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

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This manuscript examines North Atlantic deep water formation and its association with AMOC in 23 CMIP5 climate models. Much variability is found in the location, timing and strength of deep water formation. For example, only 9 out of the 23 models show deep water formation in the Labrador Sea, and not out in the Subpolar Gyre. Even so, the conclusion is that the CMIP5 models have improved compared to the CMIP3 models.

Figure 2 compares the mean mixed-layer depth versus density bias at two depths in the Subpolar Gyre and the GIN Seas, and no obvious relation is found. I think the MLD would be more related to the vertical density gradient, rather than the density itself. Too deep a MLD is probably related to too small a vertical density gradient in the deep

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[Discussion paper]

ocean below about 1500m. Models that convect to the ocean bottom probably have very weak density gradients throughout the whole column. The mean temperature bias at the same locations is shown in Fig 3. I would like to see the mean salinity bias as well, because salinity is more important is setting the density when the temperature is this low.

I would also like to see finer temporal resolution in Fig 4, as I'm unsure whether the warming is causing the MLD errors, or whether the MLD errors are causing the warming. The lag of 2 years between Subpolar Gyre convection and AMOC strength in Fig 5, and the fact that the Fram Strait heat flux is proportional to AMOC in Fig 6 have been documented before; please add some references.

Probably the most useful comment for modelling groups is that they need to get the winter sea ice extent correct in order to get deep water formation in the right location. Are there any other helpful insights that the author can make to help the modelling groups?

Minor Comments: Page 5, line 1; constrained.

Page 9, line 27: says 3 maxima, but only 2 lags are given on line 28.

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