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Interactive comment on "Intra-interglacial climate variability from Marine Isotope Stage 15 to the Holocene" *by* R. Rachmayani et al.

Anonymous Referee #1

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Snapshot experiments have been made within the interglacial periods of MIS1, 5, 11, 13 and 15 with the CCSM3 model. Temperature, precipitation and vegetation fields of these experiments are analyzed. Different effects of obliquity, precession and greenhouse gas concentration are also investigated. This paper is among the very few publications where AOGCM has been used to simulate several interglacials, especially the early ones. It is of potential interest for interglacial study, but improvement in analysis and in writing is needed.

My general impression is that different variables have been briefly described, but in-depth analysis to explain the changes is lacking. Moreover, the focus of the paper is not obvious. From the title, it is expected to see the characteristics of each interglacial and their differences from MIS15 to MIS1, but this is not clearly given or summarized

in the paper. From the abstract and conclusion, it seems that the focus of this paper is on the response of African and Indian monsoon to precession and obliquity, but this is only briefly mentioned in several places and the analysis of processes was not done by this paper but was refereed to other studies which have similar findings. The authors should stress what is new in the paper and its original contribution to interglacial and monsoon study.

The conclusion of the authors that the global monsoon concept is challenged is actually based on the differences between 416kyr and 394kyr and between 495kyr and 516kyr where the precession is very similar between two time slices. It means that the role of precession is minimized in these comparisons. However, Fig10 tells that both Africa and Indian monsoon are mainly controlled by precession and both are highly and negatively correlated with precession. It means that at the astronomical time scale, both monsoon systems would co-vary with precession, and therefore the global monsoon concept could still be valid.

In sections 3.1-3.6, it would be more interesting and add more value to the paper if the CCSM3 results are compared to proxy data and to other model results, even qualitatively. Moreover, in most of the discussions, only insolation has been used to explain the changes, and the role of CO2 seems to have been forgotten.

Specific comments:

1. Title: Not all the interglacials from MIS15 to MIS1 have been analyzed in this paper, so please be precise.

2. Please change everywhere "orbital" to "astronomical" because obliquity is not orbitally related.

3. Page 3037:

L1: for the periodicity of the astronomical parameters, Berger (1978, J.Atmos.Sci) deserves to be cited.

L1-4: about the influence of evolution of astronomical parameters on the internal structure of interglacials, I recommend the paper Yin and Berger (2015, QSR) to the authors.

L8-29: many interglacial simulations (both snapshot and transient) have been done in earlier time with both EMICs and GCMs, eg. Kubatzki et al (2000, Clim Dyn), Crucifix and Loutre (2002, Clim Dyn), Loutre and Berger (2003, global planetary change), Yin and Berger (2012, Clim Dyn) and Yin and Berger (2015, QSR). These deserve to be included in the introduction.

L22-26: please specify what is the advantage of using realistics interglacial astronomical configurations as compared to the idealized astronomical forcing.

4. In Section 3.1, 3.2 and 3.3, only insolation is used to explain the difference between the interglacials, but what is the role of CO2?

5. In section 3.1, please explain the southern ocean cooling in Group I. This is quite similar to the results of Yin and Berger (2012) where this cooling is attributed to summer remnant effect of local insolation.

6. Page3078, L15-17: is the cooling over southern hemisphere continents statistically significant? By the way, are the features given in fig3, 4, 5,6 significant?

7. Page3079:

L8: ....southern hemisphere (except Antarctica)

Page3079, L19-23: are these observed in your model or in other study? The same processes have been demonstrated in Yin and Berger (2012) where the definition of "summer remnant effect" was given.

L24: I would add "probably" before "masked".

8. Page3080, L1-3: is it possible to give explanation about the temperature change?

9. Page3081, L29-28: why does the JJAS warming over southern ocean and Antarctica

not appear in 495-516? For 416-394, the summer remnant effect happens over the polar oceans, how to explain the warming over Antarctica continent and a cooling over western Antarctica? CO2 effect needs to be discussed here.

10. Page3082:

L11: the effect of obliquity on annual insolation at high and low latitudes does not need to be implied, it is explicitly demonstrated in Berger et al (2010, QSR).

L18-22: what is the role of lower CO2 at 495 than 516 to explain the weaker Sahel rainfall increase during MIS13 than during MIS-11?

11. Section 3.6: how were the correlations made? Are these correlations statistically significant?

12. Page3083:Figre9a: why is the correlation between GHG and high latitude temperature very weak? This seems not consistent with the knowledge that high latitudes response to GHG change is much larger than the other part of the world.

13. Page 3083: For the relative impact of obliquity and precession on surface temperature and precipitation, I recommend the paper Yin and Berger (2015, QSR) where results were obtained from transient simulations covering a large range of precession and obliquity.

14. Page 3083, L15: how about the monsoon change in other Southern Hemisphere regions?

15. Page 3083, L17: in some doubling CO2 experiments, it is shown that monsoon precipitation is sensitive to CO2 change (eg. IPCC report), but in your figure 10a, there is no correlation between the two. Please explain.

16. Page 3083, L23-24: how about the precession influence on the East Asian monsoon in your model?

17. Page 3085:

L15-16: pay attention that the GHG and precession are not exactly the same between the time slices.

L26-29: the dating uncertainty and the tuning procedure of LR04 stack should not be ignored here in such discussion. Moreover, lag between climate forcing and ice sheet response should also been taken into account.

18. Page 3086, L1-5: although 495kyr is the warmest in Group II, it is still much cooler than Pre-industrial in NH summer (fig3). How can you conclude that this cooling is not enough for ice sheet growth? In the simulation of Ganopolski and Calov (2011), there is a small ice sheet developed around 495 kyr.

19. Page 3087, L4-6: please demonstrate this statement.

20. Page 3087:

L16-17: please specify which is more important in controlling the Africa monsoon, precession or obliquity.

L21-23 and Page 3072, L15-17: These lines are not convincing, see my comment 18.

21. Page 3088, L8-9: I remind that transient simulations for earlier interglacials have been given in Yin and Berger (2015, QSR).

Interactive comment on Clim. Past Discuss., 11, 3071, 2015.