Geophysical Research Abstracts, Vol. 8, 08418, 2006
SRef-ID: 1607-7962/gra/EGU06-A-08418

Mechanisms and predictability of multidecadal and interannual variability in the North Atlantic Ocean

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The mechanisms that govern the variability and predictability of variations in the Atlantic Ocean's Thermohaline Circulation, and associated aspects of climate, are being studied using a coupled climate model, HadCM3. Analyses have been carried out on an unforced control integration of the model and also on "perfect ensemble" experiments, in which ocean initial conditions are fixed and ensembles are generated by taking different atmospheric initial states. These experiments were performed as part of the European Union Framework 5 project PREDICATE.

Analysis of the control integration data reveals two regions in the Atlantic Ocean where the decadal variability has large amplitude relative to interannual variability, suggestive of potential predictability. The regions are located a) in the Greenland Sea (around 20W-0; 72.5N-77.5N), and b) to the east of Newfoundland, associated with the North Atlantic Current front (around 50W-30W; 42N-52N). We find that on multidecadal to centennial timescales the sea surface temperature (SST) and salinity (SSS) time series in these two regions are in phase, while no significant surface correlations are found elsewhere. This finding suggests an oceanic rather than atmospheric teleconnection, and we find that variations in both regions are highly correlated with the Meridional Overturning Circulation (MOC) at a lag of 18 years.

On interannual timescales there is no significant correlation between the Greenland Sea and North Atlantic Current regions, but we find an intriguing 6-8 year periodicity visible in upper few hundred metres (about 300m) in the Greenland Sea region. Analyses reveal that this periodicity arises from a competition between advective/diffusive

and convective processes, associated with the interaction between cold fresh Arctic water and warm salty Atlantic water. Furthermore, fluctuations in this region are predictable several years in advance.