

Interactive comment on “Sensitivity of Pliocene climate simulations in MRI-CGCM2.3 to respective boundary conditions” by Youichi Kamae et al.

Anonymous Referee #2

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Based on several experiments performed with the model MRI-CGCM2.3, the authors have analyzed the climate response to the updated boundary conditions of PlioMP2, including the CO₂ concentration, the orography+vegetation+lake (OVL) as a whole, and the ice sheets. They have also compared their results with those obtained during PlioMP1 by the same model and with proxy data. This work is helpful for understanding better the origin of the Pliocene warm climate and the individual contributions of CO₂, OVL and ice sheets. The manuscript is well organized and the introduction and method are well explained. The research topic is quite suitable for publication in *Climate of the Past*. However, this manuscript is lack of depth due to insufficient explanation on mechanisms. I would recommend to reinforce the analysis and discussion on physical mechanisms before publication by taking into account my following comments.

1. The authors have described the impact of OVL and ice sheets on sea surface

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temperature, sea ice, AMOC and the Hadley circulation, but almost no explanation is given on the physical mechanisms. I would recommend to add explanations on how the changes in OVL and ice sheets cause the changes in these climatic variables.

2. The OVL is the major contributor for a stronger AMOC. What is the mechanism?
3. Page 8, line 29: how do the ice sheet and OVL enhance northward heat transport?
4. The OVL causes significant change in the tropical precipitation. Any idea about which factor contributes the most, orography, vegetation or lake?
5. In the ice sheet experiment, how is the ice sheet defined? By changes in albedo and topography? In the lake experiment, how is the lake defined in the model? These should be explicitly explained in the paper.
6. The effect of ice sheets should include the effect of its topography. In the OVL experiment, the effect of the ice sheet topography seems to be also included. In this case, there should be an overlap of the effect of ice sheet topography in these two experiments. Is it true?
7. Page 9, line 19: Please explain what the “nonlinear residual” means in terms of physics.
8. Page 5, line 10: would there be any difference between with and without the addition of deep ocean temperature to the initial condition?
9. Page 5, line 26: what does the “nonlinear” mean exactly?
10. Page 5, line 29: does it suggest no interactive effect of the CO₂, OVL and ice sheets?
11. Page 8, line 12: isn't better to change “suggesting” to “resulting from”?
12. Fig11: how was the confidence level (medium, high, very high) defined?
13. Page 10: lines 2-3: PlioMP2 is cooler than PlioMP1 over N. Atlantic, so the under-

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estimation of the warming there is actually increased but not reduced as written by the authors. And why A.Atlantic is cooler in PlioMP2 than PlioMP1?

14. Page 10, line 15: the linear additivity of the Pliocene climate simulation is not necessarily obvious at regional scale (see fig6).

15. Page 10, line 21: Please comment what are the possible reasons that the model fails to reproduce the extremely warm condition over the Arctic to high-latitude North Atlantic region.

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