Influence of AMOC variability on the atmospheric circulation in CCSM4

Claude Frankignoul[1], Guillaume Gastineau[1], and Young-Oh Kwon[2]

1: LOCEAN, University Pierre and Marie Curie, Paris, France,
2: Woods Hole Oceanographic Institution, Woods Hole, MA (yokwon@whoi.edu)

Feedback between the AMOC variability and atmospheric circulation is investigated in a 1300 year-long pre-industrial control simulation of the Community Climate System Model version 4 (CCSM4) using the lagged maximum covariance analysis (MCA). The feedback is strongest in winter. Positive phase of the winter North Atlantic Oscillation (NAO) is found to precede an AMOC intensification by a few years, while the negative NAO-like atmospheric circulation anomalies appear following the AMOC intensification by ~7 years. The negative NAO-like atmospheric response is driven by a meridional SST dipole with warming in the subpolar gyre and cooling near the Gulf Stream (GS)-North Atlantic Current (NAC). The meridional SST dipole alters the low-level baroclinicity near the storm track by shifting the maximum eddy growth southward. The SST anomalies originate from a deep circulation change. Cyclonic deep subpolar boundary currents accelerate in response to changes in the Nordic Sea overflows and interacts with surface currents to result in an equatorward shift of the GS-NAC path near the Tail of Grand Banks and also a poleward shift downstream near the Mid-Atlantic Ridge. A zonal SST dipole caused by the GS-NAC path shifts in the opposite directions subsequently becomes a meridional SST dipole as the downstream warm anomalies advect cyclonically in the subpolar gyre.