Atmospherically-forced and ocean-driven interannual variability of the AMOC

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We investigate the origin and features of AMOC interannual to decadal (1-28 year) variability from a large (50 member) ensemble of global, eddy-permitting (1/4°) ocean-sea ice hindcasts. Each member is slightly perturbed in its initial conditions and driven by the same realistic atmospheric forcing over 1960–2015. The magnitude, scales, and patterns of atmospherically forced and intrinsic/chaotic interannual AMOC variability are characterized from the ensemble mean and ensemble spread, respectively. AMOC fluctuations north of 40°N are largely driven by atmospheric variability, which forces meridionally coherent fluctuations reaching decadal scales. The amplitude of chaotic (i.e. random) interannual AMOC variability reaches up to 100% of the latter around 35°S and 60% in the Northern midlatitudes. Chaotic AMOC variability exhibits a large-scale meridional coherence. An EOF analysis over the basin shows two large-scale leading modes that together explain 60% of the interannual chaotic variability. The first mode is likely excited by intrinsic oceanic processes in the Southern Ocean and affects latitudes up to 40°N; the second mode is mostly restricted to, and excited within, the northern midlatitudes. These features of chaotic intrinsic variability (intensity, patterns, random phase) are barely sensitive to the atmospheric evolution, and strongly resemble the ‘‘pure intrinsic’’ interannual AMOC variability that emerges in climatological simulations under repeated seasonal-cycle forcing. These results raise questions about the attribution of observed and simulated AMOC signals and about the possible impact of intrinsic signals on the atmosphere.