Contents

Cover letter

Dear Editor and Reviewers,

Based on the reviewers' comments, our revision focuses on the following main points.

First, in the abstract section, we point out the shortcomings of previous studies and the scientific problems. We have added the following sentences in the abstract section:" *While previous studies in this area are all single-point climate reconstruction studies, there is a lack of research on the interaction areas and driving mechanisms of the two major circulations. Dendroclimatology can provide high-resolution, long-term and reliable multi-point proxies for the study of inter-annual and inter-decadal climate change*".

Second, in the introduction, we explained why dendroclimatology is better suited to address the interaction between the East Asian summer monsoon and the westerlies. Because "*dendrochronology is one of the best tools for studying paleoclimate changes due to its precise dating, high resolution, good continuity and high replication*". We have combined the two previous subsections into one.

Third, in the materials and methods section, the interpretation and description of statistical data (Rbar, SSS) and drought indices (SPEI) have been added.

Fourth, the figures and tables have also been revised. In Figure 1 (below), we have added the three major geographic regions of China (Tibetan Plateau zone, inland arid zone and East Asian monsoon zone) and the boundaries of the modern East Asian monsoon. Table 2 (see below) has been merged with Figure 3 to make it easier to read. An indication of dry and wet variations has been added to Figure 5.

Further details can be found in the other reply files. We thank the editors and reviewers for their consideration of our manuscript and look forward to receiving positive feedback.

Yours sincerely,
Shengchun Xiao, on behalf of all authors
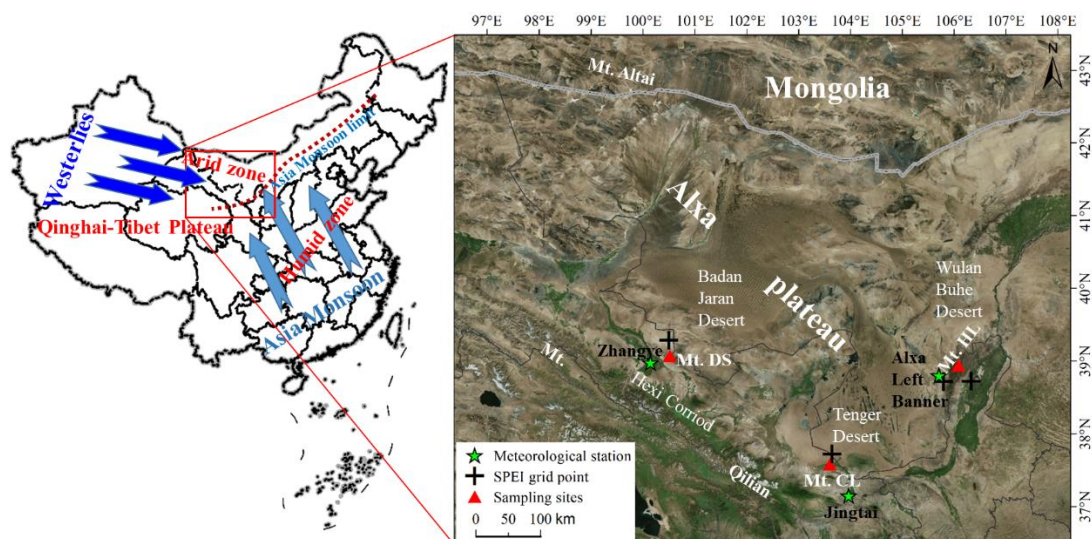
Figure 1. Location of tree-ring sampling sites and meteorological stations
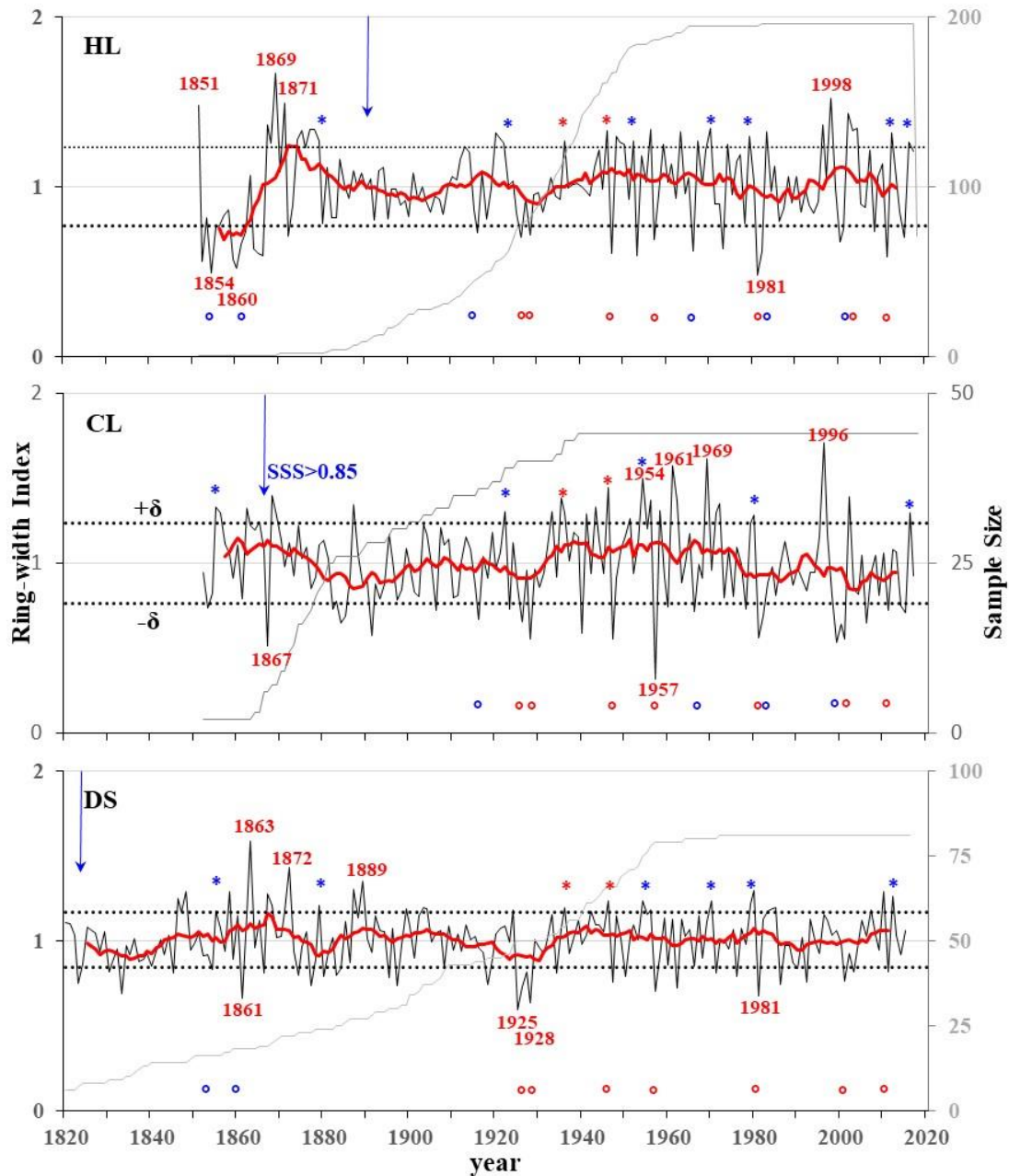
Figure 3. Residual ring-width chronologies for the three study areas. The dark lines indicate the chronology; grey lines indicate the sample depth; red lines indicate the 11-year running mean chronology; dotted horizontal lines indicate the mean value ±1δ; years with data identified as >/< mean ±2δ (δ: standard deviation); blue * and o indicate the years shared between two of the three sample sites, red * and o shows years shared between three sample sites; blue arrows indicate the start of the reliable residual chronology (SSS>0.85).

Anonymous Referee #1

1. To understand the influence of the westerly wind and EASM on precipitation in the Alxa Plateau, Xiao et al. used dendrochronology to examine the tree-rings from its three sites. It is well known that the study region is influenced by the interaction of EASM and westerly, and there have been quite a few studies on this topic using different approaches. However, in this article, the authors didn't not identify shortcomings of previous studies and point out the scientific problems.

Reply: While previous studies in this area are all single-point climate reconstruction studies, there is a lack of research on the interaction areas and driving mechanisms of the two major circulations (Westlies and East Asian summer monsoon). This paper aims to study the spatio-temporal heterogeneity of climate change and the driving mechanisms of the two major circulations using the dendroclimatological methods and three sample sites around the Alxa Plateau. It has been added in the Abstract and Introduction sections.

2. They also didn't explained why their approach is better suited to address these issues. In summary, the motivation behind this study is unclear.

Reply: Dendroclimatology can provide high-resolution, long-term, and reliable multi-point proxies for the study of inter-annual and inter-decadal climate change.

3. The article exhibit poor overall writing quality, making it challenging to read. The authors excessively use abbreviations, some of which are unnecessary. Many sentences require rephrasing, and there are organization problems. Several sections, especially Introduction, need reorganizing or rephrasing. After introducing the background, the literature review doesn't need to include all the previous studies. The purpose of the review is to summarize the major findings or our current understanding of the topic with this article, highlighting the problems with existing studies, and present scientific questions that this article aims to address.

Reply: The English in this paper has been reviewed by Karen Lofstrom (MA), a professional editor and a native speaker of English. Abbreviations that appear for the first time are explained in the text, such as EASM, PDSI and SPEI. The references in the Introduction section are relevant and necessary to the topic and study region.

We have revised the review in the Introduction section and the scientific questions and research objectives in this paper.

4. The Abstract needs rewriting. A good abstract should include the following components: the general background with scientific questions, details about investigation methods, major findings, and hypothesis for what you observed. The implications or significance can be included at the end, although it is optional.

Reply: The abstract section has been rewritten.

5. To establish a correlation between two data sets, the authors intentionally divided them into different groups and conducted correlation analysis (Figures 6 and 7). However, the methodology for this correlation analysis is questionable and lacks scientific basis. For any pair of data sets, it's

possible to selectively choose a small portion of data and find a so-called correlation between them.

Reply: Tree radial growth in the three sample sites was influenced by the interaction of the westerlies and the East Asian summer monsoon on interannual and interdecadal scales. Meanwhile, there are interannual and interdecadal variations in the westerlies and the East Asian summer monsoon. Therefore, it is necessary to carry out correlation analyses of the two circulation indices and chronology indices for the corresponding high, medium, and low value groups (or typical years) to explore their driving mechanisms. For details, see line229-233, line358-362.

6. Several figures were presented in the text without detailed explanations or descriptions, and some captions lack informativeness.

Reply: We have added some explanations and descriptions to the figures. In Figure 1, we have added the three major geographic regions of China (Tibetan Plateau zone, inland arid zone, and Eastern Asian monsoon zone) and the boundaries of the modern East Asian monsoon. We have merged Table 2 with Figure 3 as suggested by the reviewer. In Figure 5, we add an indication of dry and wet variations.

7. In the results section, the first part is extremely challenging for any reader to follow, and this section should be merged with the next, focusing on introducing general observed patterns rather than detailed or exact years with variations.

Reply: This section has been revised.

8. While reviewing the article, I made some comments (see attached annotated PDF file). Hope that they can assist the authors in improving their article during the revision.

Reply: The details of the revision are as follows.

Specific editing suggestions in the manuscript:

1. The abstract needs to be rewritten.

Reply: The abstract was rewritten.

2. Please rephrase this sentence, as it sounds weird, especially the first part. "Against the background of changes in global atmospheric circulation, local changes in the East Asian summer monsoon (EASM) and the mid-latitude westerly winds will inevitably affect the climate and ecology of the arid zone of Northwest China".

Reply: We rewrote this sentence: Atmospheric circulation changes, their driving mechanisms and interactions are important topics in global change research. Local changes in the East Asian summer monsoon (EASM) and the mid-latitude westlies will inevitably affect the climate and ecology of the arid zone of Northwest China.

3. What changes, global or local or both? Be specific.

Reply: We revised it to: " Hence, it is important to study these regional changes ".

4. This is just a method you used to analyze your data. You cannot use a method to study the

changes. You need to study something or some objects (samples, data and so on) using some methods (like your method used in this study) to investigate your scientific questions. Therefore, you need to rephrase this sentence and the following few sentences.

Reply: We revised it to:" Dendroclimatology can provide high-resolution, long-term, and reliable multi-point proxies for the study of inter-annual and inter-decadal climate change. We chose to observe these changes in the Alxa Plateau using dendrochronological methods".

5. these two subsections should be merged into one and no point to divide them.

Reply: We have revised the section accordingly.

6. It would be great to show a map with these three zones for the convenience of readers who are not familiar with the geomorphology of Chinese mainland. Probably, you can modify the figure 1 to include this information.

Reply: We have revised the figure accordingly.

7. It displays the typical climatic characteristics of a continental climate.

Reply: We have revised the sentence accordingly.

8. To estimate the impact of global climate change on this interaction, it is crucial to comprehend its historical context.

Reply: Following with the suggestions.

9. As I commented above, it is better to include this information in the figure 1 for the convenience of readers.

Reply: In Figure 1, we have added the three major geographic region of China (Tibetan Plateau zone, Inland Arid zone, and Eastern Monsoon zone) and the boundaries of the modern East Asian monsoon.

10. You need to point out what you actually studies or what you did in this study using dendrochronology. In your abstract, you pointed out what you actually did in this study, and need to say that again somehow here.

Reply: We have revised the last paragraph of the introduction and added a simplified version to the abstract.

11. What are the scientific questions that were not answered and you will address in this study? What I mean is that what the previous studies have found regarding the topic of this study and what are the problems with their findings.

Reply: We summarize the results of previous research as follows and place them in the second-to-last paragraph of the introduction.

"Most modern researchers studying climate change in the region are mostly carried out on single sample sites (Wang et al., 2004; Liu et al., 2005; Chen et al., 2010; Chen et al., 2016; Li et al., 2016; Liu et al., 2016; Chen et al., 2018). While, there is a dearth of multi-site, regional and long time scale studies on the interaction of the westerlies and the EASM. "

12. how large is large scale study?

Reply: We have deleted this unclear statement.

13. "our group" changed by "we"

Reply: Following with the suggestions.

14. give the definition of SPEI for readers' convenience.

Reply: We revised it to: "We used SPEI (Standardized Precipitation Evapotranspiration Index) to represent the local drought and wetness conditions, which is widely used in the dendrochronology studies and considering the effects of potential evapotranspiration, precipitation and time scales (Vicente-Serrano et al., 2010). "

15. citation is needed

Reply: We added it accordingly.

16. citation is needed.

Reply: We added it accordingly.

17. What general pattern were observed in this three time series? You need to point out the general patterns or do not present this figure.

Reply: The chronologies are the core data of this paper and it is necessary to place it in the main text. In the revised version, we have merged Table 2 into Figure 3, following the reviewers' comments.

18. DO you mean only the correlation is only statistically significant p<0.05 in P9 but not significant in other months? Rephrase these two sentences.

Reply: CL chronology was negatively correlated with the mean temperature in most months, but only reached a significant negative correlation (P<0.05) with P9.

19. It is extremely hard, if not possible, for readers to follow the description in this section, as it is not systematic and not presented in some general patterns. This whole section is just result.

Reply: Section 3.3.1 focused on comparing extreme drought/wetness years on an interannual scale. Section 3.3.2 focused on comparing dry/wet changes on an interdecadal scale. We believe that the organization of these two subsections is reasonable.

20. what is correlation coefficient?

Reply: We revised the statement.

21. It is extremely hard for readers to sort out these data and thus to understand the change pattern among these three. You should try a different way to present these data to readers so that they can easily understand them, in a figure or something, or in time series?

Reply: In the revised version, we have merged Table 2 into Figure 3, following the reviewers' comments.

22.   extremely wet or dry?

Reply: In the revised version, we have merged Table 2 into Figure 3, following the reviewers' comments.

23.   this section(3.3.2) should be combined with the previous section.

Reply: Section 3.3.1 focused on comparing extreme drought/wetness years on an interannual scale. Section 3.3.2 focused on comparing dry/wet changes on an interdecadal scale. We believe that the organization of these two subsections is reasonable.

Indicate the dry and wet direction on the figure. In your region, higher index suggests dry or wet conditions?please tell readers what red represent and what blue represent in the caption.

Reply: We revised it to: "Figure 5. Three regional chronologies demonstrating alternation between dry (red) and wet (blue) years on interdecadal scales (11 a running mean). "

24.   delete"close to"

Reply: We revised it accordingly.

25.   what is this? I don't understand your correlation.

Reply: See Figure 7 for details

26.   probably it is better to label r and p in all these figures

Reply: Only data sets that reached a significant level of correlation are highlighted in the figure.

27.   what is the difference between Figure 6 and Figure 7?

Reply: The grouping is based on different bases. In Figure 6, the datasets are grouped by chronological values. In Figure 7, the datasets are grouped by the index of the two atmospheric circulations.

28.   very strange division. what are your bases to divide the index into, high, middle and low? Why you correlate them separately with ring-wide index?

Reply: This is because the correlation between tree growth and the circulation index at the three sample sites was not linear, so we performed a correlation analysis using two methods.

Method 1: Chronological indices were categorized into three groups: high, medium and low. Each group of data was correlated with its atmospheric circulation corresponding indices. Results showed the effects of circulation under different growth conditions for trees.

Method 2: The indices of the atmospheric circulation were categorized into three groups: high, medium and low. Each group was correlated with its corresponding chronological data. The results showed the response of tree radial growth under different circulation intensities.

29.   For"we control one factor".

Reply: We revised the statement: " At HL, if we control one variable (the WCI or EASMI) from our analysis, the other variable will all showed a positive correlation with its chronology ($P<0.0001$)."

30. show positive correlation with what?

Reply: It is positive correlation with HL chronology. We revised the statement: " At HL, if we control one variable (the WCI or EASMI) from our analysis, the other variable will all showed a positive correlation with its chronology (P<0.0001)."

31. correlation of what with EASMI?

Reply: We revised the statement:" at CL, if we controlled the WCI, we find a positive significant correction between the chronology and EASMI (P<0.0001). "

32. how and in which way, be specific a little here.

Reply: The related details can be seen in the next paragraph.

33. only one year's change???? One year change cannot be considered a trend.

Reply: This year was the turning point. Before the year, the climate was wetter; after the year, it turned dry.

34. be crucial

Reply: We revised it accordingly.

35. not sure what do you mean? Do you mean that it's positively related to rainfall?

Reply: yes.

36. not quite sure what you mean and rephrase this

Reply: We revised it to: "When the weakened of the westerly wind and latitudinal circulation".

37. ???????

Reply: We revised it to:" when they are weaker, the zone moves southwestward. "

38. go too far and your data cannot answer this

Reply: Climate change is a temporal process and therefore requires an understanding of changes not only on interannual and interdecadal scales, but also over geological time. In order to understand climate change, circulation interactions and environmental effects at longer scales.

39. your data cannot address these questions

Reply: The westerlies and the monsoon, which are the two main circulation systems affecting climate change in the study area, are of interest in this paper. However, these two are only part of the global atmospheric circulation and they are also influenced by other circulations, i.e. they have global properties. This is an issue that needs further attention in the future for the subject of this study.

Anonymous Referee #2

1.   This manuscript attempts to interpret the interaction between the westerlies and monsoons in the arid regions of northwest China from the perspective of historical climate using tree-ring data from three locations. While it has some regional representativeness, upon reviewing the entire manuscript and comparing it with previous work, significant deficiencies are identified.

Firstly, the theme and content of the manuscript lack cohesion, failing to pose scientific questions for resolution.

Reply: While previous studies in this area are all single-point climate reconstruction studies, there is a lack of research on the interaction areas and driving mechanisms of the two major circulations (Westlies and East Asian summer monsoon). This paper aims to study the spatio-temporal heterogeneity of climate change and the driving mechanisms of the two major circulations using the dendroclimatological methods and three sample sites around the Alxa Plateau. It has been added in the Abstract and Introduction sections.

2.   The discussion section is unclear, lacking coherence and substance.

Reply: We think the discussion section is closely related to the results section.

3.   Secondly, the chosen theme has seen considerable innovative research, yet the manuscript fails to distinguish itself from similar studies or highlight intriguing aspects.

Reply: While previous studies in this area are all single-point climate reconstruction studies, there is a lack of research on the interaction areas and driving mechanisms of the two major circulations (westlies and East Asian summer monsoon). This is the theme and highlight of this article.

4.   Lastly, the entire document requires thorough language editing and improvement. Paragraph distribution should be compact and logical, unnecessary content should be removed, and detailed explanations should enhance content relevance.

Reply: It has been rewritten and reorganized.

Specific editing suggestions:

1) Line 24: "Qinghai spruce?" Use the Latin name for plant species, the same applies to line 284, etc.

Reply: We revised it accordingly.

2) Lines 45 and 51: Citation error, reference 2019a should precede 2019b.

Reply: We revised it accordingly.

3) Line 48: What does EASM stand for? Same for subsequent instances.

Reply: We revised to EASM (East Asian summer monsoon) accordingly.

4) Lines 49 to 52: Grammar errors, merge long and short sentences into one.

Reply: We revised it to:" This was true even before the onset of global climate change in the area, and it is even more pronounced in recent years. ", according to the comments of Reviewer 1.

5) Line 55: Unclear subject reference.

Reply: This sentence was deleted.

6) Line 72: Extra space.

Reply: It was corrected.

7) Lines 77 to 80: Does "which" refer to your team or dendrochronology? Clarify.

Reply: "which" refer to dendrochronology, and we revised it.

8) Subsection 1.2: Summarize previous research concisely, highlighting key points rather than listing references.

Reply: We have rewritten the introduction section.

9) Lines 122 to 123: Currently, there is no clear theoretical support for the impact of reconstruction results on desertification control.

Reply: Because desertification/environmental change processes in the Alxa Desert Region are strongly influenced by the regional climate, clarifying climate change processes is beneficial to desertification control.

10) Line 129: Unclear referent for "it." Merge sentences for clarity.

Reply: It changes as this area.

11) Line 130: Add reference.

Reply: We revised it (Xiao et al., 2017; Xiao et al., 2019).

12) Subsection 2.1: Streamline, remove irrelevant content.

Reply: Figure 1 has been redrawn to correspond to the relevant content.

13) Line 186: What standard method? Provide reference.

Reply: We added the references accordingly.

14) Line 190: Specify the method for constructing the chronology or provide a reference.

Reply: We have added the references and reasons for choosing the RES chronologies.

15) Lines 200 to 203: Reference for SPEI data source and justification for choosing SPEI over PDSI needed.

Reply: We have added the references.

16) Line 230: What is SD? Specify the full name if it is standard deviation.

Reply: We have added the full name.

17) Lines 238 to 241: Why use RES chronology?

Reply: In order to highlight the high frequency signal, the RES chronology is selected for later climate analysis.

18) Table 1: Statistical indicators should be based on synthetic chronology results.

Reply: At each mountain, we had multiple sampling points, and we first created a chronology for each sampling point and then used a weighted average to calculate a regional chronology representing that mountain. So, statistical indicators of all chronologies were used to illustrate the reliability of the chronology.

19) Subsection 3.2: Why no discussion of seasonal correlation? Which season does the radial growth signal indicate?

Reply: This paper does not deal with climate change reconstructions, so seasonal-scale correlations are not analyzed.

20) Table 2: Consider using a graphical representation for better clarity; tables appear disorganized.

Reply: We have merged Table 2 with Figure 3 as suggested by the reviewer.

21) Figure 5: Inconsistent color transparency in gray bands.

Reply: The difference in transparency is to distinguish between dry and wet years.

22) Line 479: Clarify the intended message.

Reply: We have merged this paragraph with the previous one.

23) Lines 511 to 534: Unclear discussion; is there a close connection to the manuscript's theme?

Reply: This section focuses on analyzing the global atmospheric circulation interactions including monsoon and westerlies and the driving mechanisms. It is also the subject of this paper.

24) Line 540: Extra space.

Reply: We deleted the space.

25) Lines 553 to 554: No significant correlation between DS and EASM; how can monsoon decline be interpreted as promoting tree growth?

Reply: On the interannual scale, the monsoon declined in the 1970s while the westerlies were strengthening. This is the new finding of this study.

Anonymous Referee #3

1. Xiao et al present tree ring width records from three different parts of the Alxa Plateau covering climate history of this region for about two centuries. The region was claimed to be affected by both the westerlies and the East Asian Summer Monsoon. To understand the history of the interactions between the westerlies and the EASM, the authors attempts to use the presented tree ring records from the Alxa Plateau to reconstruct the history of such interactions. Although understanding the interaction is the main focus, however it is still unclear to me how did the westerlies and the EASM interact with each other in this region after reading through the manuscript. Many scientific terms and expressions in the manuscript lack a concise definition to improve readability. Further, the authors need to improve the presentation of manuscript not only for language but also the organization of the paper.

Reply: As the result in the section 3.2 showed, the chronology of the three sites in the monsoon-westerly interaction region was significantly positively correlated with SPEI in the growing season (April-July) and precipitation in May-June. It showed that the tree growth was mainly limited by growing season precipitation. Section 3.3.2 showed the spatial and temporal heterogeneity of the three study sites in the annual and decadal time scales. These results systematically illustrate the interaction between westerlies and EASM over the study area.

The English in this paper has been reviewed by Karen Lofstrom (MA), a professional editor and native speaker of English. Abbreviations that appear for the first time are explained in the text, such as EASM, PDSI and SPEI.

Major comments:

2. When the authors indicate the interaction between the westerlies and the EASM, it is not clear what is the precise meaning of the interaction. Did the authors mean the shift of the boundaries, the influence between each other, or something else? The authors should make this point clear to let readers correctly understanding the scientific content delivered by the authors.

Reply: In the monsoon-westerlies interaction zone, both atmospheric circulation systems are all can bring precipitation to the region and promote tree growth. However, the interaction between the two circulation systems is characterized by high spatial and temporal heterogeneity. As the abstract showed: "*The results show that radial growth was indeed affected by changes in the monsoon and westerlies. The heterogeneity of precipitation and climatic wet-dry changes in different regions is primarily influenced by the interactions between atmospheric circulation systems, each with its own dominant controlling factors. In the case of the Helan Mountains, both of these major atmospheric circulation systems play a significant role in shaping climate changes. Changling Mountain in the southern part of the Alxa Plateau are mainly influenced by the EASM. Dongdashan Mountain is mainly influenced by the westerlies.* "

3. The authors should briefly introduce the definition and calculation procedure of any index that

has been used in manuscript. For instance, there are many different definitions of the EASM index. Only give a citation to the index that has been used is not friendly to readers not familiar with these indexes.

Reply: The related information was added as suggested. The East Asian summer monsoon (EASM) index is defined as an area-averaged seasonally (JJA) dynamical normalized seasonality (DNS) at 850 hPa within the East Asian monsoon domain (10°-40°N, 110°-140°E) (Li and Zeng 2005). The EASMI is currently the most popular index.

4. When calculating correlation coefficients, the authors may need to make it clear how the degrees of freedom were adjusted to account for serial correlation in the data, and that this procedure applies to all correlation coefficients and significance levels.

Reply: Answer: All correlation statistical tests were performed using the SPSS19 program and the two-tailed test.

Other comments:

5. L284-286: is it a quantitative representation of a specific index of the wet/dry conditions or just a qualitative representation?

Reply: It's a qualitative representation.

6. L284-286: as low precipitation is the major limiting factor, is it possible that the records are more sensitive to drought while less sensitive to wetter conditions?

Reply: As shown in section 2.1, the study area is located on the eastern edge of the Central Asian inland arid zone. The mean annual precipitation is lower than 220 mm in the nearest meteorological station of the sampling sites. Thus, low precipitation is the main limiting factor for radial growth of trees.

7. Figs 6 and 7: from the figure captions, these two figures look identical. The authors may need to revise the figure caption to make the difference between the two figures clearer.

Reply: It has been revised as suggested.

Figure 6. Grouping related charts among the ring-width index of three regions (HL, CL and DS) and the two atmospheric circulations' indices (EASMI and WCI), grouped by chronological values. The noted numbers are the person correlation coefficients (two-tails test) and the corresponding significant credible level. Only the significant correlations were labeled. Red dots indicate the higher ring-width index group (>mean+1δ), gray dots indicate the middle ring-width index group (>mean-1δ~< mean+1δ), and blue dots indicate the lower ring-width index group (>mean-1δ).

Figure 7. Grouping related charts among the two atmosphere circulations' index (EASMI and WCI)

and the ring-width index of three regions (HL, CL, and DS), grouped by the two atmosphere circulations' index. Red dots indicate the higher atmosphere circulations' index group (>mean+1δ), gray dots indicate the middle atmosphere circulations' index group (>mean-1δ~< mean+1δ), and blue dots indicate the lower atmosphere circulations' index group (>mean-1δ).

8. There are some typos and grammar errors in the manuscript. The authors need do a through check on the writing of the paper.

Reply: The English in this paper has been reviewed by Karen Lofstrom (MA), a professional editor and native English speaker.