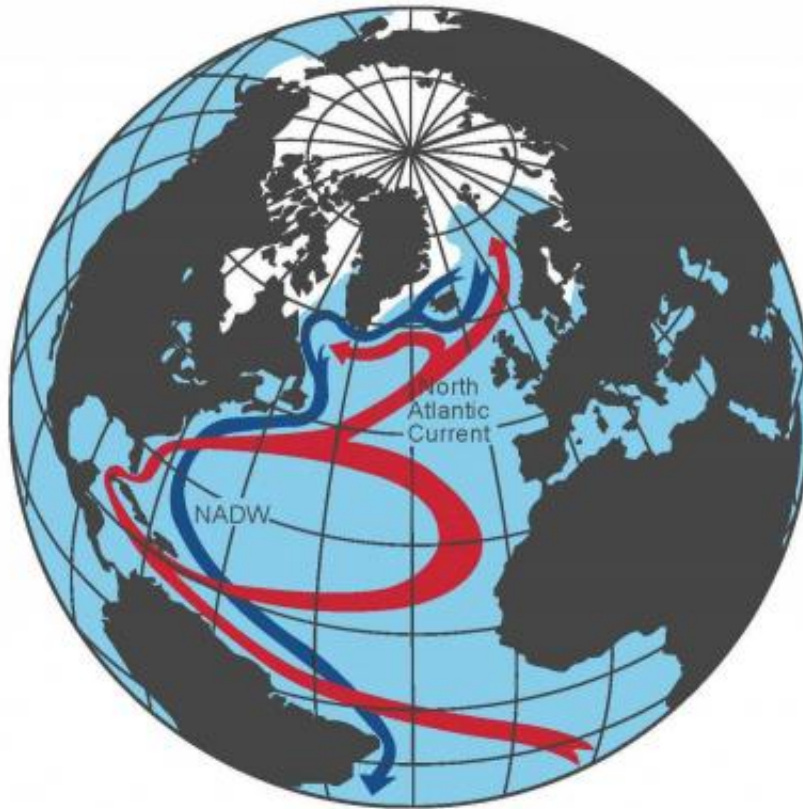


# Atlantic Ocean overturning found to slow down already today

March 23 2015

---



The Atlantic Conveyor -- a graph of the Atlantic Meridional Overturning Circulation. Credit: Stefan Rahmstorf/PIK

The Atlantic overturning is one of Earth's most important heat transport systems, pumping warm water northwards and cold water southwards. Also known as the Gulf Stream system, it is responsible for the mild climate in northwestern Europe. Scientists now found evidence for a slowdown of the overturning—multiple lines of observation suggest that in recent decades, the current system has been weaker than ever before in the last century, or even in the last millennium.

The gradual but accelerating melting of the Greenland ice-sheet, caused by man-made global warming, is a possible major contributor to the slowdown. Further weakening could impact marine ecosystems and sea level as well as weather systems in the US and Europe.

"It is conspicuous that one specific area in the North Atlantic has been cooling in the past hundred years while the rest of the world heats up," says Stefan Rahmstorf of the Potsdam Institute for Climate Impact Research, lead author of the study to be published in *Nature Climate Change*. Previous research had already indicated that a slowdown of the so-called Atlantic meridional overturning circulation might be to blame for this. "Now we have detected strong evidence that the global conveyor has indeed been weakening in the past hundred years, particularly since 1970," says Rahmstorf.

Because long-term direct ocean current measurements are lacking, the scientists mainly used sea-surface and atmospheric temperature data to derive information about the ocean currents, exploiting the fact that ocean currents are the leading cause of temperature variations in the subpolar north Atlantic. From so-called proxy data - gathered from ice-cores, tree-rings, coral, and ocean and lake sediments - temperatures can be reconstructed for more than a millennium back in time. The recent changes found by the team are unprecedented since the year 900 AD, strongly suggesting they are caused by man-made global warming.

## "The melting Greenland ice sheet is likely disturbing the circulation"

The Atlantic overturning is driven by differences in the density of the ocean water. From the south, the warm and hence lighter water flows northwards, where the cold and thus heavier water sinks to deeper ocean layers and flows southwards. "Now freshwater coming off the melting Greenland ice sheet is likely disturbing the circulation," says Jason Box of the Geological Survey of Denmark and Greenland. The freshwater is diluting the ocean water. Less saline water is less dense and has therefore less tendency to sink into the deep. "So the human-caused mass loss of the Greenland ice sheet appears to be slowing down the Atlantic overturning - and this effect might increase if temperatures are allowed to rise further," explains Box.

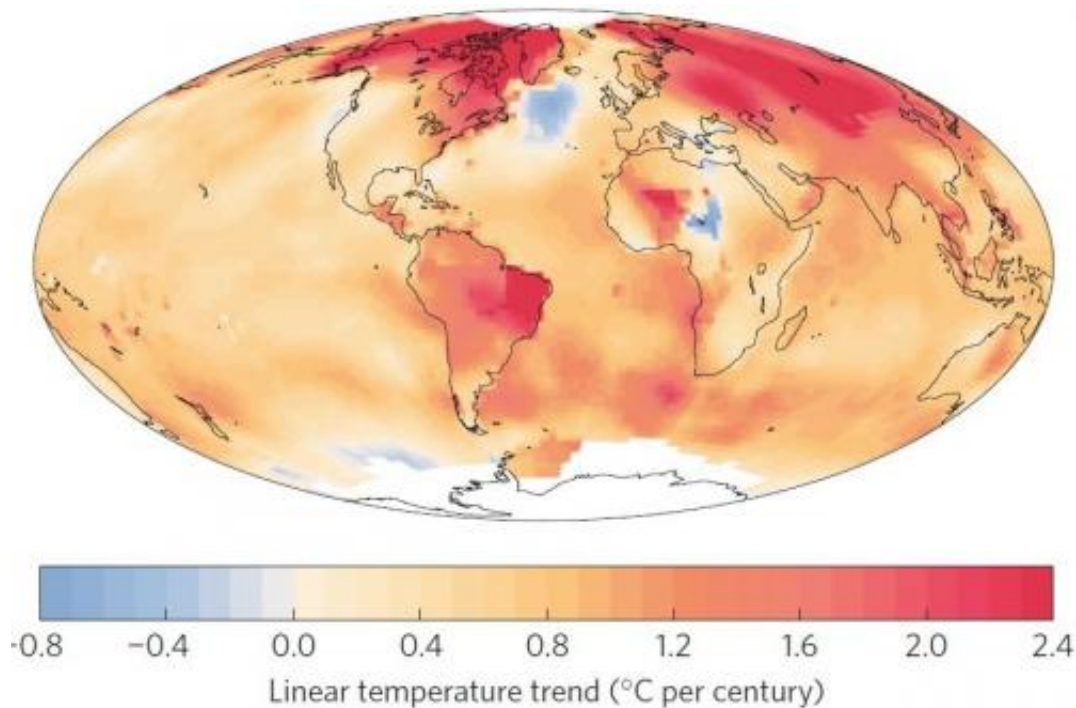


Figure 1 of the article by Rahmstorf et al (2015) shows linear trends of surface temperature for 1901-2013, based on the temperature data of NASA GISS

(white indicates insufficient data). Credit: Rahmstorf et al (2015)

The observed cooling in the North Atlantic, just south of Greenland, is stronger than what most computer simulations of the climate have predicted so far. "Common climate models are underestimating the change we're facing, either because the Atlantic overturning is too stable in the models or because they don't properly account for Greenland [ice sheet](#) melt, or both," says Michael Mann of Pennsylvania State University in the US. "That is another example where observations suggest that climate model predictions are in some respects still overly conservative when it comes to the pace at which certain aspects of [climate change](#) are proceeding."

## **No new ice-age - but major negative effects are possible**

The cooling above the Northern Atlantic would only slightly reduce the continued warming of the continents. The scientists certainly do not expect a new ice age, thus the imagery of the ten-year-old Hollywood blockbuster 'The Day After Tomorrow' is far from reality. However, it is well established that a large, even gradual change in Atlantic ocean circulation could have major negative effects.

"If the slowdown of the Atlantic overturning continues, the impacts might be substantial," says Rahmstorf. "Disturbing the circulation will likely have a negative effect on the ocean ecosystem, and thereby fisheries and the associated livelihoods of many people in coastal areas. A slowdown also adds to the regional sea-level rise affecting cities like New York and Boston. Finally, temperature changes in that region can also influence weather systems on both sides of the Atlantic, in North

America as well as Europe."

If the circulation weakens too much it can even break down completely - the Atlantic overturning has for long been considered a possible tipping element in the Earth System. This would mean a relatively rapid and hard-to-reverse change. The latest report by the Intergovernmental Panel on Climate Change (IPCC) estimates there to be an up to one-in-ten chance that this could happen as early as within this century. However, expert surveys indicate that many researchers assess the risk to be higher. The study now published by the international team of researchers around Rahmstorf provides information on which to base a new and better risk assessment.

**More information:** Rahmstorf, S., Box, J., Feulner, G., Mann, M., Robinson, A., Rutherford, S., Schaffernicht, E. (2015): Evidence for an exceptional 20th-Century slowdown in Atlantic Ocean overturning. *Nature Climate Change*, [DOI: 10.1038/nclimate2554](https://doi.org/10.1038/nclimate2554)

Study on possible impacts of a shutdown of the thermohaline circulation: [link.springer.com/article/10.1007%2Fs10584-009-9561-y](https://link.springer.com/article/10.1007%2Fs10584-009-9561-y)

Expert assessment of an AMOC tipping: [www.pnas.org/content/early/200.../0809117106.abstract](https://www.pnas.org/content/early/200.../0809117106.abstract)

Provided by Potsdam Institute for Climate Impact Research

Citation: Atlantic Ocean overturning found to slow down already today (2015, March 23) retrieved 20 March 2024 from <https://phys.org/news/2015-03-atlantic-ocean-overturning-today.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private
---

study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.