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Climate of the Past
Discussions
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Interactive comment on "Reconstruction of the March–August PDSI since 1703 AD based on tree rings of Chinese pine (*Pinus tabulaeformis* Carr.) in the Lingkong Mountain, southeast Chinese loess Plateau" *by* Q. Cai et al.

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The authors would like to thank the editor and reviewers for their valuable and constructive comments that help improve the manuscript.

Editor: J. Guiot

Dear authors

You can see that the comments from three reviewers are all positive and that your paper can be accepted after minor revision. They raise several points that you can see

in their review text. Among them, I insist particularly on these ones:

- The introduction should end with the scientific question you want to answer in the paper: you present the methodology that you want to develop but nothing is told about the climatic aspects of your results.

Answer: We have posed two scientific questions at the end of the introduction and answered them in the revised manuscript as follows (Please also see our answers to the 1st question of Reviewer#1):

Questions: Results of this work would be conducive to answer the following two questions: Whether did the drought severity or frequency increase in response to the global warming? Whether the drought condition nowadays in Lingkong Mountain is unprecedented during the last three centuries?

Answers: It's visible that the severity and duration of dry or wet events seemingly strengthened after 1800 AD compared with the earlier stages, possibly due to the impact of global warming. Even so, the recent drought in 1993-2008 was still within the historical framework.

- In the same idea, when you compare IAPO and PDSI, you should go in deeper explanation about the underlined mechanisms.

Answer: We added such explanation to better understand the relationship between IAPO and PDSI in the revised manuscript as follows (Please also see the answer to the 10th question of Reviewer #1):

Theoretically, on the decadal scale rather than the annual scale, when IAPO was in stronger stages, the thermal contrast between eastern Asia and the North Pacific was strengthened because the low-pressure system of lower-troposphere over eastern Asia strengthens, and the western Pacific subtropical high strengthens with its location shifting northwards (Zhao et al., 2007, 2008). Therefore, lower-troposphere of the East Asian region was dominated by stronger southwesterly winds, in other words, stronger

EASM, resulting in more rainfall and wet condition in North China, and vice versa.

- Your dendrochonological methodology (used to construct the final chronology) is not explained in enough details for a more general public (CP is not a disciplinary journal for dendrochonologists)

Answer: Ok, we tried to make it more understandable to the general public in the revised manuscript as follows:

The tree-ring width chronology was developed using the ARSTAN program (Cook, 1985). To retain as much long-term climate variance as possible, negative exponential curve or straight line with negative slope was applied to each tree-ring measurement series to remove the non-climate trends related to tree age or the effects of stand dynamics. We divided the raw data of each ring width by the corresponding year's value of the fitted curve to give a dimensionless index. Finally, all individual indices were combined to produce a standard STD chronology by means of "biweight robust mean".

- A question raised by two reviewers is why there is a so important reduction in the number of cores finally used? Is there is confusion between cores and trees? Are they representative of the complete set?

Answer: Actually, the 3rd question of Reviewer#1 and the 2nd question of Reviewer#3 are different (Please see their questions and our answers). We have clearly described that the sample numbers from site 2 were 40 cores from 20 trees (not 10 trees), and from site 3 were 8 cores from 4 trees (because trees older than 100 yr are very difficult to find), as showed in line 11-15 of page 6316 in the original paper. In this work, 108 cores form 54 trees were collected, and we successfully included 88 (enough to be representative) to produce a regional tree-ring chronology, then for final reconstruction. The other 20 cores were discarded because of short ages or that were abnormal in comparison with the majority of series.

- More explanation is needed to make better understandable the behaviour of PDSI,

as well in relation with temperature, precipitation than on the fact that this variable is highly persistent (see the comments of rev#2 and rev#3)

Answer: We supplemented a new section in the fourth part of "Discussion" as "4.1 Climate-growth relationship", answering this question and the relevant questions of the reviewers. Please see the following part as well as the corresponding content in the revised manuscript.

4.1 Climate-growth relationship

Lingkong Mountain belongs to the semi-arid area where annual evaporation is more than twice of annual precipitation. High precipitation during the growth season actually benefits the radial growth of tree by providing necessary water for the radial cell division and elongation, while low precipitation limited the radial growth. Inversely, increased temperature before and during the growth season inevitably strengthen the water stress by accelerating water consumption in the soil and trees through evaporation and transpiration, resulting in the formation of narrow rings, and vice versa. Reasonably, positive correlation of tree rings with monthly precipitation and negative correlations with monthly mean temperature in current growth year was identified in this study, and this climate-growth pattern was generally reported in the arid to semi-arid CLP (Gao et al., 2005; Liu et al., 2005; Cai and Liu, 2013) and other areas of northern China (Liang et al., 2007).

In the present work, monthly mean temperature from March to August exerts more important influences upon tree growth than monthly precipitation (Fig. 4), which is similar to studies in the Kongtong Mountain (Fang et al., 2012), Guiqing Mountian (Fang et al., 2010a) and the Ortindag Sand Land (Liang et al., 2007), showing the temperature-induced water stress was likely the key factor limiting tree growth. The correlation analysis between PDSI and tree-ring chronology further tested the above hypothesis. Significant correlation is identified from March to August, especially significant in May and June when the temperature is comparatively high and precipitation is very low (Fig.

2), indicating an intensified drought stress. PDSI is a measurement of dryness which was calculated based on a water balance equation, depending on not only temperature and precipitation, but also other parameters such as evapotranspiration and recharge rates. Thus, it's unsurprised that the monthly PDSI of previous year had significant influence on tree growth due to the well-known lag effect, though climatic factors in previous year (except the precipitation of September) showed weak correlation with tree growth.

Interestingly, the period of limiting months coincided with the results of cambial activity of trees in northern China. Tree-ring anatomical analysis disclosed that the radial wood formation of Chinese pine usually started at the end of April (Zhang et al., 1982), and fast growth usually happened from May to August (Zhang et al., 1982; Liang et al., 2009). Similar finding was reported from Larixprincipis-rupprechtii, a different coniferous species from Liupan Mountain, north-central China (Guan et al., 2007). Location of our studied sites is far south than the above reported sites, and it's warmer and wetter, therefore, it's possible that the radial growth of tree in Lingkong Mountain may start earlier.

- I do not think that there is so precise peaks in your spectrum. First they are not extremely significant, second you have not a sufficient resolution to distinguish between 2.5 and 2.7, between 3 and 3.2, 7.6 and 7.8, third it is clear that the 102 yr cycle is not reliable because of the low number of years. Then be more cautious in interpreting it.

Answer: Yes, we agree the suggestion that we should be more cautious in interpreting the cycles detected by the MTM analysis.

In Fig. 10, significant 2.0–2.1, 2.5, 2.6, 2.7, 3.0–3.1, 3.5, 3.9 and 7.6–7.8 yr cycles were revealed by the Multi-taper spectral analysis. All these cycles were at 95% confidence level, and the 2.6, 3.0–3.1, 102 yr cycles were at 99% confidence level. We agreed with the suggestion and replaced the short cycles with 2-7 yr cycles; In the original text we also pointed out that the 102 yr cycle may not be reliable considering the limited length

of our reconstruction (306 years). We presented this cycle in the text just want to hint that there may exists possible relationship between the solar activity and local moisture condition. To support this hypothesis, the sunspot time series from 1700 to 2009 were derived from National Geophysical Data Center (http://www.ngdc.noaa.gov/) to compare with our PDSI reconstruction (Fig. 9b). The high correlation coefficient between the PDSI reconstruction and sunspot numbers convincingly supported the influence of solar activity on moisture variations in the Lingkong Mountain area.

- You should merge table 1 and table 2; in the caption of the tables, you need to be more explicit (what is r, R2, F etc...).

Answer: We deleted Table 1. As suggested by Reviewer#1, we take split calibration-verification method instead of leave-one-out method, and explain the result in the text. Moreover, we explained the meaning of r, R2, R2adj, F and P below Table 1 (actually Table 2 in the original manuscript).

Please submit a revised version with a cover letter where you explain the change you have done in the revised version. Provide also a reply to the comments of the three reviewers. Best regards Joel Guiot

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/9/C3246/2014/cpd-9-C3246-2014-supplement.pdf

Interactive comment on Clim. Past Discuss., 9, 6311, 2013.

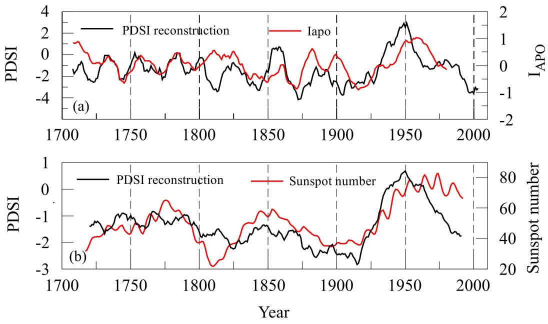

Fig. 9

Fig. 1. Figure 9