

## ***Interactive comment on “Nonlinear regime shifts in Holocene Asian monsoon variability: potential impacts on cultural change and migratory patterns” by J. F. Donges et al.***

### **Anonymous Referee #1**

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The manuscript by Donges et al. attempts to detect episodes with pronounced changes in Asian monsoon dynamics during the Holocene by using a recurrence network analysis, a newly developed technique for time series analysis, on the Holocene speleothem records in Asian monsoon regions. The authors identified several epochs with abrupt regime shifts in Asian monsoon variability (8.5–8.0, 7.3–5.7, 5.4–4.1, 3.6–2.8 and 2.2–2.8 ka BP), which align with the high-latitude Bond events and other episodes of Holocene rapid climate change. The co-occurrence of these epochs with pronounced minima and strong variability in solar activity confirmed the previously proposed solar forcing of these abrupt changes in Asian monsoon climate. The authors also discuss the linkage of changes in monsoon climate variability and major culture changes. As a whole, the

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paper is good and interesting, although the linkages of abrupt shifts in Asian monsoon with the Bond events and RCC periods, and the relationship between culture changes and monsoon climate variations, have been already discussed by other authors. I believe, however, that it could be gain in quality and clarity, if the following comments and suggestions are considered.

Usually, nonlinear means that one variable is not directly proportional to another variable. So I was wondering what's the input variable (forcing) while we view the monsoon climate as the output variable (response). What's the nonlinear regime shifts in monsoon variability? Correspondingly, what's the linear regime shifts in monsoon variability? How to define and distinguish them? My understanding is that the nonlinear regime shift here means the abrupt changes in monsoon climate, i.e., from one state switch to another state within a relatively short time period. So I suggest the authors change the title as "Abrupt shifts in Holocene . . ."

Page 909 line 16."High T values indicate epochs with regularly varying climate . . . or time intervals with stationary or slowly changing climate, while low T values imply epochs with more erratic (i.e. less predictable) climate fluctuations. In contrast, large L values highlight time intervals including rapid shifts between different climatic regimes, while low L values point to a more stationary climate during the corresponding epoch." It seems to me that the climate variability in the epoch with high T values may similar to the epoch with low L values. In figure 6, it is apparent that both T and L are large during the period of ~7.0-8.0 ka BP for COPRA sequences and both T and L are large during the the period of ~3.8-4.4 ka BP for raw and COPRA series. There are also some periods with the similar pattern in figure 7 and 8 for other record. So, how to interpret these contradictions.

The authors use the Figure 11 to show the relationship of regional monsoonal regime shifts relative to cultural change and migratory events in Arabia, India, South-East Asia and China during the Holocene. However, I can's see there are close linkages between the abrupt establishments or terminations of human cultures and climate regime shifts

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indicated by the RN analysis. The authors may need to indicate clearly how these two things were connected.

In chapter 5 “Effects on human societies”, the authors obviously have a comprehensive understanding of the culture changes and migrations, but I don’t think the manuscript in its present form makes the best use of their considerable expertise. Instead connecting all the changes in culture with climate events (e.g. page 926 line 21-28), they need to concentrate on the epochs identify with RN analysis, as many papers have discussed the influence of climate change on the human societies.

The authors state that they observe a epoch with significant variation in monsoon variability around 7.3 ka BP, which has been rarely reported so far. Actually, in the paper by Wang et al., (2005, Science), this event has been reported and highlighted in figure 1.

other minor changes

page 903 line 14, ‘China’ should be ‘East China’

page 937 line 14, During the period of 3.0-2.7 ka BP, the Tarim Basin should be dominated by the westerlies, but not monsoon climate. So it’s unsuitable to discuss the culture change in this region with monsoon climate variations. Also in line 13, ‘the Tarim basin in western China/Tibet’, the Tibet should be deleted.

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