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C20C - Climate of the 20th Century: Mechanisms of the internally generated decadal-to-multidecadal variability in the Atlantic

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This study investigates the role of the weather noise in the low-frequency climate variability and predictability in the Atlantic in a 300 year 1990 control simulation (CONTROL) made with CCSM3. The structures, amplitudes and time scales of the Atlantic Multidecadal Variability (AMV), tripole variability and meridional mode Tropical Atlantic Variability (TAV) from CONTROL have properties similar to the observed variability, indicating that CCSM3 is appropriate for studying their mechanisms. These three modes are closely related to the variability of AMOC on decadal time scales. Specifically, the AMV lags AMOC by 4 years, the TAV lags the AMOC by 4-5 years, and the tripole variability is most correlated with AMOC at lag zero, suggesting that all of these types of variability may be manifestations of a single decadal "mode" of variability. The weather noise surface fluxes, including the net heat flux, wind stress and freshwater flux, are obtained from CONTROL by removing the SST forced surface fluxes, which are the ensemble mean surface fluxes from an ensemble of six CAM3 AGCMs forced by the CONTROL SST. The weather noise surface fluxes are then applied to the ocean model in an interactive ensemble version of CCSM3 (IE-CCSM3: 6 copies of CAM3 coupled to the POP OGCM through the flux coupler). The IE-CGCM simulation demonstrates that the weather noise is responsible for most of decadal variability in the Atlantic. The relative influences of the surface heat flux, wind stress, and fresh water flux are examined with IE-CCSM3 simulation, with emphasis on the roles of the ocean dynamics through the gyre and overturning circulations.