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Ocean Science Discussions

Interactive comment on "North Atlantic 20th century multidecadal variability in coupled climate models: sea surface temperature and ocean overturning circulation" *by* I. Medhaug and T. Furevik

Anonymous Referee #2

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This manuscript presents very interesting analyses on AMOC and AMO using the 20c3m experiment from 24 IPCC AR4 coupled climate models. The results suggest that the observed 20th century extreme in temperature are due to primarily internal climate variability, not dominated by external forcing, consistent with pervious studies. The manuscript also explores the relationship between AMOC and AMO in the IPCC AR4 coupled models, and found that the models strongly disagree in phase and strength of the covariability. The work shows progressive contribution to the field studying Atlantic climate variability. In particular, the comparison of AMOC variability

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in different IPCC coupled models and the linkage to the AMO have not been studied widely before. The manuscript is well presented, and I recommend the paper to be accepted for publications in Ocean Science after some minor revisions outlined in the following review comments.

1, The simple conceptual model in Section 4 is very confusing, and does not represent the correct physical mechanism for AMOC variability. The equations (1-6) do not distinguish the mean state and the transient variability. The concept of the flushing time scale is confusing and misleading. I suggest this part and Figure 11,12 be deleted from the manuscript.

2, Page 354, Line 25, the THC component is part of the AMOC, not "is know as" the AMOC, i.e. the AMOC includes both the THC and the wind-driven circulation.

3, Page 356, Line 7, the statement "driven by advection of anomalous dense water from the south" is not true for Delworth et al. 1993, which is driven by anomalous freshwater flux from the northern high latitudes linked to the Arctic.

4, The manuscript should be aware that many IPCC AR4 models do not simulate the correct locations of the deep convection sites, and such modeling biases would strongly affect modeled AMOC variability and its relationship with the AMO, that is probably one of the reason that models strongly disagree in phase and strength of the AMOC-AMO covariability. Only model results showing realistic simulations of the deep convection in the Labrador Sea and Nordic Sea can be trusted for the study of the AMOC-AMO relationship.

Interactive comment on Ocean Sci. Discuss., 8, 353, 2011.