The AMOC in CMIP5 Models: RCP and Historical Simulations

We examine the AMOC simulated by ten CMIP5 models for the historical (1850-2005) and future climate. The historical simulations of the AMOC mean state are more closely matched to observations than those of the CMIP3. Similarly to CMIP3, all models predict a weakening of the AMOC in the 21st century, though the degree of weakening varies considerably between the models. Under RCP4.5 scenario, the weakening by year 2100 is 5%–40% of individual model's historical mean state; under RCP8.5, the weakening increases to 15%–60% over the same period. RCP4.5 leads to stabilization of the AMOC in the second half of the 21st century, and a slower (than weakening rate) but steady recovery thereafter, while RCP8.5 gives rise to a continuous weakening of AMOC throughout the 21st century.

In the CMIP5 historical simulations, all but one model exhibit a weak downward trend (ranging from −0.1 to −1.8 Sv/century) over the 20th century. Additionally, the multi-model ensemble mean AMOC exhibits multidecadal variability with a ~60-year periodicity and peak-to-peak amplitude of ~1 Sv; all individual models project consistently onto this multidecadal mode. This multidecadal variability is significantly correlated with similar variations in the net surface shortwave radiative flux in the North Atlantic, and with surface freshwater flux variations in the subpolar latitudes. Potential drivers for the 20th century multi-model AMOC variability, including external climate forcing and the North Atlantic Oscillation (NAO), and the implication of these results on the North Atlantic SST variability are discussed.