

## ***Interactive comment on “North Atlantic deep water formation and AMOC in CMIP5 models” by Céline Heuzé***

### **Anonymous Referee #2**

Received and published: 15 March 2017

**General comments** The manuscript investigates the CMIP5 model suite on consistency with observations. This is a follow up on an earlier study by de Jong et al. (2009), who investigated the hydrography in the CMIP3 models. While the big discrepancies found by this earlier study made some observational oceanographers very cautious about climate models, it was generally not picked up by the climate community. It is important to see whether the newer generation models is doing a better job, especially because these model are used more and more to explain observed variability on (interannual) time scales for which the models were not intended.

The correlation between deep water formation and sea ice found by the author seems straightforward. It is clear the sea ice extends to far over the Labrador Sea in several of the models. It would be interesting to know why this is the case, although apparently the ice model is one factor. The (sign of the) correlation deep convection and heat

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fluxes in some models is confusing, as in the observations there is no doubt about what this sign should be. Even though it is not in the scope of this study to find out why this is, it should be a warning to modelers.

I do have two remarks about possible causes that should be within the scope of this study. Firstly, the difference in MLD may be due to differences in stratification. Even though their offset in density is small (Section 5.2) their stratification may be off enough to cause significant differences in convection.

Secondly, in the real ocean the stratification is set by eddy exchange between the cold interior and the warm boundary current. At high latitudes, like the Subpolar Gyre, these eddies are not resolved by the climate models. Differences in eddy parameterization may therefore affect the MLD. Some of the CMIP5 models include the newer Fox-Kemper (2008) parametrization that is supposed to address this issue, other do not. This aspect of the models deserves to be investigated and it would be good if Table 1 is expended with a column including information on parameterization.

**Minor comments** 3.2 Line 30. The study by de Jong seems a bit misquoted here. They did investigate the convection in the Labrador Sea, which was too shallow, but did not investigate where else convection occurred. They cited other studies that suggested this. Please correct.

4.1 Line 27. “...” Best to either replace with one dot or write out explicitly what the author means.

Figure 1. The contour of the ice edge is hard to see in several of the panels. It would be good to make the color of this contour a couple of shades darker. Also, some lines appear to be broken (example panel r), which makes them very hard to see as well. Potentially they'd be clearer if the fonts of the model names were made slightly smaller and the actual plots bigger.

Table 2. It would be good to restate the sign conventions in the table caption.

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Figures 2, 3 & 6. Please add some information about the grey lines in the figure captions.

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Interactive comment on Ocean Sci. Discuss., doi:10.5194/os-2017-2, 2017.