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Atmospheric triggering of the warming of the North Atlantic subpolar gyre after 1995

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In the mid-90s, the North-Atlantic subpolar gyre has shown a dramatic warming that has been attributed to changes in the large-scale atmospheric variability. This warming has often been attributed to an abrupt change in the North-Atlantic Oscillation, from highly positive in 1995 to highly negative in 1996. However, decadal prediction experiments suggest that this warming is the signature of a delayed ocean response to the positive NAO conditions of 1988-1995.

Using four ocean hindcasts sharing the same modelling platform but using different forcings, resolutions, and parameterizations, the causes of the 1995 warming of the subpolar gyre are addressed. Heat budget calculations are performed in closed domains and the respective influences of surface heat fluxes and ocean heat convergence are separated. The novelty of this study is the further decomposition of the gyre into a western and an eastern part, the separation being provided by the Reykjanes and Mid-Atlantic Ridges.

Our results suggest that in the western subpolar gyre, which contains the Labrador and Irminger seas, the warming is due to a delayed spin-up of the meridional overturning circulation to the strong NAO+ conditions of 1988-1995, consistent with the decadal prediction experiments. In the eastern subpolar gyre, the warming is due to a fast, barotropic wind-driven change in ocean convergence due to the switch in the NAO of 1995. Hence, the separation of the subpolar gyre reconciles the literature about the 1995 warming of the subpolar gyre.