markers. Labels, north arrow and panel numbering (a,b,c) are added. Caption changed and now reads: "*Figure 1. A) Study site location in Greenland. B) Zoom in on study site with location of hydrograph and Promice weather station. C) UAV mission area I and II with location of GCPs overlaid on a four band Planet (2017) acquisition from 23/8-2021. The yellow triangles illustrate the only two reliable fix solution GCPs. Due to image gaps at the western part of the lake the produced UAV DEM is filled with elevation data from two ArcticDEMs acquired on the 19/9-2014 and 2/8-2015.*"

Line 69: Keep your date format consistent - I prefer this, but it's different to the date at the end of the intro**.**
All dates in the manuscript formatted as day, month, year.

Line 72: Does this mean the lake was 408 m deep at its lowest point? Needs a bit better clarification.
The sentence has been rewritten to clarify. It now reads: "*As the lake did not fully drain we were unable to survey the entire lake topography, however, a standing water level of 408.8 m was surveyed in the lake, which is almost identical to the minimum lake levels observed after other previous GLOF events (Russell et al., 2011)"*

Line 91: What were these? Please specify - assuming some kind of survey target?
Added info on type of survey targets. The sentence now reads:

"For the purpose of validating the accuracy of the produced DEMs we placed a combined total of 33, 0.3 x 0.3 m black and white, ground control points (GCPs) and measured their position using an Emlid Reach RS2 GNSS receiver (Table 1)."

Line 92-94: That's almost all of your GCPs gone... I'd like to see more comment on how much of a problem this was / how it might impact your results. These things do happen with field data, but I think it's important to note the potential impacts on accuracy etc**.**

We fully agree on this issue and Reviewer #1 raised similar concerns. To accommodate this, we applied an additional method for uncertainty estimation and, as suggested by reviewer #1, based this estimate on the relative offset between the DEMs over stable bedrock. However, instead of a cloud-to-cloud comparison, we compared the DEMs by applying the co-registration framework developed by Nuth and Kääb and adopt the results as our main measure of uncertainty. We have added a paragraph in section 3.2 describing this:

"Previous studies, using a similar setup and approach (Chudley et al., 2019; Jouvet et al., 2019), reported horizontal and vertical uncertainties in the range of 0.1 – 0.4 m, without the use of GCPs. By measuring the horizontal and vertical displacement between the fix solution GCPs and their observed location in the Mission II orthomosaic and DEM, we estimated the accuracy to be 0.14 m and 0.35 m, respectively. Due to a lack of reliable GCPs, we applied an additional method for determining the uncertainty. Inspired by similar studies (Chudley et al., 2019; Jouvet et al., 2019), we estimated the uncertainty by calculating the relative offset between the Mission I and Mission II DEM over stable bedrock, assuming no change in the topography. We applied the python module PyBob (McNabb, 2019) based on the co-registration method developed by Nuth and Kääb (2011), which determines the X,Y and Z offset from elevation difference residuals as well as the terrain's aspect and slope. Using the Mission I DEM as the reference, we found a relative offset of X = -0.43 m, Y = 0.11 m and Z = 0.53 m and adopted this as our main measure of uncertainty. By applying this offset to the Mission II DEM, we were able to reduce the mean elevation difference and RMSE over stable bedrock from 0.39 m to 0.00 m and 0.42 m to 0.17 m, respectively."

Line 103-104: But as noted above, this was only for 2 GCPs, so how reliable is this assessment? Is there anything else you can validate against??
See the comment above.

Line 108: Again I find this a bit confusing. DO you mean the average depth across the lake was 407 m? Or that the lake surface was at 407 m.a.s.l.? Needs stating clearly.
We refer to the lake surface. The sentence has been corrected for clarity and now reads:
"At the time of acquisition, both ArcticDEMs had a standing water level of approx. 407 m"

Line 151-152: Is this a reasonable assumption? How much would the answer vary if you used other approaches to flow routing?
Yes, we believe that this is a reasonable assumption as the minimum elevation is commonly used for calculating the flow direction. As illustrated in figure 4B, there are two directions for the water to flow in as it exists the glacial outlet; i) across the ice margin or ii) towards the outlet lakes. Therefore, varying our approach to flow routing would not change the overall conclusion about the flow, but only show as small variations in drainage route I and II and the corresponding drainage thresholds, illustrated in figure 4B.

Line 167-168: Did you need to apply any filters for missing data to this or was the record reasonably complete? Worth noting either way.
No missing data filters were applied as the dataset is complete. Sentence added: *"For each of the analysed periods, the air temperature data contained no missing values."*

Line 172: above sea level?
No, above the ellipsoid. As stated in the data section of the manuscript "*All elevations are reported as height above the WGS84 ellipsoid, unless otherwise stated*"

Line 182: million? I'd just write million yo emphasize the volume.
We have decided to go with the abbreviation, as it is used in previous studies reporting drainage volumes from the lake.

Line 190: Perhaps you discuss this later, but is the limited drainage corroborated by the geomorph evidence? Put simply, do you see limited geomorph change in years with low outputs? If so, I'd suggest noting it, as a 'sense' check that you're not somehow missing events that occur between your images.
This is a great consideration. However, we checked for missing events by going through all satellite images for the entire melt season. We added a statement regarding this – line 250:
"In years with an early drainage date and a low drainage volume (2014, 2015, 2017, 2020), we checked for additional late seasonal drainage events by manually going through satellite images starting from the observed drainage date to the end of the melt season."

Figure 3: x axis labels are rather hard to read - I'd turn them 90 degrees or have two number format.

Figure edited according to comments from reviewer #1 and #2. Size increased, ticks added to x-axis and labels rotated, improved y-axis labels.

Figure 4: I find it hard to orientate these maps in their present form, e.g. where is the ice margin? I'd add key features and labels to help and also contours to help the topography pop.
Figure has been edited according to comments from reviewer #1 and #2
The 2015 and 2021 ice margin is included. We did not add contours as it conflicted with other surface features, but we did increase the transparency of the DEM to make the hillshade topography show better.

Line 231: Can you suggest how you might approach investigating it further?
We would like refrain from hypothesizing further on the discrepancies between these two measurements in the paper. Since the two different methods show very good agreement during all other events, we have great confidence in our ability to deduct the GLOF volume from imagery alone in combination with a high resolution DEM. We have tried to figure out why there is a big offset for this particular event, using all available data and must settle with that. Alternatively, we will end up being too speculative without the data to support these speculations.

Figure 5: Needs a bit of tidying, e.g. titles are overlapping x labels.

The figure has been edited according to the suggestions made by reviewer #1.