Importance of the seasonality of the ocean-atmosphere relationship to produce multidecadal natural AMV/AMOC variability.

The internal component of the North-Atlantic/Europe climate variability is investigated from a 1000-year simulation of the CNRM-CM5 model where external forcings are fixed to their 1850 values. The model Atlantic Multidecadal Variability (AMV) compares reasonably well to the observational estimates both in terms of spatial pattern and amplitude. Its preferred timescale is around 100 years but is not oscillatory.

We show that AMOC is a precursor for AMV. AMOC variability is forced by the winter atmosphere through the so-called East Atlantic pattern. For a positive phase of the AMV, the latter induces a spinup of the subpolar gyre (SPG) and a concomitant warming of Greenland-Iceland-Norwegian (GIN) Seas leading to sea-ice reduction. SPG salinity increases and deep convection intensifies in spite of progressive warming. Summer atmosphere response then acts as a relay to spread positive SST anomalies towards the subtropical basin.

The AMOC/AMV build-up takes about 30-40 years and is damped in about 20 years through two main processes. (i) Warmer North Atlantic drives a northward shift of the ITCZ that favours a negative phase of the winter and summer NAO just prior to multidecadal AMOC maxima. Both seasonal NAO-, (ii) combined to fresh water inflow through Fram strait, act as negative feedbacks for salinity in GIN seas and SPG while SST continues to rise leading to back-to-normal conditions for deep convection. (iii) ITCZ northward shift leads to negative salinity anomalies in the tropical surface and subsurface ocean that are advected to the SPG along the mean western boundary mean circulation.