Dear the Editor and Reviewer

Thank you very much for giving us the opportunity to revise and improve our manuscript. Many thanks also to your valuable comments. We have revised our manuscript accordingly. The revised text is in red in the manuscript. A point-to-point response to all the comments is provided below. The comments are copied in black text. Our responses are in red text.

Responses to Reviewer #2 Evaluations:

1. Surged glacier is an important concept in the paper and I think they need to define what is meant by Surged glacier with a paragraph early in the paper, maybe under section 1.3. As it is we suddenly meet surged glaciers for the first time in equation 8, line 335 and below. Surged and disappeared glacier is an important part of the analysis. Definition of surged glaciers is not obvious to the general reader. Surge is a periodic sudden advance of the glacier during a short time period of months to a few years. The glaciers have a long quiescent (up-building period) of several years between each active surge advance. Karakoram, Kunlun and Pamir are regions with high number of surging glaciers.

Response: Thanks for your valuable suggestion. The definition of surged glaciers has been added as "If a glacier occurs advancing from RGI 4.0 to GIC-Ⅱ, it is defined as a surged glacier. In detail, surge is a periodic sudden advance of the glacier during a short time period of months to a few years. The glaciers have a long quiescent (up-building period) of several years between each active surge advance" in Lines 125-128, and basic information related to the mountains has been added as "Karakoram, Kunlun and Pamir are regions with high number of surging glaciers." in Lines 140-141 in the revised manuscript.

2. Delete: "led by a distinguished expert in glacier studies in China", It is not appropriate to characterize the authors refer to. Just write: A study predicted that ...

Response: Thanks for your correction. The sentence has been changed accordingly in Line 48 in the revised manuscript.

3. Line 331-333. They write: "Meanwhile, the shear stress would also increase and basal sliding would accelerate, which is the key interpretation of how the glacier movement and deformation will develop.". I do not think this statement is correct, or at least it is more complicated. The basal shear stress depends on both the thickness of the ice and the slope of the glacier surface. When you have more melt and a thinning of the ice the basal shear stress will decrease, however, if the glacier gets steeper it will increase. It is not obvious that the basal sliding will accelerate. Rather opposite in the long run, as the glaciers get thinner, the shear stress will decrease and the basal sliding will decrease. The impact of the dynamics is not a part of this paper anyway so I think they should take out or rewrite these lines. The disintegration of the glaciers which is one of the points of this paper is more related to melting, thinning of the ice and lowering of the glacier surface than

to the flow dynamics. Also, in the Abstract, line 32 they write: “Pamir Plateau, which displays the highest trends of glacier movement and deformation.”. I do not understand this statement. Is this based on what they write in line 331-332? If so I think they should rewrite and delete the statement as I said above. See also my comments to lines 522-524 below.

Response: Thanks for your correction. The sentence in the Abstract has been revised as “Pamir Plateau, which displays the highest trends of glacier disintegration.” in Line 32. The statement in Lines 331-332 in the original manuscript as you mentioned was removed, and the sentence as “Thus, a higher fragmentation index explains a larger possibility in the disintegration of glaciers.” has been added in Lines 339-340 in the revised manuscript.

4. In the paragraph starting at line 372 they discuss GRACE data. They say that GRACE data are chosen to compare and validate the calculated results and products of volume changes as given in Table 2. They say that “An underestimation is observed in the results obtained with the volume-area scaling.” But is that compared to GRACE data? This is unclear to me. From Table 2 there are huge differences between equation-based volume change and DGA (Derivations of Gravity Anomaly) volumes. GRACE data is only able to indicate mass changes as average values over quite large areas of about 100×100 km and therefore not for individual small glaciers. In the context of this paper it is therefore only useful as a very coarse estimate of mass changes. It can be compared to the average values obtained in the paper to indicate or validate the results, but with very limited or no value down on individual glaciers. It is unclear to understand how the GRACE data is used.

Response: We are sorry for this confusion. The Gravity Recovery and Climate Experiment outputs (GRACE) (Liu et al., 2015, 2016) were derived to produce the derivations of gravity anomaly (DGA) data by Liu et al. (2016). In detail, the DGA data are a sum of changes in soil moisture and glacier volume over the QTP from 2003 to 2010 on the grids with spatial resolution of 1°. To extract the glacier volume from DGA data, soil moisture data with spatial resolution of 0.25° were extracted from the Global Land Data Assimilation System (GLDAS) products (Hiroko and Rodell, 2016). Then the glacier volume was obtained by subtracting soil moisture (resampled from the 0.25°×0.25° to the 1°×1° pixel) from DGA data and called DGA-derived results in this study. The DGA-derived data have a resolution of 1°, and were used to compare with the recalculated and equation-based results integrated by individual glacier volume within corresponding 1°×1° pixels.

5. Line 522-524 is unclear. They write: “For the maritime glaciers, the ocean current, the strength of wind and self-melting all induce and even accelerate glacier fracture. In … to the deformation of glaciers”. What is self-melting? And fracture means breaking (like when you get crevasses in the ice) And deformation of glaciers? I suppose they mean glacier fragmentation or glacier separation. Deformation is related to the flow dynamics. The glacier ice deforms under high pressure, but the deformation will not increase due to climate warming and shrinking glaciers, rather decrease as the glaciers get thinner. Maybe they could write: “For the maritime glaciers, the

changes in ocean currents (affecting the precipitation pattern), the strength of wind and increased surface melting of the glaciers all induce and even accelerate glacier thinning and thus disintegration. In the continental glaciers, topographical, geological and climate changes are the dominant factors contributing to the disintegration of glaciers." However, changes in ocean currents, wind changes and surface melt are all effects of climate changes so both maritime and continental glaciers are affected by climate changes, but the continental dominated by air temperature changes.

Response: Thanks for your correction. The sentence has been changed to "For the maritime glaciers, the ocean current (affecting the precipitation pattern), the strength of wind and increased surface melting of the glaciers all induce and even accelerate glacier thinning and thus disintegration. In the continental glaciers, topographical, geological and air temperature changes are the dominant factors contributing to the disintegration of glaciers." in Lines 545-548 in the revised manuscript.

6. They use in general very precise numbers, as in line 401 to 403. It looks strange to me to write: "… is approximately 54874.79 km^2" as in line 401. This is a very precise number, even given with two decimals, thus it is not "approximately". There are many similar examples of very precise numbers in the paper. There are large uncertainties in the RGI 4.0 so it does not make sense to give such exact numbers.

Response: Thanks for your valuable comment. As for Lines 401-403 in the original manuscript, the results are initial values of statistics. To include the uncertainty in the results, the error estimates have been included. The relevant descriptions are added in the "Abstract" and "6 Uncertainties in the recalculated inventories". Specifically, the description has been revised as "The comparison of the two inventories reveals a total area of glaciers in the QTP of 54874.79±2207.23 km^2 in the RGI 4.0 and 43745.48±1707.62 km^2 in the GIC-Ⅱ. The total glacier volume is 4045.81±170.76 km^3 in the GIC-Ⅱ compared with 4716.76±220.72 km^3 in the RGI 4.0." in Lines 26-28. The sentences have been added as "Considering the uncertainty from the inconsistency in size of boundary pixels, the error estimates of calculated glacier volume in Table 5 and the error of glacier area estimated by Eq. (10) are included. The results indicate a total area of glaciers of 54874.79±2207.23 km^2, 43745.48±1707.62 km^2 in the QTP, respectively, in the RGI 4.0 and GIC-Ⅱ. The total glacier volume changes from 4716.76±220.72 km^3 in the RGI 4.0 to 4045.81±170.76 km^3 in the GIC-Ⅱ." in Lines 625-629 in the revised manuscript.

7. The reference list is fine. However, in line 74 they refer to Machereet et al. (1988). This reference is not in the reference list.

Response: Thanks for your careful correction. I'm sorry for the writing error. The citation should be "Macheret et al. (1988)" and has been modified in Line 74. The specific reference is shown as follows and has also been added in Lines 830-832 in the revised manuscript.

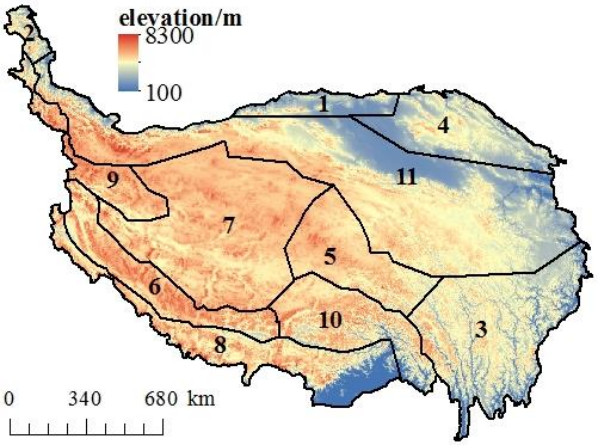
Macheret, Y. Y., Cherkasov, P. A., Bobrova, L. I.: Tolschina i ob'em lednikov djungarskogo alatau po danniy aeroradiozondirovaniya, Materialy Glyatsiologicheskikh Issledovanii: Khronika,

Obsuzhdeniya, 62, 59-71, 1988. [in Russian]

8. Figure 1 shows the regions and elevation pattern, but why do they use so precise numbers as elevation from 84 m to 8299 m? Why not just use 100 m to 8300 m. In the captions they give length and width for some regions, but area, length and width for others; why not area, length and width for all?

Response: The legend has been changed as you suggested in Fig.1. The caption of Fig.1 has also been added as follows in the revised manuscript.

Note: 1-Altin Mountains (area: 6.23×10^4 km^2; length: 730 km; width: 100 km); 2-Pamir Plateau (area: 2.45×10^5 km^2; length: 260 km; width: 50-100 km); 3-Hengduan Mountains (area: 3.42×10^5 km^2; length: 900 km); 4-Qilian Mountains (area: 1.74×10^5 km^2; length: 800 km; width: 200-400 km); 5-Tangula Mountains (area: 1.72×10^5 km^2; length: 700 km; width: 150 km); 6-Gandise Mountains (area: 1.49×10^5 km^2; length: 1100 km; width: 60-100 km); 7-Qiangtang Plateau (area: 4.46×10^5 km^2; length: 1200 km; width: 760 km); 8-Himalayan Mountains (area: 2.16×10^5 km^2; length: 2450 km; width: 200-350 km); 9-Karakoram Mountains (area: 9.45×10^4 km^2; length: 800 km; width: 240 km); 10-Nyainqentanglha Mountains (area: 1.73×10^5 km^2; length: 1400 km; width: 80 km); and 11-Kunlun Mountains (area: 7.3×10^5 km^2; length: 2500 km; width: 130-200 km) (Guo, 2011).



9. Figure 4 shows mountain regions with surged and disappeared glacier. However, this figure is impossible to read. Even when I enlarge the figure in the pdf-file to 400% it is hard to get any readable information out of it. I would suggest to take out that figure. Or maybe replace it by a close-up of one region with both surging and disappeared glaciers.

Response: Thanks for your valuable suggestion. To generally show the distribution of surged and disappeared glacier over the study area, the Fig. 4 in the original manuscript remains. In the revised manuscript, we have extracted two sub-regions from Karakoram and Gandise Mountains to show the amplification of surged and disappeared glaciers, respectively. The specification of the revised Fig. 4 is shown as follows.

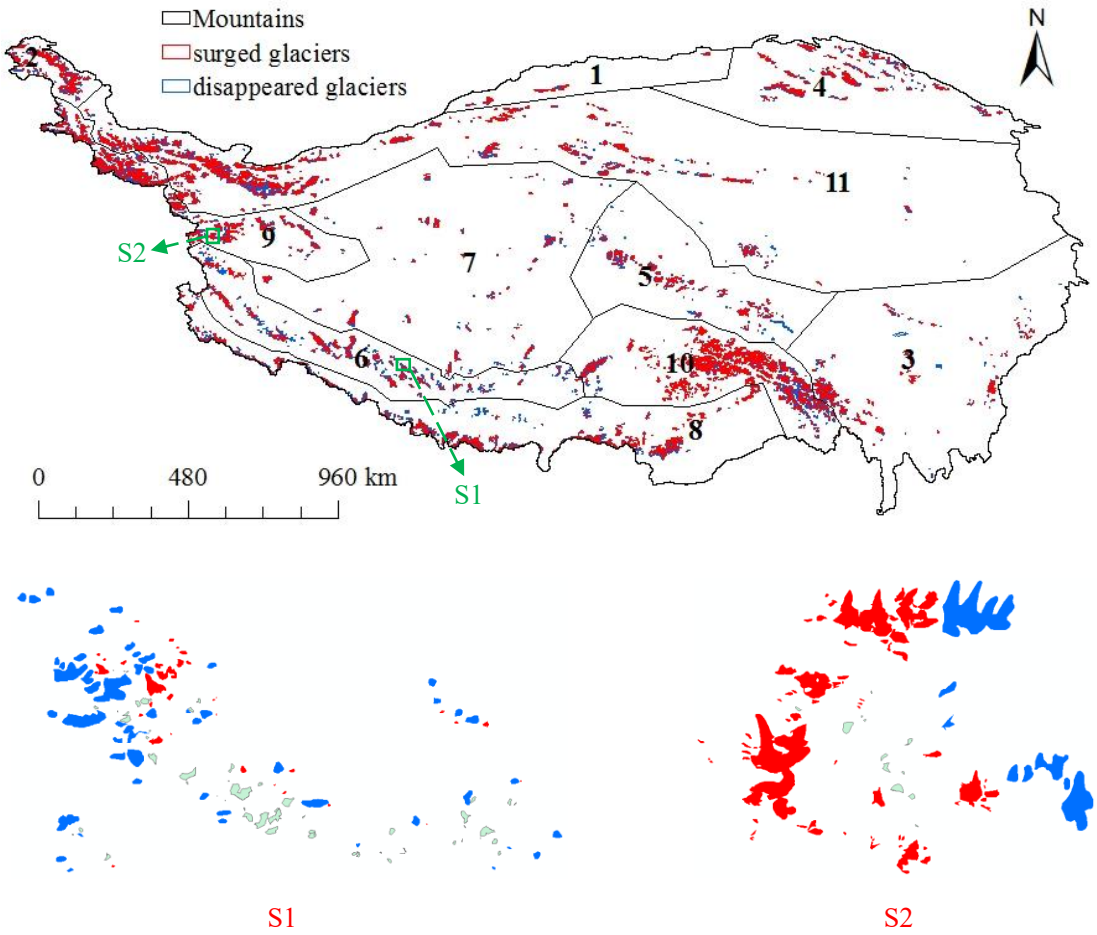


Fig. 4 Disappeared and surged glaciers from the 1970s to 2000s over the QTP

Note: 1-Altin Mountains; 2-Pamir Plateau; 3-Hengduan Mountains; 4-Qilian Mountains; 5-Tangula Mountains; 6-Gandise Mountains; 7-Qiangtang Plateau; 8-Himalayan Mountains; 9-Karakoram Mountains; 10-Nyainqentanglha Mountains; and 11-Kunlun Mountains.

In addition, S1 is extracted from the Karakoram Mountains, in which glacier advancing typically occurs. S2 is taken out from the Gandise Mountains having the largest loss of glacier volume. In S1 and S2, the blue polygons, red polygons represent disappeared and surged glaciers, respectively. The cyan polygons with a black border are the unchanged part of glaciers between the two datasets.