

Response to the Editor – Minor revisions

Dear Editor,

Thank you for this thorough feedback. We have taken in consideration all your comments, and believe the quality of the manuscript has greatly improved. Please find below detail replies to your comments.

Comment 1: There are occasional grammatical issues in the text that the authors should correct before submitting, particularly where new text was added. Eg, “(note that the resolution is 140 m but the sampling scale is finner).” TC does not do language editing of the ms at any stage.

Reply 1: Apologies for not having caught all the typos in the manuscript. We have corrected them.

Comment 2: Reference to Table 1 in the text has fallen away, and the table itself should appear after the use of GCPs for rectification has been described in the text.

Reply 2: The only missing reference (l. 149 in the track-change document) refers to a table (formerly Table 2) that was removed from the manuscript, as suggested by Reviewer 1. We have checked all references in the new version. The order has been changed to present Table 1 after the text.

Comment 3: When you discuss taking the GCPs in this section, you should then refer to appendix B2 with the RMSEs for each image – both for KH-Argon and Landsat data. Ok, I see B2 is a figure with the RMSEs for the KH-Argon data but not the Landsat data. At least a table with the RMSEs for the Landsat data should also be given.

Reply 3: We have added references to appendix B2 in these sections, and completed the appendix with Landsat residuals and RMSE.

Comment 4: I note that in Fig B2, some of the RMSEs for the KH-Argon data are rather high (especially frame b with 234 m RMSE)– although I understand the challenges. It would be helpful if you referenced another article that discusses this, eg, <https://link.springer.com/article/10.1007/BF02829175> (Sohn, HG., Kim, KT. Horizontal positional accuracy assessment of historical ARGON satellite photography. KSCE J Civ Eng 4, 59–65 (2000). High RMSEs and their potential effect on the delineation of the glacial front should be discussed factually in the manuscript.

Reply 4: We have further commented on the high RMSEs in Sect. 2.6. Indeed these RMSE values are high, but they remain similar or lower to those we assessed by comparing front positions. Moreover, our average frontal change results are given with the corresponding uncertainty, and we used these values to filter advances and retreats to mitigate the risk of false detection due to the georeferencing error. We have also extended the discussion about the RMSE in Appendix B2 and referred to Ye et al. (2017), which compares geometric accuracies of orthorectified KH-5 ARGON images.

Comment 5: In Table 1 – list the images in chronological order.

Reply 5: We have reorganised the table.

Comment 6: Please indicate which Landsat satellite data were used (Landsat -1, -2, and/or -3?) All of these were operating between 1976-1978. Indicate what Level data you have used (L1GT? L1TP?) – this is important so that the reader knows the geographic accuracy of the data.

Reply 6: We have use Landsat 2 and 3 L1GS data. This precision has been added to the manuscript.

Comment 7: Also, The Ground Sample Distance (GSD) of Landsat 1 (MSS) was originally 79 meters (commonly cited as 80 m), but the data provided via Earth Explorer today is resampled to a 60-meter pixel size. Please acknowledge this.

Reply 7: We have added this information.

Comment 8: The section on Landsat data should also refer to the dates and number of GCPs used in Table 1.

Reply 8: Reference to Table 1 already exists in this section (l. 126).

Comment 9: I find Fig 4 difficult to interpret – is there a black outline being used to represent something? If so, maybe it should be dashed or white so that one can really tell where your lines are. Maybe in Fig 5, a box around the area shown (corresponding to Fig 4 area) would help the interpretation of Fig 5, which I also find difficult to interpret.

Reply 9: We removed the black outline used to represent the coastline, and replaced the Hornsund point with a box indicating the extend of Fig. 5.

Comment 10: Figure 5 prominently features the “Randolph inventory” which is only briefly mentioned in the Introduction but no details are given and it wasn’t clear that the authors were using this data in their analysis. If it makes sense to keep it in, please give a little detail as to the dataset and what it is based on.

Reply 10: The RGI is not used in the analysis. It was simply used as a visual aid to split the fronts consistently. We included details in this paragraph about the RGI, but we do not think it requires its own data section.

Comment 11: Please remove “. . . and ensure correctness” from the end of the following sentence, as giving larger error margins doesn’t ensure correctness. Therefore, our uncertainties are conservatively bigger than these RMSE values and ensure correctness.

Reply 11: We have removed this part of the sentence.

Comment 12: According to Fig 9, use of the “Early” ERA5T dataset is written. I believe the authors should be using the standard dataset and not the Early dataset, especially since the long historical record going back to 1940 is shown. The authors also haven’t referenced which dataset they used in the text (Early or Standard).

Reply 12: "Early" referred to the data (after 1940) and not the dataset. We removed this term to prevent confusion. The dataset used is the standard ERA5, monthly averaged on single levels, as cited in the text (l. 231).

Comment 13: I think that the sentence in your Conclusion “An analysis of the average glacier behavior over the whole study period yields an average retreat rate of ($R^2 = 0.89$) $27.3 \pm 3.0\text{myr}^{-1}$, which agrees with the value of 25-50myr⁻¹ found by Li et al. (2025) for period 1985-023.” could benefit from putting the actual years (from 1936 to 1978) instead of “over the whole study period”.

Reply 13: We have written the precise years.

Comment 14: The authors added to the Conclusion the sentence “This difference is likely due to increasing T2m and SST in Svalbard, as well as a decrease in SIC between 1940 and 2023.”. The reference to “This difference” is vague, particularly since the preceding paragraph discusses the difference between other studies’ results and the authors’ own. I don’t think this is what the authors mean – I think they mean to say that these factors are influencing the glacial loss. Please look over.

Reply 14: We replaced ‘This difference’ by ‘It’, referring to the mass loss in the previous sentence.

Comment 15: A more major point: Reviewer 2 is concerned about the rectification of the imagery, and I believe this is the main issue for your manuscript. Figure B2 is helpful, but the axes should have the Lat Long on them, and it would be helpful to know the location of the glacier front represented within each plot. Otherwise the reader has no way of knowing where the GCPs were taken and if they are valid.

Reply 15: Unfortunately, the QGIS georeferencer tool only gives the residuals in pixel coordinates and does not display the transformation coefficients needed to plot the residuals in geographical coordinates, nor does the backend tool gdalwarp. Moreover, documentation is lacking to recalculate exactly the transformation. Therefore, we could not plot the residuals in geographical coordinates, but we added the images in the background and an approximate north arrow to enhance readability.

Comment 16: In addition, the May frame B appears to show systematic errors. Please comment on this, and take careful consideration of your method and in the discussion consider the possibility of how this affects your results and the potential error sources are here. This will help future researchers who may try to build on your study.

Reply 16: The errors are higher for this frame, but they are not consistent (residual orientations vary). For this specific frame, the RMSE is 389 m, and our uncertainty assessment for 1962 is 720m. The georeferencing error is therefore already taken into account for this frame. We added this discussion to appendix B2.

References

Ye, Q. et al. (Dec. 2017). “Improved glacier mapping with Landsat 8 OLI and Sentinel-2 MSI data in the Karakoram”. en. In: *Remote Sensing* 9.12, p. 1238. ISSN: 2072-4292.