Session: C9 Poster: M98A

Cold-season atmospheric response to the natural variability of the Atlantic meridional overturning circulation

Guillaume Gastineau[†]; Claude Frankignoul; Young-Oh Kwon
[†] University Paris 6, France
Leading author: ggalod@locean-ipsl.upmc.fr

The influence of the natural variability of the Atlantic meridional overturning circulation (AMOC) on the atmosphere is studied in multi-centennial control simulations of seven global climate models, using Maximum Covariance Analysis (MCA). In all models, a significant but weak influence of the AMOC changes is found during the Northern Hemisphere cold-season, when the ocean leads the atmosphere by a few years. In all models but CCSM3, an intensification of the AMOC is followed by a negative phase of the North Atlantic Oscillation (NAO). For CCSM3, no atmospheric response is detected in the first half of the simulation when the AMOC is in an oscillatory state, but a positive NAO response is found when the AMOC variability has a red-noise like behavior. The signal amplitude is typically 0.5 hPa. It only explains about 10% of the yearly fluctuations of the NAO, but a larger fraction at lower frequencies. The negative NAO response seems to be primarily due to an increase of the heat loss along the North Atlantic Current (NAC) and the subpolar gyre associated with an AMOC-driven warming. Sea-ice changes appear to be less important. Stronger heating decreases and shifts southward the baroclinicity of the lower troposphere and the eddy activity in the North Atlantic storm track. This in turn drives an equivalent barotropic perturbation resembling a negative NAO. In the red-noise regime of the AMOC in CCSM3, the warming mostly occurs in the eastern portion of the NAC, which reinforces the storm track and shifts it northward, resulting in a positive NAO response. In the oscillatory regime, there is an additional cooling along the western part of the NAC and the storm track is only slightly weakened.