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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.

Anonymous Referee #3 This paper presents an interesting reconstruction of PDSI in the southeast part of the Chinese Loess Plateau for the period 1703-2008. Based on 54 trees (108 cores) analyzed with standard dendrochronological techniques (standardization with a negative exponential curve and linear regression model), it is gener-

ally well-written. I recommend its publication after a few minor revisions listed below.

Comment 1. 2.1. Study area and climate, Fig 1. The authors should have mapped the existing tree-ring network or tree-ring reconstructions in the region. These information would help the reader to understand that their reconstruction really fills a gap in this region.

Answer: We have showed the locations of the existing tree-ring reconstructions as black stars (âŸĚ) in the small map of China on the top left corner of original Fig. 1. In the revised version, we improved Fig.1 and made them easier to see.

Comment 2. 1) 2.2. Tree-ring data. Informations about the position of the tree line in the Lingkong Moutain area would be helpful to know whether the pine trees have been cored at the upper part of their area of distribution. 2) I am also surprised by the reduced number of tree in populations from sites 2 (10 trees) and 3 (4 trees). The authors should explain why they have chosen to include these trees in the final reconstruction. 3) In this section, I think that information about the Mean Segment Length (average number of rings per core) should be added as this parameter has an influence on the maximum wavelength of recoverable information by a resulting chronology.

Answer: 1) Unfortunately, there isn't significant tree line in the Lingkong Mountain area for the highest peak of this mountain is 1953 m. The altitude of Lingkong Mountain generally ranges from 1600 m to 1850 m. Our tree-ring samples were collected at 1480–1700, 1450–1650 and 1450 m, respectively, it's easy to see these locations belong to the low-middle part of the mountain. In the mountainous area of arid to semi-arid northern China, trees at the low altitude usually were limited by the moisture conditions combined by precipitation and temperature (Gou et al., 2005; Peng et al., 2008; Cai and Liu, 2013).

2) I think it's a misunderstanding. 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 (trees older than one hundred years are very difficult to find), as showed in line 11-15 of page 6316 in the original paper. We included totally 88 cores to produce a regional tree-ring chronology, then for final reconstruction. Usually, 40 tree-ring cores form 20 trees in a specific site have met the criterion of sample request of International Tree-Ring Data Bank.

3) The mean segment length is 180.5 year, we added it in the revised manuscript.

Comment 3. 2.4.. Statistical analysis. The authors have computed the Coefficient of Efficiency (RE=0.437) to evaluate the model skill. Would it be possible to provide the coefficient of efficiency (CE) (Comparison the estimated data for the veriïnËĞAËŻcation period to the mean of this period)? Table 1 is very short. It should be removed and added into the manuscript.

Answer: We deleted Table 1. As answers to the 6th question of Reviewer# 1, we gave up the leave-one-out test, and did the split calibration-verification test (Meko and Graybill, 1995), RE and CE were correspondingly presented in the manuscript as follows:

The fidelity of the reconstruction was verified by comparison with the Dai-PDSI data and checked by the split calibration–verification method (Meko and Graybill, 1995). Result of the split period calibration-verification test showed that the regression model is stable over time. The explained variance (R2) for the verification period 1983-2005 was 52.1%, and reduction of error (RE) and coefficient of efficiency (CE) were 0.603 and 0.375, respectively, when the data during 1954-1982 was used to establish the regression model. R2, RE and CE were 32.3%, 0.411 and 0.113, respectively for the verification period 1954-1973, when data during 1974-2005 was chosen as calibration. RE and CE, the two rigorous verification statistics during verification periods showed positive values, indicating sufficient similarity exists between the reconstruction and Dai-PDSI data (Cook et al., 1999).

Comment 4. 1) 4.1. Annual, inter-annual and centennial variation of the PDSI. Amongst the 10 wettest years listed in the first paragraph of this section, 4 occurred between

1946 and 1950. Was this period really wet in the area or does this result from remanance (persistence) effects in the tree-ring chronologies? 2) How did you compute the accumulated anomalies of PDSI ?

Answer: 1) Yes, we can't exclude the possibility of remanance effects in the tree-ring chronologies since the explained variance of our reconstruction was only 46.4%. We checked the Dai-PDSI record of 1946-1950, the 4 wet years disclosed in our reconstruction were not extremely wet in the Dai-PDSI record. However, Dai-PDSI records before 1950 were calculated by interpolation from data of surrounding meteorological stations (with longer records) for the local records only started from the early 1950s. We also can't say that the Dai-PDSI records before 1950 was absolutely accurate. To solve this problem, we added a sentence "we should point out that low-frequency variation of the reconstructed PDSI was more reliable than high-frequency variation."

2) The accumulative anomalies of the PDSI (AC), achieved by calculating the cumulative departure from the arithmetic mean for the period of reconstruction (Wei, 2007), can intuitively and effectively evaluate the long-term trend of dryness and wetness (Tian et al., 2007). The long-term trends of decreasing and increasing movement of AC indicate the persistently dry or wet conditions. We supplemented this in the revised manuscript.

Comment 5. 4.2 Temporal and Spatial representation of the PDSI reconstruction. Could you provide the distance between Lingkong Moutain and (i) the Ortindag Sand Land and the Kongtong Mountains?

Answer: The distance from the Lingkong Mountain to the Ortindag Sand Land is about 840 km, to the Guancen Mountain is about 260 km, to the Taihang Mountain is about 200 km, to the Kongtong Mountain is about 530 km. We added these data in the revised manuscript.

Comment 6. Fig.4b. I am really surprised by the persistent positive correlation between PDSI and tree-series especially for previous years as very low correlations are observed with both temperature and precipitations. Could you comment on these differences?

Answer: We explained it as follows. In order to answer this question, as well as the 2nd question of Reviewer#1 and the 7th question of Reviewer#2, we added a new chapter in the revised manuscript as “4.1 Climate-growth relationship”, Please see the corresponding part in the new version.

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.

Please also note the supplement to this comment:
http://www.clim-past-discuss.net/9/C3230/2014/cpd-9-C3230-2014-supplement.pdf

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

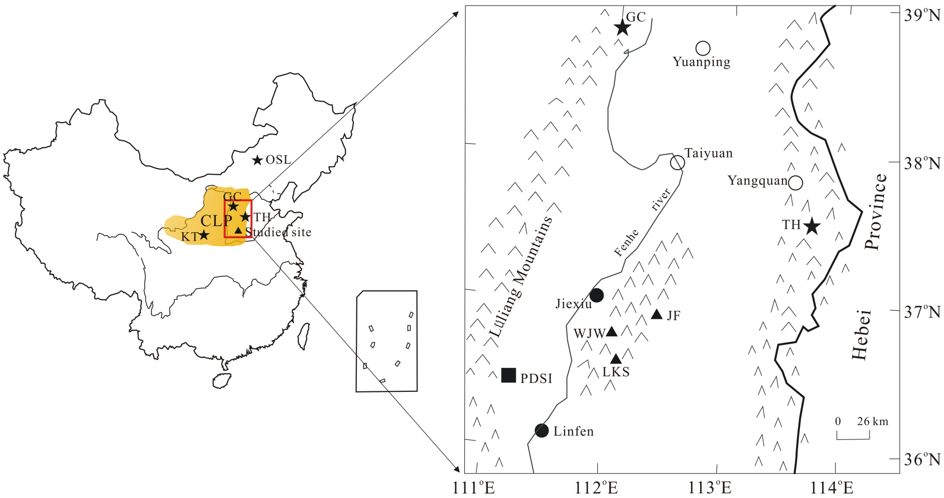

Fig. 1. Figure 1