The authors would like to thank the reviewer #1 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.

In this manuscript, the transient deglacial simulation with CCSM3 by Liu et al. (2009) is revisited by means of two new sensitivity experiments. These experiments make use of a Partial Blocking (PB) scheme that inhibits oceanic exchanges between the North Atlantic (NA) and the GIN Seas. The results show that the NA-GIN Sea exchange is crucial for the Atlantic meridional overturning circulation (AMOC) overshoot during the Bolling-Allerod (BA) observed in the transient simulation by Liu et al. (2009).

This is an interesting contribution that provides insight into the physical processes that potentially played a role in triggering the BA warming event. Before publication, however, some revision is needed as described in the following.

(I) Citations:

The citation is really poor. As proxy evidence of an AMOC overshoot during the BA, the papers by Stanford et al. (2006) and Barker et al. (2009) are cited. Both papers show no evidence of an AMOC overshoot.

We agree with you about Stanford's record, but don't agree with you about Barker's records. For the absence of the value during the period of Last Glacial Maximum, the proxy record of Stanford et al. (2006) is not a good one to support the AMOC overshoot during the BA. But, this proxy record has the similar evolution feature to the simulated AMOC intensity in DGL-A run of Liu et al. (2009). There is a robust short-term (hundreds years) enhanced value during the early BA in both simulated AMOC intensity and Stanford's record. We will remove this reference in the revised manuscript.

Based on the same proxy records to their paper in 2009, Barker et al. (2010) found that, there's an extreme deepening of the AMOC during the BA. They also demonstrated that the deepening of the AMOC was accompanying with an overshoot phenomenon in one OGCM simulation. So, we thought these two references have the evidence of an AMOC overshoot during the BA.

By contrast, a recent paper by Thornalley et al. (2011, Science) shows some records that may corroborate the overshoot hypothesis.

Thanks for this additional literature you provided to us, it's really useful to support the occurrence of AMOC overshoot during the BA.

The high-impact paper by McManus et al. (2004, Nature) does not provide evidence for an AMOC overshoot during the BA. The Pa/Th record of McManus et al. rather suggests an AMOC during the BA of similar strength than during the LGM, but weaker than during the Holocene. Nevertheless, this important paper should be cited and it should clearly be stated that some - but not all - proxy records of deglacial AMOC variability show evidence for a BA AMOC-overshoot.

Yes, this literature should be cited to state that not all proxy records of deglacial AMOC variability show evidence for a BA AMOC-overshoot. We will add this literature in the revised manuscript and state it clearly.

Basically the same holds true for the citation of modelling papers. The authors cite the studies by Manabe & Stouffer (1997), Knutti et al. (2004) and Mignot et al. (2007) as suggesting that the "AMOC overshoot is a common and robust phenomenon in freshwater-hosing experiments". In fact, none of theses model experiments really shows an overshoot after removal of the freshwater perturbation.

We partially agree with you. Actually, Figure 6 of Manabe & Stouffer (1997), and Figure 11 of Mignot et al. (2007), show that these two studies all have simulated overshoot phenomenon.

In figure 6 a of Manabe & Stouffer (1997), the peak value of AMOC intensity during recovery period reaches about 21 Sv, which is obviously higher (3 Sv) than the initial value of about 18 Sv and lasting about hundreds years.

In figure 11 of Mignot et al. (2007), there is a robust overshoot signal with the magnitude about 3 Sv, too. In this paper, the occurrence of overshoot seems like connected with the time scale of freshwater perturbation. It's interesting point about overshoot generation and will be stated in the revised manuscript.

Only a few of the cited studies (Weber & Drijfhout, 2007; Krebs et al., 2007 and Arzel et al., 2008) show a short and weak AMOC overshoot in response to removing the freshwater injection (although it should be noted that Weber & Drijfhout and Krebs et al. basically use the same climate model).

Yes, we will add the statement about models of each simulations.

The model inter-comparison by Stouffer et al. (2006) nicely shows that an AMOC overshoot is rather an exception than the rule.

Yes, there are only about 3 of total 15 models which got the overshoot after removal of the freshwater perturbation. One point should be noted is that, the total length of integration in this literature are all just 200 years. Based on the increasing trend of AMOC intensity, we can speculate that the model number which with robust overshoot will increase when these experiments integrate longer than 200 years. We will state this point in the revised manuscript.

In Schmittner et al. (2008) AMOC overshoots were triggered by negative freshwater perturbations, while Weaver et al. (2003) applied a freshwater perturbation to the Southern Ocean.

Thanks, we will state these experiments more clearly in the revised manuscript.

In summary, the authors should be more careful with their citations and clearly state that some models simulate an AMOC overshoot, while others do not.

Thanks for the comments of the citation. You're right, not all experiments have overshoot phenomenon. We will follow your comments and make the corresponding revisions.

More model studies that support the importance of NA-GIN Sea exchange for deepwater formation should be cited, as this is the key point of the manuscript. I suggest Schulz et al. (2007, GRL) and Oka et al. (2006, Ocean Modell.) to include but there may be many more.

Thanks, we will add these two references and another reference as following, in the revised manuscript.

Dong, B., Sutton, R.T., 2005. Mechanism of interdecadal thermohaline circulation variability in a coupled ocean－atmosphere GCM. J.Climate 18, 1117－1135.

Last but not least, some references in the model description would be helpful. As not everybody is familiar with CAM3, CLM3, POP and CSIM at least one reference for each model component should be included.

Yes, thanks for your suggestions. We will add these references in the revised manuscript.

(II) Language:

The paper needs a major revision in terms of language. The paper is full of grammatical errors and inappropriate use of words (e.g. "allodiality"). This shouldn't be a problem as at least one of the co-authors is an (American) English native speaker.

We will improve the content of this manuscript following your suggestions, and improve the language presentation with the help of English native speaker.

(III) Conclusions:

One of the major conclusions is that "if the deep-water formation in the GIN Sea is kept in a suppressed state artificially, the change of the deep-water formation in the Labrador Sea will be affected too". I don't see this from the results. Fig. 1 rather suggests a similar temporal evolution of Labrador Sea deep-water formation in the PB and DGL-A experiments. The authors should be more specific or revise their conclusions.

Thanks for your comments. Fig. 1 is not clear enough to show the difference of temporal evolution of Labrador Sea deep-water formation in PB and DGL-A experiments. We will improve the presentation of Fig. 1 in revised manuscript.

Actually, there're significant impacts of PB scheme on Labrador Sea deep-water formation. During the BA onset, the peak value of deep-water formation in Labrador Sea reaches about 8 Sv in the PB_PreBA experiment, this peak value is smaller about 2 Sv than that in DGL-A experiment. In another PB experiment, PB_REC, the stable value of Labrador Sea deep-water formation after the early BA is higher about 1 Sv than that in DGL-A experiment. We will improve the figures and statement in the revised manuscript.

(IV) Supplement:

The supplementary figure should be included into the manuscript.

Thanks, we will include the supplementary table and figure into the revised manuscript.

Additional References:

McManus et al. (2004) Collapse and rapid resumption of Atlantic meridional circulation linked to deglacial climate changes, Nature 428, 834-837.

Thornalley et al. (2011) The Deglacial Evolution of North Atlantic Deep Convection, Science 331, 202-205

Schulz et al. (2007) Low-frequency oscillations of the Atlantic Ocean meridional over turning circulation in a coupled climate model, Climate of the Past 3, 97-107

Oka et al. (2006) Deep convection seesaw controlled by freshwater export through the Denmark Strait, Ocean Modell., 15, 157–176

Thanks for the additional references; we will add them in the revised manuscript following your suggestions.