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Contrasting future changes in the North Atlantic and Nordic Seas overturning circulations

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The Atlantic meridional overturning circulation (AMOC) carries warm and saline waters northwards near the surface and cold, dense waters southwards at depth. The northward branch of the AMOC terminates north of the Greenland-Scotland Ridge that separates the North Atlantic Ocean from the Nordic Seas and Arctic Ocean. Here, we use large ensemble simulations and CMIP6 models to show that future circulation changes in the subtropical North Atlantic (26.5°N) and in the Nordic Seas show contrasting behavior.

In a high emission scenario (SSP585), CMIP6 models show a gradual weakening of the subtropical AMOC. This weakening can be deconstructed by quantifying changes in the Gulf Stream, Deep Western Boundary Current (DWBC), and gyre recirculation (Asbjørnsen & Årthun 2023). By the end of the century, the Gulf Stream weakens by 29% and the DWBC weakens by 47%. The gyre recirculation component shows a weakening of 12%, indicative of a weakened subtropical gyre. 33% of the Gulf Stream weakening is due to changes in winds.

In contrast to the North Atlantic, the overturning circulation in the Nordic Seas increases throughout most of the 21st century as a result of changes in water mass transformation and horizontal circulation (Årthun et al. 2023). The increased Nordic Seas overturning is furthermore manifested in the overturning circulation in the eastern subpolar North Atlantic (OSNAP-East). A strengthened Nordic Seas overturning circulation could therefore be a stabilizing factor in the future AMOC.

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