

Interactive comment on “The onset of Asian Monsoons: a modelling perspective” by Delphine Tardif et al.

Anonymous Referee #2

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Summary:

There is much debate about when modern-like Asian monsoons first formed. This paper investigates the existence of Asian monsoons during the Eocene by an earth system model IPSL-CM5A2. The model simulation shows there were no modern-like Asian monsoons at that time and the authors point out the large uncertainties of paleogeography result in conflicting modeling results of Asian monsoons in the Eocene. The paper also indicates that most of the current Asian proxy records are located in the seasonal transition zone so they are not ideal for testing the existence of the monsoons. Thus more proxy records and cautious interpretation of the records are necessary to solve the Eocene monsoon puzzle in the future. The paper brings new ideas to the long-debated Eocene monsoons and has sufficient evidence to support it, and it is

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well-written. I would like to suggest accepting it after minor revisions.

Comments:

1 The authors conclude there were no modern-like Asian monsoons based on atmospheric circulation (Fig. 4) rather than precipitation seasonality (Fig. 8) in the Eocene simulation. I think it is necessary to have criteria of what atmospheric patterns can be viewed as modern-like monsoons or not. Otherwise, one may argue that Fig. 4c also shows a modern-like monsoon pattern since there is still cross-equator circulation over the Indian ocean though it locates at much lower latitudes.

2 When explaining the Eocene atmospheric circulation (section 3.2), I suggest considering some existing monsoon theories (Boos and Kuang 2010), in which low-level enthalpy or equivalent potential temperature is more physically fundamental to cause circulation and convection anomaly than “blocked by the Tethysian high in Line 267” and “mid-level atmospheric layers very dry and prevents air masses to reach ...” in Line 280. Generally, we can say that without the blocking of the TP and Iranian Plateau, cold air is easy to intrude the Indian subcontinent and does not allow building up strong positive low-level enthalpy anomaly, thus not triggering much convection as today.

3 I feel like the word “onset” (of Asian monsoons) is confusing. I know that it refers to the beginning of the modern-like monsoons over the geological time scales, but it is also usually used to represent the starting time (day or month) of the summer monsoon season and actually authors use this meaning in Line 144. I suggest replacing “onset” with “origin” or other synonyms.

4 The authors discuss the model-data comparison problem and point out the importance of correct interpretations of paleo-records. One way to better fill in the gaps between model and proxy records is by using isotope-enabled models (e.g., comparing simulated precipitation isotope ratios to proxies based on precipitation isotopes) and proxy forward modeling (e.g., translating climate variables of simulations directly to pseudoproxies). It would be great if authors can add discussion about this.

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Line 71: These findings “postpone”... Is it “postpone” or “bring forward”?

Line 75: «doubthouse» -> “doubthouse”

Line 98: “A third mechanism”: It is not a mechanism but a conjecture (or other synonyms)

Line 128: expend -> expand

Line 136: improved -> improves

Line 218-221: Cloud feedbacks can also contribute to the model bias: Zhu, J., Poulsen, C. J., & Tierney, J. E. (2019). Simulation of Eocene extreme warmth and high climate sensitivity through cloud feedbacks. *Science Advances*, 5(9), eaax1874. <https://doi.org/10.1126/sciadv.aax1874>

Line 270: I don't see easterly winds from the Pacific Ocean

Line 272: Theses-> These

Line 275: How to determine the condensation height? The condensation can occur at multiple layers at a single time in the model.

Line 282: Figure 5->6?

Line 283: “multiple deep convection”: how do you identify convection here? By upward motion?

Line 283: add “center” between humidity and around

Line 320-325: Do these records all represent precipitation seasonality/seasonal contrast or annual mean precipitation?

Line 392-393: “When oriented in a NW-SE orientation”: change one of the “orient” words

All figures: please enlarge the font size of labels of latitude/longitude/color bar. It is

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especially important for Figure 7.

Figure 2: How do you calculate sea level pressure anomaly? Is it seasonal mean minus annual mean? Are winds climatological mean or anomalies?

Line 462: Please add “5” before “Pondaung”

It would be great to add a figure like Figure 5 (a)(b) but in the summer monsoon season in the supplements

Interactive comment on *Clim. Past Discuss.*, <https://doi.org/10.5194/cp-2019-144>, 2019.

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