EGU22-7340
https://doi.org/10.5194/egusphere-egu22-7340
EGU General Assembly 2022

Future increase in Nordic Seas overturning as a response to enhanced horizontal circulation

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The Atlantic meridional overturning circulation (AMOC) carries warm and saline water toward the Arctic. The North Atlantic is separated from the Arctic by the Nordic Seas. Here, the warm Atlantic inflow across the Greenland-Scotland ridge is gradually transformed by atmospheric heat loss and freshwater input as it travels along the rim of the Nordic seas and Arctic Ocean, leading to the formation of dense overflow waters that feed the lower limb of the AMOC. Recent studies have demonstrated an important role of ocean circulation and water mass transformation in the Nordic Seas for the large-scale North Atlantic circulation. Understanding future change in the Nordic Seas is therefore essential, but the impact of anthropogenic climate change on Nordic Seas circulation and overturning remains little explored.

Here we show, using large ensemble simulations and CMIP6 models, that in contrast to the overturning circulation in the North Atlantic, the Nordic Seas overturning circulation in density space shows no persistent decline in the future and is rather characterized by an increase between 2040 and 2100. This increase in Nordic Seas overturning can be explained by enhanced horizontal circulation within the interior of the Nordic Seas. The strengthened Nordic Seas overturning is furthermore found to influence overturning changes in the subpolar North Atlantic. This study thus provides evidence that the overturning circulation in the Nordic Seas could be a stabilizing factor in a weakening North Atlantic Ocean. These regionally dependent circulation changes in response to future climate change furthermore imply that current changes in the North Atlantic overturning should not be extrapolated to the Nordic Seas and Arctic Ocean.