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Climate of the Past Discussions

Interactive comment on "Understanding the Australian Monsoon change during the Last Glacial Maximum with multi-model ensemble" *by* Mi Yan et al.

Anonymous Referee #2

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The authors examined response of Australian monsoon to LGM forcing among CMIP5/PMIP3 multiple models. Simulated annual range of Australian monsoon rainfall during LGM is larger than present day, distinct from other regional monsoon systems. However, in a previous paper published in 2016, it has been already explored that this unique monsoon behavior was found among CMIP5/PMIP3 models and changes in land-sea contrast (due to change in land sea configuration arising from sea level drop) and east-west SST gradient are important for that. In that paper, the authors emphasized dynamic contribution to the spring-to-summer monsoon enhancement (rooted from changes in land-sea contrast and SST gradient) because thermodynamic contribution (reduced surface water vapor rooted from surface cooling) cannot explain

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this enhancement. Most of the contents described in the current paper are just re-confirmations of previous paper (Yan et al. 2016).

In the current paper, the authors also tried to quantify relative contributions of dynamic and thermodynamic components related to the LGM Australian monsoon response. However, their quantitative decomposition is not reasonable. They did not follow widely-accepted methodology decomposing dynamic and thermodynamic components of rainfall response under climate change based on concepts of atmospheric water vapor budget. They also simply compared model-ensemble-mean anomaly between LGM and present day and dismissed inter-model differences in regional gradients in temperature, pressure and circulation response although they are essential for their main discussion. As an overall evaluation, novelty of this study seems very limited. I would like to recommend the authors to conduct any additional tests (e.g. Chiang et al. 2003: Toracinta et al. 2004; Ueda et al. 2011) to quantify effect of the land configuration (for example) to the Australian monsoon circulation and rainfall. Such sensitivity tests in addition to the quantitative evaluation of the hydrological response in multiple models are necessary for improving quality of this study.

Other comments

1. Please follow commonly-used dynamic-thermodynamic decomposition method. In line 165-173, 183-191 and other parts, ratio of specific humidity change should not be simply converted to that of precipitation change. Please read carefully Held and Soden 2006, O'Gorman et al. 2012 to catch current understanding of response of hydrological cycle under climate change, and Chou et al. 2009, Seager et al. 2010, and Chadwick et al. 2013 to understand widely-accepted methods for decomposition of dynamic and thermodynamic contributions to rainfall response under different climate states.

2. Please show inter-model consistency in (1) regional gradient in surface temperature, sea level pressure and rainfall, and (2) east-west SST gradient. In this paper, the authors checked inter-model consistency in LGM anomaly compared to PI. How-

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ever, inter-model consistencies in the regional gradients in LGM anomaly (for example, are east-west dSST gradients really consistent among 7 models?) are not accessed although they are essential for the conclusion.

3. Please check inter-model consistency in LGM land configuration. Although the LGM land configuration was specified in PMIP3 protocol, land configuration implemented in each model could be different because model resolutions are much different between different model. Land-sea mask data in native grid of each model should be checked because any inter-model difference possibly affect inter-model difference in results.

4. Figures S1 and S2 seem identical to Figures 2 and 1 of Yan et al. (2016). You may need any copyright permission from Springer-Nature.

5. Line 26: relative -> related?

6. Line 41-44: I couldn't catch what do you mean here. Are "the local processes" you mention here land-sea configurations?

7. Line 110: thermal dynamics -> thermodynamic

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