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Decadal predictions of the cooling and freshening of the North Atlantic in the 1960s and the role of ocean circulation

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In the 1960s North Atlantic sea surface temperatures (SST) cooled rapidly. The magnitude of the cooling was largest in the North Atlantic subpolar gyre (SPG), and was coincident with a rapid freshening of the SPG. Here we analyze hindcasts of the 1960s North Atlantic cooling made with the UK Met Office's Decadal Prediction System (DePreSys), which is initialised using observations. It is shown that DePreSys captures - with a lead time of several years - the observed cooling and freshening of the North Atlantic SPG. DePreSys also captures changes in SST over the wider North Atlantic and surface climate impacts over the wider region, such as changes in atmospheric circulation in winter and Sea Ice extent. We show that initialisation of an anomalously weak Atlantic Meridional Overturning Circulation (AMOC), and hence weak northward heat transport, is crucial for DePreSys to predict the magnitude of the observed cooling. Such an anomalously weak AMOC is not captured when ocean observations are not assimilated (i.e. it is not a forced response in this model). The freshening of the SPG is also dominated by ocean salt transport changes in DePreSys; in particular, the simulation of advective freshwater anomalies analogous to the Great Salinity Anomaly were key. Therefore, DePreSys suggests that ocean dynamics played an important role in the cooling of the North Atlantic in the 1960s, and that this event was predictable