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Climate of the Past Discussions

Interactive comment on "Weakened atmospheric energy transport feedback in cold glacial climates" *by* I. Cvijanovic et al.

Anonymous Referee #1

Received and published: 6 May 2011

Title: "Climate and carbon-cycle variability over the last millennium"

Authors: Cvijanovic et al.

Summary: The authors present a set of sensitivity AGCM simulations under present day (PD) and LGM conditions with respect to SST forcing derived from a fresh water hosing experiment. The focus of the analysis is set to the response of the atmospheric energy transport in the Northern Hemisphere. The authors find that the energy transport of PD simulations is more sensitive than the one of the LGM simulations. This is important as a higher sensitivity suggests that during the PD the atmosphere reorganizes itself more easily and could thus dampen temperature anomalies (from the ocean) more efficiently. The reason for a higher sensitivity is identified in larger changes of the transient eddy heat transport rather than latent heat.

General comments: General the manuscript is clearly structured. Focusing on a important aspect of the coupled atmosphere ocean system the paper is relevant and is a nice contribution to the community. Still there some shortcomings, Therefore, I recommend that the manuscript should be accepted after minor to major revisions.

Major comments:

page 1238, line 19-24: It is unclear for which climate state (PD or LGM) the freshwater hosing experiments are performed. So a better description of the used simulations is needed. I guess that the authors use only simulations for one climate state, e.g. PD. This assumes that the reaction of the climate system on freshwater hosing is independent from the climate state, a rather strong assumption. The authors need at least discuss this issue.

page 1240, line 11-12: How are the transports calculated. Using 6-hourly data, daily means, monthly means ??? Please be more specific.

page 1242, line 14-16: the DES is a residual, so how could this decomposed?

page 1242, line 22-25: the authors need to explain in more details how the fluxes are calculated. E.g., it is unclear if the prime denotes deviations from the monthly mean the seasonal mean and if so which season.

section "conclusions": I think the authors use a coarsely resolved model configuration. Clearly atmospheric eddies are resolved but underestimated in a T42 resolution. Moreover, 18 levels also affect the atmospheric waves and therefore the atmospheric energy transport. So at least the authors should discuss the issue of how the rather coarse resolution may affect the results presented.

Given the rather coarse resolution of simulations I encourage the authors to include observations, e.g., it would be nice to see where the observation (just one point) lies in Fig. 2.

How does the PD simulation compare to observation for atmospheric transport (Fig.

3, suggestion to show the difference to observations) stationary and eddy heat flux anomalies (Fig. 4)

The authors could also include observations in Fig. 6, 7, and 8 and discuss the differences to give the reader the ability to assess the findings in the light of observations.

Minor comments:

page 1236, line 10: Suggestion to improve readability: "... which, in turn, is mainly driven by larger ..."

page 1237, line 5-9: The sentence is needs clarification, maybe split into two sentences would help.

page 1239, line 3: Please include "... ranging from -2 to 2 in 0.5 steps."

page 1239, second paragraph: Please define summer - It sounds like JJA, so why is September not included? You might also show September, as this is the month with the least sea ice extent (at least for PD).

page 1239: NHTG: Gradient is a bit misleading here as one would expect the unit K/km.

page 1240, line 20 and elsewhere: Please set "rc" italic as it is a variable.

page 1240, last sentence: It would be nice to see this, so maybe the authors could do a similar figure as Fig.2 but for 45N and 60N. So the reader could actually see a peak around 45N.

page 1241, line 2: Maybe "reveals the canceling effect of the two at the equator" reads better.

page 1241, line 13-15: I think the simulation LM_p3 has to be introduced in section 2.

page 1242, line 7: Please change to "is the tail in the PD".

page 1242, line 20: Please change to " is mainly done by eddies"

page 1242, line 23: Please change to "and transient eddy [... (lower panels) meridional heat"

page 1244, line 11-12: Please be more specific about how the position depend on the perturbation strength.

page 1244, line 15-18: I t remains unclear what the authors would like to express, so please clarify this.

Page 1244, line 24-28: I think it would be helpful for the reader to see the changes of the Hadley Circulation.

Page 1245, line 27: " 0.22 PW is found."

Fig. 4 caption: "annual meridional heat"

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