

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

**M. Berkelhammer et al.**

Max.Berkelhammer@colorado.edu

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Dear Editor, Please find the revised version of the manuscript, On the low frequency component of the ENSO-Indian Monsoon relationship; a paired proxy, attached. A number of clarifying language regarding the methodologies of the spectral approach are peppered through the manuscript. As well, we have included a number of new analyses that take advantage of additional monsoon and ENSO proxies as well as long climate simulations. In general, the results presented in the first version of the manuscript remain robust. Overreaching interpretations of the dynamics are removed and a more conservative interpretation is included in the Discussion and Conclusions

C2404

sections.

Reviewer #1 response: 1) The reviewer expressed a number of concerns regarding the dynamical interpretation of the ENSO-ISM phasing shown here. Namely, the concern was a sense that too definitive conclusions were reached on the plausible mechanisms. Throughout the Discussion section (lines 540-630), the dynamics were restated in terms language that more accurately represents our uncertainty on this matter. Discussion is included that clarifies a possible role for the North Atlantic and also for shifts in SST patterns in the Indian Ocean. Because the PDO influences the ISM in a manner similar to ENSO, this was not considered a likely mechanism and therefore was not presented as a likely mechanism. 2) The reviewer requested we add phase analysis using the Cobb et al., 2003 coral data. This is now included (see Figures 3 and 4) and discussion in Section 3, Results. 3) Additional clarification on the filter used for graphing is presented in the caption of Figure 3. No filtered data was used in the cross spectral analysis, this filtering was principally for cosmetic purposes.

Reviewer #2 response: 1) Concerns were expressed regarding confusing descriptions of ENSO, ENSO variance and the cross spectral methodology. Through the manuscript this language was clarified. We use both ENSO amplitude (year to year changes in ENSO strength) and changes in ENSO variance calculated as a running variance. The two are related through the fact that changes in ENSO variance arise from an increased frequency in large positive ENSO events. For ENSO we follow the recommendations of the authors who published the original ENSO datasets (e.g. Li et al., 2011) in dealing with ENSO vs. ENSO variance. 2) Line 330-360, provides new discussion on the cross-spectral technique. It was a common MTM approach, so we also include a number of references for more details on the method. 3) A lanczos filter is used and stated in Figure 3 caption. This filter was only for cosmetic purposes so the choice does not influence the cross spectral results. 4) Clarification on the time windows is provided and, in fact, the analyses were re done to make sure all analysis were done with consistency in the time window of analysis. 5) The caption

C2405

of Figure 3 is left long to allow a reader to interpret it without referring to the text too intensively. Additional guidance on how to interpret the phase wheels is included in Lines 400-422. 6) Details on the jittering is included in Line 390-395 7) Our previous work (Sinha et al., 2011) show that little spectral impact is imposed from averaging the speleothem timeseries' though averaging only influences a small portion (where the two timeseries' overlap) of the overall 1400 year timeseries. 8) A number of new analyses using the MADA tree ring data are now included throughout (e.g. Figures 3 and 4).

Please also note the supplement to this comment:

<http://www.clim-past-discuss.net/9/C2404/2013/cpd-9-C2404-2013-supplement.pdf>

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