Annual to seasonal glacier mass balance in High Mountain Asia derived from Pléiades stereo images: examples from the Pamir and the Tibetan Plateau

Falaschi et al. TC Discussion
Review by César Deschamps-Berger

This article presents a time series of three annual and two seasonal mass balances for two glacerized massifs in High Mountain Asia. In line with previous studies, it is found that the Pamir glaciers have a mass balance close to equilibrium between 2019 and 2022 while the glaciers from the Tibetan Plateau have a negative mass balance. Various satellite products (Pléiades, Sentinel 1 and 2) were combined to identify the surface elevation change and the accumulation and ablation areas. The snow/firn density and the firn densification are taken into account based on field measurements. The authors put the measured mass balance in longer time scale context and improve the description of the glacier accumulation regimes. It is a detailed work which combines advanced methodologies with good knowledge of the region. I think this article will be a valuable contribution after the following main concerns are addressed.

Thank you for the overall positive assessment of the manuscript and for the critical but supportive comments.

1. The winter elevation changes show disturbing patterns (Figure 4, 6 and blue lines in Figure 5). In Western Nyainqêntanglha, elevation loss in winter are stronger at the highest elevation. On the contrary, elevation loss in winter are measured in the Muztag Ata between 6000 m asl and 7000 m asl with areas of elevation gain below and above. Are these elevation change significant or within the calculated uncertainties? What process could explain such altitudinal distribution of elevation change? I wonder if it could be related to remaining errors in the elevation change map (jitter correction, gap filling, shaded areas, see areas highlighted below). Jitter correction might not be perfect due to the lack of stable terrain, especially for Muztag Ata. Better highlighting and explaining these errors might impact the conclusions on the accumulation regimes (e.g. L496, 5.2) and on the sources of uncertainty of the mass balance estimation (e.g. L595-601 and 5.1.2). Left: Figure 4. c. Muztag Ata; Right: Figure 6.c. Western Nyainqêntanglha,
We are grateful to the reviewer for dwelling in the detailed analysis of the elevation change grids. In response we have carefully inspected all elevation change tiles and actually detected more problematic maps than those in the review Figure. To our knowledge, the effect of satellite (Pléiades, ASTER) jitter varies on a region- and year-specific basis. We are in possession of Pléiades data acquired over other mountain regions, which do not show such strong jitter effect compared to the dataset used in the present study. We agree that limited stable terrain might be responsible for a non perfect jitter correction (and vertical coregistration, for that matter). However, upon examining our grids, we nevertheless came to the conclusion that the artefacts in our elevation change grids were not necessarily the consequence of remaining errors in the jitter correction, but probably more related to the void filling procedure. We are currently exploring different possibilities of void filling on all the problematic grids.
In Muztag Ata, we inspected and identified the elevation bins that showed artefacts (paying particular attention to the bins showing very high elevation gains). We will amend the dh grids by removing cells exceeding the mean value ±3σ. This basically means applying the method of GArdelle et al. (2013) for the problematic bins.
In the case of the Western Nyainqentnaglha grids, we examined the problematic winter 2022 elevation change grid in detail and noticed that at the uppermost elevation, there are negative elevation change values of local extent that are most probably related to crevasses and maybe wind-blown snow to a lesser degree. These are valid cells in the "raw" elevation change grids (with no corrections applied) and in our opinion they should not be treated as outliers. They do not look like random or high slope-related artefacts, nor do the Pleiades scenes look especially saturated in those areas. In addition, these negative change areas are not placed in shadowed areas. The problem in the void-filled grids arises as there are relatively few valid cells at similar elevations (these are the highermost reaches of the entire

Western Nyainquetanglha study area). The glacier-wide void-filling polynomial fitting thus gives too much weight to these negative values, and fills in the large voids in the saturated areas with rather negative values. This gives the wrong impression that all of the upper part of the glaciers has gone through significant thinning at high elevation during that period. To solve this, we will remove the few highly negative elevation change values in the uppermost reaches and adjust a new function. In doing so, we will resample the elevation bins to 25 m so that sufficient bins are available for a representative fit.
Whilst we acknowledge that some of the mass balance estimates might change (final calculations need to be redone at this point), we doubt that this will have an overly large impact on them, and will most probably not alter any conclusion on the proposed accumulation regimes.

2. I estimate that this manuscript would result in an article of more than 20 pages. The article readability would benefit from being more concise. I would advise the authors to revise the manuscript with that in mind. Some of my minors comment should help to gain space (e.g. L89, L108, L125, L194, L283...). If a radical choice was to be made, moving to supplement or removing the parts about the correlation of mass balance with climatological variables might not alter the value of the article. It is almost a distinct topic from the core of the article (see title). The data used partly come from other articles and finally, few (or no) significant correlation are found.
We appreciate the reviewer's concern for the overall readability of the manuscript. We will do a conscious effort to reduce the paper length by keeping in mind the suggestions made by the reviewer, and will put an additional effort to shorten each section wherever possible, writing in a more concise way. We think that this approach is preferable over moving entire sections of the manuscript regarding climate analyses to the supplementary material.

3. The quality of the figures should be improved. Almost all the plots with lines are hard to read due to the style and colour of the lines. For instance, it is very hard to distinguish several lines of Figure 5, the individual glaciers in Figure 7, Mass balance from Solid precipitation in Figure 8. Select better colour and line style.
Based on these comments and the critical review by the other reviewers, we will introduce changes to all figures to improve visibility. Specifically, in Fig 5 we will increase the font size and increase the line thickness. We will incorporate color-blind friendly palettes for plots. In Fig 7 we will increase the font size and line thickness. In Fig 8 we will change the color from solid precipitation and separate the results from this study against previous ones. In Fig 9 we will modify the figure by changing the color of the annual time step lines for an improved visualization. Please see the specific replies to Figure suggestions toward the end of this document. Since we do not know the final sizes of the figures at this stage, we are happy to introduce further modifications to the figures in the production stage shall this manuscript be accepted for publication.

Minor comments and suggestions
L26. Pléiades. Throughout the text.
We will correct this accordingly.

L31. delete « previously observed »
If this clarification is removed, then it would seem that the mass balance records from the last 6 decades was generated in this study, which is clearly not. We chose to keep this in the text.

L32-33. delete « *on average* ». « *mean*» is already stated at the beginning of the sentence.
We will correct this accordingly.

L33. « *increased* » compared to what?
Good point. We will add "to the previous ~6 decades" (which is the period covered in Battacharya et al., 2021))

L33. Why is Western Nyainqêntanglha qualified here as summer accumulation type when summer mass balance (-0.66 m w.e.) is more negative than the winter one (-0.04 m w.e.)? Besides,

this conclusion (Western Nyainqêntanglha being summer accumulation type) seems based on other studies in the dedicated Discussion paragraph (L696-698). « *The 2022 winter (+0.21 ±0.24 m w.e.) and summer (-0.31 ±0.15 m w.e.) mass budgets in Muztag Ata and Western Nyainqêntanglha (-0.04 ±0.27 m w.e. [winter]; -0.66 ±0.07 m w.e. [summer]) suggest winter and summer accumulation-type regimes, respectively.*» I suggest rephrasing as: « The seasonal mass balance in Muztag Ata (winter: XX m w.e., summer : XX m w.e.) and Western Nyainqêntanglha (winter: XX m w.e., summer : XX m w.e.) suggest... ».
We acknowledge that W. Nyainqentanglha is actually located in a transition area between the monsoon-dominated glaciers in the SE Tibetan Plateau and Himalaya and the westerlies-dominated glaciers to the Northwest (see e.g. Bolch et al. 2010, TC or the recent paper by Zhu et al., 2023 in GPC). Whilst we reckon that the winter mass balance estimate (-0.04 m w.e.) in W. Nyainqentnglha must yet be corrected (due to the artefacts in the elevation change maps), we did not observe elevation gains in the uppermost reaches of the glaciers. Yet, the summer elevation change panel in Figure 6 (see also Figure 5) does indeed show elevation change that can be attributed to accumulation, which is not the case in the winter panel. Zhang et al (2013) clearly show that in W Nyainqentnglha, accumulation trough precipitation is higher in summer than in winter, but contemporary mass losses though runoff and evaporation can exceed mass gains and lead to a strongly negative mass balance. We interpret this as the reasoning for the observed mass balance in our study. We will clarify the information about the accumulation-type in the revised manuscript.

L80. Not only WorldView-2 (see Shean et al., 2020). Simply put « WorldView ».
Changed

L86. Deschamps-Berger.:)
Many thanks for noting; we will correct this accordingly.

L89. «*(e.g. Ice, Cloud and land Elevation Satellite-2 -ICESat-2)*» ICESat-2 is not further used. Give only the acronym.
We will change this accordingly

L92. Quit the brackets.
In general, and following the suggestion by another reviewer, we will go throughout the manuscript and will remove redundant and unnecessary brackets for an improved readability.

L96. «*displayed dissimilar mass change rates*.» precise over which epoch, otherwise it sounds like an article's result is given away.
We will add the six decade period

L97. « *mass balance for longer period* » Longer than what?
We will rephrase this part of the text for clarity.

L104. In 2.1., provide the max elevation as in 2.2. Tell if the whole massif is covered.
We will rephrase this to incorporate the maximum elevation of Muztag Ata Mountain.

L108. Delete «*(along with the nearby Kongur Shan mountains).*» It is never mentioned again.
We will remove this accordingly

L124. «*glacier ice*»
We are unsure about what this particular correction is, Can you please clarify?

L125. «*Glaciers in the arid NW Tibetan Plateau are predominantly continental-type, cold–based (with their basal part entirely below the pressure melting point) and receive little precipitation.*» Might be deleted? All these informations are repeated in the next lines.
Good point. We will delete this accordingly

L131-134. Give periods for each mass balance epoch, confusing otherwise.
We will add the year 2009 and 2019 as the start and end (according to the literature) of the slight mass loss period in Muztag Ata.

L147. « *~230 km in length reaches* » => « extend over ~230 km in length and reaches... »
We will correct this accordingly.

L163. « *in their model* »? An energy balance model is not a source of information about precipitation.
We will correct this accordingly.

L165. « > » => « more than ». Delete « here ».
We will correct this accordingly.

L168. Why use []? And why « accelerated »? compared to what?
We will rephrase the sentence and include time intervals to clarify the accelerating rate of glacier mass loss.

L170. Keep giving MB with two digits precision « (–1.0X m) ».
We thank the reviewer for the suggestion. We will amend the manuscript in this regard based on the provided citations.

L172. « *Zhadang glacier* » first time it is mentioned. Introduce shortly the glaciers of interest (size, specificities).
Many thanks for the suggestion. We will introduce Zhadang Glacier and includ it in Figure 1.

L192. Delete « *relatively* ».
We will delete this accordingly

194. « *separated in time on most occasions (Table 1). In all cases, partial acquisition dates were no more than 2 weeks apart.* » => « separated by two weeks in the worst case (Table 1).»
We will correct this accordingly.

L195. Was the DEM produced in one run from the raw stereo images to a high-resolution DEM? A common practice to reduce errors is to first project the images on a low-resolution DEM (idea for future work).
Yes, the DEMs were generated in one run from the raw stereo images as described. Whilst generating the DEMs using the suggested approach again might be an excessive amount of work for this study, we thank the reviewer very much for the methodological tip for future work!

L196. « *implementing* » => « using »
We will correct this accordingly.

L197. Why «although»? The first part of the sentence refers to a method of this work, the second refers to results from other studies. Grammatically hard to understand.
This is correct. We will remove the word although.

L200. « *Pléiades DEMs are currently amongst the most common very high resolution DEMs used in geodetic mass balance assessments* ». Maybe not necessary as there are anyway few high resolution photogrammetric satellite and studies exists with WorldView (Shean et al., 2020).
We will remove this accordingly

L203. « *beyond the higher spatial resolution,* » not true for WorldView satellites, could be deleted.
We will delete this accordingly

L205. ***«saturated areas»*** **=> « areas prone to saturation »**
We will correct this accordingly.

L209. Did you request that the images were acquired with reduced Time Domain Integration (TDI)? It can help preventing saturation (Deschamps-Berger et al., 2020).
No, we did not require this option to be active during our acquisitions, but many thanks for the suggestion. We have now two sources that recommend this specific setting for the next acquisitions. Upon reviewing the AIRBUS image acquisition request form, however, we noticed that this is not explicitly shown as an available option. We understand that only by adding it as an additional comment may work.

L223. I understand that the lower resolution saves computational time but less the number of images. Is the opening and closing of the images really a bottleneck in the treatment?
This is an interesting question. We used the ASMAG algorithm, whose current version can incorporate Landsat and Sentinel-2 scenes. It has not been adapted for Pleiades images yet. We will clarify this in the manuscript. Moreover, we had to modify the existing code so that it could open and read Sentinel scenes from the two sources we used (EarthExplorer and the Copernicus Hub). Since the Sentinel image files are structured differently depending on the source, this required independent processing for each image source.

L232. delete « ***see also*** **»**
We will delete this accordingly

L235. «*To this ends, it implements an automatic threshold to the near-Infrared*» => « It determines automatically a threshold for the NIR band values ».
We will correct this accordingly.

L241. Move the « Muñoz » citation after « daily data ».
We will change this accordingly.

L257. Delete « see e.g. ».
We will delete this accordingly.

L260. Move the UTM info somewhere else more generic.
We will delete this part of the sentence, since it is of little relevance really.

L265. In future work, you might want to first co-register your reference DEM to an external reference (e.g. Copernicus DEM) to ensure a better absolute co-registration.
Good point. Many thanks for the tip for future work!

L269. «*reprocessed 2019 Pléiades DEM from Bhattacharya et al. (2021)*» is confusing. Was the 2019 DEM eventually calculated like the others of this study? Then, the Bhattacharya reference could be deleted. Maybe, the link between this study and Bhattacharya et al. (2021) should be better explained in introduction. At least better introduce the Bhattacharya et al. (2021) study as some products are used here (L 472).
This is a valid question and the writing was indeed confusing. The 2019 DEM from Bhattacharya et al were originally processed using commercial software. Our 2019 DEMs (to which all later DEMs were coregistered) were newly generated using the Ames Stereo Pipeline as written in the manuscript. We will reword this paragraph to avoid any confusion.

L270. Which metric is used to correct the vertical biases? The mean, the median?
As per Nuth and Kääb (2011), the metric used to correct biases is the mean value on stable terrain. During the preparation of the study, we also tried DEM coregistration using the algorithm of Berthier et al. (2007, RSE), which we run using the median value of the elevation changes on stable terrain. This provided coregistration results of lower quality compared to Nuth and Kääb (2011).

L271. Delete « *(reference)* »?
We will delete this accordingly

L275. «*implemented*» to be clarified. It sounds like you implemented the code (i.e. wrote the code). However in the acknowledgement the tools of Etienne Berthier are mentioned. Also note that it is a different method than the one used in Deschamps-Berger et al. (2020). The first one fits polynomial functions to the residual while the second calculates and modifies the Fourrier transform spectrum of the residual. Make sure which one was used or implemented.
We greatly appreciate the reviewer's insight into these methodological differences. Indeed, we used the tools of Etienne Berthier, which f, it a spline function for correcting the systematic bias, and included the reference of Falaschi et al. (2023).

L277. « *on- and* » missing blank
We will correct this accordingly.

L283. « *We chose a 3-cell buffer so as not to remove valid cells from the original dDEM grids.* » This kind of sentence could be deleted to make the article more concise.
We will remove this accordingly

L284. « *mosaiced*»? merged? How are managed areas where there is overlap between tiles (concisely)?
From our understanding, the correct term should be *mosaiced* as these are raster files and this is the GIS operation that we have used. For the overlapping areas, we opted to use the average value of each grid elevation change. Void filling and firn densification correction were carried out on each elevation change individually before final mosaicking. Finally, since we applied a seasonality correction to adjust each grid to the hydrological year, using the mean elevation change on overlapping areas seems a technically sounding approach. We consider that any uncertainty owed to this should be within the overall elevation change uncertainty. We will include these clarifications in the text.

L305. « *in the energy balance model comprising Muztag Ata N15 and Zhadang glaciers (in Muztag Ata and Western Nyainqêntanglha districts, respectively) by Zhu et al. (2018a). According to the authors, this density value was retrieved from snow pits.*» Maybe no need to repeat the districts if the glaciers are introduced before. Why mention the energy balance model if the density actually come from pits measurements? Merge sentences concisely.
We will remove the district reference. We will amend this part of the text to avoid mentioning energy mass balance, but still pointing at the in-situ surveys mentioned in Zhu et al (2018a).

L318. « time interval » dt might be more clear than *t*?
We will change to dt

L321. Eqn (2) « k » is missing. Replace «i»?
Thanks for noting. We will discard k and keep i in the equation instead.

L326. It is not clear what the « i » of Ai refers to? Ice? The previous sentence mentions ice and snow areas.
We will remove the "i" in Eqn3. By using the i, we originally intended to make it clear that we considered the accumulation and ablation areas independently for the mass balance calculation.

L330. I cannot find easily in this paragraph if the correction is applied on a pixel scale or at the firn area scale? Please clarify.
Good question. We applied the correction on a pixel scale and included this information in the text.

L346-347 () [] to homogenise
We will correct this accordingly.

L346. «*most recent elevation grids available* » => « most recent elevation change grids »? Since period are provided in brackets (2013-2019, 2018-2019).
Yes, we will correct this accordingly..

L374. « *is not to be expected* » => « is not expected ».
We will correct this accordingly.

L395. what does « *addressed* » mean? Calculated, defined?
We will change this to defined

L397. By construction, the mean elevation difference over stable terrain is zero or close to it. Depending whether the mean or median elevation residual was used for vertical coregistration (to be added in 3.1.4). This underestimate potential systematic error. Besides, I do not find sigma_sys further in the uncertainty calculations.
In our study we have assessed both systematic and random uncertainties. Systematic and random uncertainties need to be determined separately (see the original reference of Koblet et al, 2010) in the manuscript. Our systematic uncertainty estimates are displayed in Table 2, whilst the corresponding calculation is given in Eqn 5. As per the Nuth and Kääb (2011), the mean elevation residual on stable terrain is used to perform vertical coregistration. It is our opinion that the relatively small stable terrain areas around our glaciers causes a systematic uncertainty in some of the elevation change grids. In Table 3, the ±values refer to the random uncertainty, which are calculated from Eqn 7.

L410. Delete « *see also* »
We will delete this accordingly

L415. Eqn 7. What is « f »?
Thanks for noting the absence of the definition for $f_{\Delta v}$. $f_{\Delta v}$ **is** the volume to mass conversion factor of ice and snow. We will add this to the text.

L424. Huang et al. (2022) missing in the bibliography.
The citation is correct. We simply had written the wrong year in the reference list. We will correct this accordingly.

L433. The index
We will correct this accordingly.

L433. Please repeat that firn area is measured at the end of the winter and the wet snow area at the end of the summer. Or clarify this point if I misunderstood.
We will add this accordingly.

L449. « the influence of XX to YY » Is this grammatically correct? Otherwise replace «*to govern*» by «on».
We will correct this accordingly.

L452. Put the citations at the end of the sentence. Why mentioning the period of availability of the data? Idem L463.
We will move the citation and remove the reference to the data availability

L456. Delete « *either* »?
We will delete this accordingly

L458. Cite APHRODITE along with ERA5, HARv2 in the previous sentence and delete « (APHRODITE, ERA5, HARv2) » in this one.

We will add APHRODITE along with ERA5, HARv2 in the first sentence and removed all the datasets in the second one.

L459. «*(or instrumental records*» to delete
We will delete this accordingly

L461. «*Muñoz-Sabater*»
We will correct this accordingly.

L463. « *to monthly time step* » Was ERA5 initially at a daily or monthly time step? Mention it in the previous sentence.
This information is stated in line 455 of the preprint.

L468. «*found*» => « calculated »?
We will correct this accordingly.

L468. Redundancy with « mean » and « average » in the same sentence.
We will correct this accordingly.

L472. « *added the geodetic mass balance values in Bhattacharya et al. (2021)* » see comment about L269. I understand that data from Bhattacharya et al. (2021) are not at a yearly or seasonal resolution. Do you think that mixing periods of different durations could have an impact on the correlation calculated?
Mixing periods of different durations might certainly affect the correlations. However, we think that the small number of observations overall available (considering both Bhattacharya et al (2021) and our study) is the main limiting factor that does not allow to obtain correlation coefficient values that are statistically significative. We will comment on this in the manuscript.

L481. Cite « Table 3 » only once in this paragraph.
We will correct this accordingly.

L483-484. Please provide value in brackets for each year. Or alternatively do not provide any.
We will add the missing values in brackets.

L486. « *the (largest and debris-covered) Kekesayi Glacier* » hard to read. Rephrase without ().
We will remove this, as is it was anyway introduced in the study area section

L502. « > » => «above»
We will change this accordingly

L510. « *but interestingly, recovered during the 2022 winter season* » why is it interesting? It slightly implies that there is a causal relationship between the summer and winter mass balance.
The reviewer is correct. We therefore removed this statement.

L546. 2019 does not seem to be an extrema for wet snow area ration in Muztag Ata in Figure 7. Why would it be the most negative mass balance year?
We did not actually produce geodetic results for the hydrological year 2019. Whilst we reckon that our earliest dataset stem from 2019, in the study we actually assess the geodetic mass balance of three hydrological years (2020, 2021 and 2022). The hydrological year 2020 starts in 2019, so this issue is a bit tricky. We will clarify the issue with the hydrological year in the text.
It is actually the hydrological year 2020 which has the most negative mass balance (-0.19 m we), and has also the smallest wet snow area ratio except for the hydrological year 2022. Both years have rather similar Glacier Index values, so we do not necessarily see a contradiction between the Index and the mass balance data.

L561 « *departures* » => anomaly
To our knowledge, it is perfectly acceptable the use of departures as a surrogate for anomalies. We originally tried to use both terms as not to constantly repeat the same word, but in the end decided to use anomaly in the manuscript only.

L565 « *Of the last 16 years, summer air temperatures have experienced positive anomalies.* » To be deleted? This is expected from a series of anomalies. Maybe the number of summer with positive anomalies is missing.
Yes! Many thanks for noting. We were missing the number of years with positive anomalies. We will correct this accordingly..

L567. «*rather strong (though not significant*...» It is hard to interpret this results.
We will delete "rather".

L570. « *respectively* ». Move « *scale* » before the brackets.
We will move this accordingly

L571. « *likely had an impact* » => « contributed to »
We will correct this accordingly.

L571. Is « *in turn* » necessary?
We will delete this accordingly
L587. Cite a study which used this method. One that comes to my mind is Nuth et al. (2013,10.3189/2012JoG11J036) but there must be others.
Many thanks for the reference. We will cite it as suggested.

L588. «glacier-wide» sounds like a single glacier. Maybe find another term like massif-wide? Check throughout the manuscript.
To our knowledge, the term "glacier-wide" is fully accepted in the literature to refer to all glaciers or all glacier ice area. See for example McNabb et al (2019), a study that we reference in the context of the usage of the term glacier wide.

L594. Give respectively, the value for each glacier.
Do you mean the triangulation residuals for each glacier? It would seem to us an overkill (and of little added value) to provide the residuals for 117 glaciers in W. Nyainqentanglha and 86 glaciers in Muztag Ata, even in a supplementary Table. We have provided the residuals for the full glacier area and illustrate the variability with other 4 glaciers.

L607. How can two scenarios with the same dh grid but different densities result in the same mass balance for Muztag Ata?
This was a simple typo since values were very similar but still different. We will correct this accordingly.

L615. I would rephrase in: « variable density should be used for time spans of 3 years or less. » No conclusion can be drawn on longer time span periods since solely a 3 years period is studied here.
Agreed, we will correct this accordingly.

L630. Too long phrase.
We will split the sentence in two shorter ones.

L633 « *bias* » => errors. Bias often refers to systematic error.
We will correct this accordingly.

L641 « Around our reported biases, » rephrase. Does bias means error?

Yes, we will change to errors.

L642. Delete +-, the standard deviation is a single value, not a range of uncertainty.
That's correct, we will delete this accordingly

L644. Cite Höhle and Höhle (2009, https://dx.doi.org/10.1016/j.isprsjprs.2009.02.003) along with Dehecq et al. (2016).
Many thanks for the reference, we will add it in the manuscript.

L656. First paragraph of 5.2. It sounds like an introduction paragraph not a discussion one. Maybe only keep the first sentence.
This is a good point, and a simple mean to shorten the manuscript as pointed out earlier in the review. We will keep the first sentence of the paragraph only.

L666. Too long sentence.
We will rephrase and shorten the sentence.

L674. « *as* » => that.
This actually needs to be changed to "at"

L686. Avoid intricating () and [], please rephrase.
We have gone throughout the manuscript and will make a conscious effort to remove unnecessary or redundant parenthesis and brackets, and split long sentences into shorter ones for better reading. Among these amends are the specific lines indicated by the reviewer above.

L688. No undercatch of the weather station is expected ?
There is a possibility of undercatch like for many other weather stations. The very low precipitation is however, consistent with gridded climate data and also the vegetation in the region. Even if the precipitation would be twice as much there would still be a huge difference to the precipitation at the top of the mountain.

L691. « *have allowed us* » => allows
We will change this to allowed

L700. « *too* »=> also
We will correct this accordingly.

L711. «*Several of the stronger correlations between glacier mass balance and temperature and solid precipitation were not significant,*» Which one were significant ?
Actually, only the correlation between annual temperature anomalies in W. Nyainqentanglha and mass balance was significant at the 95% confidence interval. We will correct this accordingly.

L715. What is a « *relevant development* »? Not clear.
We will rephrase for clarity.

L757.« *trend* » sounds like there is a continuous decrease or increase of the mass balance while only two periods are compared. Replace with « period »?
Good observation, we will change to period.

L810. Provide the « period ». Idem as previous comment about the term «trend»
Not fully clear what is meant here. The periods are included in the manuscript: (-0.50 ±0.17 m w.e. a-1 between 2000 and 2014, Li and Lin., 2017; -0.60 ±0.19 m w.e. a-1 between 2000 and 2017, Ren et al., 2020).

Figure 1. Top panels : Legend for « investigated glaciers » does not match with the figure. The bottom panels should be merged to show both study sites on the same map. Consider changing the geographical features (topographical map ? countries borders ?), the colours and texts. It is blurry and very hard to read.
We will modify the figure, correcting the legend for investigated glaciers. We have will also merge both location maps into a single one to better illustrate the location of Muztag Ata and W. Nyainqentanglha in High Mountain Asia. The figure inset will feature a topographic map. We will also add the highest elevations on each study site. We have chosen not to include country borders based on the fact that this is a region where a number of border conflicts exist between several countries. We will still provide an overview of the relative position of the countries.

Figure 3. Which map is in winter and which one is in summer?
We will add winter and summer labels to the figure

Figure 4. f is not annual but multi-annual. I would put all annual mass balance on the upper row (move e map to c position).
Many thanks for the suggestion. We will move the panels as indicated.

Figure 5. Improve readability, change line colours, increase line width.
We will increase the font size and line thickness.

Figure 7. Hardly readable. Change the line style and/or the marker style.
We will modify the figure to make the plots larger in size, increase font size and line thickness, and use different line types for improved visibility.

Figure 8. Highlight which mass balances comes from this study.
We will distinguish the mass balance and solid precipitation/temperature anomalies stemming from Bhattacharya et al. (2021) from our own results in the figure using different line styles and colors.

Figure 9. Zhadang line style is too similar to annual time step of this study.
Many thanks for the suggestion. We will revamp the figure, using a color-blind friendly palette, and separating our results from previous studies using different line styles We will also increase line thickness and font size.

Table 1. Consider adding a « Difference (days) » column?
This was suggested by another reviewer too. We will add a column with the time interval (in years) between consecutive Pleiades acquisitions for each portion of the study sites covered by the Pleiades scenes.

Table 2. What are these values of SE 10-4? Cite Höhle and Höhle (2009) for the NMAD. Would be nice to have the same number of significant digits. SD and SE in full letter in the first line. Caption says on-glacier too but not found.
We will check the SE values. As suggested in one of the comments, we will cite Höhle and Höhle (2009) in line 650 regarding NMAD, and will write standard deviation and standard error in full letters. We will correct the figure caption, as “on-glacier” values were not included.

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