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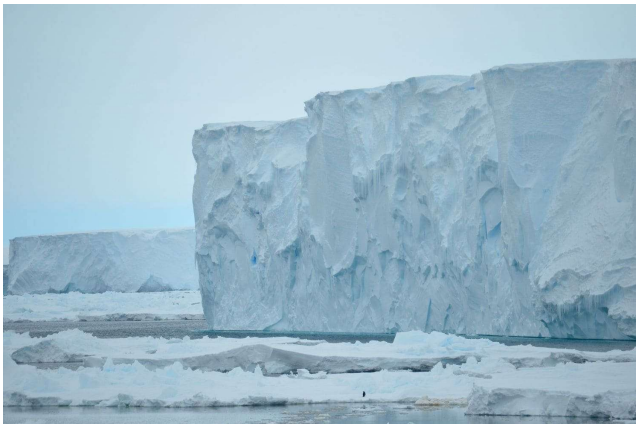
One of the most worrisome predictions about climate change may be coming true

by Chris Mooney April 23 at 12:33 PM Email the author



Mertz glacier in East Antarctica. (Alessandro Silvano)

Two years ago, former NASA climate scientist James Hansen and a number of colleagues laid out a dire scenario in which gigantic pulses of fresh water from melting glaciers could upend the circulation of the oceans, leading to a world of fast-rising seas and even superstorms.

Hansen's scenario was based on a computer simulation, not hard data from the real world, and met with skepticism from a number of other climate scientists. But now, a new oceanographic study appears to have confirmed one aspect of this picture — in its early stages, at least.

The new research, based on ocean measurements off the coast of East Antarctica, shows that melting Antarctic glaciers are indeed freshening the ocean around them. And this, in turn, is blocking a process in which cold and salty ocean water sinks below the sea surface in winter, forming "the densest water on the Earth," in the words of study lead author Alessandro Silvano, a researcher with the University of Tasmania in Hobart.

[An alarming 10 percent of Antarctica's coastal glaciers are now in retreat, scientists find]

This Antarctic bottom water has stopped forming in two key regions of Antarctica, the research shows — the West Antarctic coast and the coast around the enormous Totten glacier in East Antarctica.

These are two of Antarctica's fastest-melting regions, and no wonder: When cold surface water no longer sinks into the depths, a deeper layer of warm ocean water can travel across the continental shelf and reach the bases of glaciers, retaining its heat as the cold waters remain above. This warmer water then rapidly melts the glaciers and the large floating ice shelves connected to them.

In other words, the melting of Antarctica's glaciers appears to be triggering a "feedback" loop in which that melting, through its effect on the oceans, triggers still more melting. The melting water stratifies the ocean

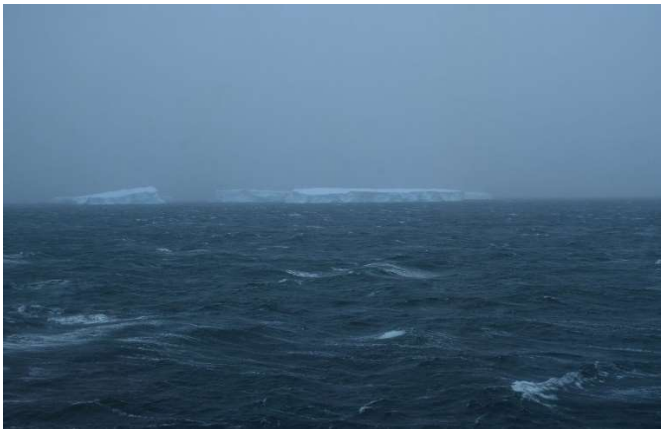
column, with cold fresh water trapped at the surface and warmer water sitting below. Then, the lower layer melts glaciers and creates still more melt water — not to mention rising seas as glaciers lose mass.

[Hot temperatures made these birds shrink]

"What we found is not only a modeling study but is something that we observed in the real ocean," said Silvano, who conducted the research in Science Advances with colleagues from several other institutions in Australia and Japan. "Our study shows for the first time actual evidence of this mechanism. Our study shows that it is already happening."

Hansen said that "this study provides a nice small-scale example of processes that we talk about in our paper."

"On the large-scale issue, it is too early to say how these feedback processes will play out, based on empirical evidence," Hansen said by email. "If we stay on business-as-usual [greenhouse gas] emissions rates, so that global warming continues to increase, I expect that the freshwater injection rate will increase (mainly via ice faster ice shelf breakup and underwater melt) and sea ice area will increase. This experiment will be playing out over the next years and decades."



A photo of Antarctic icebergs in December 2016. (Alessandro Silvano)

According to Matthew Long, an oceanographer at the National Center for Atmospheric Research, the study "is consistent with a large body of existing literature that shows warming and freshening of the deep ocean in the southern hemisphere."

"The fact that we see consistent warming and freshening indicates that the processes we expect to play out over the next century are already underway," Long said. "Indeed, this study is part of a growing body of evidence suggesting that the world's oceans are changing — and that the pace of change is beginning to accelerate."

If the process of Antarctic bottom water formation is being impaired, at least in some regions, then it would be a Southern Hemisphere analogue of a process that has already caused great worry and drawn considerably more attention — a potential slowdown of the overturning circulation in the North Atlantic Ocean, thanks to freshening of the ocean from the melting of Greenland.

[The shipping industry is finally going to cut its climate change emissions. That's a big deal.]

“Of those two key areas of deep water formation, the northern Atlantic one has been widely considered more vulnerable to global warming,” said Stefan Rahmstorf, a scientist at the Potsdam Institute for Climate Impact Research, who says he has found changes to the formation of dense deep water in the North Atlantic. “It is therefore of some concern that we now see increasing signs that the deep water formation around Antarctica is already being affected.”

Rahmstorf pointed to additional studies that also suggest Antarctic bottom water formation is changing. In one case, a 2017 study relying on measurements from the Southern Indian Ocean, where Antarctic bottom water travels after leaving the Southern Ocean, found that this deep water has been growing fresher over time, especially in the past decade.

One limitation with the current study, however, is that although the researchers have found that deep water is not forming in two key Antarctic regions, they cannot say when a change in these regions occurred. Measurements do not go back far enough for that, study author Silvano said. Thus, it’s possible that deep water formation in these regions shut off a long time ago, well before the modern period of intense climate warming. That would make it harder to pin current events on human-caused climate change.

Still, the mechanism detected by the study, in which freshening water from glaciers inhibits the sinking of colder waters at the surface, would presumably continue to apply.

Silvano said his main worry is that in addition to melting by the ocean, Antarctica could also start melting on its surface more if the climate warms further — leading to far more melt water forming in the ocean. So far, unlike in Greenland, this is mostly not happening in Antarctica. But it could.

Silvano also said that if the formation of Antarctic bottom water slows, the global consequences could be massive. The process buries heat and carbon dioxide deep beneath the ocean surface — without that process, the heat and carbon dioxide could remain in the atmosphere.

And then, there’s the problem of rising sea levels if the feedback between the ocean and the glaciers continues.

“The idea is that this mechanism of rapid melting and warming of the ocean triggered sea level rise at other times, like the last glacial maximum, when we know rapid sea level rise was five meters per century,” Silvano said. “And we think this mechanism was the cause of rapid sea-level rise.”

In the future, he said, “it’s possible that with global warming, some other areas of Antarctica will see a complete inhibition of bottom water formation, and then this feedback will kick off.”

Chris Mooney covers climate change, energy, and the environment. He has reported from the 2015 Paris climate negotiations, the Northwest Passage, and the Greenland ice sheet, among other locations, and has written four books about science, politics and climate change.