Clim. Past Discuss.,
https://doi.org/10.5194/cp-2017-68-AC1, 2017

Interactive comment on "Interhemispheric Effect of Global Geography on Earth's Climate Response to Orbital Forcing" *by* Rajarshi Roychowdhury and Robert DeConto

Rajarshi Roychowdhury and Robert DeConto

rajarshi.es@gmail.com

Received and published: 2 November 2017

We fully acknowledge the limitations of using a slab-ocean GCM to study the effect of hemispheric asymmetry on the climate response to orbital forcing. These limitations are addressed directly in the text. We also stress that the slab-ocean configuration also has important advantages: its computational efficiency allows a range of orbital conditions to be explored, while simplifying interpretations of the results and minimizing ocean-model dependencies. We hope this initial work sparks further studies using fully coupled models to further quantify the results shown here. We stress that giving a fully mechanistic explanation of the hemispheric effects is beyond the scope of this

initial short paper. This is the focus of ongoing work and a forthcoming manuscript. However, we have extended the discussion in our revised paper based on other observable parameters from the model simulations. In the revised paper we show that the observed hemispheric effects on climate are related to asymmetry in clouds, snow cover, and surface pressure patterns that impacts heat transport (e.g. Figures 1 and 2).

1. We chose PDD as one of our climate variables because both temperature and the duration of summer are important for Earth's climate response. In this case, Positive Degree-Days are calculated as PDD=$\sum\_i\_iT\_i, whereTiisthemeandailytemperatureondayi, and\alpha$ is one when Ti $\geq 0^{\circ}$C and zero otherwise. The PDD captures the extremity as well as the duration of the warm season.

As requested, we will include the statement that we address other climate variables along with PDD in our paper in the abstract.

2. After doing additional analyses, we conclude that cloud fraction, liquid water content in the atmosphere and pressure are the most important. We extend the discussion towards causes of the observed hemispheric effect in the revised paper.

3. We agree with the Reviewer's suggestion, and we have rewritten our introduction accordingly.

4. The mixed layer depth is 50m, and will be specified in the manuscript.

5. The land model is not interactive, and the vegetation is prescribed. This was done purposefully to simplify interpretations of the results.

6. We have corrected the same.

7. The muted polar amplification in Antarctica observed in models may be caused in part by the asymmetrical landmasses between Northern and Southern Hemispheres. However, the Land asymmetry effect has a dependence on the specified orbit (astro-

nomical configuration), which in turn might alter the effect on polar amplification.

8. The reason we chose to mask out one hemisphere in the figures is because the hemispheric effect is calculated differently for Northern and Southern Hemispheres, i.e. for the effect in Northern Hemisphere; the Southern Hemisphere is made symmetric, and vice-versa. We can update the figures as per Reviewer's suggestion and show the global response in single maps for both Northern and Southern Hemispheres.

9. Based on our model simulations, we observe that there is a positive warming effect in the North-Atlantic Ocean, and in general the Northern Hemisphere oceans are slightly warmer relative to a symmetric Earth. However, as mentioned in the paper, our model does not capture the explicit changes in ocean currents and the deep ocean. Hence we refrain from making any additional comments on the behavior of the AMOC or any other global ocean current, which would likely alter greatly in a symmetric or near-symmetric Earth.

Interactive comment on Clim. Past Discuss., https://doi.org/10.5194/cp-2017-68, 2017.

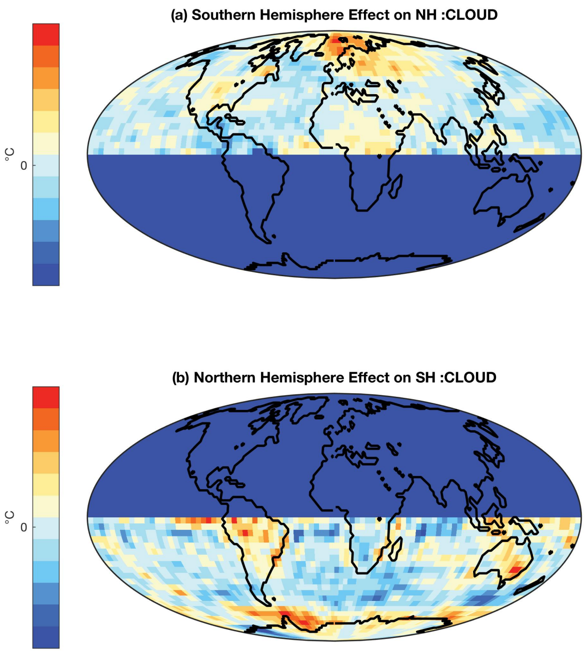

Fig. 1. The hemispheric effects on 3D Cloud Fraction âĂČ

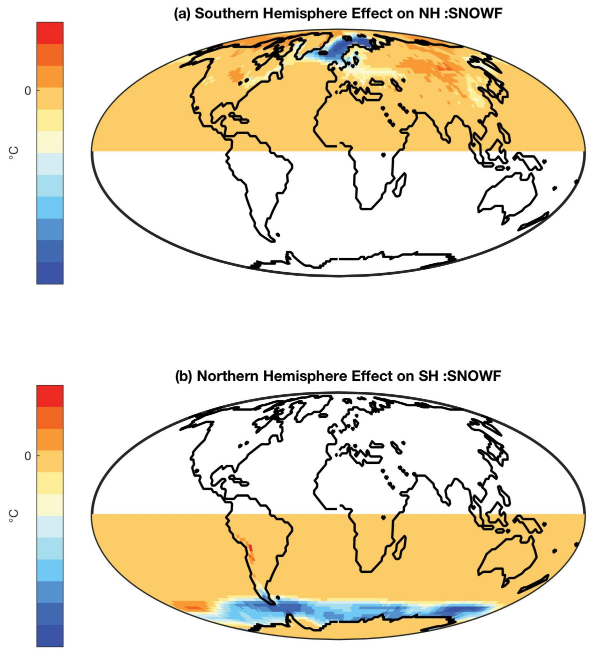

Fig. 2. The hemispheric effects on fractional snow cover