

## ***Interactive comment on “A chironomid-based record of temperature variability during the past 4000 years in northern China and its possible societal implications” by Haipeng Wang et al.***

**Anonymous Referee #2**

Received and published: 13 November 2017

Northern China is one of the most important cradles of Chinese civilizations, which makes it an ideal region to study climate change and culture evolution. While high resolution regional rainfall records during the Holocene were reconstructed in the recent years, temperature records longer than 2000 years are scarce. This study reconstructed the temperature variability during the past 4000 years in northern China using fossil chironomid assemblages in an AMS  $^{14}\text{C}$ -dated sediment core from Gonghai Lake. The chronology of the record is robust, and the interpretation of the chironomid assemblages is convincing. This could deep our understanding of the Holocene climate change in this crucial region. My general comments are as follows: The authors compared the chironomid-based temperature record with pollen-based precipitation re-

C1

construction from the same core, and suggested the temperature and rainfall variations in northern China were out –of –phase during 650-900 AD and 1650 AD to present. Then, they suggested the recent decreasing rainfall and increasing temperature pattern in northern China may be due to natural variability. I am not fully convinced. As I see from Figure 6, the temperature and rainfall records are well consistent with each other before 1650 AD, if different resolutions are considered. During 650-900 AD, both temperature and rainfall shown similar pattern, like a letter “M”. Although the temperature didn't decrease as much as the rainfall did, this could be due to the uncertainties of the record. Multiple factors could cause the inconsistence between the temperature and rainfall variations during the last 450 years, such as the uncertainties of both reconstructions, possible influence of human activities to pollen and chironomid during the last 450 years. For example, many temperature reconstructions show gradually warming trend from 1650 AD to present, like the records cited in Fig. 5, which is different from this reconstruction. The temperature maintained in a high level during the last 300 years in this record. Moreover, it shows a slight decreasing trend in the last 50 years, which is not true. In addition, Tan et al. (2011, CP) compared the tree ring and stalagmite reconstructed temperature records with synthesized rainfall record in northern China, and suggested a warm-humid/cool-dry pattern on centennial timescale over the last 1800 years. I think the authors should discuss the difference between the temperature reconstruction of this study and other studies in the last 300 years, or just leave it an open question. This do not affect the main contribution of this paper. The other suggestion is that the authors should emphasize the differences of this work and the previous one (Wang et al., 2016) in the Introduction. In the previous study, the same authors used chironomid assemblages from this core to reconstruct rainfall variations. I understand they are different assemblages, but general readers will benefit from a clearer explanation. The authors mentioned it, but not enough. I also have some special comments: 1. If the inconsistence of temperature and rainfall variations are plausible, conclusion 3 in the abstract should be modified. Rainfall changes could also had influenced the human society in northern China. 2. Line 46: Stalagmite  $\text{d}^{18}\text{O}$

C2

record from Dongge cave is not a typical EASM rainfall record, so Dykoski et al. (2005) should be removed from the reference list. The authors can replace it with Hu et al. (2008, EPSL) or Cai et al., (2010, EPSL). 3. Line 92-94: Tan et al. (2011, Holocene) compared the climate changes and war frequencies in northern China during the last 1860 year, and detailed discussed the impacts of regional climate changes on social evolution. This paper should be cited. 4. Line 142-146: did you exclude the winter temperature in the reconstruction of TANN? 5. Line 186-188: seems inconsistent with line 143-146. 6. Better to combine section 5.3 with 6.2 and section 5.4 with 6.4. 7. It's better to use bars to indicate different periods in figure 5 and figure 6. It's hard to compare in the present version. 8. Line 382: 1150-1350 cal yr BP should be MWP, and 650-950 cal yr BP should be STWP. 9. Line 453: as I see from figure 6, the rainfall also decreased during 760-230 BC and 260-600 AD.

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Interactive comment on Clim. Past Discuss., <https://doi.org/10.5194/cp-2017-126>, 2017.

C3