

Reply to Editor:

Dear editor,

Thanks very much for assessing our manuscript. We have carefully read the constructive comments given by you and tried our best to revise the presented manuscript and datasets accordingly. Please see the point-by-point reply for details. We wish to have a chance to send the revised manuscript to you for further consideration. Please do not hesitate to contact us if you have any further comments.

Sincerely,

Lei Guo

On behalf of all co-authors

2 February 2023

Comments:

1. Both the reviewers and the editors had requested that your dataset should clearly indicate where the glacier surges occurred. We have noted that you have changed the underlying glacier inventory and that you have trimmed the glacier to the area affected by the surge for further analysis. However, the outlines of the revised dataset is again that of the original dataset without this clear distinction between surge-affected and non-surge affected areas within a given glacier body. We encourage you to also provide your DEM difference products, i.e., those you show in Figures 2 and 6. One solution would be to provide spatially tiled grids (e.g., in $1^\circ \times 1^\circ$ grids) of the DEM difference products, or to provide grids for each glacier that you define as having a surge according to their names in the GAMDAM inventory.

Reply: Thanks for your suggestions. We have noticed that both you and reviewers have raised the issue of specifying the location of glacier surges. As Reviewer #2 commented that, we should at least separate the obvious surging tributaries from the very huge glacier complexes. In the presented inventory, we have already done this operation through a self-defined tributary separation strategy, as described in Section 4.3.3. We have also updated the outlines of some surging glaciers with obvious terminus advance through the elevation change map. Therefore, we need to clarify that we have updated the glacier outlines to indicate the surge-affected area in the presented inventory, by trimming the surging tributary and update the terminus position, which is not the original GAMDAM2 outlines anymore. Figure R1 shows the samples of the difference between the glacier outline in our inventory and original GAMDAM2.

However, the delineation of exact location of the active surge is actually too hard to complete. That would lead too much uncertainty as the elevation pattern is indeed a partly and incomplete presence of the surging process. Hope you could understand that.

Following your suggestion, , we have divided the DEM differencing results of surging glaciers into $1 \times 1^\circ$ tiled grids and uploaded them to the same data repository. Now it should be much easier for others to check our published inventory.

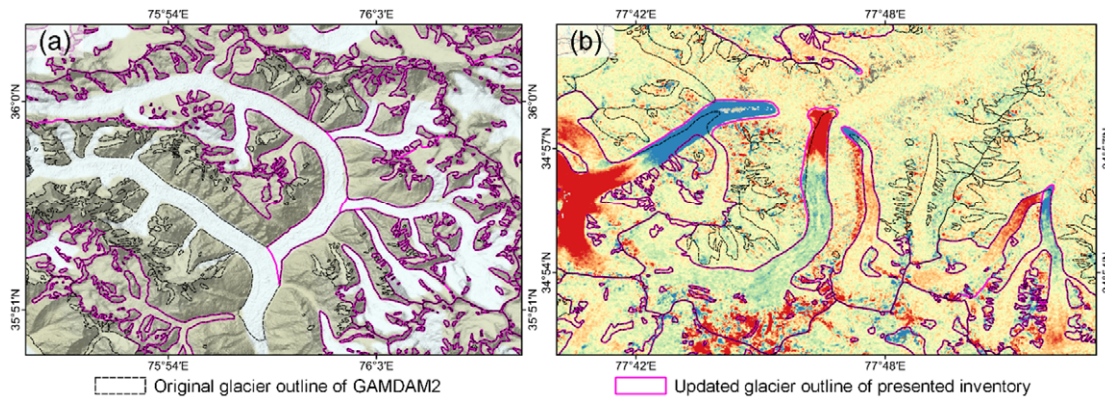


Figure R1: Samples of glacier outline difference in presented inventory and original GAMDAM2 inventory. (a): surging tributary separation (Panmah Glacier); (b) terminus position.

2. In addition, you might consider modifying your point feature dataset so that the point is centered on the glacier surface that had a surge.

Reply: Thanks for reminding. We have manually modified the point-feature inventory. Now the points are centered on the surface of surging glaciers. This dataset has been uploaded to the same data repository.

3. We also noted that in your discussion you could also address the study published by Vale and colleagues last year: Vale, A.B.; Arnold, N.S.; Rees, W.G.; Lea, J.M. Remote Detection of Surge-Related Glacier Terminus Change across High Mountain Asia. *Remote Sens.* 2021, 13, 1309. <https://doi.org/10.3390/rs13071309>

Reply: Thanks for reminding. We have added the detailed comparison with this study in the discussion section.

4. Finally, we wondered why you used a subset of the data when comparing glaciers with and without surges (L338-343). Since your analysis focuses primarily on data density and its statistical properties, perhaps you should use the entire data set rather than sampling from the distribution.

Reply: Thanks for your comment. We presented the comparison between all non-surging samples and surging samples in the text, and the subsampled dataset (reference group) was used for additional comparisons to illustrate the biases that could be raised by sampling strategy. In Figures 8 and 9, each comparison contained three groups of glacier samples, including non-surging glaciers (entire dataset), reference group (subsampled non-surging glaciers), and surging glaciers.

We found that the comparison between the surging and all non-surging glaciers is flawed, because the number and distribution of these two groups of samples are quite different. The number of non-surging samples is near 35000, about 35 times of the number of the surging one. Most importantly, among the non-surging glaciers, small ones (<3 km²) take up ~85%, while among surging glaciers the percentage is only 20%. If we considered the very small glaciers (<0.4 km²), this disparity is even larger (~94% vs ~22%). As glaciers of different sizes could show great discrepancy in the geometric attributes, the sample biases would lead to unreliable conclusions of the comparison. Hence, we added comparison with the reference group, among which the sizes of non-surging glaciers are closer to surging glaciers.

Moreover, we found that the comparison between all non-surging glaciers and surging glaciers could

only draw the conclusion that larger glaciers are prone to surge than smaller ones, which has been presented by previous studies. However, it is quite common that two glaciers have similar sizes which only one is surging. So we controlled the area distribution of the non-surging samples to find the potential reasons. We observed that the surging glaciers are generally steeper than the non-surging glaciers that have similar sizes, which has not been reported by previous studies.

Other changes:

In order to further improve the quality of the manuscript, we have also done some extra changes after careful check. Most of them are typos or language issues. All changes are highlighted in the updated manuscript.