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Interactive comment on "The role of subpolar deep water formation and Nordic Seas overflows in simulated multidecadal variability of the Atlantic overturning" *by* K. Lohmann et al.

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Reply to OSD-10-C677-2013

The authors would like to thank the reviewer for his/her comments, which will improve the manuscript.

Reviewer comment:

One major concern that the reviewer has is that SDW formation and Nordic Seas overflows are not completely independent as authors acknowledge. Because of this, reviewer likes authors to make some comments on how this would affect their conclu-

sions on relative roles of the variation in SDW formation and Nordic Seas overflows in AMOC variability.

Author response:

To discuss how the fact, that subpolar deep water formation and Nordic Seas overflows are not completely independent, affects our conclusions, we have added the following paragraph to section 5 (Discussion and conclusions):

"However, AMOC variations related to either subpolar deep water formation or Nordic Seas overflow variability will, through varying northward heat and fresh water transport, influence the surface density in the northern North Atlantic and might consequently affect the other of these two processes. Above discussed conclusions about the respective role of variations in subpolar deep water formation and Nordic Seas overflows for multidecadal AMOC variability might therefore be biased by the fact that these two processes are somehow coupled. If the respective role of variations in subpolar deep water formation is overestimated (due to influence by Nordic Seas overflows), then the multidecadal AMOC variance explained by subpolar deep water formation and Denmark Strait overflow will be of comparable order. If, on the other hand, the respective role of variations in Denmark Strait overflow is overestimated (due to influence by subpolar deep water formation), then only a minor part of multidecadal AMOC variance will be explained by the Denmark Strait overflow. We note, however, that in MPI-ESM-CR, which is the only model (apart from HadCM3) where subpolar deep water formation index and Denmark Strait overflow are not significantly correlated in the control integration, the respective role of these two processes for multidecadal AMOC variations is similar to the conclusions drawn from the presented analysis (Table 3)."

Reviewer comment:

1. Line 2 on page 1. Add "circulation" after "overturning"

Author response:

The title of the manuscript has been changed accordingly.

Reviewer comment:

2. The results from the two sensitivity experiments are important and the main outcomes from them shall be better summarized in the abstract.

Author response:

The results from the two sensitivity experiments have been included in the abstract by adding the following sentences:

“Apart from analysing multi-model control simulations, we have performed sensitivity experiments with one of the models, in which we suppress the variability of either subpolar deep water formation or Nordic Seas overflows. The sensitivity experiments indicate that variations in subpolar deep water formation and Nordic Seas overflows are not completely independent. We further conclude from these experiments that the decadal to multidecadal AMOC variability north of about 50oN is mainly related to variations in Nordic Seas overflows. At 45oN and south of this latitude, variations in both subpolar deep water formation and Nordic Seas overflows contribute to the AMOC variability, with neither of the processes being very dominant compared to the other.”

Reviewer comment:

3. Table 1. Atmosphere grid for HadCM3 is in “3.75 (lon) x 2.5 (lat)” rather than “3.25 (lon) x 2.5 (lat)”

Author response:

Table 1 has been changed accordingly.

Interactive comment on Ocean Sci. Discuss., 10, 1895, 2013.