Geophysical Research Abstracts
Vol. 14, EGU2012-3099, 2012
EGU General Assembly 2012

A 20th-century reanalysis forced ocean model to recover North Atlantic climate variability from 1870-2007

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The MPI ocean model MPIOM is forced with the NOAA 20th-century reanalysis to examine North Atlantic climate variability for the period 1870-2007. Ocean model results are compared with a gridded observational data base (CLISAP) for the later period (1950-2007, NCEP-period hereafter) and selected reconstructions for the earlier period (1870-1949, preNCEP-period).

During the NCEP-period the forced MPIOM provides coherent decadal variability of temperature and salinity in the North Atlantic compared with observations. The Labrador Sea water properties follow the observed shift during the 1960s and 1990s and reversal afterwards. Sea water properties within the sub-polar gyre also capture observed decadal variability. The modeled Atlantic meridional overturning circulation (AMOC) at 26°N exhibits a time-mean maximum of $\sim$17 Sv, which is within the current uncertainty range of the RAPID observations. During the first decades of the preNCEP-period sea water properties are substantially different compared to the NCEP-period. Salinity within the sub-polar gyre drops to -0.4PSU during from 1880-1910 and strongly increase afterwards. Similarly the AMOC strength is reduced to 12SV and increased to 17SV from the 1920s to the 1940s. This drop is found independent of the initialization of the forcing components suggesting responsible atmospheric forcing fields.

Examination of the atmospheric forcing fields yields a weakened pressure gradient and respective geostrophic flow component over the northern European area during the preNCEP period. In association a weaker heat transport is found towards the Arctic area with considerable lower temperatures during the preNCEP period than for the NCEP period. Sea ice thickness and extent is largely increased within the preNCEP period throughout the Arctic and the Nordic Seas. Consequently more sea ice is transported along the Greenland current exporting large amount of fresh water into the Irminger and Labrador Sea. This fresh water release is considered to affect the mean state of AMOC and water properties in the sub-polar gyre.