Hemispheric-scale impacts of centennial-scale AMOC variations in the GFDL CM2.5 high-resolution coupled model

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We present results from a 1000 year simulation using a new high-resolution global coupled model, GFDL CM2.5. The model has ocean resolution ranging from 27Km at the Equator to 8 Km at high latitudes, with an atmospheric resolution of 50 Km. This model has a far more energetic ocean simulation, including a more realistic representation of intense boundary currents.

The output of this model shows significant centennial scale variations of Northern Hemisphere areal mean temperature. These fluctuations can be as large as 0.6 degrees over a 50 year period. The atmospheric temperature variations appear to be driven by sea surface temperature (SST) changes in the higher latitudes of the North Atlantic, particularly over the Nordic Seas. These changes are directly linked to centennial scale fluctuations of the AMOC. The atmospheric impact of the AMOC fluctuations is amplified through their effect on high-latitude sea ice cover – regions of positive upper ocean heat content lead to reduced sea ice cover, and a greatly enhanced flux of heat from the ocean to the atmosphere. The AMOC-induced temperature fluctuations drive changes in areal mean precipitation. Qualitatively similar variations appear in a 4000 year simulation of the GFDL CM2.1 model, although the amplitude in the high resolution model can be substantially larger.

Various proxy records around the Atlantic also indicate the existence of significant variations on the centennial to multi-centennial time scale.