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

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During the last century the long term trend of global temperature due to external factors appears to be modulated by interannual to multi-decadal internal variability. A pressing challenge for the climate community is to significantly reduce the forecast uncertainties for the next decades, that are associated with the latter. To do so, targeted simulations have been designed and consits in initializing the internal modes of the ocean to their best-estimated states in order to account for their evolution and their potential influence on near-future variability in addition to external forcings.

The present study takes place within this ongoing initiative kicked by CMIP5. Within a perfect model framework, we study the predictability of the North Atlantic - Europe multidecadal internal variability in the CNRM-CM5 model. We use the so-called pre-industrial control run (PiCTL, a 1000-yr long integration where all external forcings are kept constant to their estimated 1850 pre-industrial values) whose simulation of the Atlantic Multidecadal Variability (AMV) bears a strong resemblance to the observed one in terms of pattern and amplitude. We show that the model AMV is a multidecadal mode that is linked to AMOC variation and that is heavily damped with any hint of oscillation. We found that it is primarily exited by stochastic atmospheric forcings, its temporal characteristics being controlled by oceanic/sea-ice processes.

In order to assess and quantify the AMV predictability of the CNRM-CM5, we perform 4 ensemble simulations of 10 members, starting from 4 different dates of PiCTL corresponding to a given phase of AMOC/AMV or a specific phase transitions. All members within a given ensemble have the same oceanic initial state, but different atmospheric initial states taken randomly from PiCTL. We measure the predictability from the relative entropy diagnosis and find (1) that the North Atlantic potential predictability in the ocean reaches 10 to 30 years, depending on the initial starting states. (2) Only the ensemble simulation initialized from the negative phase of the AMV/AMOC, exhibits predictability of the European temperature up to ~10yr for the winter season and ~20yr for summer both in terms of mean and extremes diagnosed from daily data.