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Climate of the Past Discussions

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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Li et al. presented high resolution mean grain size record of the Gulan loess in this study and took it as proxy record of the East Asian winter monsoon variation over the last two climatic cycles. They also analyzed the speleothem d18O record in the East Asian caves and took it as proxy record of the East Asian summer monsoon variation. They further made spectral analyses on these proxy records and quantitatively classified the different cyclic components in these proxy records into six groups. Then, they made the most important speculation that the various cyclic components of the East Asian winter and summer monsoons > 50 kyr, 30-50 kyr, 9-30 kyr, 1-3 kyr and 3-9 kyr, and the centennial scale residual correspond to various forcing of ice volume, obliquity, precession, North Atlantic cooling and the centennial scale forcing respectively.

The authors concluded that glacial and orbital components are dominant in the loess grain size, which implies that both ice volume and insolation have distinctive 15 impacts on the winter monsoon variability in contrast to the predominant precession impact on the summer monsoon patterns, and that abrupt changes in the winter and summer monsoons over the last 260 kyr share common features and similar driving forces linked to high-latitude Northern Hemisphere climate. The studies of the Asian monsoons over the past 30 years based on terrestrial and marine records have revealed that the driving mechanism of the Asian monsoon variability on orbital time scale have been externally controlled by Earth's orbital geometry and internally modulated by other Earth's surface process like ice volume change, and also that the millennial scale variability in the Asian monsoons are closely related to the ocean circulation change such as the North Atlantic Meridional Overturning circulation. 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.

Interpretation on the southeast China cave speleothem d18O records is still blurry and debatable. As summarized by Clemens et al. (2010, Paleoceanography), Wang et al. (2001, Science, 294, 2345-2348), Cheng et al. (2006, Geology, 34, 217-220), and Cheng et al. (2009, Science, 326, 248-252) interpret it as the 'ratio of the amount of summer to winter precipitation' or 'the relative summer to winter monsoon intensities'. Yuan et al. (2004, Science) interpret cave d18O as 'the fraction of water vapor removed from air masses between the tropical IndoâĂŘPacific and southeastern China,' a summer monsoon interpretation focused on ocean to land moisture flow. A recent study (Caley et al., 2014, Nature Communication) further summarized that there are potential control of seasonality, as well as large-scale atmospheric circulation effects in addition to the amount of Asian summer monsoonal rainfall on the speleothem d18O signal. Caley et al. (2014) questioned the validity of Asian speleothem d18O records as a proxy for summer monsoon intensity together with the ultimate forcing and timing of the monsoon by using the results of a 150,000-year transient simulation including water isotopes. They demonstrated that Asian speleothem d18O records are not a

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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 d18O 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.

Also, the authors need to pay careful attention on the interpretation of the spectral analyses. For example, 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.

The results of the spectral analyses usually vary with the length of the proxy record and the time resolution. For example, the authors can try other very useful and convincable tools such as Analyseries or Arand to perform spectral analyses on the 500 kyr long speleothem d18O record (Cheng et al., 2012, GRL, VOL. 39, L01705, doi:10.1029/2011GL050202) and the loess record, and compare the new results with the present results.

Based on the above comments, the authors should re-interpret their new loess record.

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