Atmospheric influence of the Atlantic Meridional Overturning Circulation

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The North Atlantic Oscillation (NAO) dominates the European and North American climate variability during the cold season, for time scales ranging from 10 days to several decades. At decadal time scale, the SST also has an influence, as a warming in the subpolar Atlantic Ocean leads to a negative NAO in winter. Such SST influence might involve the ocean dynamics, as climate models show that the Altantic meridional overturning circulation (AMOC) is followed by a supolar Atlantic basin warming accompanied by a similar atmospheric response. The atmospheric changes seem to be driven by the diabatic heat flux in the main eddy development region, over the Gulf Stream/North Atlantic current region. But the stratosphere or the tropical Atlantic SST forcing may also play an important role.
To further establish the causality links between the ocean and the atmosphere, ensembles of atmosphere-only simulations are designed. The atmospheric model simulations use prescribed SST and sea-ice anomalies that follow an intensification of the AMOC in the coupled model IPSL-CM5A-LR. We confirm that the main influence is due to warm subpolar Atlantic SST anomalies north of 30°N and the associated upward heat flux which are responsible for a decrease of the lower-tropospheric baroclinicity in the region of maximum eddy growth. But we also found that the positive sea-ice anomalies over the Arctic associated with a larger AMOC further amplify the atmospheric circulation anomalies, as they act to warm the stratosphere one month before the tropospheric circulation anomalies.

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