Editor
Climate of the Past

Dear Dr. Joel Guiot,

We have completed the revision of our manuscript No. cp-2013-87, entitled "Tree-ring inferred glacier mass balance variation in southeastern Tibetan Plateau and its linkage with climate variability". My coauthors and I are very grateful to you for your positive comments. We also appreciate very much the two anonymous reviewers for their valuable comments to help improve the manuscript.

The comments given by the two reviewers were well-taken and fully considered in our revised manuscript. Point-by-point responses are presented below in this letter.

We hope the revised manuscript is now acceptable for publication in CP.

Thank you very much for your attention.

Yours truly

Jianping Duan (corresponding author, Email: duanjp@ibcas.ac.cn)

Reply to the comments made by the referee #1:

General Comment: The paper is a maiden attempt to reconstruct mass balance variation in Tibetan Plateau. I consider this study is a novel approach and I suggest the Journal to accept this paper. However, before accepting I suggest to consider some of the minor points.

Reply: Thanks very much for the positive comments and suggestions. The questions raised were addressed point-by-point as follows.

Comment 1: Authors are requested to provide short description of wastage for general readers in simple words.

Reply: The "wastage" in the manuscript means that the decrease of glaciers area, retreat of glaciers terminus or thinning of glaciers. This short description has been added in the revised manuscript as follows (see lines 52–53).
"and these glaciers are largely experiencing wastage (Fujita and Nuimura, 2011; Yao et al., 2012; Bolch et al., 2012; Kääb et al., 2012) which mainly appears as the decrease of glaciers area, retreat of glaciers terminus or thinning of glaciers".

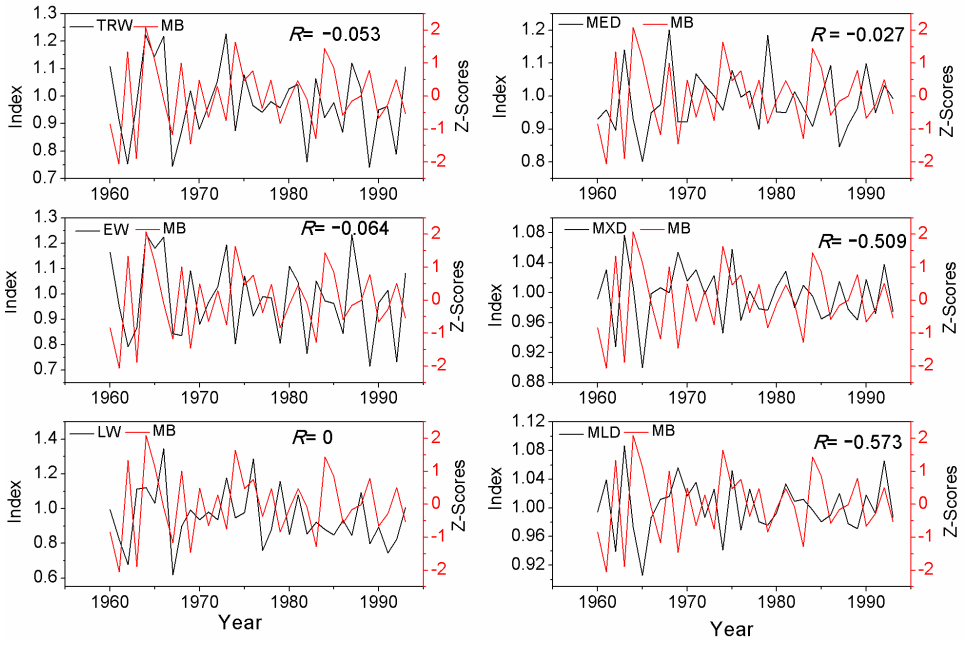
Comment 2: Page 3666, Line 23: later or late

Reply: Line 102 (original manuscript, page 3666, line 23): the word "later" has been revised into "late".

Comment 3: Authors mentioned the Duan et.al., 2010a, 2010b deals with the climate variables but not with mass balance relationship. For the present study authors used the same taxa which they used in their earlier study (Duan et.al., 2010a and 2010b) but for mass balance study. However, in this study mass balance data is consider but only used mean latewood density (MLD). Authors are advised to compare mass balance data with other six tree-ring parameters also and provide the results with figure as supplementary material.
After doing these steps they can provide the reason why only mean latewood density (MLD) is considered for the present study. Is there any ways to explain the biological/physiological explanation for this relationship?

Reply: we compared the mass balance data with six tree-ring parameters (including MLD) over the period 1960–1993 in the revised manuscript (see the following figure). The tree-ring parameter minimum density was not been compared with the mass

balance data because that most of the measurement values of this parameter are zero, which is difficult to establish a reliable chronology. The comparison figure has been added as supplementary material (see lines 428-443 in the revised manuscript).
From the comparison figure we can see that the correlation between the MLD and the MB is stronger than any other tree-ring parameters. This is the reason why we choose the tree-ring mean latewood density (MLD) as the predictor in the present study.
The biological/physiological explanation for this relationship was explained in the Section 4.1 as follows (lines 169-197).
"The significant negative correlation between the MLD and the MB suggested that the mean latewood density of *Abies fabri* could be a useful indicator of the MB variation at the Hailuogou Glacier, and implied inverse response of the two parameters to the climate condition in the study region determined by different processes. How did the climate condition drive the two different processes? We examined the relationships between the MLD, the MB and the instrumental climate data (i.e., monthly mean temperature and monthly total precipitation) from the nearest meteorological station (Luding station; Figure 1a). The results demonstrated that the MLD correlated positively with May-September temperature ($r_{1957\text{-}2007}$ =0.607, p<0.0001) and negatively with August-September ($r_{1957\text{-}2007}$ = –0.317, p<0.05) precipitation. The correlation coefficient between the MLD and May-September precipitation is $r_{1957\text{-}2007}$ = –0.164 (p=0.265). Meanwhile, the MB correlated negatively with May-September temperature ($r_{1957\text{-}2007}$ = –0.574, p<0.001). The correlation coefficient between the MB and May-September precipitation is $r_{1957\text{-}2007}$ = 0.180 (p=0.33). These results indicated that high May-September temperatures (especially August–September temperature) was conducive to photosynthesis, and contributed to latewood cell wall thickening and production of higher latewood density (Duan et al., 2010a), and vice versa. In contrast, high summer temperature could accelerate the melting of glacier. Warming-induced fast retreat of the terminus at the Hailuogou Glacier also has been reported (Li et al., 2010). Importantly, 80% of the annual precipitation in the study region also occurred in warm season (i.e., May-September) (Figure 1c). Thus, the significant negative correlation between the MLD and the MB and their inverse response to the same climate condition could be understood as the following. Cold summers with abundant precipitation inhibited tree growth in the region and positively affected the net MB of the glacier. Similarly, but contrary, during hot summers tree-ring growth in the region was usually enhanced but glaciers showed stronger melting rates. Such a summer climate driving the two different processes was also reported in other studies in the high-latitude glacial regions (Lewis and Smith, 2004; Watson and Luckman, 2004; Linderholm et al., 2007)."



Supplementary figure: Comparisons of the residual chronologies of the six tree-ring parameters with the mass balance data over the period 1960–1993.
TRW = tree-ring width; EW = earlywood width; LW = latewood width; MED = mean earlywood density; MXD = maximum latewood density; MLD = mean latewood density.

Comment 4: Page 3667, Line 7: replace the word gotten with extracted

Reply: Comment accepted. See line 110 in the revised manuscript.

Comment 5: Page 3667, Line 16: replace resulting in the with to prepare/to build

Reply: Comment accepted. Line 119 (original manuscript, page 3667, line 16): the "resulting in" has been revised into "to build".

Comment 6: Authors used SSS criterion to evaluate the reliable time span of the chronology. Why authors did not considered EPS threshold (>0.85) to select the number of series reliable for cut off year.

Reply: the SSS criterion has been changed into EPS threshold (>0.85) to evaluate the reliable period of the chronology in the revised manuscript (see lines 120, 132–133).

Comment 7: Authors prepared two models, period 1960–1993 and period 1960–1990. Why the second period (1960–1990) showed good results when 3 years data

(1991–1993) deleted from the model. Why these 3 years diluting the results.

Reply: the second period (1960–1990) showed good results because that the tree-ring index over the 3 years (1991–1993) doesn't show a coherent relationship as the period 1960–1990 (i.e., negative correlation relationship). When the 3 years was deleted, the correlation coefficient between them has an obvious improvement ($r_{1960\text{-}1993}$= –0.573, $r_{1960\text{-}1990}$ = –0.646), which allows us to establish a more reliable regression model.

The 3-yr data diluting the result should be attributed to the anomalous climate in the previous growth season.
Based on the climate data of the nearest meteorology station (Luding), we found that the cold-season precipitation (previous October to current March) in the period 1991–1993 is obviously higher than the mean cold-season precipitation over the whole period 1961–1993 (the cold-season precipitation in 1991–1992 is more that the mean plus 1.1 standard deviation (SD) of the period 1961–1993). This was conductive to the high MB. While, the September temperature (a main month of influencing latewood density) in the period 1991–1993 is relatively higher than the mean value of the period 1960–1990 (the September temperature in 1992 is more than the mean plus 1.1 SD of the period 1960–1993), which produced the higher MLD. Consequently, both high MLD and high MB occurred the period 1991–1993, which is contrary to the relationship of MLD with MB over the period 1960–1990 and resulted in the diluting of the result.

Comment 8: Fig. 2(c): What does red line represent in the figure 2c. Kindly mention in the figure caption.

Reply: the red line in the figure 2c represents the 10-yr FFT (Fast Fourier Transform) smoothing curve, which has been added in the figure caption in the revised manuscript (see lines 396–397).

Reply to the comments made by the referee #2:

General Comment: The paper of Duan et al. is of high scientific relevance since it brings observation on recent glacier shrinkage and short-term glacier mass-balance measurements into a longer time perspective by using tree rings as palaeoclimate proxies. Glaciers in the monsoonal realm of the southeastern Tibetan plateau respond to similar climatic forcing (i.e. summer temperature) than latewood density of high-elevation conifers (MXD) and so the long-term trends of MXD can be seen as a proxy for glacier mass-balance changes. The methodology is sound and the tree-ring data are reliable as indicated by the statistics and the known context of relationships between MXD and summer climate conditions on the Tibetan plateau. The graphics are nice, however, the usage of English needs refinement, unclear and odd expressions like e.g. "Understanding of such knowledge is limited..." or "However, a whole out of phase occurred..." should be clarified. The introduction should include more recent regional studies about glacier recession, e.g. Bolch et al, Science 2012.

Reply: Thanks very much for the positive comments. The questions raised were addressed point-by-point as follows.

1) The unclear expression "Understanding of such knowledge in a long-term scale is limited..." has been revised into "Understanding of the long-term response of glaciers variation to climate change is limited ..." (see lines 56–57 in the revised manuscript).

2) The expression "However, a whole out of phase occurred..." has been revised into "However, a negative phase occurred..." (see line 241 in the revised manuscript).

3) The following two recent regional studies about glacier recession have been added in the Introduction Section (see line 52).

Bolch, T., Kulkarni, A., Kääb, A., Huggel, C., Paul, F., Cogley, J. G., Frey, H., Kargel, J. S., Fujita, K., Scheel, M., Bajracharya, S., and Stoffel, M.: The state and fate of Himalayan glaciers, Science, 336, 310–314, doi: 10.1126/science.1215828, 2012.

Kääb, A., Berthier, E., Nuth, C., Gardelle, J., and Arnaud, Y.: Contrasting patterns of early twenty-first-century glacier mass change in the Himalayas, Nature, 488, 495–498, doi: 10.1038/nature11324, 2012.