

Historical analogues to the recently observed minima in the Atlantic meridional overturning circulation

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Recent observations of the Atlantic meridional overturning circulation (AMOC) revealed an anomalously low minimum over the winter of 2009/10. This minimum was substantially lower than any observed since the start of the 26°N array in April 2004. The pronounced 2009/10 minimum was followed by a second, slightly less severe and shorter minimum during the winter of 2010/11.

Output from numerical model experiments forced with observed surface fluxes and integrated to 2011 demonstrates that the model is able to reproduce the observed minima. We examine output from an ensemble of ORCA025 simulations integrated over the period 1958-2001 and identify several historical events which exhibit similar characteristics to the one observed by the 26°N array in the winter of 2009/10. There are instances of individual events, and two clear examples of pairs of events which happened in consecutive years. Individual events appear to be associated with negative phases of the North Atlantic Oscillation (NAO) which are mainly confined to the North Atlantic region. In contrast, the first event in pairs of consecutive MOC minima coincide with more widespread anomalous atmospheric conditions associated with a negative phase of the Arctic Oscillation (AO). In all cases the absolute minimum, which occurs in late winter to early spring, is associated with a short, sharp reduction in the Ekman component which accounts for around 1/2 to 2/3 of the signal. As in the observations the simulated AMOC minima are also reflected in the geostrophic transport. This is most clearly seen for the recent AMOC events in 2009/10 and 2010/11.