Dear RC2,

Thank you for reviewing our manuscript and for your constructive and comprehensive feedback. Please find our responses below. To help distinguish between comments and our responses, comments are shown in black and our responses in Blue.

The manuscript presents a valuable and well-executed study that reconstructs high-quality Digital Elevation Models (DEMs) and orthomosaics from 1989 aerial imagery over the western Antarctic Peninsula. I find this to be a very strong and useful paper; not only because of the released dataset, which fills an important temporal gap, but also because the workflow serves as an excellent methodological guideline for others processing historical aerial data. I recommend minor revisions to improve clarity and consistency in a few sections, but overall the work is scientifically sound and ready for acceptance after minor adjustments.

General Comments

- The calculation of Shannon entropy per image is an interesting quality metric. However, it is unclear whether this value was further used for image selection, filtering, or weighting, or if it is purely descriptive. Please clarify its role in the processing chain.

Thank you for this important point. We used Shannon entropy as a descriptive measure to see if we could explain the coverage variations in our DEMs. However, we also excluded the images with low entropy from the western part of Adelaide Island from our analysis. We have updated L199 of the manuscript to make this aspect clear as follows,

"We estimated Shannon entropy for each image as an indicator of texture. This was used to assess whether variations in DEM coverage were related to image texture and to filter out low-texture images prior to SfM processing."

Furthermore, to improve clarity, we have now removed the following sentence from **Section 3.3 DEM generation**

"We excluded images from the western part of Adelaide Island, due to the lack of stable areas and insufficient image features, and from north of Adelaide Island near Grandidier Channel, where images predominantly cover water pixels (Figure 1)."

and added an updated sentence in **Section 4.1 Image Quality and Coverage**

"Overall coverage (Glacier + Ice-free Areas).....on-glacier coverages spanning 20-42 %. We excluded images from the western part of Adelaide Island due to the lack of stable areas and insufficient image features (low entropy; Figure 4), and from north of Adelaide Island near the Grandidier Channel, where images predominantly cover water pixels (Figure 1). Notably, DEMs for PPI and North1, South1……."

- The LIMA mosaic is visually appealing but reduces the readability of the point symbols and subset boundaries. Consider replacing it, for example, with the high-resolution coastline polygons. The subset colours are also difficult to distinguish; labelling them (e.g., A–H) or adding clearer outlines would improve readability.

Thank you for your opinion about the visual appearance of the background used in the figure. We updated the figure with your suggestion.

- Will the raw digitized images or their metadata (e.g., image positions, flightlines, scale information) be publicly available?

We decided to publish the pre-coregistration point cloud data, flightlines with image positions in the Zenodo repository. However, the raw images can be obtained from the Archive for German Polar Research (Archive für deutsche Polarforschung - AdP) at the Alfred Wegener Institute (AWI) in Bremerhaven, Germany. We have now included the following information in the Data Availability section,

"The aerial images used in this study from the 1989 IfAG survey are open to everyone and can be obtained from the Archive for German Polar Research (Archive für deutsche Polarforschung - AdP) at the Alfred Wegener Institute (AWI) in Bremerhaven, Germany."

Specific Comments:

P1 L3: Spelling Error: acquired by the (...), which is kept in the

Corrected.

P3 F1: Spelling Error: Fiducial mark is spelled wrong (the i is capitalized)

Corrected.

P3 L54: Please specify whether the imagery is entirely nadir or includes oblique frames? * I see it's mentioned in the previous chapter, but please restate it here again for better understanding.

Yes, the imagery was intended to be entirely nadir-looking. We updated the text in the manuscript as follows,

"The archive consists of approximately 2000 vertical aerial images, acquired during a photogrammetric survey by the Institut für Angewandte Geodäsie (IfAG), Frankfurt am Main, Germany."

P3 L58: Is it possible to replace “most of the images” with precise percentages?

We updated the text to include the percentage of the images,

“Approximately 61% of the images were acquired at an average flight elevation of 5895 m, yielding a nominal photoscale of 1:70,000 with forward overlap of about 60%.”

P4 L84: Provide the version and citation of the ADD rock mask used.

We updated the text to *“Glacier outlines, ice-free areas, and rock outcrops are taken from the Silva et al. (2020) and Antarctic Digital Database (High resolution vector polygons of Antarctic rock outcrop V7.3 (Gerrish et al., 2020))”*

P4 L99: Wouldn’t it be possible to extract at least an approximate yaw based on the position of the images and the following flightpath?

Thank you for the suggestion. While it is theoretically possible to estimate the yaw based on the flight path and rough estimates of the position of the images, we intentionally provide an initial yaw of 0° with a loose accuracy of 180° to Metashape. This allows the software’s Structure-from-Motion (SfM) bundle adjustment to freely estimate the true yaw (along with pitch and roll) during photogrammetric processing. Metashape robustly refines camera orientations using image overlap and feature matching, making pre-computed yaw estimates unnecessary at this stage.

P5 F2: Distinguish the process boxes from technical detail boxes (e.g., OpenCV matchTemplate) using for example italics.

We updated the figure accordingly.

P5 L107: Please rephrase to make it clearer that the median fiducial position is computed per flightline, not across all images.

We updated the text to “....the median position of all matches for each fiducial marker, computed per flightline.”

P6 L109: Spelling error: 29.50% of images had three fiducial markers

Corrected.

P6 L112: Please make clearer that at least two fiducial marks from different axes are required to compute the principal point.

Thank you for this helpful comment. You are correct, at least two fiducial marks from different axes (left-right and/or top-bottom) are required to compute a valid principal point. We have revised the text for clarity as follows,

"The principal point was estimated from fiducial markers that passed quality checks. It was computed as the average of axis-aligned pairwise midpoints (left–right and/or top–bottom). For instances where only two non-opposing markers were detected (e.g. left and bottom), the principal point was estimated using the X coordinate from either the top or bottom marker and the Y coordinate from either the left or right marker (HIPP, 2021)."

P6 L112: Clarify whether the principal point is determined by intersection or by averaging?

As explained above, we used the "average". We updated the text to clarify this.

P6 L131: Since the total number of processed images should be known precisely, please provide the exact figure instead of an approximation.

We updated the text.

P6 L131: Please clarify whether the subsets were processed as independent Metashape projects, as separate chunks within a single project, or as one project later divided into eight exported subsets.

We processed each subset independently. We updated the text.

"We processed approximately 550 images from 12 flightlines photogrammetrically in Agisoft Metashape version 2.1.1 in 8 different projects (Figure 4)."

P7 T1: The table also includes parameters related to alignment and export. Consider expanding the caption to reflect that it lists both photogrammetric and processing parameters. In addition, please specify whether any tie points were masked or filtered (e.g., stationary tie points or water areas).

We updated the caption to *"Photogrammetric and processing parameters used in Agisoft Metashape for image alignment and dense point cloud generation."*
We have used the option of "Exclude stationary tie points", we updated this in the table to reflect this.

P7 T2: Very interesting table. How are the DEM resolutions derived? Aren't these chosen by the user?

Thanks for your comment. You are correct, the resolution of the DEMs can be manually set. In our case, the resolutions of the DEM are determined by 3-5 times the effective ground sampling distance (different at different quality levels) of the input images (Shean et al. 2016). This

reduces the interpolation artefacts in the analyzed DEMs, which helps us to compare different depth quality settings with respect to coverage. We have already clarified this aspect in L150 of the manuscript,

"...resolution corresponds to approximately three times the effective GSD of the input images processed…"

P8 L162: In my experience, the rock outcrops from the ADD rock outcrop mask can contain inaccuracies. Did you check for their quality in that region?

That is true. We also experienced the same, we found inaccuracies in the ADD rock outcrop in the studied region. Therefore, we used ice-free areas from Silva et al. 2020 as a major source for the coregistration surfaces (please check our response below on your comment P9 F3).

P8 L167: As this is the first reference to the Nuth and Kääb (2011) method, consider adding one sentence summarizing its function

Thanks for this suggestion. We updated the text to *"We used the Nuth and Kääb (2011) algorithm from the demcoreg package for subpixel coregistration over stable areas, which has a higher accuracy compared to ICP, as demonstrated by a reduction of NMAD after coregistration (Shean et al., 2021). This method estimates and corrects systematic offsets by relating elevation differences to terrain slope and aspect."*

P8 L177: Spelling Error: and the 3D shift

Corrected.

P8 L187: The sentence in its current form is difficult to follow; please rephrase for clarity

We updated this sentence as *"The uncertainty of the IfAG DEMs is assessed using ICESat-2 data by analyzing the distribution of elevation differences between the two datasets over stable areas."*

P8 L182: Please place "REMA mosaic" in parentheses to make clear that this refers to the reference DEM.

We will update the text to "....(REMA mosaic)..."

P9 F3: Only ice-free areas are displayed. Is there a reason the rock-mask extent is not also shown? Including both could improve transparency of the stable-area selection.

We appreciate the suggestion. As noted earlier, we compared the ice-free areas from Silva et al. (2020) with the rock-outcrop mask from the ADD and found that the latter contains some false positives. For this reason, we used the Silva et al. (2020) ice-free areas as a major source for

the coregistration surfaces. The ADD rock-outcrop mask was only used in a few manually selected locations (e.g., in the northern part of the Arrowsmith 2 subset). Therefore, to highlight this aspect, Figure 3A shows only the ice-free areas from Silva et al. (2020), and Figure 3B shows the actual coregistration surfaces used in our study.

P11 F4: Right-side coordinates overlap; adjust spacing.

Thanks for noting this. We updated the figure.

P13 T3: It may be interesting to also include the percentage of glacier and ice-free terrain within each subset.

We appreciate the suggestion. We updated the table as per your suggestion.

P16 L246: The text refers to normalized elevation values, but these are not visible in Figure 8. The caption of panel A seems inconsistent. Please verify and correct.

Thanks for noting this. We updated Figure 8A.

P19 L281: The sentence is not complete.

We updated the text to *"The ICESat-2 validation dataset was reduced from ~70,000 to ~6,000 points after outlier filtering, highlighting the validation challenges in a complex terrain (Table 6, Figure 11)."*

P19 L281: Spelling Error: nr. of observations (space is missing)

Corrected.

P19 L283: ibid.

We presume this comment is incomplete. However, we rechecked L283.

P20 L288: Spelling Error: These biases reduce to

Corrected.

References

Gerrish, L., Fretwell, P., & Cooper, P. (2020). High resolution vector polygons of Antarctic rock outcrop (7.3) [Data set]. UK Polar Data Centre, Natural Environment Research Council, UK Research & Innovation. https://doi.org/10.5285/cbacce42-2fdc-4f06-bdc2-73b6c66aa641'

Shean, D.E., Alexandrov, O., Moratto, Z.M., Smith, B.E., Joughin, I.R., Porter, C. and Morin, P., 2016. An automated, open-source pipeline for mass production of digital elevation models (DEMs) from very-high-resolution commercial stereo satellite imagery. ISPRS Journal of Photogrammetry and Remote Sensing, 116, pp.101-117.