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Interactive comment on "Arabian Sea upwelling over the last millennium and in the 21st century as simulated by Earth System Models" *by* Xing Yi and Eduardo Zorita

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Arabian Sea upwelling, temperatures and monsoon activity have been documented to show major natural variability and cyclicity. It is therefore commendable that the authors attempt to calibrate and verify their model against pre-industrial natural changes of the past 1000 years before embarking on the forward modelling part, the future predictions. In chapter 3 of their manuscript, the authors say that this hindcast was successful, therefore the model can be used for simulations of future upwelling. There are, however, two issues that cast doubt on the validity of this hindcast calibration:

1) DOES THE MODEL USED IN THIS STUDY ACCOUNT FOR SOLAR ACTIVITY FORCING, WHICH IS KNOWN TO BE STRONG IN THE ARABIAN SEA?

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Discussion paper

Holocene upwelling, temperatures and monsoon activity in the Arabian Sea are long known to be controlled significantly by changes in solar activity changes. There is a great amount of literature on this subject, see e.g. the recent paper by Munz et al. 2016 http://www.clim-past-discuss.net/cp-2016-107/ Other important papers: Neff et al. (2001), Gupta et al. (2005), Thamban et al. (2007), Menzel et al. (2014). You can find the detailed references in the regional synthesis in Lüning & Vahrenholt 2016 (page 296) https://www.researchgate.net/publication/308928345_The_Sun%27s_Role_in_Climate

It is clear that any model used for climate simulations in the region has to account for this strong solar forcing that has been clearly documented in many studies from the region. In order to fully calibrate the model, it would be important to extend the calibration period backwards several millennia. Only then, the millennial-scale cyclicity becomes apparent.

2) USE UPDATED AND LONGER VERSION OF UPWELLING PROXY RECORD

The authors are using the uwpelling reconstruction of Anderson et al. 2002 as comparison for the hindcast comparison. However, this paper has been superseded by a much improved and longer version published in Anderson et al. 2010, uncited by Yi & Zorita. http://onlinelibrary.wiley.com/doi/10.1002/jqs.1369/abstract

The age model has somewhat changed and the dataset been extended. It is crucial that the model used in Yi & Zorita replicates e.g. the weak monsoon phase during the 'Dark Ages Cold Period' described by Anderson et al. 2010:

"In addition to the well-known decrease in the Indian summer monsoon since the early Holocene 9 ka BP, we found a minimum in the monsoon 1500 a BP, following by an increasing trend to the present. Superimposed on this increasing trend is a strong monsoon interval 1200–800 a BP and a weak monsoon interval 600–400 a BP that we correlated with the Medieval Warm Period and Little Ice Age in a previous study (Anderson et al., 2002)."

Other proxy series in the region that confirm the strong climate variability and cyclicity in the Arabian Sea are: Van Rampelbergh et al. 2013: http://www.sciencedirect.com/science/article/pii/S0277379113000255

Hoti Cave: Fleitmann 2008: http://www.speleothem2013.uni-hd.de/materials/S4_Fleitmann.pdf Fleitmann et al. 2007: http://www.sciencedirect.com/science/article/pii/S0277379106002265

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