Climate of the Past Discussions, 1, S174–S176, 2005
www.climate-of-the-past.net/cpd/1/S174/
European Geosciences Union

Climate of the Past Discussions

Interactive comment on "Effect of land albedo, CO_2, orography, and oceanic heat transport on extreme climates" *by* V. Romanova et al.

Anonymous Referee #1

Received and published: 6 February 2006

The manuscript by Romanova et al. investigates the sensitivity of the climate system to the initial and the boundary conditions in their climate model. They find that the orography or the oceanic heat transport have insignificant effects on the onset and on the stability of a snowball Earth climate. Conversely, they put forward that the land albedo is the most important forcing factor in triggering a global glaciation in their model. The paper is well written and well organized.

Although several climate modelling studies have been conducted these last years on the snowball Earth, it is of primary importance to investigate the sensitivity of these results to the climate model used. As such, my recommendation would be to publish this study in the Climate of the Past journal. However, I have a number of major concerns which prevents me to recommend publication in the actual state of the paper.

1) My main concern is the sea-ice model used in this study and more generally the

absence of an ice-albedo feedback in their model. Indeed, at p. 263, they investigate the sensitivity of the ice-planet simulation. Leaving from an initial state of SST close to freezing point (hence, equivalent to a global oceanic sea-ice cover with an albedo of 0.6), their model generates a deglaciation just because of the land albedo which is left free to evolve. This contradicts every modelling study which clearly and cleanly demonstrates the stability of the climate once the ocean is globally ice-covered. Budyko was the first to demonstrate that with a globally ice-covered ocean, due to the high albedo of the sea-ice, the Earth is completely locked in this state. The only way to initiate a deglaciation is to leave the atmospheric CO2 to increase in the atmosphere during several million years (Caldeira and Kasting, 1992). Land surface covers a third of the planet and then it is the albedo of the ocean which is the most important driver of climate. So, maybe, their simulation has a problem with the albedo of the ocean at -1.9 °C which should be at 0.6 ... It must be clarified.

2) Other concern comes from the weak sensitivity of their model to the atmospheric CO2 level. How is it possible that with one ppm you do not simulate a global glaciation. The global temperature is around -7°C. Calculating the equilibrium temperature in a very simple way, it is easy to show that the Earth temperature should be around -18°C with no greenhouse gases. Once again, it is as they are no ice-albedo feedback in their climate model.

3) While they cite and they know up-to-date snowball Earth references, it is somehow frustrating that they do not compare their results to other modelling studies. I know that each modelling study differs from another and then, the comparison is hard. But, if they carefully read the modelling papers on snowball Earth, they will figurate that their model is the warmest and the less sensitive I ve ever seen to the sea-ice albedo and to atmospheric CO2 levels. They must explain why.

4) In the paragraph (3.4), the authors investigate the effect of the orography and of the CO2 on the present-day distribution of the precipitations. Even if it is interesting, I do not figure why such a part in their paper which is introduced a modelling study on

CPD
1, S174–S176, 2005

EGU

global glaciation.

Interactive comment on Climate of the Past Discussions, 1, 255, 2005.