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Climate of the Past Discussions

Interactive comment on "Permian Megamonsoon Sensitivity to Paleo-Tethys Warm Pool: Model Simulations using CCSM3" *by* Christine A. Shields and Jeffrey T. Kiehl

Anonymous Referee #1

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In this paper, the authors investigate the mechanisms driving the Permian megamonsoons and test the hypothesis that the location of the Paleo-Tethys Warm Pool, rather than the land/sea contrast, is the primary forcing agent of the monsoon. To do this, the authors conduct sensitivity experiments using the Community Climate System Model to evaluate the response to elevated CO2 and changes in geography.

This paper is perplexing. On the one hand, the topic and numerical experiments are interesting, as is the simulated influence of the warm pool on the monsoonal circulation. On the other hand, the definition of the megamonsoon is never made clear, and the results do not support the warm pool hypothesis (see below). One point that the authors should consider is that previous generations of models used to investi-

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Discussion paper

gate megamonsoons used slab ocean models that did not simulate warm pools and yet simulated megamonsoons. To me, this is pretty solid evidence that the warm pool hypothesis cannot be right. This paper has the potential to be a nice contribution by demonstrating the interaction between the warm pool and the monsoonal circulation, but the current version confuses monsoonal and warm pool precipitation and requires extensive refinement and clarification.

In Section 4, the primary result is that after removing the Cathyasian Peninsula "the "monsoon" precipitation does not change in character, indicating that the underlying and primary forcing for the monsoon is unrelated to the land-sea temperature gradients." Figure 5 does not support this characterization. As shown in Fig. 5, JJA and DJF precipitation over the Cathyasian Peninsula certainly does change (e.g. the DJF minimum and JJA maximum at 30N on the Cathyasian Peninsula disappears), indicating that the land-sea contrast is critical to monsoonal precipitation on the peninsula. Similarly, Fig. 6 shows that JJA-DJF wind vectors are no longer converging over the Cathyasian Peninsula.

In Section 5, the main result is that "The monsoon precipitation does indeed follow the warm pool, in fact, the SST warm pool not only migrates landward, it clearly expands in all directions and in all seasons." (As an aside, this sentence structure is not logical.) The latter resultâĂŤthat the SST warm pool migrates and expandsâĂŤ is clearly shown and is interesting. The former resultâĂŤthat monsoon precipitation follows the warm poolâĂŤis not. (I would have appreciated DJF and JJA precipitation maps for the NoIsle case and recommend adding them as subpanels to Fig. 5.) The analysis of temperature and precipitation (Figs. 8 and 9) is over marine regions and has no bearing on monsoonal precipitation. (In the modern climate, the warm pool is a region of high precipitation; this is not considered monsoonal precipitation.)

The paper requires considerable editing. There are numerous grammatical errors, incomplete and awkwardly phrased sentences. In some places, these mistakes make the text incomprehensible (e.g. p. 4, line 12). The figures are fine. The figure captions should be expanded to include more detail. Units and labels should be added to all label bars. Undecipherable experiment names (e.g. b30.111) should be removed from the figures.

Additional minor points:

Introduction. The introduction lacks description and substantive discussion of the megamonsoons and also a review of previous works on the megamonsoons, of which there have been a considerable number most unreferenced here. The third paragraph of the introduction, except for the final sentence, is irrelevant and should be removed.

p. 3, lines 8-9. The explanation for why the 1x Permian case is colder than the 10x case includes lower solar forcing. According to Table 2 both the 1x and 10x cases have the same solar forcing so that this is not a reason.

p. 3, line 18. Some further discussion of the cause of the shift in precipitation would be welcome here. Presumably this is linked to the shift in maximum SSTs (p. 4, line 4). Please then comment on the shift in the seasonality of the SSTs.

p. 4, lines 10-11. This statement may be true, but vertical velocities are not a good indicator of convective activity (implied by "sinking due to colder seasonal SSTs"). The vertical velocity changes described here are most likely associated with dynamical changes in winds.

Fig. 1. caption. "Plots. . ..are spaced every 30 degrees." Latitudinal/longitudinal lines are spaced every 30 degrees; the plots are spaced every couple of inches.

p. 8, line 9. Please explain in more detail how precipitation and salinity are affecting upper ocean vertical velocity.

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