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Interactive comment on "A critical humidity threshold for monsoon transitions" *by* J. Schewe et al.

Anonymous Referee #1

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This manuscript discusses a minimum model of monsoon precipitation and shows that a minimum humidity value is needed over the ocean to maintain the monsoon activity. The results are then used to explain some of the transitions between periods of high and low monsoon intensity in the past.

Even though the concepts discussed in the paper are interesting, the model is too simplistic to pretend to explain the monsoon transitions. First the simplistic model is only valid when the monsoon is developed and the assumption can be made that the latent heat release by condensation in the atmosphere is the major driver of the atmospheric circulation. In that case it sounds obvious that once the assumption is made that the only moisture source on the continent is moisture advection, critical moisture over the ocean is needed to provide enough moisture for condensation over the continent. The

interesting point in this paper is that the author quantified the moisture amount through a calibration on the NCEP/NCAR reanalysis. In the same way a minimum wind or temperature gradient could be estimated and discussed. The values found are not fully discussed. In particular, the threshold humidity should be linked to evaporation over the ocean, considering the implication for temperature, wind, and atmospheric boundary layers over the tropical ocean and the fact that the relative humidity remains almost the same whatever the period? What are the conditions when the threshold is reached? The effect of a minimum humidity should be compared to other possible sources such as minimum wind of temperature gradient. Is the gradient (change in wind) or humidity more efficient in changing the amount of water vapour available for convection? Also this process should be put into perspective compared to the large scale gradients that trigger monsoon onset and decay.

I am not convinced by some of the choices made for the model itself. In particular, the temperature gradient considered here is not the one that drives the large scale circulation and the monsoon advection. Further justification should be provided for the choices of the different boxes considered for the different monsoon systems. In particular, what motivated the choice of the boxes for Africa? The Gulf of Gulf of Guinea would be more appropriate. Notation should also be revised since there is an ambiguity with the use of W for wind. In most papers it is the vertical velocity. Error bars should be provided for the estimates and used to provide an error bar (or envelop for P) in figure 10.

The application is a poor part in the paper. We do not understand why the example is only considered for one region and one record. The record is only shown between 160 and 220 kyr, because it seems to be the period during which the conceptual model has some skill. The results should be shown for the entire record. Otherwise there is absolutely no credibility in the results, and we have the feeling that the authors get something that fits the data only by chance. If it doesn't work for the other periods there is a need to discuss it, at the light of the hypotheses made. Also the assumption

is made that humidity other the ocean varies linearly with insolation at 65°N. This is only valid if the 65°N insolation considered represents well an annual mean change in global forcing that can be linked to temperature and atmospheric moisture content. However, the insolation forcing has a negligible signature in annual mean, so that this assumption doesn't hold. Simulation with general circulation in response to changes enhanced boreal summer insolation in the northern hemisphere show that the tropical ocean is colder, and evaporation is reduced over the ocean. Moisture increases over land because inland advection increases. The net result is a decreased humidity over the Tropical Ocean and increased humidity over land. It is not obvious to me to reconcile this result with the one proposed using the simple model described here.

In conclusion, even though some aspects are interesting in this paper, the model and assumptions made are too simplistic to pretend to explain the rapid monsoon transition shown in the record. Additional work is needed to put the proposed process into a wider perspective and to check that the threshold values proposed make sense in terms of tropical circulation and atmospheric moisture content.

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