

Interactive comment on “On the low frequency component of the ENSO-Indian Monsoon relationship; a paired proxy perspective” by M. Berkelhammer et al.

Anonymous Referee #2

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Comment on "On the low frequency component of the ENSO-Indian Monsoon relationship; a paired proxy perspective" (Berkelhammer et al.)

Synopsis

The paper describes the coherence and phase angle between proxy time series of ENSO and the Indian Monsoon. The relation between the two is not constant over time and the authors address whether this is due to multidecadal changes in ENSO variance affecting the ISM system. This question is obviously relevant in view of the recent change in correlation between ENSO and monsoon and the question of changing teleconnection in a future climate. The analysis is presumably carefully done and includes

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aspects that were novel to me (such as the inclusion of dating uncertainties - missing in most other studies). However, the methods are not well described. I honestly was not able to completely follow all of the steps the authors have done. The paper should be published subject to a major change in the method description.

Main Comments

- There is confusion as to the terms "ENSO" and "ENSO variance". Although the authors explain this in the introduction, the methods and results section are sometimes confusing. On the short time scale the authors address ENSO warm events, i.e. the ENSO time series as such. On the long time scales they use "ENSO variance", or the amplitude modulation of the ENSO time series (arguing that low ENSO variance would produce low correlations between ENSO and ISM). But they do not explain what "ENSO variance" actually means and how it was calculated (other than referring to Torrence and Webster (1999)). In Fig. 5 they show variance in the form of a high-pass filtered ENSO time series, but I guess this is not how the ENSO variance series was generated. Also, as there are many statements on the "relation between ENSO and the monsoon" where the reader gets confused whether this refers to the correlation (on short tie scales), the possible modulation of the correlation, or both. Very often the authors just speak about "the timeseries" or "the two timeseries", leaving the author wondering whether they mean the original proxy time series, a filtered time series, or a time series of variance. Another example is p. 3111, l. 5, where the authors speak about the phase angle between ENSO (not ENSO variance) and the ISM in the low and high frequency band. Another example is Fig. 4, where a spectral analysis of ISM variance (not ISM) is shown in support of the previous Figure (3) where ISM was compared to ENSO variance. Even if it sounds repetitive, please be more specific, maybe best by using symbols or defining a terminology and sticking to it. Also, it would be helpful if the authors could better explain their method (rather than just referring to Torrence and Webster (1999) and Chave et al. (1987)).

- The authors use filtering at several instances without explaining the filter.

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9, C1866–C1869, 2013

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- The time windows are addressed as 60-80 yr and 5-15 yr (p. 3110, l. 19), >60 yr and <15 yr (p. 311, l. 6) and 60-90 yr and 5-15 yr (p. 311, l. 24). This is confusing the reader.

- The caption of Fig. 3 contains a lot of methodological information that would be better suited - in extended form - in the text. Time scales are here given in angles instead of years (60° - 80° , 5° - 15°). The sign of the phase relation is not explained (lead or lag?). This figure is hard to understand.

- The authors conclude (p. 3112, l. 25) that ENSO produces no consistent measurable impact. This sentence sounds strange as "produces" implies causality while their methods addresses coherency. Second, I interpret Fig. 3 as showing significant and clustered coherence in the 60-80 yr band. Please rephrase.

Minor comments

- The "jittering" of the time scale with a random number generator: Please give some more info. Is the "jittering" a linear scaling, an offset, or any other function? From what distribution were the random numbers drawn?

- Is there an effect of averaging the two ISM proxies over their 400 yrs of overlap on the noise of the combined time series at the spectral interval considered?

- A further assessment of the ISM time series could be done by comparison with the Cook et al. (2010) tree ring based Asian drought atlas.

- Fig. 3: Please say that the left scale in (a) is inverted

- The assumption that sign and strength of the teleconnection of North America with ENSO has remained constant is strong given the fact that the papers addresses changes in the relation of another ENSO teleconnection.

Reference

Cook, E.R., Anchukaitis, K.J., Buckley, B.M., D'Arrigo, R.D., Jacoby, G.C., Wright, W.E.:

Asian Monsoon failure and megadrought during the last millennium, *Science*, 328, 486-489, 2010.

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