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Surface predictor of overturning circulation and heat content change in the subpolar North Atlantic

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In the North Atlantic, the northward transport of warm surface waters compensated for by the southward transport of cold deep water – the Atlantic Meridional Overturning Circulation (AMOC) – is tightly linked to the rates at which warm waters are being transformed into colder ones through buoyancy exchanges at the air-sea interface. The large-scale meridional heat transport associated with this transformation is a primary driver of temperature variability in the North Atlantic, and models have particularly suggested its important role in the warming (1993-2005) to cooling (2005-2017) reversal recently observed in the subpolar gyre. Here, we present a validation of those theoretical and model-based inferences on the AMOC thermodynamics and its impact on ocean temperature during 1993-2017 from a combination of ocean and atmosphere observational products. We find that surface-forced water mass transformation led AMOC variability at 45°N by 5 years and drove its 1993-2010 decline and the associated bi-decadal warming-to-cooling reversal of the upper ocean. We then build on the 5-year time-lag between surface-forced water mass transformation and AMOC variability to suggestively predict extreme AMOC intensities for the early 2020's and an upcoming new climatic reversal towards warming conditions in the subpolar gyre.