

Interactive comment on “Variations in the East Asian summer monsoon over the past millennium and their links to the Tropic Pacific and North Atlantic oceans” by Fucai Duan et al.

Anonymous Referee #2

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The manuscript entitled “Variations in the East Asian summer monsoon over the past millennium and their links to the Tropic Pacific and North Atlantic oceans” by Duan et al. presents a new high-resolution stalagmite $\delta^{18}O$ record (YX262) from Yongxing Cave, central China over the past millennium. This record, combined with a published record from the same cave (YX275), is used to investigate the relationship between the East Asian summer monsoon (EASM) and Tropic Pacific and North Atlantic oceans during the period. They suggested that the EASM was intensified during the Medieval Climate Anomaly (MCA) and the Current Warm Period (CWP), but wakened during the Little Ice Age (LIA). These observed EASM variations were causally linked to the precipitation change in the tropical Pacific (or ENSO), as well as in the North Atlantic (e.g., NAO

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and AMOC). While the d18O record itself appears to be robust, the interpretations are rather tentative and sometimes confusing. I have a few suggestions/comments for improvement pending on which I recommend acceptance of this paper.

General comments:

(1) In the introduction, in order to better introduce research background to readers, it is necessary to add some more references. For example, after the sentence of Lines 46-48, Lines 49-51 and Lines 61-63. In addition, some references are not properly used (not the most proper one).

(2) Please add more information about the stalagmite sample. For instance, the sample image can be added in the figure 2, including subsample locations of U-Th dates and if possible stable isotopes as well. Was the whole sample (YX262) or only one portion analyzed in this study? What is the mineral of the sample? The authors only mentioned 'calcite record' in the discussion (Line 241).

(3) For discussion 4.1, in Lines 153-156, "Thus, the stalagmite d18O signal reflects the regional summer monsoon intensity.", how to understand the term "regional summer monsoon intensity"? In addition, the authors should always point out the timescale when they discuss the significance of the stalagmite d18O proxy. In Lines 146-148, "two most recent studies have reconciled these two contradictory interpretations.", it sounds like that the two studies already resolved the debates of the Chinese stalagmite d18O proxy. There are many papers that have addressed to some extent this issue recently, such as Zhao et al., 2018 and Zhang et al., 2019. Additionally, it appears that the cave d18O was considered to be the 'monsoon intensity' and local precipitation as well at different places, lacking a consistency.

(4) The small amplitude changes in stalagmite d18O value may have complicated mechanisms behind, such as temperature effect, amount effect, source changes, upper stream rainout, and evaporations etc. If explained solely as local rainfall amount, please provide a comparison to the instrumental record for each cave record or cite

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related published papers.

(5) In the section 4.2, the authors should compare their record with the stalagmite record from Heshang Cave, which is fairly close to Yongxing Cave. I suggest adding the Heshang d18O record in the figure 3, and have a related discussion in the section. In addition, I strongly encourage the authors to compare the Yongxing record with local historical records or cite related papers, which may provide a validation test on the interpretation of the Yongxing d18O record.

(6) When comparing the d18O values between different time periods (the MCA, LIA and CWP), the differences of the mean values should be provided. The trends of records, as well as similarities between different records are merely visually defined. Statistical methods should be considered to show their significances.

(7) In sections 4.4 and 4.5, I suggest that the authors analyze the relationship of the local precipitation (and/or d18O) at Yongxing Cave site with ENSO, NAO, PDO and AMOC indexes (reconstructed from instrumental data).

(8) Overall, the causal links of the stalagmite d18O records with the AMOC, NAO, ENSO as suggested by the authors are rather tentative. For example, a visual similarity between two records cannot be used to definitively validate their causal linkage.

Specific comments:

Lines 24-26: I don't think we can say the "EASM intensity is similar in both northern and central China,". I mean we cannot say local EASM intensity instead of local precipitation amount. In addition, the timescale should be always mentioned.

Lines 31 and 278: The authors use "surprisingly" twice in the manuscript. Actually, many studies already found the North Atlantic climate can influence the EASM changes, for example He et al. (2017).

Lines 74-77: Zhang et al. (2018), which discussed the EASM precipitation changes in the monsoonal China during the weakening AMOC, may be cited here.

Line 129: The sentence “Stalagmite YX262 was deposited under the condition of isotope equilibrium” should be moved to the end of line 133 as a conclusion.

For the figure 1, what does the background color in the map indicate? If it's meaningful, please add a legend.

References:

Zhang, H., Brahim, Y. A., Li, H., Zhao, J., Kathayat, G., Tian, Y., Baker, J., Wang, J., Zhang, F., and Ning, Y.: The Asian Summer Monsoon: Teleconnections and Forcing Mechanisms-A Review from Chinese Speleothem $\delta^{18}\text{O}$ Records, *Quaternary*, 2, 26, 2019.

Zhang, H., Cheng, H., Cai, Y., Spötl, C., Kathayat, G., Sinha, A., Edwards, R. L., and Tan, L.: Hydroclimatic variations in southeastern China during the 4.2 ka event reflected by stalagmite records, *Climate of the Past*, 14, 1805-1817, 2018.

He, S., Y. Gao, F. Li, H. Wang, and Y. He (2017), Impact of Arctic Oscillation on the East Asian climate: A review, *Earth-Science Reviews*, 164, 48-62, doi: <https://doi.org/10.1016/j.earscirev.2016.10.014>.

Zhao J Y, Cheng H, Yang Y, Tan L, Spötl C, Ning Y, Zhang H, Cheng X, Sun Z, Li X, Li H, Liu W, Edwards R L. 2018. Reconstructing the western boundary variability of the Western Pacific Subtropical High over the past 200 years via Chinese cave oxygen isotope records. *Clim Dyn*, 52: 3741–3757.

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