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## ***Interactive comment on “The Global Monsoon across Time Scales: is there coherent variability of regional monsoons?” by P. X. Wang et al.***

### **Anonymous Referee #2**

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#### The Global Monsoon across Time Scales

Wang et al. present a literature review, that summarises Paleo-Monsoon related research over the last 10 years or so. Given the large interest in this topic and the huge amount of available literature, such reviews are very welcome contributions to the discussion within the community. The task of this review is very challenging since the authors aim at all ranges of geologic timescales, however in my view they manage in most cases to give a good overview of the most important recent studies.

While I find a general review of the field useful, I am less convinced by the special focus that the authors concentrate on. As the authors state, a central goal of the paper is to demonstrate the applicability of the so-called global monsoon concept by showing coherent variability across all timescales in all the different regional monsoonal sub-

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systems.

This statement gives the impression that the global monsoon concept on one hand and a coherent variability of all subsystems on the other, are interdependent. However, the global monsoon concept is to my knowledge commonly defined as e.g.: “seasonal migration of the intertropical convergence zone (ITCZ) and, hence, a climate system of the global scale” (see e.g Wang, 2008). In this definition regional subsystems could vary independently on different timescales, while still being part of a global system (basically the ITCZ) . Therefore, I suggest a clarification in that respect. Even if one would identify differences between regional sub-systems, it would not argue against the concept of a global monsoon.

Would one expect coherent variability at all timescales? I would not think so. A tectonic “event”, a build up of a mountain range will certainly have strong regional effects. An asymmetric forcing between the hemispheres (e.g orbital precession) will lead to a different response (out of phase between the hemispheres), compared to a global forcing (e.g. global warming through greenhouse gas forcing) where both hemispheres will react in a more similar fashion.Ã

Page 2179, line 11: I think Ruddiman is the wrong reference here, I would suggest one of Steve Clemens papers here.

The review would benefit from some additional references. It is probably impossible to really give a complete picture of the literature, however there are some key papers/discussions missing.ÃIt would be important to discuss the different interpretations of the important Chinese speleothem record. One key paper in that respect is probably Pausata et al. (2011).

Another, interesting open issue that is not yet mentioned in the paper is related to the MIS 13 debate. Many records hint at a very intense monsoon during this lukewarm interglacial. A strong global monsoon under those boundary conditions is however surprising (see e.g. Yin et al., 2008, Ziegler et al., 2010, Muri et al. 2012). I think

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that understanding this particular event could teach us a lot about the dynamics of the global monsoon in general and therefore it should be studied in more detail in the future.

A couple of comments on some of the conclusions (page 2228):

1. As explained above, I do not think that the global monsoon concept depends on coherent variability of subsystems at all timescales. I also argue above that such a coherent variability at all timescales is actually very unlikely.

4. I would not necessarily agree with that comment. There is a large community working on “deep-time” climate variability on an ice-free planet, also investigating the paleo-monsoon in those time intervals (e.g. PETM). Maybe these studies are not sufficiently considered in this review.

References:

Pausata, Francesco SR, David S. Battisti, Kerim H. Nisancioglu, and Cecilia M. Bitz. "Chinese stalagmite [ $\delta$ ] 18O controlled by changes in the Indian monsoon during a simulated Heinrich event." *Nature Geoscience* 4, no. 7 (2011): 474-480.

Muri, Helene, André Berger, Qiuzhen Yin, Aurore Voldoire, David Salas Y. Mélia, and Suchithra Sundaram. "SST and ice sheet impacts on the MIS–13 climate." *Climate dynamics* 39, no. 7-8 (2012): 1739-1761.

Yin, Q. Z., and Z. T. Guo. "Strong summer monsoon during the cool MIS-13." *Climate of the Past* 4, no. 1 (2008): 29-34.

Ziegler, Martin, L. J. Lourens, E. Tuenter, and G-J. Reichert. "High Arabian Sea productivity conditions during MIS 13–odd monsoon event or intensified overturning circulation at the end of the Mid-Pleistocene transition?." *Climate of the Past* 6, no. 1 (2010): 63-76.

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