

Clim. Past Discuss., author comment AC5
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Reply on EC1

Shengnan Feng et al.

Author comment on "Humidity changes and possible forcing mechanisms over the last millennium in arid Central Asia" by Shengnan Feng et al., *Clim. Past Discuss.*,
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Dear editor Mary Gagen:

Thank you for your letter and the careful review of the manuscript. We are very grateful to the editor and the three reviewers for their helpful comments. All suggestions are valuable and beneficial. Accordingly, we have carefully considered all comments and revised the manuscript. We have prepared and submitted three detailed point-by-point responses to each. Please find these detailed responses by "Supplement download" in the AC reply. For your highlights, we have revised the manuscript according to these comments and made related responses in Supplement to the AC reply.

- We have revised the discussion on the relationship with ENSO. There is a negative phase relationship between the HI and ENSO at multidecadal timescales. However, this relationship can only be revealed by the Wavelet coherence (WTC) results, rather than the two datasets, because the original HI contains a variety of signals at different timescales. To solve such a problem, we performed the ensemble empirical mode decomposition (EEMD), a new noise-assisted data analysis method (Huang et al., 1998; Wu and Huang, 2009) in the revised manuscript, to extract the multidecadal signals of the HI. Interestingly, the extracted multidecadal component of the HI exhibits a better inverse relationship with the ENSO variance almost throughout the entire time series (please see the supplement Figure 1 in the supplement figure), which is in line with the WTC results. More discussions were added to the revised manuscript. Also, we have considered the comment of reviewer 2 and made the response. The ENSO variance is the calculated 21-yr running biweight variance derived by the ENSO variability, reflecting changes in ENSO itself (Li et al., 2011). In other words, the changes of ENSO itself contribute to the multidecadal-timescale ENSO variance. In the manuscript, we suggest that the ENSO variance effect on the hydroclimate changes in ACA might be through modulating the extreme precipitation. Previous studies indicate that the water vapor from the Arabian Sea may be transported to the Xinjiang region and cause heavy precipitation, although the water vapor fluxes mostly come from the west transported by the prevailing westerlies (Huang et al., 2015; Huang et al., 2013). Observational reanalysis data show that water vapor in ACA also comes from the Indian Ocean and causes heavy precipitation, which gives us good theoretical and data support, although the driving mechanisms of ENSO variance for the hydroclimate changes in ACA require further exploration through high-resolution records and simulation experiments. Overall, we have added more relevant discussions in the section "Linkage to ENSO" of the revised manuscript. Furthermore, we have added references that also indicate the

unstable hydroclimate during the LIA. The unstable hydroclimate during the LIA is an important reference, but it is not clear how the specific unstable wet and dry climate fluctuated during the LIA. Our reconstruction provides new evidence for the unstable hydroclimate variability and captured several obvious and dramatic secondary humidity fluctuations within the LIA. More relevant discussions have been added in "section 5.2".

- We have added additional references related primarily to ENSO in the revised manuscript. The significance of ENSO variance for hydroclimate in ACA has been added in the discussion in "section 5.3.3 Linkage to ENSO" of the revision. Moreover, we have revised the introduction by adding more records about humidity evolution over the last millennium (Rousseau et al., 2020; Zhang et al., 2003; Zhang et al., 2009; Ma et al., 2008) and an overview of the driving mechanisms during the Holocene (Sorrel et al., 2021; Huang et al., 2014; Schwarz et al., 2017; Mathis et al., 2014; Lauterbach et al., 2014; Chen et al., 2019; Chen et al., 2010; Aichner et al., 2015).
- We have added the details on the background lithology, study site description, and more hydrogeology information in the revised manuscript.

Thanks very much for your attention.

Very sincerely yours,

Xingqi Liu

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Please also note the supplement to this comment:

<https://cp.copernicus.org/preprints/cp-2021-137/cp-2021-137-AC5-supplement.pdf>