Mechanisms of aerosol-forced AMOC variability in a state of the art climate model

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Mechanisms of sustained multidecadal changes in the strength of the Atlantic Meridional Overturning Circulation (AMOC) are investigated in a set of simulations with a new state-of-the-art earth system model. Anthropogenic aerosols have previously been highlighted as a potential mitigator of AMOC weakening. In this study we explain the oceanic mechanisms behind how anthropogenic aerosols force a strengthening of the AMOC by up to 20% in our state-of-the-art earth-system model. This strengthening is driven via atmospheric circulation changes which subsequently modulate the salinity budget of the North Atlantic subpolar gyre. Gradual salinification occurs via increased evaporation and decreased fluxes of ice through the Fram Straits. A component of the salinification is a positive feedback from the AMOC bringing more saline water northwards from the subtropical Atlantic. Salinification of the subpolar gyre results in increased deep convection and a strengthening of the AMOC. Following a reduction in aerosol concentrations the AMOC rapidly weakens, approximately three times faster than in the case where anthropogenic aerosol concentrations had never been increased. Similarities and differences with available observational records and long term reanalysis products are also discussed.