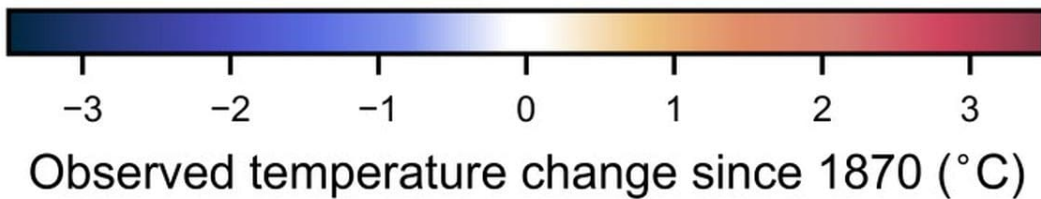
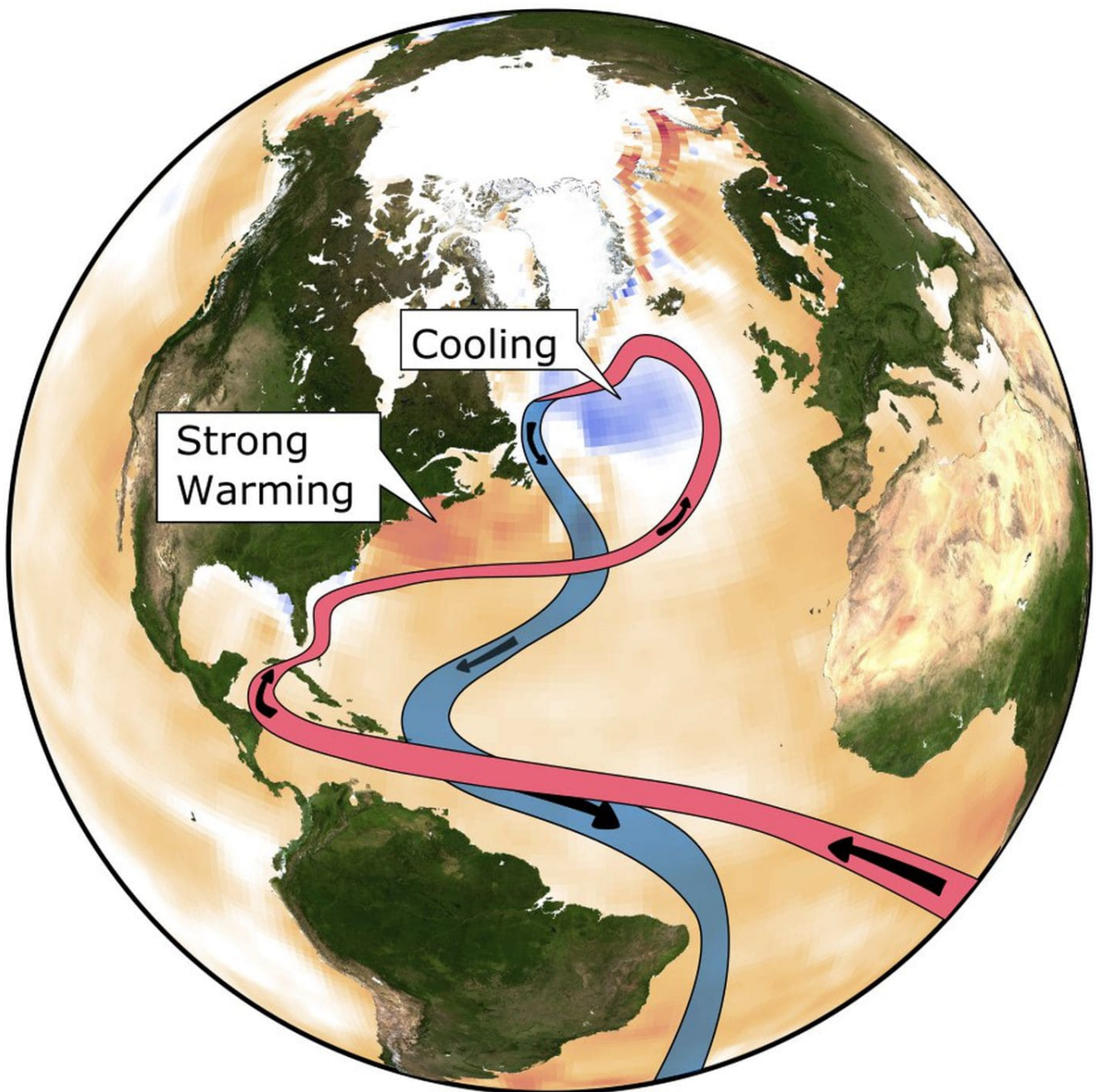


# The oceans' circulation hasn't been this sluggish in 1,000 years. That's bad news.

<https://www.washingtonpost.com/news/energy-environment/wp/2018/04/11/the-oceans-circulation-hasnt-been-this-sluggish-in-1000-years-thats-bad-news/>



(Levke Caesar/Potsdam Institute for Climate Impact Research)

The Atlantic Ocean circulation that carries warmth into the Northern Hemisphere's high latitudes is slowing down because of climate change, a team of scientists asserted Wednesday, suggesting one of the most feared consequences is already coming to pass.

The Atlantic meridional overturning circulation has declined in strength by 15 percent since the mid-20th century to a "new record low," the scientists conclude in a peer-reviewed [study published in the journal Nature](#). That's a decrease of 3 million cubic meters of water per second, the equivalent of nearly 15 Amazon rivers.

The AMOC brings warm water from the equator up toward the Atlantic's northern reaches and cold water back down through the deep ocean. The current is partly why Western Europe enjoys temperate weather, and meteorologists are linking changes in North Atlantic Ocean temperatures to recent summer heat waves.

Going Out Guide newsletter

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The circulation is also critical for fisheries off the U.S. Atlantic coast, a key part of New England's economy that have seen changes in recent years, with the cod fishery [collapsing](#) as lobster populations [have boomed](#) off the Maine coast.

Some of the AMOC's disruption may be driven by the melting ice sheet of Greenland, another consequence of climate change that is altering the region's water composition and interrupts the natural processes.

This is "something that climate models have predicted for a long time, but we weren't sure it was really happening. I think it is happening," said one of the study's authors, Stefan Rahmstorf of the Potsdam Institute for Climate

Impact Research in Germany. “And I think it’s bad news.”

The thermohaline circulation: The great ocean conveyor belt

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(NASA)

But the full role of climate change in the slowing ocean current is not fully understood, and another study released Wednesday drew somewhat different conclusions.

This study, which was also [published in the journal Nature](#), found that the AMOC has slowed over the past 150 years and similarly found that it is now weaker than at any time in more than a millennium.

“The last 100 years has been its lowest point for the last few thousand years,” said Jon Robson, a researcher at the University of Reading and one of the study’s authors. (The study’s lead author was David Thornalley of the University College London.)

The two studies have their differences: The second suggests the slowdown probably began for natural reasons around the time of the Industrial

Revolution in 1850, rather than being spurred by human-caused climate change, which fully kicked in later.

But like the first study, the second finds that the circulation has remained weak, or even weakened further, through the present era of warming.

“These two new papers do point strongly to the fact that the overturning has probably weakened over the last 150 years,” Robson said. “There’s uncertainty about when, but the analogy between what happened 150 years ago and today is quite strong.”

### **The AMOC amok?**

The AMOC circulation is just one part of a far larger global system of ocean currents, driven by differences in the temperature and salinity of ocean water. Warm surface waters flow northward in the Atlantic, eventually cooling and — because cold, salty water is very dense — sink and travel back southward at great depths. The circulation has thus been likened to a conveyor belt.

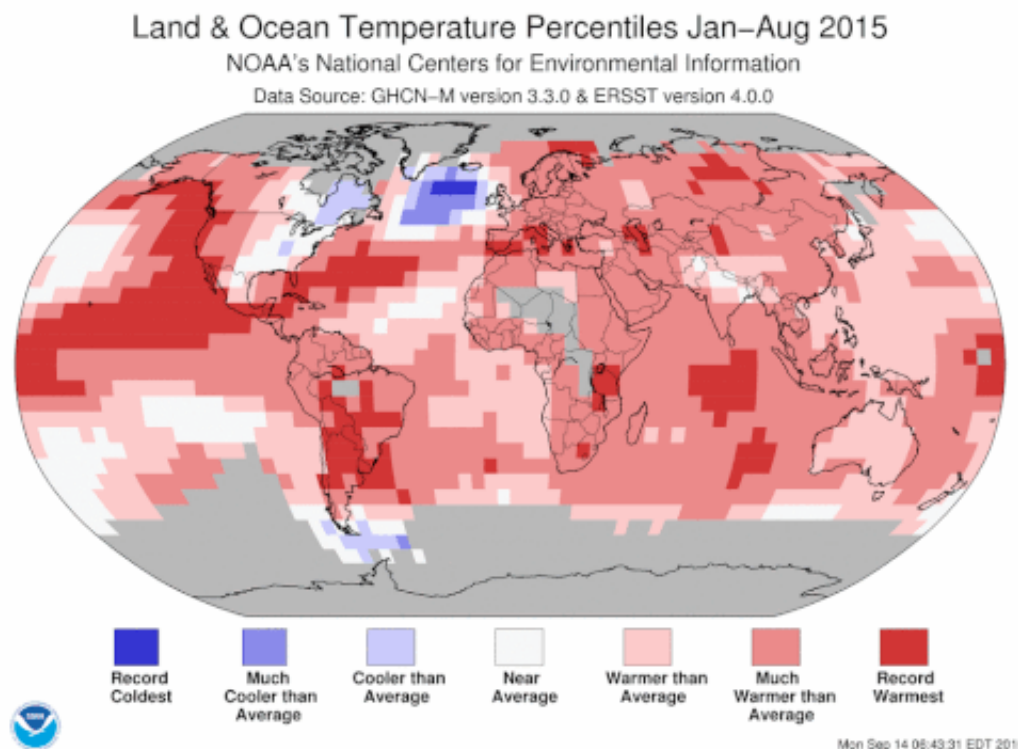
But the melting of Arctic sea ice and Greenland’s ice sheet can freshen northern waters and interfere with sinking. Recent research has in fact [confirmed](#) that meltwater from Greenland is lingering on the ocean surface, where it could be interrupting the circulation.

Direct [measurements of the circulation](#) are only a little over a decade old. And while those [have shown a downturn](#), that’s too short a time period to detect a definitive trend.

So the new studies sought to infer the state of the circulation from more indirect evidence.

In the first, the authors highlight a curious pattern of ocean temperatures that match what you would expect from a weakening AMOC — namely, a strong

warming off the coast of the eastern United States, paired with a cooling south of Greenland, which sometimes been called [the cold “blob”](#):



The cold “blob” was particularly pronounced in the first half of the year 2015. (NOAA)

The research finds that the odd alignment, which has produced regions of record cold and record warmth right next to one another, has been developing since the 1950s and closely matches what a [very high resolution climate model](#) predicted would occur.

The study was led by the Potsdam Institute’s Levke Caesar with along with co-authors at institutions in Germany, Greece, and Spain, as well as from the U.S. National Oceanic and Atmospheric Administration.

The second study, meanwhile, draws on sediment samples from the deep ocean off Cape Hatteras, N.C., to infer the strength of the current going back

well over a thousand years. Because a stronger current can carry thicker sand grains, the study was able to detect a weakening beginning around 160 or 170 years ago when the “Little Ice Age” in the Northern Hemisphere ended. That trend has then continued through the present.

“In terms of this initial drop in the AMOC, it’s very likely that’s a kind of natural process,” Robson said. “It’s very likely, based on other evidence, that human activities may have continued to suppress the AMOC, or maybe led to further weakening.”

### **Consistent, or contradictory?**

Meric Srokosz, an oceanographer at the National Oceanography Center in Britain, noted that the two studies have “somewhat different messages” — but emphasized that neither makes a direct measurement of the circulation.

“Essentially, what view you take of the results depends on how good you believe the models used are and likewise how well the chosen proxies represent the AMOC over the time scales of interest,” he said.

Marilena Oltmanns, an oceanographer at the GEOMAR Helmholtz Center for Ocean Research in Kiel, Germany, went further, saying that the two studies may not be entirely measuring the same thing.

“I think by applying different methods and looking at different time scales, the two studies focused on different components of the ocean circulation,” she said. “Both of them had to use some kind of approximation or proxy, which inevitably results in limitations and cannot give a complete picture.”

But Rahmstorf argued in an email that, given the difficulties and limitations involved in such work, “I think the overall agreement of the various independent estimates is very good!”

## Sharp changes off the coast of Maine



A lobster boat heads out to sea off Kennebunkport, Maine, at sunrise on Aug. 17, 2015. Fishermen in northern New England have been catching record numbers of lobsters, but south of Cape Cod, the lobster population has plummeted to the lowest levels ever seen, in a northward shift that scientists attribute in large part to the warming of the ocean. (Robert F. Bukaty/AP)

The authors of the first study believe the shift in the circulation may already having a big impact along the U.S. coastline.

“Of all the U.S. waters, this region has definitely warmed the fastest in the last decade,” said Vincent Saba, a marine biologist at the National Oceanic and Atmospheric Administration and one of its co-authors.

And that has had major effects on fisheries. The Gulf of Maine, for instance, has seen a giant boom in the local lobster industry and crash of the cod fishery.

“A lot of these changes are happening relatively fast, and our fisheries



management is unable to keep up,” Saba said. “We’re trying to figure out how to deal with some of these species shifts that we’re seeing.”

It’s not just fisheries: If the slowdown trend continues, it is expected to drive strong sea-level rise against the Eastern Seaboard. [Previous research](#) has already shown that from 2009 to 2010, sea level in the region suddenly shot up five inches, thanks in part to a brief slowdown of the circulation.

This occurs, Rahmstorf explains, because the northward flow of the Gulf Stream pushes waters to its right — which means that the ocean piles up against the coast of Europe. But as the current weakens, some of the water flows back toward the United States’ East Coast instead.

As for the future, Rahmstorf predicts the circulation will only weaken further as climate change advances. It may not be slow and steady: There is great fear that there may be a “tipping point” where the circulation comes to an abrupt halt.

This is one of the most infamous scenarios for abrupt climate change, as it is known: [Studies from the planet’s history](#) suggest that such a sudden change in the North Atlantic has occurred many times in Earth’s past, perhaps as recently as about 13,000 years ago. But it’s not clear how close the tipping point might be.

“I think in the long run ... Greenland will start melting even faster, so I think the long-term prospect for that ocean circulation system is that it will weaken further,” Rahmstorf said. “And I think that’s going to affect all of us, basically, in a negative way.”

**Read more at Energy & Environment:**

[Why the Earth’s past has scientists so worried about the Atlantic Ocean’s](#)

## [circulation](#)

### [Climate change is doing some very strange things to the waters off New England](#)

### [Why some scientists are worried about a surprisingly cold 'blob' in the North Atlantic Ocean](#)

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