

Authors' Response to Anonymous Referee #1

We thank the referee for his (her) valuable comments and suggestions. Following is our response.

Referee's comment:

1. First of all, the authors concluded that the NHT can influence the AM more directly than solar activity, based on their statistics analysis results. The climate system is complicated. When discussing the driving forces, they need to discuss it from the aspect of climate dynamics, but not just from correlation coefficient aspect. Many factors may influence the correlation coefficient, such as age uncertainties. Even if two variances are significantly correlated, it doesnot mean one drive the other. They might be no connects. Tan et al. (2011 CP) have given a detailed discussion among solar activity, temperature, AM and precipitation changes. The author may want to refer.

Authors' Response:

Thanks for your comment. Indeed, even if two variances are significantly correlated, it doesnot mean one drive the other. But because the solar activity and NHT can influence the AM, many researchers infer the driving forces by the correlation coefficient. For example, Zhang Pingzhong et al. said: "The AM also has correlations to solar irradiance as inferred from ^{14}C and ^{10}Be records (22) [correlation coefficient (r)= -0.33 , $n= 345$ data points for the past millennium, Fig. 2C and fig. S8]. These observations support the idea that solar forcing played a role in driving AM changes during the past two millennia."(Science, 322, 2008, Page941, line34-41).

But the inference is not particularly reliable.

For the clarity, We have changed the sentences as follows.

Page 8 Line 7-10:

Therefore, it suggests that the variations of the Asian monsoon have a close relationship with the solar activity at ~ 220 , $\sim 900\text{yr}$ time scales and trend, and the Asian monsoon have the obvious correlation to the average temperature of the northern hemisphere at ~ 60 , ~ 120 , $\sim 900\text{yr}$ time scales and trend.

Page 9 Line 7-18:

The cycles of $\delta^{18}\text{O}_R$ are similar to the cycles of ^{10}Be and NHT at most time-scales by the EEMD, which hints that there are possible internal responses between AM with solar activity and NHT. With further analysis, we found that the Asian monsoon has a close relationship with the solar activity at ~ 220 , $\sim 900\text{yr}$ time scales and trend, the Asian monsoon has the obvious correlation to the average temperature of the northern hemisphere at ~ 60 , ~ 120 , $\sim 900\text{yr}$ time scales and trend. The Correlation coefficients of the Asian monsoon and NHT are so small at ~ 10 and $\sim 24\text{yr}$, it seems that there is no direct relation between them at the two time scales. Howerer, the variation intensity of the Asian monsoon at the two time scales is amplitude modulated by NHT at ~ 60 and $\sim 120\text{yr}$. Meantime, AM intensity at $\sim 60\text{yr}$ is also amplitude modulated by NHT at $\sim 220\text{yr}$. So, AM variation may be closer relation with NHT than with the solar activity in the last 1000 years. It may be a pssible mechanism that AM can be driven at the long time scales by the solar activity, at the same time AM may be driven by the frequency and amplitude modulations of NHT in the last 1000 years.

The main work of Tan et al. (2011 CP) is to get the synthesized precipitation index record by selected four proxy records of precipitation, compare the synthesized precipitation record with the local BQ and DL temperature records, and “suggests warm-humid/cool-dry climate pattern in north central China during the last 1800 years”. Only in 3.3 (Page689), Tan et al. compared synthesized precipitation record and the IAPO record with the solar activity records by direct comparison and spectral analysis periodicities (without the figure of spectral analysis).

In the paper, we analysed the correlation of the corresponding IMF components of the original data by EEMD decomposition, in order to indicate the specific responds of AM to solar activity and NHT on different scales. Our work is not the same as Tan et al. in the method and the contents.

Referee's comment:

2. The authors concluded that “we predict the Asian monsoon is strengthening gradually and the Asian monsoon rainfall is increasing gradually in the next several decades or even the next 200 years, in \sim AD 2180 \pm 30 the local climate will reach to the next wettest period”. This is one of the main conclusion of the paper. However, neither it was shown in Figure 4, nor it was detailed discussed in the paper.

Authors' Response:

Thanks for your comment. The following sentence will be added to the end of the Page 6:

In Figure 4, the curve has reached the top in AD2001, and began to show a downward trend. According to the change rule of the curve, it may be a possible trend that that $\delta^{18}\text{O}_R$ will become smaller and smaller in future decades, even in future 200 years, and maybe reach to the lowest in \sim AD 2180 \pm 30.

Referee's comment:

3. In page 6, the drought periods deduced from EEMD result are quite similar with Tan et al.' result (Tan et al., 2011a). For example, the drought occurred in \sim 1350 AD and 1610-1650 AD were clearly shown in the abstract of Tan et al. (2011a). It is understandable, because they use the data of Tan et al. (2011a).

Authors' Response:

In page 6, our results are quite similar with Tan et al.' result (Tan et al., 2011a). Our results from EEMD partly verify Tan et al.' results. Meantime there are still some differences between the two.

Referee's comment:

4. They can't deduce 718yr and 818yr cycles from a 1000-years long record.

Authors' Response:

Yes, I can understand your confusion. But this situation possibly occur in the EEMD. The 718yr and 818yr cycles are calculated from IMF6 and IMF7 components. The cycles of IMF6 and IMF7 components can be approximately shown in Figure 2.

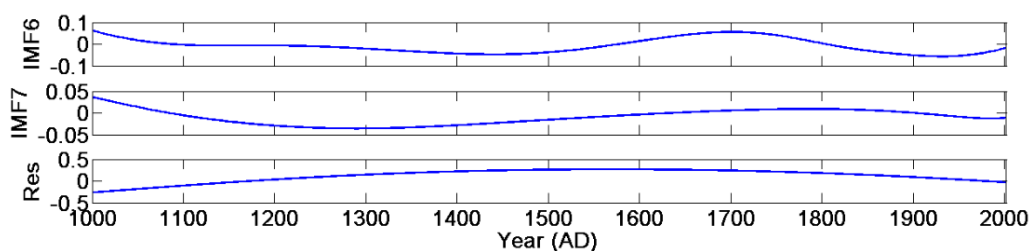


Fig. 2. IMF components and the residue of $\delta^{18}\text{O}_R$

Referee's comment

5. I think the English of the paper need to be polished further. In addition, I also have some special comments: 1. Page4, line27-29: the speleothem $\delta^{18}\text{O}$ cant reflect rainfall amount in northern China(Zhang et al., 2008; Tan et al., 2011a; Tan et al., 2011b).), but not in the region of Dongge Cave (Wang et al., 2005; Dykoski et al., 2005). Wang et al. and Dykoski et al. didn't claim that. 2. Page9, line 17: "Ansiian monsoon" should be "Asian monsoon".

Authors' Response:

Yes, the English of our paper need to be polished further.

Wang et al. said "Our previous studies have shown that shifts in the oxygen isotope ratio ($\delta^{18}\text{O}$) of the stalagmite from the cave largely reflect changes in $\delta^{18}\text{O}$ values of meteoric precipitation at the site, which in turn relate to changes in the amount of precipitation and thus characterize the AM strength." in Page854, right column, line19-25 (Science, 308, 2005). But Dykoski et al. didn't explicitly claim that. The expression in Page4, line27-29 will be:

The oxygen isotope ratio ($\delta^{18}\text{O}$) of the stalagmite from cave can reflect change of $\delta^{18}\text{O}$ of meteoric precipitation at the site, which in turn relate to the amount of precipitation (Wang et al., 2005; Zhang et al., 2008; Tan et al., 2011a; Tan et al., 2011b).

Thanks for the correction. Page9, line 17: "Ansiian monsoon" should be "Asian monsoon".