A study on the decadal mode of the internally generated Atlantic Multidecadal Variability in CCSM3

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Mechanisms of the decadal mode of the internally generated Atlantic Multidecadal Variability (AMV) are investigated in the Community Climate System Model version 3 with constant external forcing. The AMV index is decomposed into interannual, decadal and multidecadal modes based on the ensemble empirical mode decomposition. The AMV decadal mode (12-year mode) is examined in detail. The interactive ensemble (IE) coupling strategy, with an ensemble of atmospheric GCMs (AGCM) coupled to an ocean model, a sea-ice model and a land model, is used to diagnose the roles of various processes in the coupled GCM (CGCM). The noise components of surface heat flux, momentum flux and fresh water flux of the control simulation, determined from the CGCM surface fluxes by subtracting the SST-forced surface fluxes, estimated as the ensemble mean of AGCM simulations, are applied at the Atlantic Ocean surface of the IE in different combinations.
The North Atlantic Oscillation pattern in the atmosphere, dominated by the noise component, forces the AMV decadal mode through noise heat flux and noise momentum flux. The associated ocean dynamics are connected with both noise heat flux and noise wind stress, but the Atlantic Meridional Overturning Circulation related to the decadal mode is more likely to be forced by noise heat flux. The atmospheric response to SST, including the SST-forced heat flux and SST-forced wind stress, acts as a damping.

Keywords: Atlantic Multidecadal Variability, Decadal mode, Interactive ensemble CGCM

