Response to Loutre's comments (cp-2009-67)

The referees asked questions about the data. More precisely, they suggested that they may have recorded other climatic features than (or in addition to) temperature. You very briefly answer that question for oxygen isotope but you eluded it for magnetic susceptibility and you even write that organic carbon records temperature AND humidity simultaneously. Moreover, you answer to referee#2 that the series "are not temperature values series". Referee #2 suggests that you give a full evaluation of the relative contribution of the temperature to each proxy. I do not see your answer on that question. Thus please explain in more detail, with more justification, why your composite series can be considered as a true temperature record.

Reply: magnetic susceptibility and organic carbon can reflect temperature and precipitation changes simultaneously. But we cannot give a full evaluation of the relative contribution of the temperature to two proxies according to modern instrument data. However, some researches (Yancheva et al, 2007; Yang, 2007) showed that precipitation change is consistent with temperature in Asian monsoon area, i.e. when the temperature gets higher, the climate becomes wetter. So the magnetic susceptibility and organic carbon can well reflect temperature change in Hetao area.

All the referees are also concerned by the fact that three out of the six series you are using do not include a record of the last 2000 years. In your reply you provide a comparison of your composite record with other temperature records to support the accuracy of your method. However, the plot only covers the last 1000 years. What does it happen over the last 2000 years?

Reply: the high resolution series that can reflect temperature is very scarce over this region, and we cannot find more temperature series covering the last 2000 years. The reconstructed series at this stage in the paper was composite with the same three origin series. In addition, there was ice involution at wajianggou river, Inner Mongolia in 1750 yr BP (Li, 1990), and about 1450yr BP, glacier advanced in Gongga Mountain (Shi, 2000). While paleosol developed in Daqingshan Mountains (Cui et al, 1992) and Hulun Buir sandy land (Xia, 1993) after 1450 yr BP. These changes were consistent with our paper. Therefore we think that the reconstructed series can reflect temperature changes by comparing it with other temperature series.

There is no error bar on your final result. Is the error the same over the whole record? How is it affected by the fact that your reconstruction is based on six records between 5000 and 3000, and only on three records for the most recent time? What would be the result if you were applying the method on the three records available for the whole time interval?

Reply: we agree Loutre's advice, and have added error bar on our final results (Fig.3 in the final version about manuscript on page 6).

Fig.S1 is the temperature reconstructions using different origin series in Hetao and neighboring area. The trend of change is concurrent with each other, but there is a little difference between two series, especially between 5000 and 3000 yr BP. During the period of 4000-3200 yr BP, the change amplitude of two series has difference, but the trend of change is consistent with each other. In addition, the climate reconstructed by using 6 origin series during the 5000-4500 yr BP was warmer than that of during 3800-3200 yr BP, while the temperature reconstructed by using 3 origin series is nearly identical during the two periods. The series reconstructed by using 6 origin series is more accordant with the temperature change reconstructed previously (Wang et al, 2000)

than that composite by using 3 origin series.

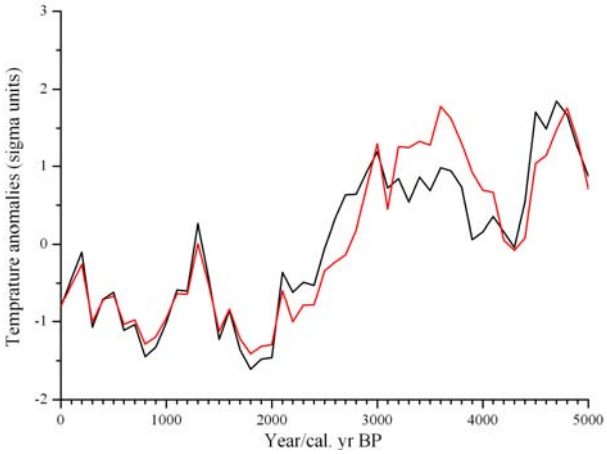

Fig. S1. Temperature reconstructions in Hetao and neighboring area. Black line: a composite series with 6 selected origin series; red curve: a composite series with 3 origin series.

Referee #2 suggested that you give a detailed process of calculations. I do not see your answer to that point. You could maybe consider adding an appendix on that point.

Reply: oxygen isotope, total organic-carbon, etc. can reflect temperature in the Hetao area. Therefore, we reconstructed the cold/warm variations using 6 series. The steps are as follows: Firstly, we standardized the selected 6 series respectively, equation is as follows:

$$T_i = \frac{x_i - \bar{x}}{\sigma}$$

Where T_i is standard score, x_i is the ith value in the origin series, $\bar{x}$ is the average of the origin series, and σ is standard deviation of the origin series.

Secondly, we synthesized a series with the 6 standardized series by using the methods of "arithmetic average" and "weighted average". The equations are follows:

$$T_a = \sum_{i=1}^{m} T_i \Big/ m$$

$$T_w = \sum_{i=1}^{m} T_i S_i$$

Where T_a is arithmetic average value and T_w is weighted average value.
Please refer to the appendix in the final version about the manuscript.

Referee # 2 asked : Page 5, lines 2-4, the authors stated that "6 reconstructions from different proxy archives represent temperature changes and explain between 83% and 94% of annual temperature variability in 1951-2007". Why?
Your Reply: the range from 83% and 94% is each grid data series's variance explanation for the whole region temperature series during 1951-2007.
Could you explain this answer? Indeed, the data series of ZYZ, HQH and DJ don't include the interval 1957-2007. How do you compute the explained variance in that case?

Reply: 6 reconstructions from different proxy archives represent temperature changes. According to instrumental temperature records, the temperature changes of each region which 6 selected series locate can explain between 83% and 94% of annual temperature variability of the study area in 1951-2007. Please refer to the line 2-3 on page 5 in the manuscript.

References

Cui, Z.J., Song, C.Q.. Holocene periglacial processes and environmental changes in the Daqingshan mountains, Inner Mongolia, China. J Glaciol Geocryol, 1992, 14: 325-331.

Li, R.Q.. Periglacial stages and the division in north China. Quaternary Sci, 1990, (2): 135-136.

Shi, Y.F.. Glaciers and their environments in China. Beijing: Science Press, 2000.

Xia, Y.M.. The Preliminary Research of the spore-pollen features at paleosol and environment of the megathermal in Hulun Buir sandy land. In: Zhang Lansheng, ed. Research on the Past LifeSupporting Environment Change of China (1). Beijing: China Ocean Press, 1993. 44-53.

Wang, S.W., Gong, D.Y.. Climate in China during the four special periods in Holocene. Prog Nat Sci, 2000, 10: 379-386.

Yancheva, G., Nowaczyk, N.R., Mingram, J., et al. Influence of the intertropical convergence zone on the East Asian monsoon. Nature, 2007, 445: 74-77.

Yang, X.L.. High resolution stalagmite $\delta^{18}O$ records over the past 1200 years in the eastern Qinghai-Tibetan Plateau. Ph.D. thesis, 2007.