Title: **Observing glacier elevation changes from spaceborne optical and radar sensors – an inter-comparison experiment using ASTER and TanDEM-X data**

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We thank Silvan Leinss for providing additional clarification regarding the radar data, specifically regarding the optimal selection of radar DEMs for assessing glacier elevation changes. We have implemented all the suggestions, which has enhanced the clarity of the paper with respect to radar data.

In addition, we checked all our figures to ensure they were colourblind-friendly by selecting colours from the colorbrewer2 tool (https://colorbrewer2.org/). Please note that for some figures, we had to use 12 different colours, and there is no palette available that can fulfil all colour vision deficiencies, as suggested in the Color Blindness Simulator. Nevertheless, the content of the figure can also be read even without colours, such as the flow directions (Fig. 4) and the total number of values for each class reported in the figure (e.g., Fig. 8).

Point-by-point reply to reviewer comments: editor and reviewer comments are in black, and the authors' response in blue, with citations from the revised manuscript in green.

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RC1: 'Comment on egusphere-2023-2309', Silvan Leinss, 14 May 2024

Review of "Observing glacier elevation changes from spaceborne optical and radar sensors – an inter-comparison experiment using ASTER and TanDEM-X data" by Livia Piermattei et al. EGUsphere-2023-2309.

Specific/technical comments:

l. 132: "Furthermore, high-relief topography can (...) cause geometric DEM distortions in radar images": What do you mean here exactly? any 3D relief causes distortion when imaged in 2D (optical or radar), but I guess, that's not what you mean here. Why would the relief distort the DEM?

Response: Here, we generically describe the challenges of the different study sites for optical and radar data. We meant that radar imagery is susceptible to geometric distortions in high mountain areas due to foreshortening, layover, and shadow and in areas affected by the layover and shadow, phase unwrapping is difficult, resulting in inconsistencies in the DEM.
We correct the sentence by removing the reference to "DEM distortion" and clarify the issue of radar data in high-relief topography.
"Furthermore, high-relief topography can cast shadows in the optical images and cause geometric DEM distortions in radar images due to foreshortening and layover effects."

Section 3.3.1 and Figure 5: approach vs. differencing strategy: The terms "self-processed", "DEM pair" (Fig. 5: "Pair"), "DEM mosaic" (Fig. 5 "Mosaic"), "DEM time series" (Fig. 5. "Time series") are sometimes called "strategy", sometimes "approach", sometimes the approaches include "DEM" sometimes not (Fig. 5). To make the manuscript easier to read, try to use consistent terms and call them all approach OR strategy. The different approaches could be described in individual subsubsubsections or, maybe preferably, in a list so that the reader can quickly find the referenced approach.

Response: Agreed. We corrected the text and figure 5 and consistently used the term “approach” throughout the paper. We prefer not to add a list of the different approaches, and we clarified that a detailed description of the adopted approach is provided in the supplementary table of each group.

l. 352: "tilts in range": Replace "in range" by "in the DEM" and add reference (Krieger, 2007). Even though the tilt appears mainly in across-track direction (ground range), along-track variations of the baseline errors result in along-track tilts. Both tilts sum up to some tilt of the DEM.

Response: Done. Thank you for the clarification.

l. 388 check sentence: "(...) in areas with low backscatter or even below the noise-equivalent-zero." -> "in areas with backscatter below the noise-equivalent-zero". End of line: "in in" -> "in"

Response: Done.

l. 391: "artifacts can be detected and removed": remove "and removed" or replace with a more suitable term. e.g. "filled", "corrected", ...

Response: Done.

l. 408: "large for dry and cold snow and ice": remove "and ice". Because for blue ice, the apparent penetration depth is almost zero because almost all scattering occurs at the air/ice interface - even though there is significant energy transfer into the ice volume (but this energy is not scattered back but absorbed in the ice).

Response: Done. Thank you for the explanation.

l. 408 "and increased moisture content": you could even say: "penetration depths decrease significantly/drastically with increasing moisture content".

Response: Done.

l. 512: "The TanDEM-X results show different signals in the large accumulation area, with several results indicating more negative elevation changes(...)": it is not clear what "different signals" exactly means. It seems you could shorten this sentence to "The TanDEM-X results indicate more negative elevation changes in the accumulation area ..."

Response: Done. We applied the suggestion by specifying that “Most of the TanDEM-X results indicate...”

l 702: "acquired at the end of the glacier ablation period provides maximum control during the processing workflow." - This seems to be the best choice for ASTER, but, according to the discussion l.647-648, for "radar data, winter DEMs were preferred". Please add this information here.

Response: Agreed and added it in the text.
"As such, a pair approach with two high-quality DEMs, with few data voids, acquired at the end of the glacier ablation period for optical data, or winter DEMs for radar, provides maximum control during the processing workflow."

l. 758: "In general, we can conclude that the selection of DEMs close to the annual mass-balance minima (around the 1st of October for northern mid-latitudes) is a good strategy to reduce the impact of differences in survey periods.": I think this is best for optical data (ASTER), but as discussed in l. 653-658, for radar (TanDEM-X), selection of DEMs up to 2-3 months after the mass-balance minimum (Dec - Jan for northern mid-latitudes) results in elevations close or even slightly below the elevation at the anual mass-balance minimum because of penetration through the fresh winter snow and even into the refreezing firn and thereby provides the smallest impact when differences in survey periods need to be corrected.

Response: Thank you. Agreed and implemented.
"In general, we can conclude that selecting optical DEMs close to the annual mass-balance minima (around the 1st of October for northern mid-latitudes) is a good strategy to minimise the impact of differences in survey periods. For radar (TanDEM-X), we recommend selecting DEMs after the mass-balance minima, up to 2-3 months later (i.e., Dec - Jan for northern mid-latitudes) when elevations are close to or slightly below the elevation at the annual mass-balance minima due to penetration through the fresh winter snow and even into the refreezing firn."

l. 760 "can be an option": Please differentiate also here: This is only an option for optical data. Radar DEMs show the highest variability (due to snow melt) and uncertainty (due to low backscatter) close to the annual mass-balance maxima.

Response: Agreed and implemented.
"DEM selection close to the annual mass-balance maxima (between March and May) can be an option only for optical data, as radar DEMs show the highest variability (due to snow melt) and uncertainty (due to low backscatter). However, even with optical DEMs, variability is high depending on the accumulation history, and it is more subject to material density uncertainty associated with the elevation change to glacier mass change conversion. In any case, selecting the same season for start and end dates is important to avoid bias in the derived trend."