Multidecadal Variability of the Atlantic Meridional Overturning Circulation and Its Impact on the Atmospheric Circulation

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Feedback between the Atlantic Meridional Overturning Circulation (AMOC) multidecadal variability and atmospheric circulation is investigated in a 1300 year-long pre-industrial control simulation of the Community Climate System Model version 4 (CCSM4) primarily 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 an intensification of the subpolar gyre circulation and subsequent interaction between the enhanced equatorward deep currents and the GS-NAC near the Tail of Grand Banks and the western flanks of 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.