NATURE CLIMATE CHANGE | ARTICLE

Exceptional twentieth-century slowdown in Atlantic Ocean overturning circulation

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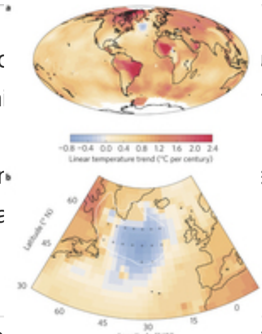
Abstract

Possible changes in Atlantic meridional overturning circulation (AMOC) provide a key source of uncertainty regarding future climate change. Maps of temperature trends over the twentieth century show a conspicuous region of cooling in the northern Atlantic. Here we present multiple lines of evidence suggesting that this cooling may be due to a reduction in the AMOC over the twentieth century and particularly after 1970. Since 1990 the AMOC seems to have partly recovered. This time evolution is consistently suggested by an AMOC index based on sea surface temperatures, by the hemispheric temperature difference, by coral-based proxies and by oceanic measurements. We discuss a possible contribution of the melting of the Greenland Ice Sheet to the slowdown. Using a multi-proxy temperature reconstruction for the AMOC index suggests that the AMOC weakness after 1975 is an unprecedented event in the past millennium ($p > 0.99$). Further melting of Greenland in the coming decades could contribute to further weakening of the AMOC.

Figure 1: Linear trends of annual surface temperature since AD 1901.

Change history

Corrected online 03 September 2015 In the version o[…]ublished, in Fig. 1 the data plotted were for the calendar month of December and not the annual mean data. Th[…] a new global temperature trend map for annual mean data, in which (due to the reduced variability of annual […]ly data) the cooling patch in the subpolar North Atlantic stands out even more. The first sentence of the caption[…]ended to: 'Linear trends of annual surface temperature since AD 1901'. None of the conclusions in the Article a[…]



Based on the temperature data of NASA GISS (ref. 48). **a**, Global equal area map (Hammer projection) for 1901–2013; white indicates insufficient data. **b**, Same analysis for the North Atlantic sector for 1901–2000. In addition to the observ…

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S.Rahmstorf conceived and designed the research and wrote the paper, E.J.S., S.Rutherford, A.R. and G.F. performed the research, M.E.M. and J.E.B. contributed materials/analysis tools and co-wrote the paper.

Competing financial interests

The authors declare no competing financial interests.

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Supplementary information

PDF files

1. Supplementary Information (1,047KB)

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