Dear Editor Dr. Yin and Anonymous Reviewers:

We really appreciate your time and efforts that you have spent in reading, reviewing and handling our manuscript. Your comments and suggestions have greatly improved our manuscript. Following these insightful comments and suggestions, we have conducted a point-to-point revision as listed below. We have reproduced the reviewers' comments in blue fonts, and our responses in black fonts directly below the comments. We hope that our revised manuscript is now considered to be suitable for publication with your high standard journal.

Main comments:

1. It should be a district heavy phase during the Medieval Climate Anomaly in the speleothem YX262 δ18O record, which includes a maximum peak around AD 1050. This indicates a strong Meiyu rain. How to obtain a weak Meiyu rain in Medieval Climate Anomaly (Page 1, lines 22-23)? The minimum peak around AD 1400 should be re-determined from an age control point.

Reply: Many thanks for your comment.

The YX262 $\delta^{18}O$ record shows a gradually decreasing trend over the MCA (~800-1400 AD, see Fig. 3). The decreasing $\delta^{18}O$ record indicates a weakening Meiyu rain state. In the revised manuscript, we have rephrased the original inaccurate expression in line 22-23. The rephrased sentence is " In particular, our record shows that the Meiyu rain has been weakened during the Medieval Climate Anomaly (MCA), but intensified during the Little Ice Age (LIA). During the Current Warm Period (CWP), our record indicates a similar weakening of the Meiyu rain."

The minimum peak around AD 1400 is indeed well constrained by two ^{230}Th dates. It is constrained by dates 1330.7 ± 13.9 year at 75 mm and 1439.1 ± 8.0 year at 48 mm (please see Table 1 in the manuscript).

2. A detailed explanation is necessary for the relationship between δ18O record and East Asian summer monsoon through the Meiyu rain, and the sentence (Page 5, lines 163-164) is unclear.

Reply: Thanks for your suggestion. The relationship was well described in a recently published paper (Zhang et al., 2018, Science), referred to in our manuscript. Here we reproduce the description to show a detailed explanation.

"The seasonal rainfall evolution over East Asia undergoes a number of quasi-stationary intraseasonal stages with abrupt transitions in between. During spring, persistent rainfall in southern China is followed by substantial convection over the South China Sea during the pre-Meiyu stage in mid-May. By mid-June, the Meiyu begins and rainfall shifts to central China, and around mid-July, the rain band shifts again to be located over northeast China, marking the onset of the midsummer stage, which terminates around mid-August."

"Rainfall changes over East Asia arise through changes in the transition timing and duration of the EASM intraseasonal stages." Increased (weakened) EASM, further penetrating inland, would lead to a shorter (longer) Meiyu rain stage and thus a decrease (increase) of precipitation in the middle and lower reaches of the Yangtze River. On the other hand, the EASM intensity is broadly measured by the stalagmite $\delta^{18}O$ variation, which reflects changes in the fraction of water vapor rained out between tropical oceans and cave locations (Zhang H et al., 2019; Cheng et al., 2019). Thus, the stalagmite $\delta^{18}O$ variation is associated with the changes in the EASM and Meiyu rain, with lower and higher $\delta^{18}O$ stalagmite values reflecting decreased and increased Meiyu rain, respectively.

We rephrased the unclear sentence at line 163-164, Page 5. The rephrased sentence is "The stalagmite $\delta^{18}O$ values reflect changes in the fraction of water vapor precipitated out between tropical oceans and cave locations (Zhang H et al., 2019; Cheng et al., 2019). A strengthened (weakened) EASM indicates increased (decreased) rainout along the moisture trajectory, and therefore lighter (heavier) stalagmite $\delta^{18}O$ values (Zhang H et al., 2019; Cheng et al., 2019)."

3. I am not a native English, but English needs to be carefully improved, e.g. 'and vice versa' is not often used in English.

Reply: Many thanks for your instruction. We have carefully polished English, and removed "and vice versa".

Specific Comments:

1. An age control point is usually found on the bottom of the published speleothem records, which is also important to determine the age of the minimum peak of the YX262 record during the Medieval Climate Anomaly.

Reply: Many thanks for your suggestion. As aforementioned in the response to Main Comment 1, the minimum peak of the YX262 record around AD 1400 is well anchored by two ^{230}Th dates, namely, 1330.7 ± 13.9 year at 75 mm and 1439.1 ± 8.0 year at 48 mm. Personally, the expected bottom date is not needed in this study. Conversely, the bottom age is indispensable at the time of dating the onset of the stalagmite growth.

2. The link between the Meiyu rain and Northern Hemisphere temperature is unclear to me.

Reply: As described in Zhang et al. 2018, the "jet transition hypothesis" (Chiang et al., 2015) links the Meiyu rain with Northern Hemisphere temperature. The hypothesis proposes that rainfall changes over East Asia arise through changes in the transition timing and duration of the EASM intraseasonal stages. When the Northern Hemisphere temperature decreases, the temperature gradient between the East Asia and tropical oceans declines, resulting in an earlier northward positioning of the westerlies relative to the Tibetan Plateau. The earlier northward would lead to an earlier termination of the Meiyu stage and prolonged midsummer stage, and thus a weakened Meiyu and strengthened EASM (Zhang et al., 2018).

3. A north-south diploe mode of the speleothem δ18O records during the Medieval Climate Anomaly period is a new information to me, which is consistent with the results from the historical documents. I suggest that the authors double check the records, since others studies shows a monopole mode in the speleothem δ18O records [Tan, 2016].

Reply: Many thanks for your suggestion. We clarify the paradox in the following words. The study of (Tan, 2016) shows a monopole climate mode during the Medieval Climate Anomaly (MCA) based on several stalagmite records from various areas of China. These stalagmite $\delta^{18}O$ records collectively display a lighter value over the MCA. Our YX262 $\delta^{18}O$ record also shows such a lighter value. Here our detailed study finds different long-term trends between the northern and southern stalagmite $\delta^{18}O$ records within the MCA period (see Fig. 3 in the manuscript). This new finding is not in contradiction with the conclusion of (Tan, 2016).

4. It is suggested to check the description of results for current warm period. The reason is that the current warm period includes the instrumental period. e.g., the authors considered that the speleothem record in Yongxing cave can represent the intensity of East Asian summer monsoon, and it means that there is an extremely increase in the YX275 record during the early of 19th century, which need evidence from the early instrumental data or other high-resolution proxy data. To the best of my knowledge, there is no significant evidence of such a strong East Asian summer monsoon based on the instrumental records.

Reply: Thanks for your suggestion. The Current Warm Period (CWP) begins from the end of the Little Ice Age to present. The CWP is usually defined as the interval from 1850 AD to present (Mann et al., 2009). As such, the CWP does not overlap the early 19th century. In addition, we could not recognize an extremely EASM increase from the YX275 record during the early 19th century. In contrast, a multidecadal-scale weak monsoon event is recognized over the period of 1800-1850AD in the YX275 record. Indeed, an extremely EASM increase occurred over the early 20th century in the YX275 record, although the EASM began to decrease since the late 20th century. This extremely EASM increase is further supported by precisely-dated Wanxiang Cave record (Zhang et al., 2008) and the annually-laminated Dongge Cave record (Zhao et al., 2015).

5. Page 2, lines 42-44. The reference is suggested to define these periods.

Reply: Many thanks for your suggestion. References (Lamb., 2002; Mann et al., 2009) have been added.

6. Page 4, line 128. There is no Fig. 3 before Fig. 4.

Reply: Many thanks for pointing out the mistake. We have exchanged the two figures in order.

7. In Fig.3, a direct comparison of the raw data with 3.8 year temporal resolution is interesting to show.

Reply: Many thanks for your comment. The 3.8-year-resolution YX262 $\delta^{18}O$ record is raw data in this figure, which is not smoothed.

8. A sententious physical process is suggested to explain the link between the Meiyu and the Indo-Pacific warm pool, the Meiyu and the Northern Atlantic Oscillation or Atlantic meridional overturning circulation.

Reply: Thank you for your suggestion. Sententious physical processes have been inserted in Section 4.4 and 4.5 to clearly link the Meiyu to the Indo-Pacific warm pool and the North Atlantic climates. The added sentences are “A northward migration or expansion of the ITCZ over the Indo-Pacific warm pool would strengthen the EASM and shorten the Meiyu stage. Conversely, a southward migration or contraction of the ITCZ would weaken the EASM and prolong the Meiyu stage (Zhang et al., 2018).” and “A strong EASM, resulting from the strong NAO and AMOC, would shorten a Meiyu rain stage. Conversely, a weak EASM, resulting from the weak NAO and AMOC, would lengthen a Meiyu rain stage (Zhang et al., 2018).”

References

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