# Comment on tc-2021-256

Anonymous Referee #2

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Referee comment on "Unravelling the long-term, locally heterogenous response of Greenland glaciers observed in archival photography" by Michael A. Cooper et al., The Cryosphere Discuss., https://doi.org/10.5194/tc-2021-256-RC2, 2021

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The authors are presenting a novel record of historical glacier retreat from a little studied region of Greenland. By exploring archival images, ortho-mosaics are created from aerial and satellite images, from which frontal positions of ice sheet outlets are digitized and length changes measured.

This work is an important scientific contribution to our understanding of the glaciology in the region, and represents a good example of the importance of maintaining and utilizing historical image sources. Importantly, the authors are studying smaller glaciers from the ice sheet and local glaciers, from which there are very few studies. The authors are able to demonstrate a heterogeneity in the glacial behavior during almost a century. This is an important observation, that can be the starting point for further understanding of this particular region.

The effort that goes into producing this type of data is huge, and the results deserve to be published.

I have a list of general questions and comments regarding the current state of the manuscript that I would like to see resolved before publication:

- It is unclear to me why first a orthomosaic is created after which it is georeferenced to a DEM. This seems like an inaccurate approach. It would result in a more accurate result if GCPs were introduced earlier in the flow, during SfM-processing. Perhaps I am misunderstanding your workflow… Under all circumstances, then I would like to see a work-flow diagram, to be sure that I have understood to process chain correctly.

- Since you are not producing a DEM, then why are you not using an image source as master for the GCPs? It seems like an inaccurate approach for rectification of an image.

- Why are you producing a 1985 ortho with with GCPs from ArcticDEM, when an ortho already exists with GCPs from in-situ measured points? You are also referenceing the correct paper, Korsgaard et al. 2016, from which the ortho and DEM was published. You mention 58 images used in the text but only 30 in the table. You also mention GCPs from SDFE associated with the images - are these the ones you have used?

- There is no information provided on how you reach the 2D and 3D errors in table1. From the way I understand your processing, I don't see how you can have a 3D error, when you state that: "For geolocalisation of the orthomosaic….. the ArcticDEM model was used. If you have a georeferenced 3D product (DEM) than it would be very nice to see it included in the manuscript.

- I would like some more information on the SMB model and specifically the area of the model the results that you are showing here represents. Since it is shown as a point/line graph does it represent the combined glacier area studied or a point in the region? Would be interesting to see the SMB plotted on a map.

- It appears that very few of the glaciers studied have data from the 1930s. Table 2 shows only 7, while fig 3 shows 18. How come have you chosen not to focus only on the glaciers that have the long record. I agree that adding more glaciers gives the

dataset more value, but I am missing a justification and most importantly some criteria for your selection of additional glaciers.

- Fig 6 is great – would it be possible to combine it with fig 7, 8, and 9, for a better overview?

- It would be nice to see on a map from where the temperature is coming – both air and SST. There is no information provided from which grid cell you have extracted the SST. I am not sure what is meant by mean annual maximum and minimum temperatures – can you please explain?

- Several places in the text is mentioned mass loss, you are not providing data to support these statements, and can with what presented only describe retreat.

- In your conclusion you write that there is been a temptation to differentiate between region. I suggest you reword this. Subdivision into regions makes perfectly sense, as climate, ocean currents, landscape and geology varies on a regional scale. While there may be variations within the regions, there are plentiful patterns that warrant these subdivisions.