

Interactive comment on “Multiscale monsoon variability during the last two climatic cycles inferred from Chinese loess and speleothem records” by Y. Li et al.

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The authors greatly appreciate the crucial remarks made by the referee.

1. Though this study presented new high resolution loess grain size record over the past 260 kyr, there are no new and innovative discoveries in the physical mechanism of the past Asian monsoon variability

Reply: East Asian monsoon (EAM) changes indeed have been extensively studied at various timescales using loess grain size and speleothem $\delta^{18}\text{O}$, and potential dynamical drivers of EAM are well accepted including global ice volume and solar radiation at orbital timescale and high-latitude northern hemisphere climate on millennial timescale.

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Our results coincide with earlier finding in terms of EAM variability and mechanisms. However, apart from linking EAM signals to plausible driving forces, the main objectives of our studies are twofold. First, we tried to evaluate the relative contributions of orbital and millennial signals in these two widely accepted monsoon proxies using spectral analysis and decomposing approaches. Second, we want to emphasize the glacial-interglacial discrepancy and millennial similarity between loess and speleothem records by comparison of the decomposed components of these two proxies. Our results confirmed that the extracted millennial-scale climatic events are almost identical in these two archives, which is very important of further evaluating the coupling between millennial-scale winter and summer monsoon variability. We will clearly clarify our motivations in the revision.

2. They demonstrated that Asian speleothem $\delta^{18}\text{O}$ records are not a valid proxy for summer monsoon intensity only at the orbital timescale but rather reflect annual variations in hydrologic processes and circulation regime over a large part of the Indo-Asian region. Thus, the spectral analyses on the loess grain size record and the speleothem $\delta^{18}\text{O}$ record, more like a purified mathematical game, cannot distinguish the differences in the responses of the cyclic variations between the East Asian winter and summer monsoons to the orbital and internal forcings.

Reply: We agree that Asian speleothem $\delta^{18}\text{O}$ may have different palaeoclimatic implications at various timescales, and thus the correlation between speleothem $\delta^{18}\text{O}$ records and monsoon is debatable. Fully investigation of the implication of speleothem $\delta^{18}\text{O}$ needs more proxy-to-proxy and proxy-to-model comparisons. Recent work by Liu et al (2014) suggests that Chinese speleothem $\delta^{18}\text{O}$ can be regarded as a monsoon proxy to reflect the southerly wind intensity rather than the precipitation change. As presented in our work, only multiscale variability were decomposed for these arguable monsoon proxies, the discrepancy and similarity of different-scale variability can provides more insights into the regional disparity and behind mechanisms. Based on our spectral and decomposed results, we can distinguish varied sensitivity of loess

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MGS and speleothem $\delta^{18}\text{O}$ to glacial and orbital forcing; however, the well-aligned MGS and $\delta^{18}\text{O}$ fluctuations on the millennial scale do indicate that they likely share a common driving force.

3. The authors detected significant 100 kyr cycles in the 260-kyr long loess grain size record. Though the 100 kyr cycle exceeds the 80% significance level in mathematics, the significance of the 100 kyr cycle is questionable because the total length of the record is only 260 kyr, about two and half 100 kyr cycles, which is far beyond the limit of the statistical samples.

Reply: From a statistical perspective, the 260-kyr records are short to distinguish the 100 kyr periodicity. However, the 100-kyr glacial cycles can be evidence by glacial-interglacial amplitude contrast. To confirm whether the 100-kyr cycle are robustly existed in loess grain size time series, in contrast to the dominant precessional cycles in speleothem record, we compared the 500 kyr MGS (Sun et al., 2006) and Hulu/Sanbao records (Cheng et al., 2012) (Fig.1). Spectral results of these two time series exhibit different peaks (Fig. 1), with a strong 100-kyr cycle at the Jingyuan MGS spectrum and a dominant 23-kyr in the speleothem $\delta^{18}\text{O}$ spectrum Fig.1 shows obvious glacial and interglacial difference, which confirms the 100 kyr period. The main periodicities detected from the 500 kyr loess and speleothem spectrum are quite similar to those from our current 260 kyr records, which further validates the reliability of our spectral results.

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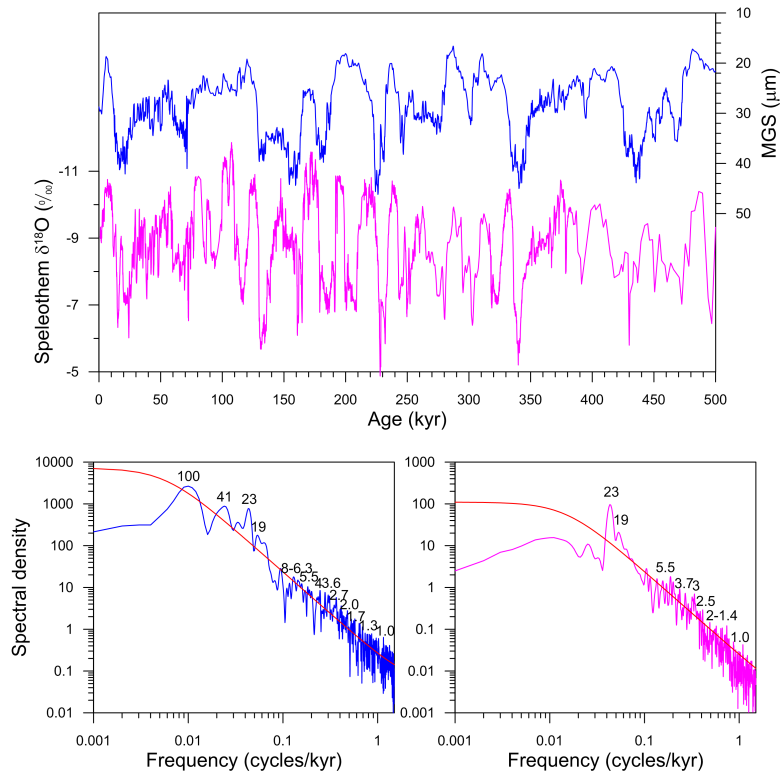


Fig. 1. Fig. 1 Original data (above) and spectral results (below) of Jingyuan MGS (blue) and Hulu/Sanbao speleothem $\delta^{18}\text{O}$ (purple) records with 90% confidence level (red). Numbers are identified periodicities