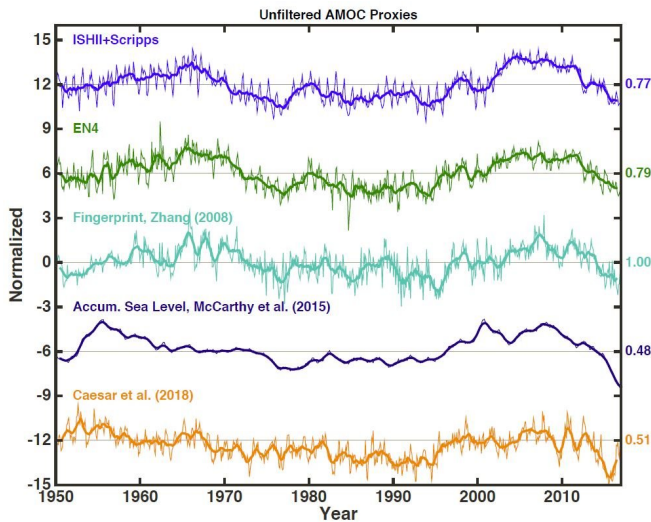


Atlantic circulation is not collapsing—but as it shifts gears, warming will reaccelerate

18 July 2018



These lines show different ways of gauging the strength of the Atlantic overturning circulation. Direct monitoring only began in 2004, so other oceanic measures are needed to extend the dataset back to 1950. Credit: Ka-Kit Tung/University of Washington

A huge circulation pattern in the Atlantic Ocean took a starring role in the 2004 movie "The Day After Tomorrow." In that fictional tale the global oceanic current suddenly stops and New York City freezes over.

While many aspects of the movie are unrealistic, oceanographers are concerned about the long-term stability of the Atlantic Ocean circulation, and previous studies show that it has slowed dramatically in the past decade. New research from the University of Washington and the Ocean University of China finds the slowdown is not caused by global warming but is part of regular, decades-long cycle that will affect temperatures in coming decades.

The paper was published July 19 in the journal *Nature*.

"Climate scientists have expected the Atlantic overturning circulation to decline long-term under [global warming](#), but we only have direct measurements of its strength since April 2004. And the decline measured since then is 10 times larger than expected," said corresponding author Ka-Kit Tung, a UW professor of applied mathematics with an adjunct appointment in atmospheric sciences.

"Many have focused on the fact that it's declining very rapidly, and that if the trend continues it will go past a tipping point, bringing a catastrophe such as an ice age. It turns out that none of that is going to happen in the near future. The fast response may instead be part of a natural cycle and there are signs that the decline is already ending."

The results have implications for [surface](#) warming. The current's speed determines how much surface [heat](#) gets transferred to the deeper [ocean](#), and a quicker circulation would send more heat to the deep Atlantic. If the current slows down, then it will store less heat, and Earth will be likely to see air temperatures rise more quickly than the rate since 2000.

"The global climate models can project what's going to happen long-term if carbon dioxide increases by a certain amount, but they currently lack the capability to predict surface warming in the next few decades, which requires a knowledge of how much the excess heat trapped by greenhouse gases is being absorbed by the oceans," Tung said.

The Atlantic Meridional Overturning Circulation, or AMOC, is a conveyor belt that brings surface water northward in the Atlantic; from there, the heavier salty water sinks and returns at depth from the Labrador and Nordic seas, near the North Pole, all the way south to the Southern Ocean. Most people are interested in what happens at the surface—the Gulf Stream and associated Atlantic currents carry warmer water north, bringing mild temperatures to Western Europe.

But the new paper argues that the most important step, from a climate perspective, is what happens next. In the North Atlantic, the saltier water from the tropics sinks almost a mile (1,500 meters). As it does, it carries heat down with it away from the surface.

When the current is faster, more of the warm, salty tropical water travels to the North Atlantic. Over years this causes more glaciers to melt, and eventually the freshwater makes the [surface water](#) lighter and less likely to sink, slowing the current.

When the AMOC is in a slow phase, the North Atlantic becomes cooler, ice melt slows, and eventually the freshwater melt source dries up and the heavier saltier [water](#) can plunge down again, which speeds up the whole circulation.

The new study argues that this current is not collapsing, but is just transitioning from its fast phase to its slower phase—and that this has implications for heating at the surface.

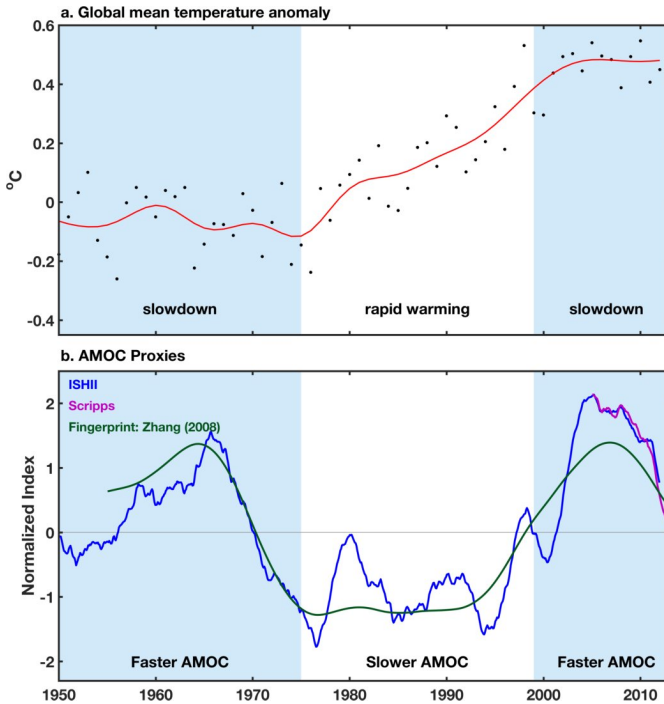
From 1975 to 1998, the AMOC was in a slow phase. As greenhouse gases were accumulating in the atmosphere, Earth experienced distinct warming at the surface. From about 2000 until now, the AMOC has been in its faster phase, and the increased heat plunging in the North Atlantic has been removing excess heat from the Earth's surface and storing it deep in the ocean.

"We have about one cycle of observations at depth, so we do not know if it's periodic, but based on the surface phenomena we think it's very likely that it's periodic," Tung said.

The new paper supports the authors' previous research showing that since 2000, during which observations show a slowdown in surface warming, heat has accumulated deep in the Atlantic Ocean. The new study shows this is the same period when Atlantic overturning circulation was in its fast phase.

Recent measurements of density in the Labrador Sea suggest the cycle is beginning to shift, Tung said. That means that in coming years the AMOC will no longer be sending more of the [excess heat](#) trapped by [greenhouse gases](#) deep into the North Atlantic.

"The good news is the indicators show that this slowdown of the Atlantic overturning [circulation](#) is ending, and so we shouldn't be alarmed that this current will collapse any time soon," Tung said. "The bad news is that surface temperatures are



The top panel shows global average surface temperature changes since 1950, with two periods of slower change and a period of rapid warming from 1975 to 2000. The lower panels show the strength of the Atlantic overturning circulation. The blue (and, on the right, purple) curve is the salinity north of 45N, an indirect measure, or proxy, for the AMOC strength. The green curve is an established proxy of AMOC. Credit: Ka-Kit Tung/University of Washington

Changes in the strength of the AMOC affect how much heat leaves our atmosphere. The new study uses a combination of data from Argo floats, ship-based temperature measurements, tidal records, satellite images of sea-surface height that can show bulges of warm water, and recent high-tech tracking of the AMOC itself to suggest that its strength fluctuates as part of a roughly 60- to 70-year, self-reinforcing cycle.

likely to start rising more quickly in the coming decades."

More information: Global surface warming enhanced by weak Atlantic overturning circulation, *Nature* (2018). DOI: [10.1038/s41586-018-0320-y](https://doi.org/10.1038/s41586-018-0320-y) , www.nature.com/articles/s41586-018-0320-y

Provided by University of Washington

APA citation: Atlantic circulation is not collapsing—but as it shifts gears, warming will reaccelerate (2018, July 18) retrieved 15 June 2021 from <https://phys.org/news/2018-07-atlantic-circulation-collapsingbut-shifts-gears.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.