Geophysical Research Abstracts
Vol. 13, EGU2011-5182, 2011
EGU General Assembly 2011

An Interdecadal Oscillatory Eigenmode of the Atlantic Meridional Overturning Circulation in a realistic Ocean GCM

Florian Sévellec and Alexey Fedorov
Yale University, Department of Gelogy and Geophysics, New Haven, United States (florian.sevellec@yale.edu)

Variations in the strength of the Atlantic meridional overturning circulation (AMOC) are believed to be a major source of decadal and longer climate variability in the Atlantic. In this study, we analyze continuous integrations of linearized forward and adjoint versions of an ocean general circulation model (OPA 8.2) and rigorously show the existence in the system of an interdecadal, weakly-damped mode of oscillation centered in the North Atlantic and related solely to ocean dynamics. The period of the mode is approximately 25 years, its e-folding decay timescale is 40 years, and the mode surface manifestation is evident in the westward propagation of SST anomalies. The dynamics of the mode are related to temporal and spatial temperature variations in the in the upper 1000 m of the Atlantic ocean north of 30°N - these temperature variations affect the ocean density field and hence, by thermal wind balance, ocean currents which then affect the temperature field. Salinity variations tend to compensate the effect of temperature on density but, in general, have a smaller impact on the oscillation. Using a generalized stability analysis we show that the most efficient way to excite this mode is *via* the optimal (decadal) growth of initial perturbations in temperature and salinity that are localized off the east coast of Greenland and Canada. Because the system is non-normal, the structure of those perturbations is determined by the least damped mode of the adjoint system. We emphasize the importance of the background meridional temperature gradient in the North Atlantic both for the optimal perturbation growth and for the oscillatory mechanism of the interdecadal mode. The crucial role of the AMOC optimal perturbations for decadal climate prediction is discussed.