Dear editor Prof. Linderholm,

We would like to thank you for giving us opportunity to upload the revised version of our manuscript. Below is the point-by-point response of authors to the referee's comments. The comments and suggestions were illustrated in blue, the author replies were illustrated in black.

We have responded each referee (including public comment) separately. Finally, uploaded (1) response letter, (2) revised manuscript (track changes accepted mode), (3) revised manuscript (within track mode), (4) supplementary file.

We hope our revised manuscript could reach the publishing standard of Climate of the Past.

Note: all the line numbers mentioned in the author response is subjected to the track changes accepted version of the revised manuscript.

Thanks again
Best regards

on behalf of all the authors

corresponding author: Zongshan Li
first author: Maierdang Keyimu

Response to referee 1:

General comments

Tree rings response to local climate conditions, and the temperature and moisture in the growing season are usually the controlling factors for radial growth. In semi-arid regions on the southern Tibetan Plateau, where the climate is cold and dry, including the upper treeline, tree-ring width of coniferous species respond to growing season climate variables, e.g. early summer, warm season, or the whole year average (Zhang et al., 2015; Liu et al., CR 2012; Liu et al, 2014 QSR). Liu et al (NSR) comprehensively revealed that tree rings in SETP respond to growing season or annual precipitation and only a few tree ring chronology respond to PDSI due to the pre-monsoon moisture deficiency. As a result the physiological dynamics of tree ring/NGS correlation should be carefully and reasonably clarified. Consider the climate background and the tree growth/climate patterns, it is suggested to see the tree ring index responding to pre-monsoon climate variables.

Comparisons with previous results in the nearby area should include the difference and attributions within series other than consistence only.

There were lots of tiny mistakes in the manuscript and some figures needs improving. Acceptance could be done after the second revision.

Author response:

Thanks for the general comments of referee 1. We would like to reply to the comment by separating it into different parts:

(1) In the discussion section, we have added isotope-based research findings which further supported our results about the association between NGS precipitation and tree growth, please refer to line 214-222 in the revised manuscript, also see below:

"*The eco-physiological importance of NGS precipitation on tree growth and tree water usage was also revealed by isotope ratios method-based investigations. Brinkmann et al's (2018) study showed that nearly 40% of the uptaken water by Fagus sylvatica and Picea abies trees in a temperate forest of middle Europe are sourced from NGS precipitation. Tree-ring oxygen isotope ratios (δ18O) are demonstrated to contain NGS precipitation signals in the Himalayan region (Huang et al., 2019; Zhu et al., 2021). Huang et al's (2019) study revealed that NGS precipitation (snowfall) increased the snow-depth, and the later snowmelt compensated soil moisture in the spring and early summer, which was a crucially important water source for the Juniper growth in the southwestern Tibetan Plateau. Zhu et al's (2021) investigation in the western Himalaya revealed that formation of earlywood in tree rings of Pinus wallachina depended on the snowmelt originated from NGS precipitation*".

(2) We have checked the correlation between TRW chronology and climate variables (PDSI and precipitation) during pre-monsoon seasons (February-March, February-April, February-May, March-April, March-May, April-May), and the highest correlation was found between TRW chronology and February-May (**0.37**), which is lower than the correlation value of 0.56 between NGS precipitation and TRW. Therefore, we kept the original reconstruction.

Correlation values between TRW chronology and climate variables

Aggregations	Precipitation	PDSI	Temperature
February-March	0.16	0.36	-0.12
February-April	0.17	0.35	-0.15
February-May	0.32	**0.37**	-0.24
March-April	0.08	0.31	-0.12
March-May	0.24	0.35	-0.25
April-May	0.25	0.32	-0.33

(3) We have compared our NGS precipitation reconstruction series with spring or early summer PDSI reconstructions from surrounding regions to illustrate the reliability of the present reconstruction. As the referee1 mentioned, there are dissimilarities between present reconstruction and other reconstructions. We have discussed that the dissimilarities could be attributed to (1) different tree species in chronologies which have different morphological structures and different drought tolerance capacities, (2) different chronology (standard/residual/ARSTAN), (3) different reconstruction target (PDSI/precipitation), (4) seasonal differences in reconstruction target (annual/summer/winter/different aggregations), (5) sample replication, (6) different methods of detrending the tree ring measurement series and different chronology establishment methods (standard chronology/residual chronology), (7) different length of calibration period. Comparisons of different reconstructions were summarized in Table S1.

Table S1 Differences among hydro-climatic reconstructions in the SETP

Differences	**Present study**	**Fan et al**	**Fang et al**	**Li et al**	**Zhang et al**
Tree species	*Tsuga forrestii*	*Picea linkiangensis* *Tsuga dumosa* *Abies ernestii*	*Abies forrestii*	*Abies forrestii*	Multi-species
Reconstruction target	precipitation	PDSI	PDSI	PDSI	PDSI
Reconstruction season	pNovember-cFebruary	cMarch–cApril	pMay-cApril	cApril-cJune	cMay-cJune
Detrending method	Negative exponential method	Negative exponential method Cubic smoothing spline	Cubic smoothing spline	Negative exponential method Linear regression curve	Cubic smoothing spline
Chronology	Residual	Residual	ARSTAN	Residual	Standard
Length of calibration period	1956-2005	1951-2000	1954-2005	1944-2012	1953-2005
Sample replication (trees)	38	98	64	47	409

(4) We have checked through the whole manuscript carefully and corrected existing mistakes trying our best, and also improved the visual quality of the figures.

Specific comments

1. It's unnecessary to show descriptive statistics of the reconstructions in the abstract. Concentrations on the key results are mainly demanded.

Author reply:

Thanks for the suggestion. We have removed the lines which interpreted the descriptive statistic of the chronology or reconstruction (*and the leave-one-out verification parameters indicated the reliability of the reconstruction*).

2. Tree rings are more and more of important in paleoclimatology. It's interesting to see that 'tree rings' are written in different way. Some are 'tree rings', and some are 'tree-rings'. Early dendrochronologists or students need standard of the terms. Would the authors like to say something on this?

Author reply:

Thanks for the simple but not simple question. Honestly, I (first author) have not really paid much attention to the context in which we use the terms of "tree ring" and "tree-ring", but I was using the latter one in most of the cases. But the above question by the referee 1 really made me think, and I have looked through a few books in tree-ring science seeking for an answer. I have realized some basic differences in the application of "tree ring" and "tree-rings". Understanding of the usage of "tree-ring" is relatively easy. It is used in compound situations, such as "tree-ring samples", "tree-ring width/density", "tree-ring data", "tree-ring indices", "tree-ring chronology", "tree-ring series", "tree-ring analysis", and "tree-ring research". But it is used as "tree ring/s" when it is a separate and independent unit, i.e., "application of tree rings", "climate signal in tree rings", "use tree rings to date years", "wide/narrow tree rings", and so on. I'd like to thank the referee 1 to make me ponder over the correct usage of above-mentioned terminologies.

Accordingly, we have checked through the whole manuscript and run corrections on the existing mistakes.

3. Line 37, ...'of the planet Earth'…, delete planet please.

Author reply:

Thanks. We have deleted as suggested.

4. Figure 1, besides the study site and the sites from previous sequence's reference, we knew quite few from the figures. We couldn't see where the sites are, and what the key geographical settings are nearby.

Author reply:

Thanks for the comment. We have updated the location map of the study area. Please refer to the revised manuscript for the updated figure, or see below:

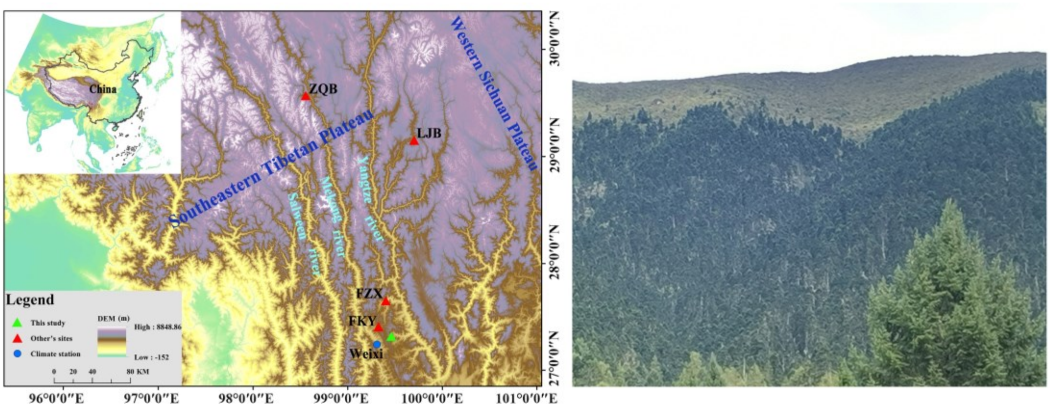


Fig. 1 in the revised manuscript.

5. Line 99, 3.26e gridded? Latest version of CRU is 4.04 (2020, Nature scientific data)

Author reply:

Thanks. We have downloaded the scPDSI data using KNMI climate explorer (http://climexp.knmi.nl/select.cgi?id=someone@somewhere&field=scpdsi). We have re-accessed the scPDSI data version 4.05 on 20th of April, 2021. We have conducted climate – tree growth relationship analysis between the TRW chronology and PDSI values of single months and aggregated months (FM, FMA, FMAM, MA, MAM, AM, NDJF). The highest correlation ($R = 0.41$, $P < 0.01$) was found between NDJF PDSI and TRW chronology, but it was still below the correlation of 0.56 between NGS precipitation and TRW chronology. Therefore, we have kept the original target (NGS precipitation) to reconstruct.

6. Line 96, 101-102, 27.17 N, 99.28 Eà17° N, 99.28° E; 27.0-27.5 N, 99.0-99.5 Eà27.0-27.5 °N, 99.0-99.5° E.

Author reply:

Thanks for pointing out the mistake. We have modified accordingly. Please refer to line 102 in the revised manuscript.

7. The EPS was below 1475 A.D., and the sample depth was less 7 according to Figure 2. Why didn't safely choose the confident period since 1600 A.D. for reconstruction?

Author reply:

Thanks for the suggestion. Combining the suggestions of referee 1 and Dr. Ji Yuhe in the public comment, we have re-calculated the running EPS and Rbar values of the chronology, and updated the Fig. 2 (please refer to Fig. 3 in the revised manuscript, or see below). As suggested by the referee 1, we have used the EPS criterion value of 0.85 to truncate the most reliable length of the TRW chronology and used it for the reconstruction (please refer to Fig. 6 in the revised manuscript, or see below:

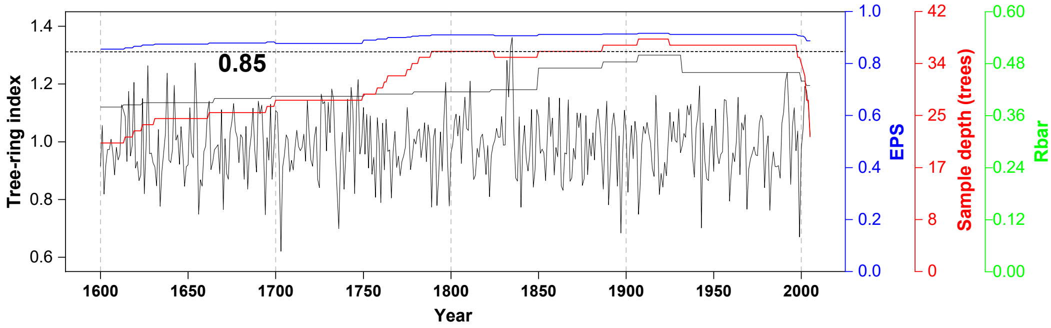


Fig. 3 in the revised manuscript.

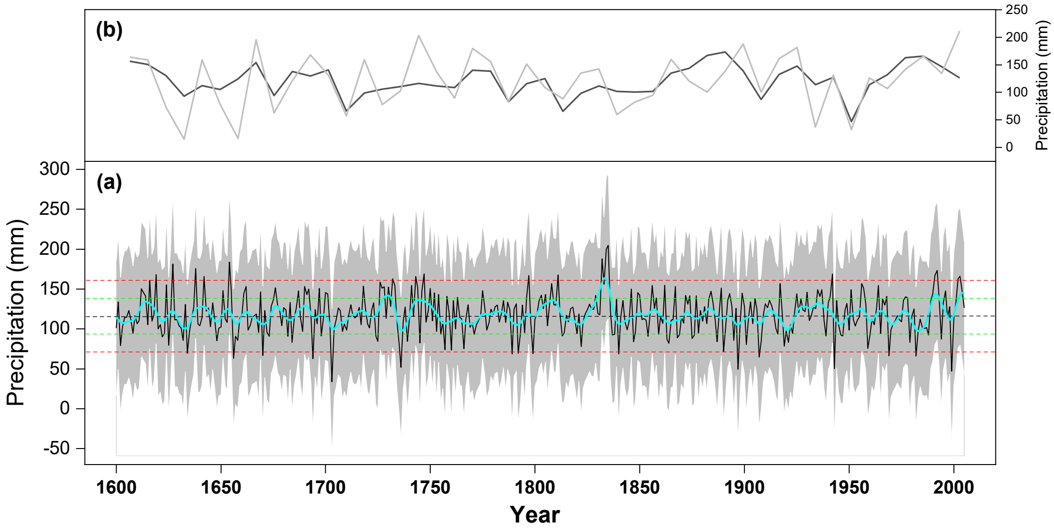


Fig. 6 in the revised manuscript.

8. Table 1, was it number of cores or trees? If it was number of cores, well, 38 cores rather than trees make the reconstruction since 1475 A.D. disputable.

Author reply:

Thanks for the concern. It was the number of trees and the cores. One core per tree was sampled intending to increase the sampling representativity. We have updated the figure (name of the scale of the figure on the right side has been modified). Please refer to the Fig. 3 in the revised manuscript, or see below:

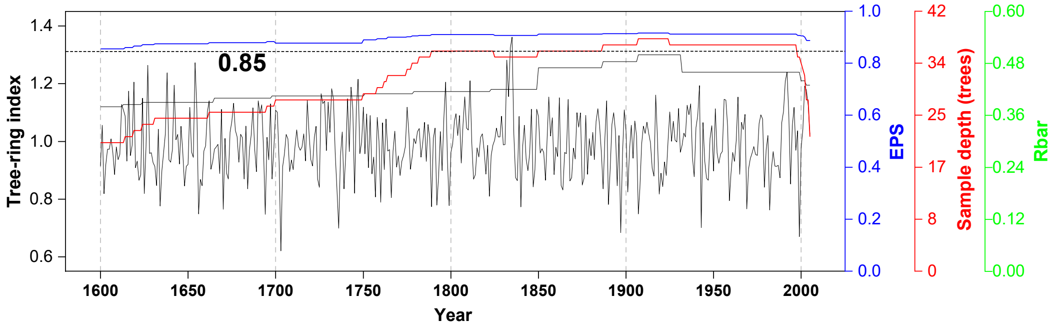


Fig. 3 in the revised manuscript.

9. The tree grown/temperature correlation pattern looks rather weird. There wasn't positive correlation coefficient found at all. If we take the climate factors together, it was found

TRW negatively correlated with temperature but positively with precipitation in current May. It is typically the pattern that the hemlock radial growth is limited by the pre-monsoon drought. The non-significant correlation coefficients with PDSI could possible attributed to temperature during the pre-monsoon season. Have the authors ever tested the correlation between TRW and pre-monsoon drought (prior December to current May)?

Author reply:

Thanks for pointing out the mistake. (1) We have corrected the interpretation of the correlation between TRW and temperature. (2) We have checked the relationship between TRW and PDSI of aggregated months (previous year December to current year May). The correlation value between aggregated PDSI and TRW was weaker (R = 0.43) than the correlation value between NGS precipitation and TRW (R = 0.56), and thus we have kept the original variable (NGS precipitation) as reconstruction target.

10. Figure 6 displayed comparison between this study and previous results where the sampling site are close. Visually compared, besides the common wet/dry variations in decadal scales were identified, much difference could be easily found. Obviously, Zhang's and Li's series showed increasing trend during the 2000s, but the other three series didn't. For Zhang's series, which was a compo-site reconstruction, could the authors adopt only sites that are close to Lijiang? During 1540s-1580s, 1680s-1720s, 1840s-1920s, no common variation patterns were identified, and some were even contrarily varied. By the way, the 'year' scale of the figure was shown in the window of 80 years, and it is difficult to read. Why didn't show it in every 50-year step?

Author reply:

Thanks for the concerns. We would like to answer the above question by separating it into three sections:

1. As mentioned by the referee 1, apart from similarities, dissimilarities were also existed among different reconstructions. The dissimilarities among reconstructions can be attributed to (1) different tree species in chronologies which have different morphological structures and different drought tolerance capacities, (2) different reconstruction target (PDSI/precipitation), (3) different chronology (standard/residual/ARSTAN), (4) seasonal differences in reconstruction target (annual/summer/winter/different aggregations), (5) sample replication, (6) different methods of detrending the tree ring measurement series and different chronology establishment methods (standard chronology/residual chronology), (7) different length of calibration period.

   We have summarized the differences among the compared reconstructions as in Table S1 (please refer to our earlier reply or to the supplementary file), and because of these, there appeared dissimilarities among the variabilities of different reconstruction series.

2. We have used the average PDSI reconstruction series of Zhang et al (2015) in the southeastern Tibetan Plateau to carry out the comparison with our reconstruction series.

3. We have updated the Fig. 6 according to the suggestion by the reviewer (using 50 years interval to separate). Please refer to the Fig. 7 in the revised manuscript or see below:

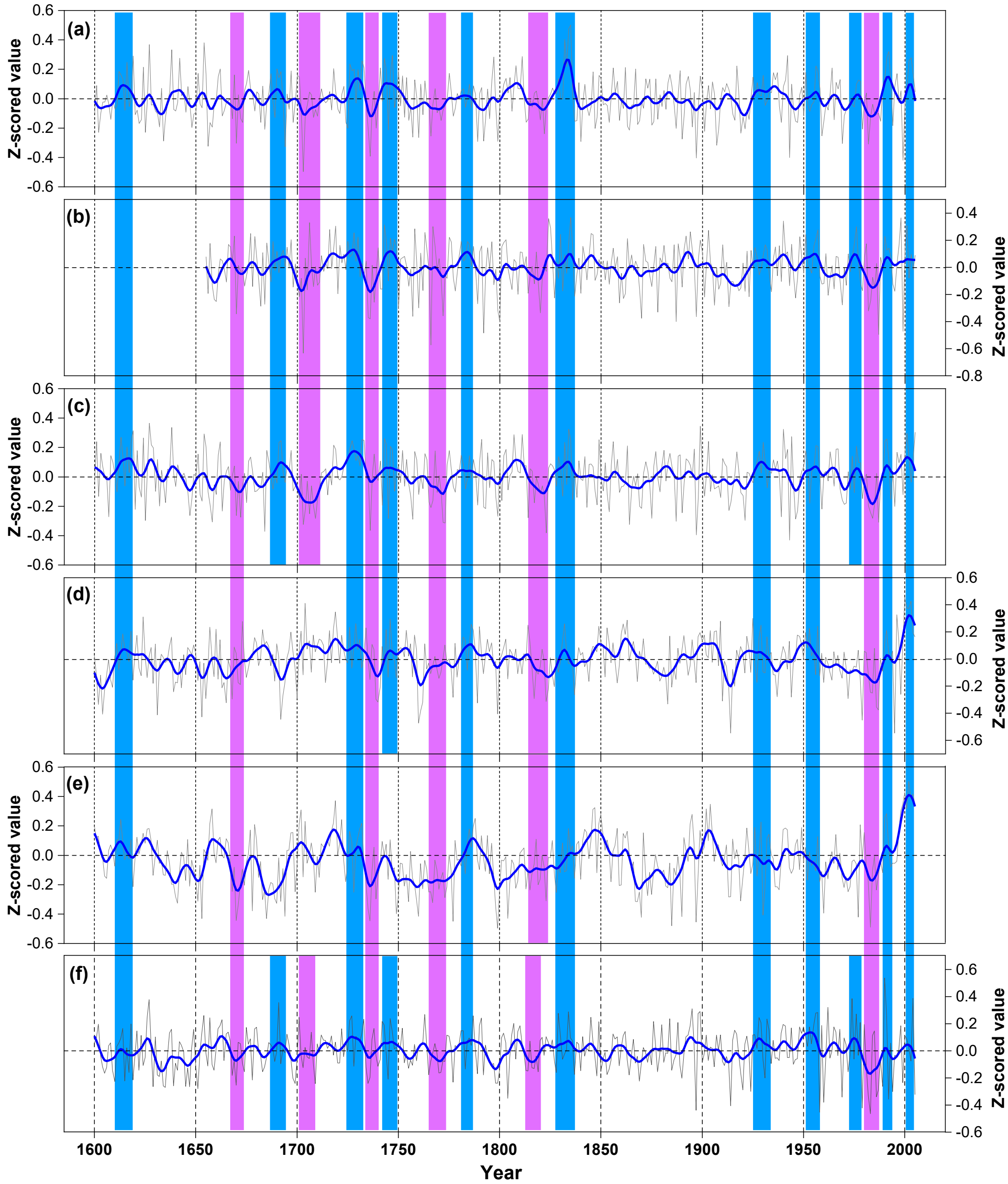


Fig. 7 in the revised manuscript.

11. Extreme dry/wet years were investigated, did they were consistent with other results in Fig 6? What did those extreme years imply? In terms of the spatial correlation analysis, did those extreme years spatially exist? Were there coincident with the Asian Monsoon Atlas (Cook et al, 2010)

Author reply:

Thanks for the questions and suggestions. We have defined the years which had more/less than one times of the standard deviation of NGS precipitation as wet/dry NGS years; two times of the standard deviation of NGS precipitation as extreme wet/dry NGS years. According to the above definition, appearances of wet/dry years were too frequent, therefore, we have selected the extreme wet/dry years to demonstrate variability of wet and dry years.

We have compared the extreme wet/dry NGS years with reconstruction series of Fan et al., 2008, Fang et al., 2010, Li et al., 2017, and Zhang et al., 2015. By comparison, some of the extreme wet/dry years in present reconstruction series were consistent with other reconstructions; some of the extreme wet years in present reconstruction were not extreme wet but wet in other series; some of the extreme dry years in present reconstruction were not extreme dry but dry in other series. We have made clear comparison of the extreme wet/dry years among different reconstructions in Table S2, S3, please refer to the supplementary file or see below:

Table S2 Comparison of extreme wet years in different hydro-climatic reconstructions in the SETP

Present study	Fan et al	Fang et al	Li et al	Zhang et al	MADA (Cook et al)
1627	—	**Yes**	**No**	**No (wet)**	**Yes**
1638	—	**Yes**	**No**	**No (wet)**	**Yes**
1654	—	**Yes**	**No (wet)**	**No**	**Yes**
1832	**No (wet)**	**No (wet)**	**No**	**No (wet)**	**Yes**
1834-35	**Yes**	**Yes**	**No (wet)**	**No (wet)**	**Yes**
1992	**No (wet)**	**Yes**	**Yes**	**No (wet)**	**Yes**

Note: “Yes” means the timely match of extreme wet years in present NGS precipitation reconstruction and compared reconstructions; “No (wet)” means the extreme wet years in present reconstruction were not extreme wet but wet in compared series; “No” means the extreme wet years in present reconstruction were not wet in compared series.

Table S3 Comparison of extreme dry years in different hydro-climatic reconstructions in the SETP

Present study	Fan et al	Fang et al	Li et al	Zhang et al	MADA (Cook et al)
1656	**No (dry)**	**No (dry)**	**No**	**No (dry)**	**No**
1670	**Yes**	**Yes**	**Yes**	**No**	**Yes**
1694	**No**	**No (dry)**	**Yes**	**No (dry)**	**No**
1703	**Yes**	**Yes**	**No (dry)**	**No**	**No**
1736	**Yes**	**Yes**	**Yes**	**No (dry)**	**Yes**
1897	**Yes**	**Yes**	**Yes**	**No (dry)**	**Yes**
1907	**No**	**No (dry)**	**No**	**No**	**No**
1943	**No (dry)**	**Yes**	**No (dry)**	**No**	**No**

1969	**Yes**	**No (dry)**	**No (dry)**	**No (dry)**	**Yes**
1982	**Yes**	**Yes**	**No (dry)**	**No (dry)**	**Yes**
1999	**Yes**	**No (dry)**	**No (dry)**	**No (dry)**	**Yes**

Note: “Yes” means the timely match of extreme dry years in present NGS precipitation reconstruction and compared reconstructions; “No (dry)” means the extreme dry years in present reconstruction were not extreme dry but dry in compared series; “No” means the extreme dry years in present reconstruction were not dry in compared series.

We have extracted the drought series of Asian Monsoon Atlas (Cook et al.2010) from the nearest point (http://drought.memphis.edu/MADA/Extract.aspx) and compared it with our NGS precipitation reconstruction (please refer to the Fig. 7 in the revised manuscript, or our earlier response, the bottom panel). The extreme wet years in our reconstruction were coincided with the extreme wet years in the MADA; six out of 11 extreme dry years in our reconstruction were matched with the extreme dry years in MADA.

12. Line 262, was the 1920s-1930s drought called World War I drought in southeastern China? (Kang et al., 2013, QI).

Author reply:

Thanks for the comment. We have checked the reference provided, and found that the drought period (1920s) should be called “China mega-drought”. We have modified as “China mega-drought” in the revised manuscript.

Referee 2 comments:

Using tree-ring width data, Keyimu et al. (2021) presented a non-growing season precipitation reconstruction from 1475 to 2005 on the southeastern Tibetan Plateau. Given that there are lot of summer precipitation or temperature reconstructions in this region, it is very interesting to obtain non-growing seasonal precipitation reconstruction. Overall, this study is well designed with reasonable data analysis, producing a robust result and conclusion. I suggest to accept this manuscript after minor revision. Detailed comments and suggestions are as follows:

1. Line 1, "non-growth" or "non-growing", which is suitable? Please check

Author reply:

Thanks for the comment. After checking many literatures, we have decided to use as “non-growing”. We have replaced as “non-growing” through the whole manuscript (at 12 sites).

2. Line 1, Add "A" before "531-year"

Author reply:

Thanks. The title of the MS is changed because, according to the EPS value of the TRW chronology, the updated length of the reconstruction will be 406 years (A.D. 1600-2005). Therefore, we have changed the title as “A 406-year non-growing season precipitation reconstruction in the southeastern Tibetan Plateau”.

3. Lines 79-83. It is better that only "Figure 1" should be in bold, other text should be normal. Same for other tables and figures

Author reply:

Thanks. We have modified accordingly.

4. Lines 192-193, it is a little difficult to see green and yellow bars, maybe it's better to change to other color combinations.

Author reply:

Thanks for the suggestion. We have upgraded the Fig. 6 combining the comments of referee 1 and referee 2 (now it is the Fig. 7 in the revised manuscript). Please refer to the revised manuscript for Fig. 7 or see below:

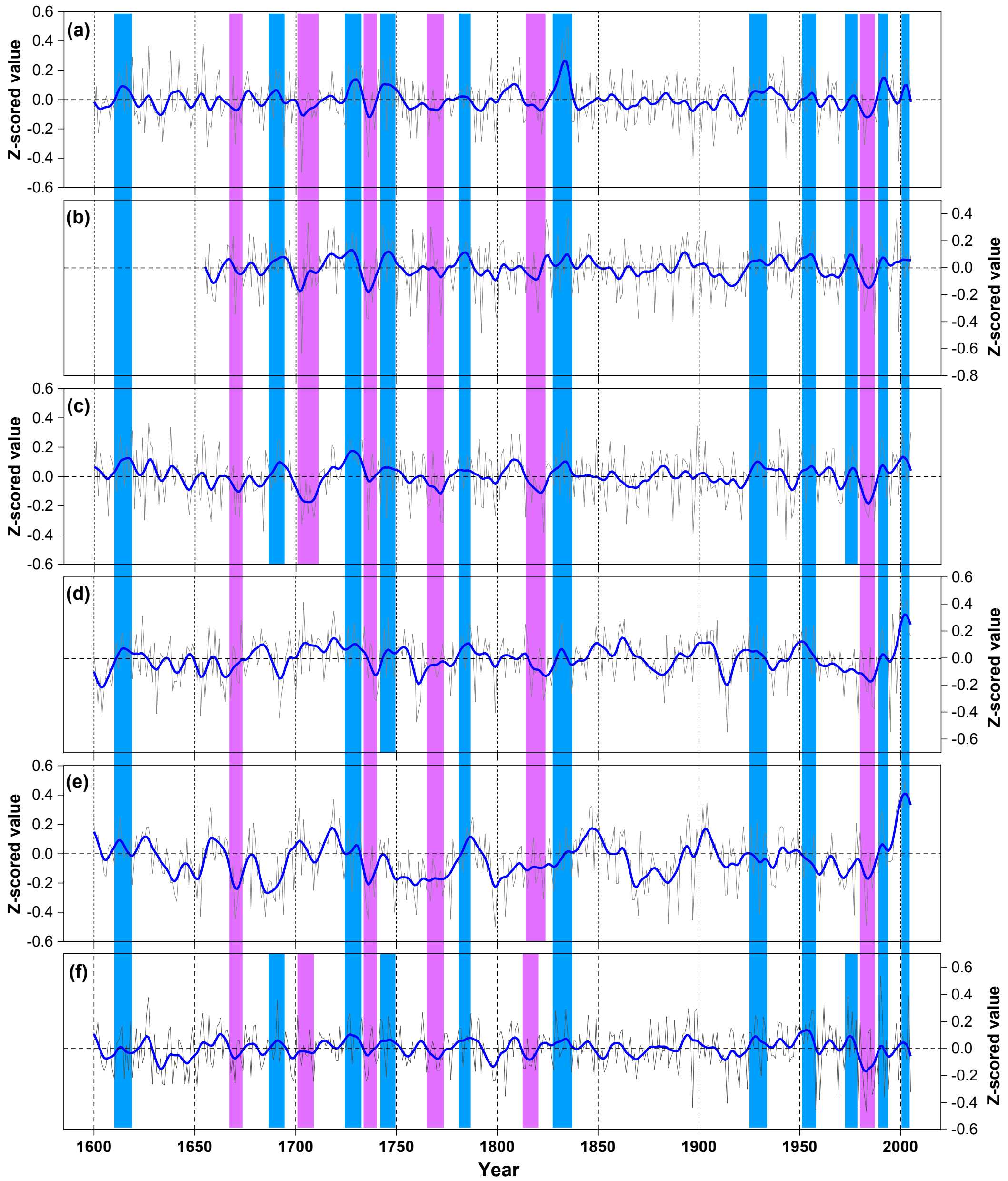


Fig. 7 in the revised manuscript.

5. Line 206-233. More detailed discussions are needed. It appeared the underlying mechanisms about the non-growing season precipitation signals of tree-ring widths were lacking. The non-growing season precipitation signals of tree-ring widths seemed to imply the non-monsoon (e.g., winter) precipitation was used for tree growth. Maybe tree-ring oxygen isotopes could provide some evidence to support non-monsoon precipitation usage of tree growth.

Author reply:

Thanks a lot for the valuable suggestion.

In the revised manuscript, we have added detailed discussion about the importance of NGS precipitation on radial tree growth combining some isotope-based findings, below is the content which we have added:

"*This is because tree growth is often water stressed in the early stages of its growth in each year on the SETP when the monsoon precipitation does not arrive (Bräuning and Mantwill, 2004;*

Zhang et al., 2015), and the earlywood of tree rings mainly use spring melt water (Zhu et al., 2021). The eco-physiological importance of NGS precipitation on tree growth and tree water usage was also revealed by isotope ratios method-based investigations. Brinkmann et al's (2018) study showed that nearly 40% of the uptaken water by Fagus sylvatica and Picea abies trees in a temperate forest of middle Europe are sourced from NGS precipitation. Tree-ring oxygen isotope ratios (δ18O) are demonstrated to contain NGS precipitation signals in the Himalayan region (Huang et al., 2019; Zhu et al., 2021). Huang et al's (2019) study revealed that NGS precipitation (snowfall) increased the snow-depth and the later snowmelt compensated soil moisture in the spring and early summer, which was a crucially important water source for the Juniper growth in the southwestern Tibetan Plateau. Zhu et al's (2021) investigation in the western Himalaya revealed that formation of earlywood in tree rings of Pinus wallachina depended on the snowmelt originated from NGS precipitation".

Public comment by Dr. Yuhe Ji,

The precipitation during non-growth season (coincide with non-monsoon season) in the monsoonal areas are extremely important for the forest ecosystems, because they are the critical moisture source in the early growth season when the monsoon has not arrived. This manuscript provided with opportunity to observe the long-time variability of the NGS precipitation in the southeastern Tibetan Plateau, where historical NGS precipitation was not reconstructed before, and such work provides with important knowledge to evaluate the future of regional forest development. The background of the study and importance of the current investigation were introduced well. The methodology was sound and provided in detail. The results and discussions were convincing and were presented logically in order. However, there are some minor points which needs to be addressed, as well as some suggestions which can be considered to refine the work.

1. It was used as "non-growth season precipitation" on the title of the manuscript, however, it was used as "winter precipitation" in the keywords, such mixed usage also existed at some other places within the main text, please synchronize.

Author reply:

Thanks for the comment. We have used as "non-growth season precipitation" throughout the revised manuscript.

2. Please separate the ombrothermic diagram of the climate variables form Fig. 1, because an important term "saddle shaped rainfall pattern" was mentioned in the discussion, and it was not clear to observe such rainfall pattern in the current status of Fig. 1.

Author reply:

Thanks for the suggestion. We have separated the ombrothermic map in the revised manuscript. Please refer to the Fig. 2 in the revised manuscript for the separated and refined ombrothermic diagram, or see below:

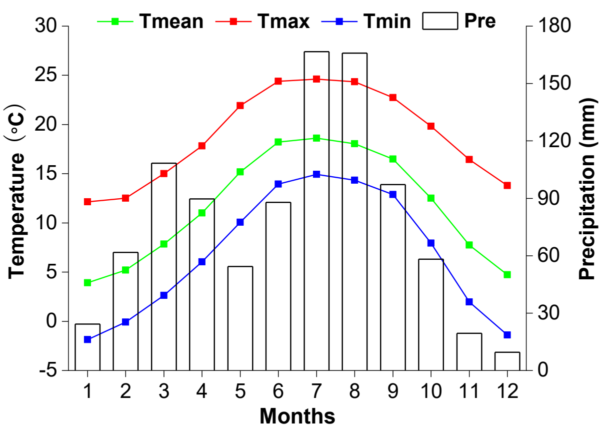
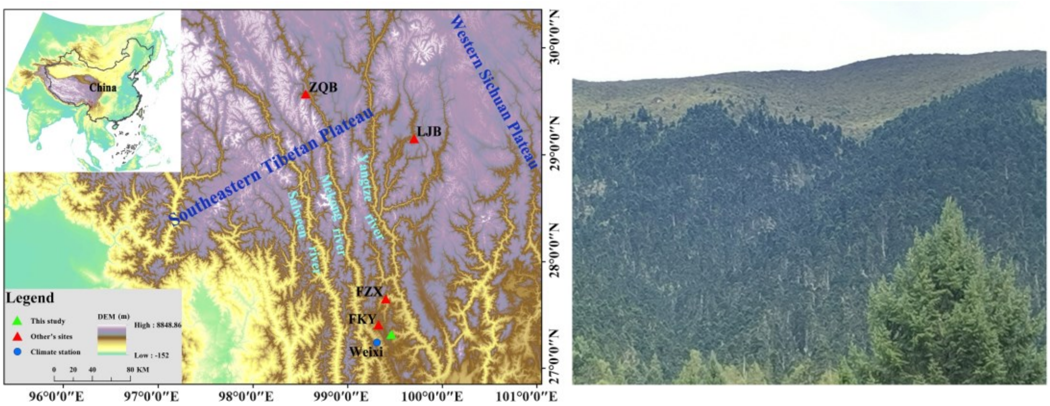


Fig. 2 in the revised manuscript.

3. Please alternate a higher resolution map of the study area because a lot of information were hard to obtain from the current map. In addition, please provide an image showing the landscape of the tree-ring sampling site.

Author reply:

Thanks for the suggestion. We have replaced a re-created map of the investigation area (updated Fig. 1) which included more information about the geographical conditions of the study area (combing the comments by referee 1). Fig. 1 also included the landscape image of tree ring sampling site. Below is the updated Fig. 1:



Updated Fig. 1 in the revised manuscript.

Hopefully, we would also provide a separated file of Fig. 1 at the final stage of the revision.

4. What is the sample depth In Fig. 2? Is it number of tree-ring cores or number of trees?

Author reply:

The sample depth in Fig. 2 is the number of tree-ring cores. We have sampled one tree-ring core per tree. We have updated Fig. 2 (now it is Fig. 3 in the revised manuscript). Please refer to the revised manuscript for Fig. 3 or see below:

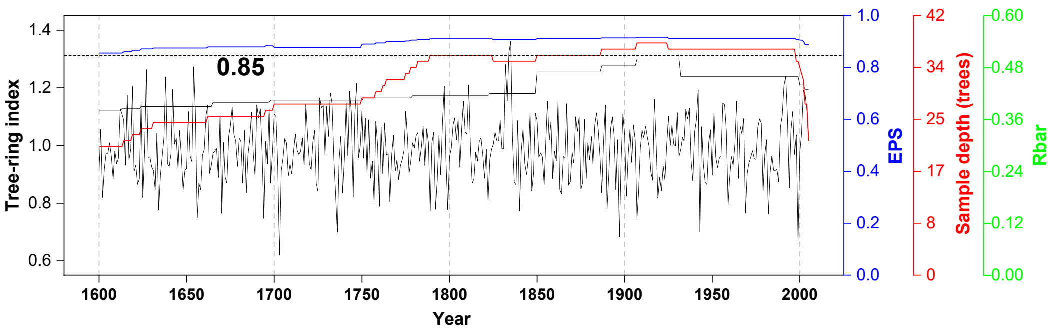


Fig. 3 in the revised manuscript.

5. It is important in dendrochronology (of course not limited to) science to present the complex and abstract results in a clear and easy to understand way for the readers. Please place the Rbar, EPS, and Sample depth on the right side of the Fig. 2, and use similar tick position for them, in this way, it would be easier for readers to have a sense that, which sample depth corresponded with which EPS and Rbar.

Author reply:

Thanks for the careful attitude and the suggestion. We have updated Fig. 2 according to the comment (now it is the Fig. 3 in the revised manuscript).

6. It is suggested to re-check the running EPS value, because it seems that sample depth was already quite high when the EPS reached threshold value.

Author reply:

Thanks. We have re-calculated the EPS value carefully, and the result was the same with the original one. Combining the suggestion of referee 1, we have used EPS criteria of 0.85 to truncate the reliable length of the chronology (Fig. 3 in the revised manuscript).

7. Please mention the meaning of Durban Watson test (Table2) in the results section, what does it imply.

Author reply:

We have removed the Durban Watson test (which represents the autocorrelation) from the Table 2, because what we used is the residual chronology (without autocorrelation), and presenting DW does not make sense.

8. Please add the unit of NGS precipitation in the transfer function.

Author reply:

We have added the unit of NGS precipitation in the transfer function (please refer to line 157 of the revised manuscript).

9. Too much area was involved in the Fig. 7 to show the spatial representativeness of the reconstruction and actual NGS precipitation.

Author reply:

Thanks for the suggestion. We have re-conducted the spatial correlation analysis, and updated the Fig. 7 (now it is the Fig. 8 in the revised manuscript). Please refer to the line 198 of the revised manuscript, or see below:

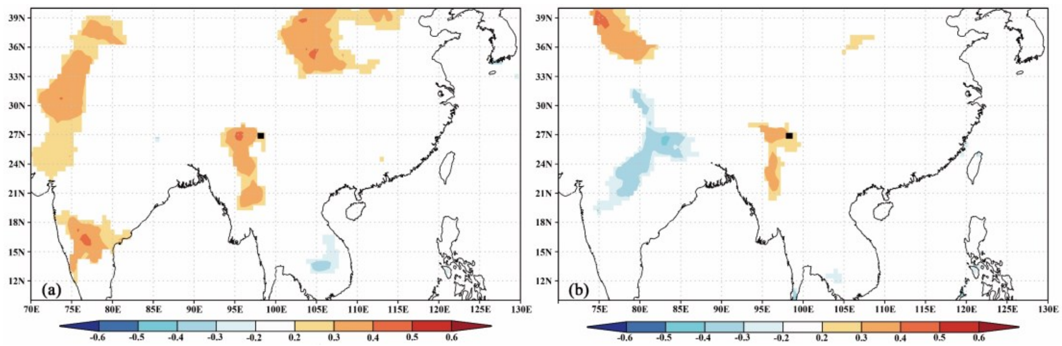


Fig. 8 in the revised manuscript.

10. Some references were not inserted in the main text, while some citations were not provided in the reference list. Besides, the references should be re-organized according to the journal template. For instance, it was used as “D’Arrigo, R. D” at one place, while it was used as “D’Arrigo, R” at another place. “Clim. Dynam.” in one place, while “Clim. Dyn.” in other place, and so on, please rectify.

Author reply:

Thanks for the careful attitude of Dr. Yuhe Ji. We have checked through the main text of the manuscript and also the reference list, and corrected the existing problems within citations and references.