

Interactive comment on “Simulation of the last glacial cycle with a coupled climate ice-sheet model of intermediate complexity” by A. Ganopolski et al.

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First, we want to express our thanks to the reviewer for the constructive and useful comments. Below, we give response to the general comments and the changes we will apply to the manuscript to improve the paper. We will also correct or modify the text of the manuscript and the figures according to the specific comments.

1. “It is not clear why the North American temperature bias should remain constant over a whole glacial cycle. The North American geography undergoes profound changes over glacial-interglacial cycles that could easily change the standing temperature eddies. What would a similar correction for Eurasia look like? Would it have a similarly

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strong impact?”

Response: The reviewer is perfectly right that the assumption on constant temperature dipole structure and magnitude over the whole glacial cycles is a crude one. The necessity to introduce this correction are not the biases in the CLIMBER-2 model – on its coarse grid it performs well –, but because the whole American continent is represented in the model by just one column of grid cells, the model cannot resolve the difference between the western and eastern parts of North America. The role of this parameterization in our model is directly demonstrated by Fig. 9. In principle, one can introduce a dependence of the dipole structure and magnitude on the climate state (e.g. ice volume), but this will introduce additional “free” parameters, which cannot be constrained by modeling or empirical data. For Eurasia, we do not need such sub-grid correction, because Eurasia is represented in the CLIMBER-2 model by four grid-cell columns and the east-west gradient in the climatological fields is captured by the model reasonable well.

2) “The references to the two-dimensional energy-balance models (p. 2271) are very old (20 years). What is strange is that the authors write that this approach has been used “until recently””.

Response: This sentence is indeed odd and will be corrected

3) “The authors should discuss the implications of the absence of an interactive river routing scheme which could quite significantly alter the outcome of the simulations (as suggested by Alkama and others)”

Response: We tested the sensitivity of the model results to different river routine schemes. We found that, although the strength and millennial scale variability of the AMOC are affected by the choice of the routing scheme, the latter has a rather small impact on the simulated glacial cycle. This does not contradict results by Alkama et al. (2008), who found appreciable impact of river routing on the AMOC strength, but a small impact on the air temperature over the continents.

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4) "The penetration of meltwater... with sediment-laden flow" -> citation needed

Response: Will be done

5) "The refreezing "parameterization" is really simple. Shouldn't the refreezing fraction depend in some simple way on the melt quality itself or, in some more detail, on ratio of melt and (solid) precipitation? This would probably lead to a faster simulated ice-sheet decay and less freshwater flow and ice sheet buildup in cold phases"

Response: We are grateful to the reviewer for this suggestion and we will test a more advanced refreezing scheme in the future.

Interactive comment on Clim. Past Discuss., 5, 2269, 2009.