Clim. Past Discuss., 6, C886–C887, 2010
www.clim-past-discuss.net/6/C886/2010/

Climate of the Past Discussions

Interactive comment on "Initiation of a Marinoan Snowball Earth in a state-of-the-art atmosphere-ocean general circulation model" *by* A. Voigt et al.

Anonymous Referee #2

Received and published: 17 October 2010

This is a useful paper, applying a true state-of-the-art coupled GCM to the snowball problem for the first time, following many efforts using simpler models. The results show that the model can get into a complete snowball state with the solar irradiance of the Neoproterozoic and an atmospheric CO2 concentration of between 1 and 4 times the preindustrial value. This result is interesting because it contradicts some previous estimates which found it more difficult to get the earth into a snowball state. It is also interesting because it does not display an open equatorial water (slush ball) state, again an issue that has been disputed in the literature. These results may not settle these debates, but add to them significantly.

It would have been nice to know what physical feedback leads to the different model results here, but I fear this may not be simple to decipher. It is not impossible that a different GCM applied to the same problem will give different results and it will be difficult to tell what difference between the two models is responsible for the different behavior. This is because the different model feedbacks (sea ice albedo, clouds, snow...) are all coupled, and if one of them is, in fact, responsible for the different model response, the others react and could mask the original cause. While this is somewhat disappointing, it simply means that we need many more studies with state-of-the-art models such as used here to put the results of the present model in perspective.

The paper is well written and is quite straightforward, as it should be. The analysis using the 1d and 0d EBMs is useful. The comparison between the two control runs a bit lengthy but useful. I feel the paper is a useful contribution and recommend that it be published pretty much as is.

Interactive comment on Clim. Past Discuss., 6, 1853, 2010.