

## **Annual to seasonal glacier mass balance in High Mountain Asia derived from Pléiades stereo images: examples from the Pamir and the Tibetan Plateau (tc-2022-264)**

**By Daniel Falaschi et al.**

### Reply to anonymous referee#1

The paper deals with mass inter- and intra- annual ballance of glaciers in High Asia focusing at two sites one in Eastern Pamirs and the second in the central Tibetan Plateau. It uses Pleiades stereo data for derivation of DSMs which are compared by differencing. A number of corections are applied prior to the differencing. Findings for the two specific sites are presented. Several auxiliary methods are utilized such as classification of snow type from Sentinel-2 data for detection of the accumulation type of gaciers or Glacier Index. The potential of Pleiades data to monitor mountain glaciers is dicussed.

The manuscript has high scientificl quality and is recomended for publication with minor changes.

We thank the reviewer for the positive review of the manuscript. Below we provide an inline response to each comment.

#### **Minor comments:**

**35: Consider using the name “Nyenchen Tanglha Mountains” instead of “Nyainqêntanglha” as it is widely used in the literature. The Chinese version has more than variants for instance “Nyainqentanglha” in Bolch et al. 2010. The English version is unambiguous and appropriate.**

We thank the reviewer for the suggestion. The name “Nyainqêntanglha” is well established in the international literature, but agree that it would be beneficial to add also the English name. Were therefore will add “Nyenchen Tanglha” in the study site section for clarification purposes.

**140: Use larger font for the coordinates around on the map frame and remove left and bottom coordinates as they are duplicates.**

Many thanks for the suggestion. We will remove duplicate coordinates and increase the font size of the grid labels. We will also thicken the glacier outlines and reduce the transparency for better visibility of the figure.

**190: What is the meaning of the “oversampled GSD”? Does this mean that the real spatial resolution is different? For how much?**

With “oversampling” we meant that Pléiades panchromatic scenes are acquired at 0.7 m pixel resolution, yet they are delivered at an (increased) ground sampling distance (GSD) of 0.5 m. Whilst we had originally explained this in the main manuscript, we will omit the word “oversampled” for simplicity.

**220: “it can be reduced to a few decimeters after DEM coregistration” This needs a citation.**

The citations for this statement are actually in the previous line. We will amend the text to clarify this.

**205: The sentence starting with “Such is the case of...” is somehow abrupt.**

We will reword this for improved reading.

**210: Table 1: add column  $\Delta t$  for each site to show what are the time differences. Otherwise, the reader is forced to do an awkward calculation.**

We thank the reviewer for the suggestion. We will include an additional column in the table, showing the elapsed time interval in years between consecutive Pleiades acquisitions over each study site.

**220: You should expand “AMSAG” if it is an abbreviation.**

We will add the full name (automated snow mapping on glaciers) of the ASMAG tool.

**240: three sentences starting with “According to ERA...” are not well understandable. Please reword.**

On the grounds of excessive manuscript length, we plan to reduce the length of the manuscript by a fair amount, and hence changes can be expected. We will keep this paragraph in mind when amending the draft.

**250: What was the source of the SLA?**

The snow line altitude is derived from ASMAG itself. We will clarify this in the text.

**280, 285: This paragraph is cryptic. Please reword it.**

On the grounds of excessive manuscript length, we plan to reduce the length of the manuscript by a fair amount, and hence changes can be expected. We will keep this paragraph in mind when amending the draft.

**295: “appreciated” to “seen”**

We will change this to “observed”.

**295: In Figure 2 the (c) and (d) and (e) and (f) are not localized. Are these subsets at terminus or in the summit part of the glacier? Please make this clear.**

The c-f panels depict glacier details that are too small to be annotated in panel a-b. We will clarify the general location of these sites in the figure caption.

**295: Figure 2 caption: “in the in the Muztag..”**

Thanks for noting this typing error. We will correct this in the text.

**305: the sentence “According to the authors” should be merged with the previous sentence.**

We will rephrase and merge these two sentences for better reading.

**385: You can remove the sentence “Alternatively Belart et al...” as it is not needed.**

We plan to keep this sentence, as it gives the necessary background on why we have neglected ice dynamics on the firn densification approach and the mass balance calculation overall.

**425: Why not using the classification of glaciers on the Tibetan Plateau based on the accumulation regime by Maussion et al. 2014?**

**Maussion, F., Scherer, D., Mölg, T., Collier, E., Curio, J., & Finkelburg, R. (2014). Precipitation seasonality and variability over the Tibetan Plateau as resolved by the High Asia Reanalysis. *Journal of Climate*, 27(5), 1910-1927.**

We thank the reviewer for the suggestion and agree that in principle, the glacier accumulation regime classification of Maussion et al (2014) would be another dataset that could provide further insight to our findings. In the first place, however, this approach is based on the High Asia Reanalysis, which covers the period 2001-2011. On one hand, Zhu et al., 2018a showed that accumulation on Muztag Ata N15 Glacier varied greatly on a yearly basis, with some years showing either summer or winter accumulation. On the other hand, Huang et al. (2022) found relevant discrepancies in accumulation regimes for some regions across High Mountain Asia (being Eastern Pamir-Muztag Ata a prime example of this mismatch) as derived from gridded reanalysis data (e.g. HARv2) on one side, and the SAR-derived glacier Index (see section 5.2; lines 668-688). With this in mind, we chose the Glacier Index of Huang et al (2022) to follow an approach which would allow us to derive an accumulation regime for our own surveyed years (2019-2022). More so, with the Glacier Index we use a third validation method fully independent from reanalysis data to validate our geodetic estimates.

**650: “in-balance”, would it be better to use “balanced” instead?**

Thanks for the suggestion, we will change this to “balanced”.

**References cited in this reply:**

- Huang, L., Hock, R., Li, X., Bolch, T., Yang, K., Wang, N., Yao, T., Zhou, J., Dou, C., & Li, Z. (2022). Winter accumulation drives the spatial variations in glacier mass balance in High Mountain Asia. *Science Bulletin*, S2095927322003644. <https://doi.org/10.1016/j.scib.2022.08.019>
- Maussion, F., Scherer, D., Mölg, T., Collier, E., Curio, J., & Finkelburg, R. (2014). Precipitation Seasonality and Variability over the Tibetan Plateau as Resolved by the High Asia Reanalysis\*. *Journal of Climate*, 27(5), 1910–1927. <https://doi.org/10.1175/JCLI-D-13-00282.1>
- Zhu, M., Yao, T., Yang, W., Xu, B., Wu, G., Wang, X., & Xie, Y. (2018). Reconstruction of the mass balance of Muztag Ata No. 15 glacier, eastern Pamir, and its climatic drivers. *Journal of Glaciology*, 64(244), 259–274. <https://doi.org/10.1017/jog.2018.16>