Clim. Past Discuss.,
doi:10.5194/cp-2016-123-RC2, 2017

Climate of the Past Discussions
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Interactive comment on "Antarctic climate and ice sheet configuration during a peak-warmth Early Pliocene interglacial" *by* Nicholas R. Golledge et al.

Anonymous Referee #2

Received and published: 3 January 2017

The behaviors of different parts of the Antarctica ice sheet were analyzed by using an ice sheet model which was forced by climate fields based on a regional model outputs. Simulations were performed under several scenarios of surface air temperature and sea surface temperature either directly from the regional model outputs or by adding 1 or 2 degree C according to proxy reconstructions. A major focus is on the tipping point analysis of the Antarctica ice sheet evolution under a constant climate forcing. I find the sensitivity analyses in this paper interesting and helpful for understanding the Antactica ice sheet dynamics in a warmer-than-present climate.

As in many early Pliocene climate simulations, a constant insolation forcing was unfortunately used in the climate simulation of this paper although the warm periods of the

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Discussion paper

Pliocene cover many precession and obliquity cycles. The insolation at 4.23Ma was used because the austral summer insolation reaches a maximum. However, this kind of insolation does not necessarily lead to a warmer condition globally or even over the Antarctica region. For example, it was shown in Yin and Berger (Individual contribution of insolation and CO2 to the interglacial, Clim Dyn, 2012, 38:709–724) that, probably due to their much higher BOREAL summer insolation, the interglacials MIS-5e and MIS-15 had a warmer Antarctica than the reference experiment although they had a lower austral summer insolation. Using one constant insolation forcing could induce uncertainty in the climate simulation. It might be one of the reasons that the simulated temperature is cooler than the reconstructed one. However, as the focus of this paper is on the tipping point analysis under a constant forcing, using the insolation forcing only at 4.23Ma would be acceptable, but the authors need to point out the limitation of their forcing selection especially when they also try to estimate the absolute contribution of Antarctica ice sheet to sea level.

The authors have run the ice sheet model for 10,000 years with a constant climate forcing. Any reason for choosing such a long time period? The inflections (tipping points) on Fig8 occur very late in the simulations. We wouldn't see them if the simulation length were not long enough. It seems unreasonable to run the ice sheet model for 10,000 years with a constant forcing because insolation reaches another extreme in 10,000 years. Moreover, under such a constant and warm condition, the ice sheet would never reach equilibrium, as confirmed by the mass loss curves in Fig8.

My impression is that the focus of this paper is on the tipping point analysis of the Antarctica ice sheet evolution under several climate scenarios warmer than present, so the title of this paper seems not precise.

The ice sheet model is not interactively coupled with climate model. The potential influence on the results should be mentioned.

In which degree would the results be affected by the initial ice sheet condition?

More information should be given on the GENESIS model, on the regional model and on experiment design.

Is the subsurface ocean temperature considered in this ice sheet simulation and how?

The role of precipitation is not much mentioned in the paper. Is it because precipitation is not important?

Page 2, line 28: temperature anomalies as inputs or temperature anomalies plus present-day observation?

Page 2, line 30: in the climate model, the WAIS is already removed. Is a circular reasoning involved here?

Page 7, line 24: please explain what the climate-topography thresholds mean.

Page 8, line 14: It seems that there is one tipping point on the yellow line in Fig8a.

Figure 1: The reference of the astronomical data should be cited.

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2016-123, 2016.