The authors would like to thank the reviewer #2 for her/his constructive comments and the time she/he devoted in carefully reviewing the manuscript. In the following, we would like to reply to her/his comments.

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).

We disagree with your points. In this study with two new experiments, we explicitly demonstrate the key convection region (GIN Sea) which controlling the occurrence of AMOC overshoot during the BA warming event, and explicitly point out the dominant processes which controlling the convection reaction in the GIN Sea. As shown in Liu et al. (2009), an AMOC overshoot is the key factor to trigger a fully BA warming. So, this manuscript provide more details of the physical processes which triggering the BA warming event.

One point should be noted is that, this study is a following one of the below paper.

*Cheng, J., Liu, Z., He, F., Otto-Bliesner, B. L. Brady, E., and Wehrenberg, M. Simulated two-stage recovery of Atlantic Meridional Overturning Circulation during last deglaciation. AGU Monograph: Understanding the Causes, mechanisms and extent of the Abrupt Climate Change, invited paper, in press.*

In this AGU paper, we investigate the restarting processes of deep-water formation in its two origins in the experiment of Liu et al. (2009) in details. Results shown that, the convection reaction in these two origins during BA onset are asynchronous, and the overshoot phenomenon during this period is associated with the processes in the GIN Sea. Maybe we can roughly speculate the main points of this current manuscript in Liu et al. (2009) and our AGU paper, but two relevant questions are still unclear. One is that, could the overshoot during the BA event occurs just depend on the convection in the Labrador Sea? Another is that, which part of the oceanic and atmospheric processes dominate the convection reaction in the GIN Sea? The current manuscript just focuses on these two questions and provides confident results.

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.

You're right, these terms used here are different with that in the idealized experiments. One point should be noted is that, this study is working with a historic transient simulation of the last deglacial climate. These terms used here actually are the combination of "pure" one with the "mean-state transition", which derived by the changed insolation and greenhouse forcing. During the BA onset, AMOC intensity in experiment of Liu et al. (2009) resumes from the suppressed state (about 3 Sv), reaches the peak (about 20 Sv) at 14.32 kaBP, and then decreases to the stable state (18 Sv). The final steady value is similar to the modern one simulated with the same model (Yeager et al., 2006). So, these terms are the specific and realized one which occurring in the transient process of historic climate change.

In an idealized water-hosing experiment under the glacial state with same model, we found a significant overshoot too. And the analysis results in this idealized experiment had shown that, the physical processes controlling the recovery and overshoot occurrence are mainly same with the transient simulation. So, we thought these two terms can be used here in a broad way.

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.

We partially agree with you about this point. The contribution of local air-sea interaction to the convection reaction of the GIN Sea is an important part which should be discussed more extensively in the revised manuscript. Thanks for your comments to improve the content of our manuscript.

Ice covering is not the key factor which controlling the impact of air-sea interaction to the convection reaction in the GIN Sea during the BA onset. One point should be noted is that, the ice covering over the GIN Sea is not complete during the whole last deglacial period (see Fig. 2c), and it also varies over the seasons. In the second PB experiments (PB_REC), the seaice covering retreats somewhat than the former one (PB_PreBA). And the air surface temperature over the GIN Sea also increases around 3℃ at the start of the PB_REC experiment (Fig. S6 of Liu et al., 2009). Even though, the local air-sea interaction still can’t alone restart the convection in the GIN Sea significantly in the second PB experiment.

So, the dominant impact of oceanic exchange revealed in this manuscript is valuable to the understanding of the convection reaction in the GIN Sea and the triggering of

BA warming.

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 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.

We will improve the English expression in the revised manuscript with the help of English native speaker.

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.

The "split-up" of the individual NADW formation volume in the Labrador Sea and GIN Sea is based on our new developed method, and it significantly reveals more details of the recovery process of AMOC during the BA event.

Actually, the issues mentioned in above comments already discussed mostly in our AGU paper. Thanks for your constructive suggestions.

In general, the current manuscript mainly aims to answer the questions about the area dependence of overshoot occurrence, and the processes controlling the convection reaction in the GIN Sea during BA event. Comparing to the results in Liu et al. (2009) and in our AGU paper, this manuscript explicitly answers these two questions with two new experiments. So, we thought it's valuable to be published in CP to increase the understanding the mechanism of AMOC overshoot and BA warming event.