

The Cryosphere Discuss., referee comment RC1
<https://doi.org/10.5194/tc-2022-203-RC1>, 2022
© Author(s) 2022. This work is distributed under
the Creative Commons Attribution 4.0 License.

Comment on tc-2022-203

Amaury Dehecq (Referee)

Referee comment on "Brief communication: Glacier mapping and change estimation using very high-resolution declassified Hexagon KH-9 panoramic stereo imagery (1971–1984)" by Sajid Ghuffar et al., The Cryosphere Discuss., <https://doi.org/10.5194/tc-2022-203-RC1>, 2022

The study by Ghuffar et al. aims at applying a previously published methodology to a different satellite data set. The methodology was developed to generate Digital Elevation Models from film-based declassified satellite images. While the previously published paper was focused on images from the Corona (KH-4) satellite series, this study focuses on the Hexagon panoramic camera images (KH-9 PC). There was apparently no novel methodological development required for this data set, but because the dataset studied here (KH-9PC) has been barely exploited so far, this study is a valuable contribution.

I only have minor comments, mostly intended to clarify the text or provide additional results, before the article can be published.

Minor comments:

- Preprocessing (section 4.1): I understand that the photogrammetric part follows exactly the method of Ghuffar et al. (2022). However, in that study, there is also an extensive preprocessing part in order to correct for film distortion using edge markers (rail holes, PG stripes...). Here you only mention the stitching of the image part. As for the KH-4 and KH-9 MC images, I would expect that some distortion exist, due to film distortion and due to the scanning. Can you please elaborate a bit more on the preprocessing? If there is no other processing step required, I would explain why as it seems rather surprising. If you applied a preprocessing step, please detail it. Are there any markers on the image that can help identify and correct for film distortion?

- DEM coregistration: at L 102, you mention the use of “coregistered DEMs”. You describe the tile-based coregistration used for the KH-9PC DEMs, but it is not clear what coregistration method you used for the other DEMs. Do you apply the same tile-based coregistration or did you use the coregistration method of the previous studies? If so, can you explain here what the method was?

- Results: In Figure 2, for Passu glacier, there seem to be a 50% difference (-6.2 vs -9.0 m) between the mean elevation change calculated from both datasets (KH-9PC and KH-9MC), but the mass balance values report in Table 1 and later in the text differ by less than 10%. Can you please explain? I believe this might be because the values are on the unfiltered results? In that case, I would suggest in that Figure 2 to also show the results after filtering and gap-filling.

Specific comments:

- L12: Mannerfelt et al. (2022) is not about aerial images. Either rephrase the sentence or use a different citation (e.g., Girod et al. (2018), Geyman et al. (2022))

- L24: “with high resolution” □ “with the high resolution”

- Figure 1, caption – two typos: “90°, 90°” should be “90°, 120°” and “with with”.

- section 4.2: I am amazed by how many different software you are able to leverage!

- L109: “We convert glacier-wide dH to volume change estimates considering the pixel size

of the dH grids”. Note that for volume calculation, it is more accurate to calculate a mean dH of all pixels, then multiply by the glacier polygon area, rather than using the pixel count and area, which is more discretized. Of course, it does not matter too much in this study since the focus is not on the glaciological interpretation of the results, and since the same method is applied in all cases, they are directly comparable.

- L110: Can you state which error correlation length was used in the Fischer et al formula?

Note that this formula tends to largely underestimate uncertainty, and I can only recommend to follow the approach of Hugonnet et al. (2022).

- Figure 3: Would you be able to show the approximate footprint of each image on the figure? This would help interpret the small steps in the DEM visible on the left.

References:

Geyman, E.C., J. J. van Pelt, W., Maloof, A.C., Aas, H.F., Kohler, J., 2022. Historical glacier change on Svalbard predicts doubling of mass loss by 2100. *Nature* 601, 374–379. <https://doi.org/10.1038/s41586-021-04314-4>

Girod, L., Nielsen, N.I., Couderette, F., Nuth, C., Kääh, A., 2018. Precise DEM extraction from Svalbard using 1936 high oblique imagery. *Geoscientific Instrumentation, Methods and Data Systems* 7, 277–288. <https://doi.org/10.5194/gi-7-277-2018>

Hugonnet, R., Brun, F., Berthier, E., Dehecq, A., Mannerfelt, E.S., Eckert, N., Farinotti, D., 2022. Uncertainty analysis of digital elevation models by spatial inference from stable terrain. *IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing* 1–17. <https://doi.org/10.1109/JSTARS.2022.3188922>