Response to Editor on "*tc-2021-352*"

We would like to thank Editor Ben Marzeion for carefully reviewing our paper. Reviewer's comments are in black while responses are in blue.

General comments:

In response to reviewer 2, and following his suggestion, you added a statement saying "Note that the model is unable to capture some small glaciers, which rely on local topography, preferential deposition and redistribution of snow, or avalanching for their existence." However, this is in contradiction to a statement a few lines above, where you say that the number of glaciers is reduced by some exceeding the model domain boundary. This would also be my prime suspicion because of the dependency on beta – and it could relatively easily be mitigated by increasing the border parameter of OGGM. A potential benefit would be that now, those glaciers are missing in your study that apparently show the strongest (relative) length changes (otherwise, they would not exceed the boundary). Including them might increase the clarity of the signal you are after.

Please have a detailed look at what causes OGGM to fail for these glaciers, and adjust the text accordingly (If it is really the smallest of glaciers, you could indicate the percentage of glacier area successfully modeled, in addition to the number of glaciers, so that it becomes clear that despite many glaciers failing in the model, you nevertheless see a signal representative of the region). Depending on what you find, you may decide for yourself whether new models run, with an increased border parameter, are necessary or desirable.

Reply: Sorry for the confusion induced. In this study, we have excluded two kinds of glaciers from our simulations. One is the glaciers that have run out of the simulation boundary and another is the glaciers that have zero length at 1950. The sentence that "Note that the model is unable to capture some small glaciers, which rely on local topography, preferential deposition and redistribution of snow, or avalanching for their existence" is referred to the latter rather than the former. In order to avoid misleading, we have rephrased this sentence into "In addition, more glaciers disappear in 1950 ($Length_{1950} = 0$; Fig. 2c) with a larger β because the model is unable to capture some small glaciers, which rely on local topography, preferential deposition and redistribution of snow, or avalanching for their existence. Although about 100 glaciers will be excluded, they are rather small glaciers which account for only 2.1 % of the total glacier areas (Fig. S3). Therefore, the results are still sufficiently representative for the regional average."

Following your suggestions, we have also increased the border parameter to test whether this method can offset the influence of increased beta. Despite more glaciers can be included when we increase the border parameter, more and more flowlines of the north-slope glaciers are incorrectly calculated (Fig. S3; Fig. R1; Fig. R2). Fig. R3 is a good example. The glacier flowline abruptly changed to a wrong direction when the border parameter is increased from 200 to 400. This will lead to large uncertainties in simulations. Therefore, we still set the border parameter to be 160 to ensure the quality of glacier flowlines.

There are about 106 glaciers exceeding domain boundaries, accounting for 12.9 % of the total area in the MC experiment with $\beta = -0.4$ and border parameter setting to be 160. Among these glaciers, glacier RGI60-13.26389 contributes most (7.0 %). However, just increasing the border

parameter could not solve this problem because larger domain would lead to wrong flowlines. In addition, setting border parameter to be 160 is large enough for LIA simulation (even large enough for the Last Glacial Maximum (LGM) simulation (Fig. S3d)), according to the mapped glaciers (Fig. 1 and Fig. R3) and previous studies (Qiao & Yi, 2017). We argue that the glaciers which extend out of the simulation boundary are suffered from large simulation bias. Besides, in this response, we have also calculated the GLR and the percentage of available glaciers with different border parameter. The results do not show obvious differences (Fig. S4).

For this revision, some small mistakes in figures and typos in articles are also corrected. We think these small mistakes does not have any impacts on our results.

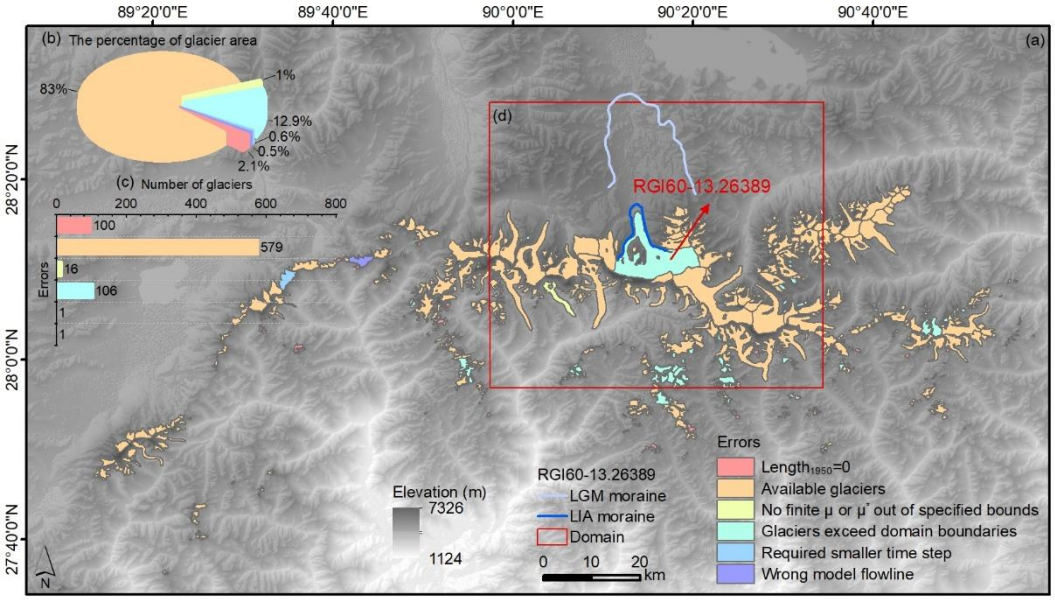

Figure S3 (a) Different simulation errors in the MC experiment with $\beta = -0.4$ and border parameter setting to be 160; (b) the percentage of glacier area of each error type; (c) the number of glaciers of each error type; (d) the spatial distribution of LIA and LGM moraine of glacier RGI60-13.26389. The LGM moraine is mapped based on regional glacial chronology and the evidence of sediment-landform assemblages (Peng et al., 2019).

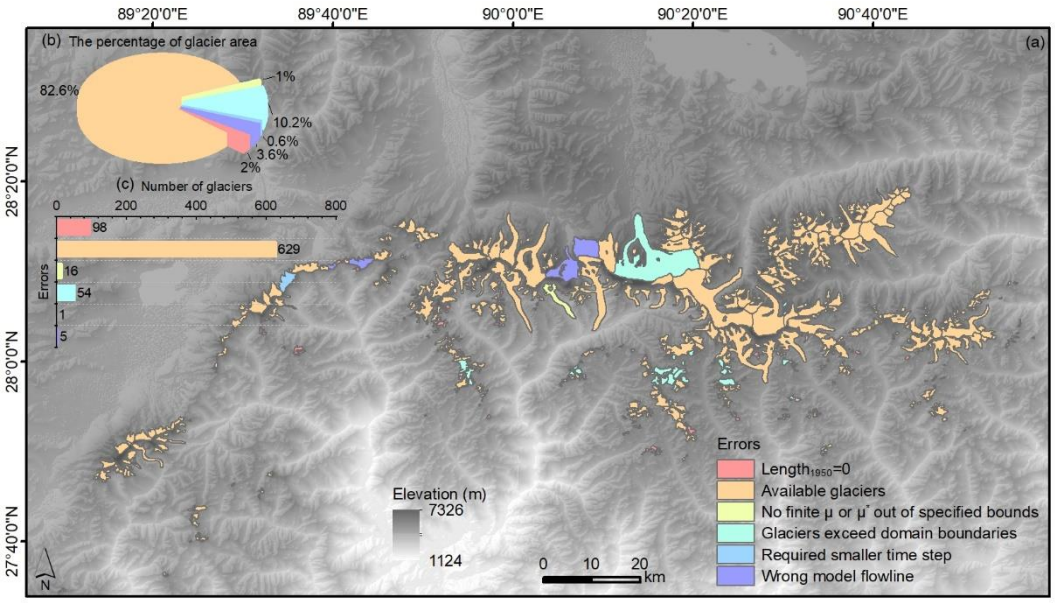

Figure R1 Same as Fig. S3 but for border parameter=200.

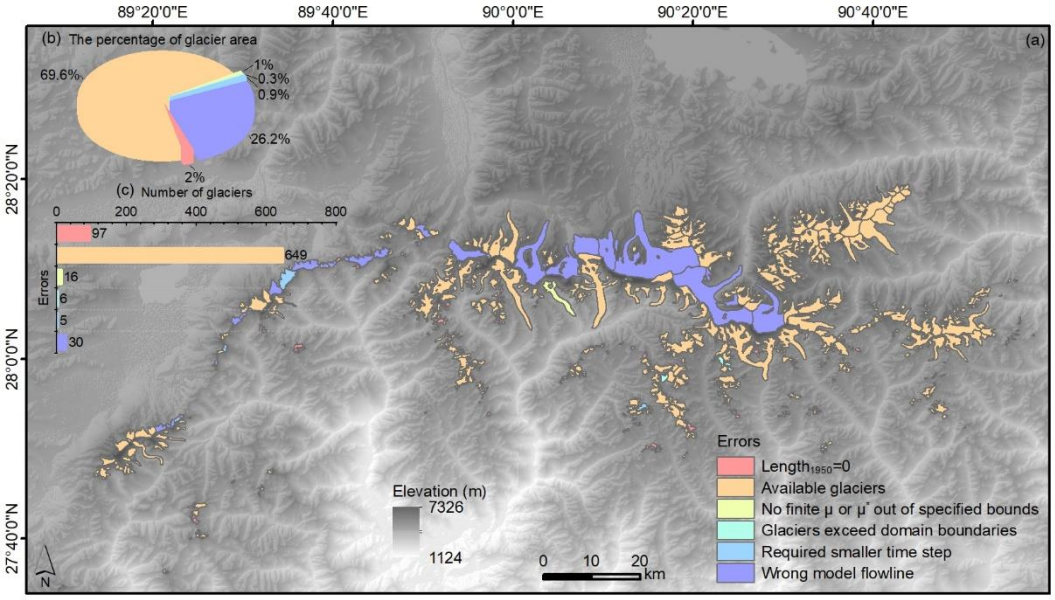

Figure R2 Same as Fig. S3, but for border parameter=400.

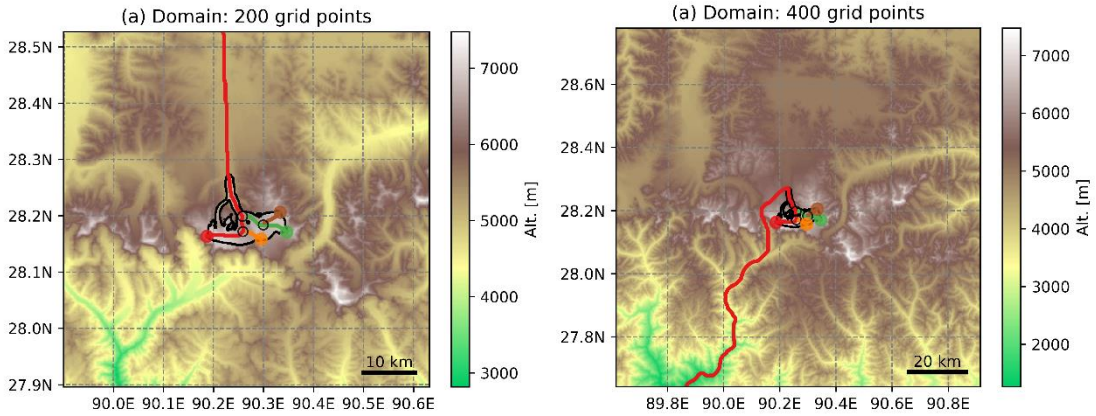

Figure R3 The flowlines of glacier RGI60-13.26389 with the border parameter setting to be (a) 200 and (b) 400.

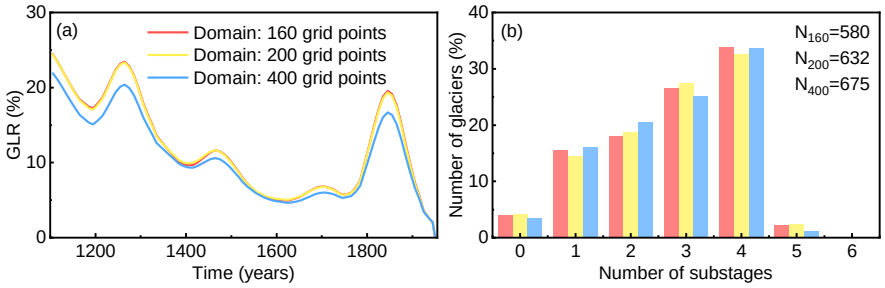

Figure S4 (a) Time series of regional average *GLR* from 1100 to 1950 in the MC experiment with $\beta = -0.4$ and different border parameter; (b) the percentage for available glaciers with each identified glacial substage.