Abstract

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Title : « *North Atlantic Variability in an idealized coupled model: the Atlantic Multidecadal Oscillation*»

At multidecadal time-scales, the principal mode of variability in the North Atlantic is referred to as the AMO (*Atlantic Multidecadal Oscillation*). It is revealed by oceanic observations, but its origin remains unclear. Some studies describe the AMO as an oceanic mode forced by the atmosphere, while other studies describe the AMO as an intrinsic oceanic mode. This significant disagreement mainly results from the methods that are used by these different studies, i.e statistical analysis of observations and climate models data *vs.* idealized simulations and sensitivity experiments.

In this PhD thesis, we focus on mechanisms that drive the low frequency North Atlantic variability in a range of simulations. Three coupled configurations of the MITgcm are integrated, with horizontal resolution of 4°, 2° and 1° (in both the ocean and the atmosphere). The idealized oceanic geometry is a flat bottom, with two meridional boundaries that delimit a small basin, comparable to the Atlantic. All these three configurations reproduce a 30-40 year variability of the Atlantic MOC (*Meridional Overturning Circulation*), associated with large scale Rossby waves that travel across the small basin. This variability remains in ocean-only experiments. The North Atlantic oceanic variability in these simulations is then intrinsically driven.

Furthermore, increasing the horizontal resolution strengthen the ocean-atmosphere coupling, with a NAO (*North Atlantic Oscillation*) that becomes significantly correlated to the MOC two years latter at 1°. Such correlations are usually found in most climate models and observations. Some studies then infer that the oceanic variability is forced by the atmosphere. Nevertheless, our sensitivity experiments to ocean-atmosphere coupling highlight that correlations do not necessarily imply causality. These experiments provide a relatively simple and illustrating example. They show that significant lag correlations can be misleading for the identification of driving processes in the context of North Atlantic low frequency variability.

The intrinsic oceanic variability is investigated in terms of large scale baroclinic instabilities with two methods: a diagnostic approach (variance budget) and a prognostic approach (local stability analysis). The diagnostic approach aims to characterize the oceanic variability that develop in the non-linear model. The prognostic approach aims to identified the normal modes of the oceanic mean state, in the quasi-geostrophic framework. Taking into account the turbulent viscosity in the stability analysis increases the consistency with the non-linear model solutions. We finally interpret the origin of large scale Rossby waves that travel across the small basin, as a baroclinic instability of the eastern boundary.