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Earth System Science Data Discussions

Interactive comment on "Consolidating the Randolph Glacier Inventory and the Glacier Inventory of China over the Qinghai-Tibetan Plateau and Investigating Glacier Changes Since the mid-20th Century" *by* Xiaowan Liu et al.

Anonymous Referee #2

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General.

This is an interesting paper that goes into details with a new evaluation of glacier changes in the Quinghai-Tibetan Plateau (QTP). They aim at improving former area and volume estimates of the glaciers and the changes that can be derived from the different glacier inventories. The authors propose a new slope-dependent algorithm to calculate the volumes and show that this approach gives better volume data than the former often used area-volume scaling algorithm. They combine and use input elevation data from different available inventories. This is a useful study. I think they

give improved data about the glacier changes in the region. The QTP region is large and varied both in climate and topography so it is a challenging task to obtain reliable data on glacier area and volume changes. QTP is an important region when comes to water balance studies and changes and this paper is a significant contribution to future analysis of water balance.

The paper is well written. It is fairly easy to follow the language. I am not English native speaker myself, but my impression from the language is good. However, there are some unclear statements and corrections that are needed before publication.

Comments.

Surged glaciers 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.

Line 48. Delete: "led by a distinguished expert in glacier studies in China", It is not appropriate to characterize the authors you refer to. Just write: A study predicted that . . .. . .

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 get 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.

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 100X100km 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.

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 in-

crease 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.

They use in general very precise numbers, as in line 401 to 403. It looks strange to me to write: ". . .is approximately 54874.79 km2" 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.

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

Figures and Tables are in mostly clear and useful.

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 8300m. 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?

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.

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