The AMOC's role in the changing relative importance of the North Atlantic and Southern Ocean in anthropogenic ocean heat uptake

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Anthropogenic aerosols increased rapidly over the past 70 years (mostly in the Northern Hemisphere) and are projected to decrease in the next few decades. In historical simulations over the twentieth century from phase 5 of the Coupled Model Intercomparison Project (CMIP5), the Southern Ocean (south of 30˚S) accounts for 72%±28% of global heat uptake, while the contribution from the North Atlantic north of 30˚N is only 6%. In the RCP4.5 (RCP8.5) scenario, in contrast, the percentage decreases to 52%±9% (48%±8%) in the Southern Ocean and increases to 28%±7% (26%±6%) in the northern North Atlantic due to different spatial distributions and trajectories of GHG and aerosol radiative forcing. Both GHGs and anthropogenic aerosols show remarkable impacts on heat uptake or loss over the northern North Atlantic. This intensive heat uptake (loss) in the northern North Atlantic is strongly associated with the ocean circulation change, specifically, the Atlantic Meridional Overturning Circulation (AMOC) in response to the anthropogenic radiative forcing. Comparing simulations with aerosol emissions fixed at the 2005-level and the RCP scenario from the Community Earth System Model (CESM), we show that the declining anthropogenic aerosols strongly affect the regional and global ocean heat uptake (OHU) in future projections due to the weakening AMOC. The results indicate that the dominance of the Southern Ocean in OHU over the instrumental historical era is likely to yield to increased relative contribution by the North Atlantic in the 21st century. We will discuss how the AMOC affects the changing relative importance in OHU between the North Atlantic and Southern Ocean, and the redistribution of OHU between the hemispheres in the future.