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Decadal variability of freshwater and heat content in the subpolar North Atlantic: the role of intergyre exchange processes

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Recent studies of ocean observations have advanced the hypothesis that an increased northward flow of subtropical Intermediate Water has added a large amount of salt to the eastern subpolar North Atlantic and the Nordic Seas during the the last decade. The advection of subtropical waters is not only suspected to have reversed the prominent freshening trend in the Subpolar Gyre during the 1960s to mid-1990s, but there is also some evidence for a conspicuous warming that has accompanied the salinification. Although there is some consensus about the coherence of this event with the state of the atmospheric forcing (NAO), only little is known about the physical mechanisms and its reverberation in the meridional net heat transport.

Using a global ocean sea-ice model, we show here that the decadal variability of both the subpolar freshwater and heat content for the period 1960-2000 can be mostly explained by the shallow meridional exchange of heat and salt with the subtropical North Atlantic. We corroborate the theory of a time dependent northward flow of warm haline water through the West European Basin; the model experiments show these meridional fluxes in the inter-gyre regime between 45°-50° to be governed primarily by changes in the wind stress curl. Due to the leading role of local forcing effects the meridional heat transport in this latitude band is not coherent with heat transport variability further south; in contrast to the subtropical North Atlantic, there is no close linkage between the heat transport and the meridional overturning circulation (MOC).