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Climate of the Past Discussions

Interactive comment on "

Impact of North Atlantic – GIN Sea exchange on deglaciation evolution of Atlantic Meridional Overturning Circulation" *by* J. Cheng et al.

Anonymous Referee #2

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Review of "Impact of North Atlantic-GIN Sea exchange on deglaciation evolution of Atlantic Meridional Overturning Circulation" by Cheng et al.

This manuscript further analyses the resumption of the AMOC during the BA event as simulated by CCSM3, already described in Liu et al. (2009), focusing more on the role of ocean heat and salt transport towards the convection sites and adding two sensitivity experiments to the run described in Liu et al. (2009).

The manuscripts is marred by several imperfections,it does not add substantial new

insights in addition to the Liu et al paper, and many of the conclusions, in particular the results of the two additional sensitivity experiments, are rather trivial and could be anticipated beforehand. However, the analysis also reveals an interesting new result that unfortunately is not discussed at all. I recommend a major revision with a refocus on this new result. In its present set-up the manuscript does not add enough new material/insight to Liu et al. (2009).

Detailed comments.

1. The use of the terms overshoot and recovery are inappropriate in the present context and confusing. Overshoot is a transient phenomenon that occurs without changing the forcing. For instance, after a hosing experiment the AMOC often increases to a peak value much higher that the final equilibrium value. In the experiments discussed here there is no trace of such an overshoot; the terms is reserved for the higher amplitude in the BA event compared to the glacial state, but in the mean time insolation and greenhouse forcing have changed, so is there is no reason at all to expect the AMOC to be the same for the BA-event and glacial state. One could speak of an overshoot if after the BA the AMOC would significantly decrease, but there is no hint of this in the simulations discussed.

2. The resumption of the AMOC is associated with the recovery of deep water formation in the Labrador and GIN Sea. The main new result of this paper is that if heat and salt transport to the GIN-Sea is suppressed and T,S characteristics at the southern boundary are kept fixed, convection never restarts in this area and the AMOC resumption is incomplete. This comes as no surprise for an area that is largely ice-covered after hosing with only weak air/sea exchanges. This result is too meager to warrant an new article.

3. The text is difficult to follow in a few instances, always related to an awkward use of English. For instance, the term "adjusted allodiality" is inappropriate in this context, it's probably the suggestion of a Chinese-English translation machine. Allodiality is

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associated with succession rights in ancient communities and its use in this sentence makes the sentence incomprehensible. Other awkward sentences are: "This non-local factor (i.e. salt and heat transport) only operates during the recovery process of the AMOC." Is it zero after the AMOC is back to 18 Sv? And: "Based on above analysis, the local and non-local factors together induces the deep-water formation in the GIN Sea unrecovered" ?????? There are also many grammar errors.

4. To end more positively: Figure 1 presents time-series of the AMOC; split-up in a Labrador Sea and GIN Sea contribution. Much of the results of the two sensitivity experiments can be anticipated by just looking to the time series of the DGL_A run from Liu et al. The split-up shows something interesting. The resumption of the AMOC is clearly a two-stage process. The Labrador Sea reacts immediately after hosing stops (uniformly distributed over the band 50-70N in the Atlantic. The GIN Sea only reacts after about 200 years, and the AMOC resumption is the sum of these two recovery processes, taking about 350 years. Why is the GIN-sea response retarded and the Labrador Sea response immediate? What sets the two-hundred year timing difference between the two. figure 2 suggests it is due to the heat transport into the GIN Sea reacting only after 150 - 200 years, but why does it take so long for the heat transport to increase? Also, the GIN Sea starts reacting after the Labrador Sea convection is fully recovered. Is the GIN-Sea slaved to Labrador Sea processes or is this coincidence accidental?

A much more interesting paper could be written if it was framed around these questions, and I strongly urge the authors to rewrite this manuscript by addressing the questions mentioned above.

Interactive comment on Clim. Past Discuss., 7, 521, 2011.