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Arctic summer sea ice reduction projection: consequences for the hydrography

Anais Bretones, Kerim Nisancioglu, Mari Fjalstad Jensen, and Mehmet Ilicak
university of Bergen, Earth Sciences, Bergen, Norway (anais.bretones@uib.no)

The Arctic region is experiencing a rapid warming which endangers its sea ice cover, a key component of the deep Arctic Ocean. The summer sea ice has indeed shrunk significantly during the last decades and prediction forecast its acceleration. On the contrary, the winter sea ice has been spared so far.

The asymmetry between summer and winter sea ice reduction has been shown to feed back on the sea ice cover stability. Moreover, in a $2\times CO_2$ experiment with CCSM (Bitz et al. 2006), this type of phenomenon was suggested to be responsible for extending the Atlantic meridional overturning circulation into the deep Arctic Ocean. While the summer sea ice decreases, this kind of mechanism could then dampen the ongoing slowdown of the Atlantic meridional overturning circulation, slowdown that is expect to enhance the sea ice reduction. Similarly we would then expected the acceleration of the winter sea ice melting to put an end to this negative feedback.

We decide to work on a more realistic experiment forced with the RCP8.5 scenario and based on the CMIP6 recommendations. Although this experiment was ran with multiple models, we focus here on one of them, EC-Earth, to get a better understanding of the underlying dynamic accompanying the abrupt reduction. Ran from 1850 to 2300, EC-Earth forecasts an acceleration of the summer sea ice reduction leading to a summer ice free Arctic in 2060 whereas the winter extent only abruptly reduces in 2140. Do we also observe an enhancement of vertical convection in the Arctic Ocean contemporary with summer sea ice reduction, and can we link it with the Atlantic meridional overturning circulation? For how long will this feedback operate?

results: In EC-Earth, we observed a steady increase in winter brine rejection in the deep Arctic Ocean until 2060, when the Arctic Ocean becomes sea ice free during summers. This extra brine turned out to be mostly located in the Canadian archipelago but also on the Siberian Shelf, a key location for deep water formation. Although we did not see its signature in the water column there, it remains to be evaluated if the vertical mixing is enhanced on the Siberian shelf and if if feeds the Atlantic overturning cell.