Geophysical Research Abstracts
Vol. 14, EGU2012-10074, 2012
EGU General Assembly 2012

Mechanisms of the North Atlantic multidecadal internal variability in the CNRM-CM5 model

Y. Ruprich-Robert and C. Cassou

CERFACS/CNRS, Climate Modelling and Global Change Team, 42 avenue Gaspard Coriolis, 31057 Toulouse, France (ruprich@cerfacs.fr)

To better assess the decadal predictability of the climate system, its internal variability is investigated here over the North Atlantic – Europe region at multidecadal timescale using the 1000-yr preindustrial control run (constant external forcings set to 1850) of the CNRM-CM5 model within the 5th Coupled Model Intercomparison Project framework. The model so-called Atlantic Multidecadal Variability/Oscillation (AMV/AMO) estimated from sea surface temperature (SST) anomalies is very close to observations both in terms of pattern and amplitude. A preferred timescale around 100yr dominates the model AMV and is found to be a damped mode of variability. We show that a strengthening of the Atlantic Meridional Overturning Circulation (AMOC) leads by about 5 years the maximum of AMV.

Enhanced AMOC is preceded by about 30 years by the so-called East Atlantic Pattern atmospheric circulation (negative anomalous pressure monopole located in the center of the North Atlantic basin) and/or the Scandinavian mode (see-saw between Greenland and Scandinavia). The anomalous atmospheric circulations force a northward oceanic heat transport intensification of the eastern branch of the subpolar gyre and through the Iceland-Faroe strait leading to an increase of heat transport between the subpolar gyre and the Norvegian sea. The concurrent subsurface and SST warming is advected along the Norvegian gyre and precludes sea ice formation along the eastern Greenland Coast leading to positive surface salinity anomalies due to enhanced local evaporation The latter is advected by the mean circulation along Greenland to the Labrador Sea where it drives deeper convection about 20-yr before a maximum of AMOC. By geostrophy, the subpolar gyre intensifies bringing extra heat and salt from its southern edge. The current anomaly gradually propagates backward along the Western boundary current (Gulf Stream etc.) up to the equator. Associated with a northward shift of the tropical Atlantic Inter-Tropical Convergence Zone (ITCZ) and predominant negative North Atlantic Oscillation atmospheric circulation. These all together product an increase of northward heat transport into the Atlantic ocean leading in fine to AMV maximum. This cycle takes about 30-40 years to build and is damped about 20 years later by negative salinity anomalies advected into the subpolar gyre from the western tropical Atlantic basin, due to ITCZ changes.