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Interactive comment on "The impact of the North American ice sheet on the evolution of the Eurasian ice sheet during the last glacial cycle" *by* J. Liakka et al.

Anonymous Referee #2

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General comments

The paper aims at quantifying the effect of atmospheric circulation changes induced by the Laurentide ice sheet on the evolution of the Eurasian ice sheet during the last glacial period. For this purpose the authors employ a chain of models that are run sequentially. They use the ocean heat transport modeled by a fully coupled atmosphere-ocean circulation model and reconstructions of ice sheet topography and extent to drive an atmosphere general circulation model for different time slices during the last glacial. The modeled climate anomalies are then used to force an ice sheet model at equilibrium. This stepwise approach certainly suffers from some limitations. In particular, it cannot

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properly capture the feedbacks between atmosphere, ocean and ice sheets and it assumes that climate and ice sheets are in equilibrium, which is certainly not always the case.

However, as long as fully coupled transient simulations with state-of-the-art Earth system models remain challenging because of their high computational demand, idealized studies like this can be useful to improve our understanding of climate-ice sheet interactions.

The paper is generally well written and easy to follow and the experimental setup is clearly explained.

I find the paper suitable for publication in Climate of the Past after some minor issues have been addressed.

Specific comments

- The main results in the paper are based on simulations using the preindustrial modeled ocean heat transport. The authors also show that the main result of the paper, namely that the Eurasian ice sheet is shifted westward by the changes in atmospheric circulation induced by the Laurentide ice sheet, strongly depend on the ocean heat transport used. The westward shift is actually much less pronounced if the modeled LGM ocean heat transport is used. The authors should make this clear in the abstract and the conclusions.

- The authors should discuss the assumption that climate and ice sheets are at equilibrium during the simulated time slices in some more detail. What is the possible role of the ice sheet history for the actual ice sheet state at the simulated stages?

- The separation of precipitation into rainfall and snowfall based on temperature between -10°C and +7°C seems somehow arbitrary to me. Are the model results sensitive to this particular choice?

Technical comments

CPD

11, C2703–C2705, 2015

Page 5212, line 19: ERA-Intirim -> Era Interim

Page 5215, line 10: ‘high latitude height anomalies’. Please specify that it is geopotential height.

Page 5219, line 7: ‘a monotonically decreasing’ should be ‘monotonically decreasing’

Page 5223, line 17: ‘yields a cooler summer’ should be ‘yields cooler summer’

Page 5223, line 21: ‘a equivalent’ -> ‘an equivalent’

Page 5223, line 21: here and elsewhere in the paper please specify that you are referring to cyclonic and anticyclonic ANOMALIES and not absolute values.

Page 5224, line 13: ‘our results is’ -> ‘our results are’

Interactive comment on Clim. Past Discuss., 11, 5203, 2015.