

## ***Interactive comment on “Interhemispheric bias in earth’s climate response to orbital forcing” by R. Roychowdhury and R. M. DeConto***

### **Anonymous Referee #2**

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This paper studies the climate impact of interhemispheric asymmetry of the land mass in a coupled AGCM-slab ocean model, with the focus on the potential impact on ice sheet melting, by using indexes of accumulated threshold insolation/temperature. In addition to the control run, two experiments are performed with the symmetric land mass using the present NH and SH land mass, respectively. The topic and experimental design are interesting. However, the paper is not well presented, the discussion and conclusion are ambiguous. I will not recommend the paper for publication unless it goes through a major revision.

Major comment: My major criticism is the way the discussion is presented on the S, J, and  $b^{\wedge}$  indexes. These indexes are not easy to understand, because of the threshold cut off and the time accumulation, and therefore the mechanism for their response patterns are not always straightforward (e.g. Figs.3-6). At least, the authors should

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present and discuss the global climate response in terms of the basic variables, such as temperature, before discussing the corresponding threshold index, say, S. As it stands, it is very difficult to follow the discussion and understand the pattern of index response is. For example, in Fig.5, why the sign is negative over land, and why the sign is reversed over the ocean?

Minor comments: 1) I don’t like the word “bias” here. Bias, at least to a climatologist, usually implies some systematic error (from some truth). Here, the LHB really refers to the potential climate impact of land mass of each hemisphere, and there is no error involved. It is just some idealization. (save a serious comparison with paleo world). I think “impact” or “effect” or some other words, will be much better than “bias”.

2) The authors should highlight one serious caveat in their study, the slab ocean, which assumes a constant ocean heat transport such that the readers should realize the paper is studying an idealized land hemispheric effect (or bias if they call it) in an idealized coupled world. This is important for two reasons. First, the slab ocean works only for short time scales. For paleoclimate application (as the paper is intended for), however, it is the final long term impact that matters. The long term impact can depend critically on the ocean circulation and can differ dramatically from that derived from slab ocean model. Second, due to Bjerkness compensation, the ocean heat transport usually will change in response to climate forcing.

3) Fig.2, caption: seems to be of wrong sign in (b), from low to high obliquity i.e. (b) is high obliquity – low obliquity. Please clarify. Partly, this reflects the lack of discussion mechanism of the pattern of the index as discussed above.

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