

Interactive comment on “Cyclone trends constrain monsoon variability during Late Oligocene sea level highstands (Kachchh Basin, NW India)” by M. Reuter et al.

Anonymous Referee #2

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Review of: Cyclone trends constrain monsoon variability during Late Oligocene sea level highstands (Kachchh Basin, NW India)

By: M. Reuter, W. E. Piller, M. Harzhauser, and A. Kroh

Submitted to: Climate of the Past

The authors use a shallow-marine tempestite sequence from Northwest India as a record of variability in tropical cyclone activity during the late Oligocene, and make inferences about the initiation and variability of the Asian monsoon system. The authors present interesting results with potentially important and fundamental connections about the dynamics and evolution of the Asia monsoon. I especially like the use

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of the geologic record in attempting to quantify deep-time changes in cyclone activity. The paper is well-written and the figures are informative and well-constructed. However, I'm left wondering about some of the dynamical inferences made by the authors, which at times seem a bit too general and idealized. I feel the paper is worthwhile and publishable in *Climate of the Past*, but revisions are warranted.

I am not an expert in sedimentology, thus I will not comment on the methods. However, the manuscript reads like a methodology paper, with much emphasis on sedimentology details and results, and a relatively short (and dense) discussion at the end on connections to cyclone activity and monsoon dynamics (p598-599). This is a bit disconcerting, given these connections are the focal point of the paper, and I think the paper would benefit from a more thorough discussion of the dynamical implications.

The authors rely heavily on the effect of vertical wind shear in controlling cyclone activity. While vertical wind shear off NW India associated with the monsoon circulation is a major factor in limiting the cyclone activity during the summer months for the current climate, other factors are also generally important for quantifying tropical cyclone activity, such as sea-surface temperature, atmospheric humidity, etc., which also control TC activity in the Arabian Sea (see Evan and Camargo 2011). And I wonder what role these other factors may play for past climates. For instance, perhaps the proposed cyclone variability is not driven entirely by changing vertical shear but also by changes in sea surface temperatures—e.g. cyclone activity for large SST/large wind shear climates could look similar to small SST/small wind shear conditions. The authors even comment on the correlation between increased TC activity and SST for the Late Oligocene warm period (P599, L27-29). More discussion is necessary to reconcile effects of vertical shear from sea surface temperatures in controlling possible cyclone variability.

The authors base much of their inferences about cyclone/monsoon connections on the recent Evan et al paper (2011), which suggests recent decreases in vertical wind shear are responsible for increasing cyclone intensity in the Arabian sea. This result has been challenged recently in a comment that claims the observed changes in cyclone activity

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are more likely due to changes in monsoon onset timing (Wang et al. 2012). I wonder if the same argument could be applied to the Late Oligocene. In other words, how is it possible to differentiate the relative contributions of monsoon strength from the annual timing of monsoon onset?

References:

Evan, A. T. & Camargo, S. J. A climatology of Arabian Sea cyclonic storms. *J. Clim.* 24, 140–158 (2011).

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Wang, B., Xu, S. & Wu, L. Intensified Arabian Sea tropical storms. *Nature* 489, <http://dx.doi.org/10.1038/nature11470> (2012).

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