

The Gulf Stream is slowing down. That could mean rising seas and a hotter Florida

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The Gulf Stream, the warm current that brings the east coast of Florida the mixed blessings of abundant swordfish, mild winters and stronger hurricanes, may be weakening because of climate change.

Visible from the air as a ribbon of cobalt blue [water](#) a few miles off the coast, the Gulf Stream forms part of a clockwise system of currents that transports warm water from the tropics up the east coast and across the Atlantic to northwestern Europe. In the frigid [climate](#) near Greenland, the water cools, sinks and flows south again, rolling through the deep ocean toward the tropics.

This marine circulatory system has reached its weakest point in 1,600 years, recent studies show, having lost about 15% of its strength since the mid-20th century. Scientists disagree on whether climate change or natural cycles account for the slowdown. But a consensus has emerged that climate change will lead to a slower Gulf Stream system in the future, as melting ice sheets in Greenland disrupt the system with discharges of cold fresh water.

A weaker Gulf Stream would mean higher sea levels for Florida's east coast. It could lead to colder winters in northern Europe (one reason many scientists prefer the term climate change to global warming). And it could mean that a lot of the heat that would have gone to Europe would stay along the U.S. east coast and in Florida.

"If you slow down the sinking of water in the North Atlantic, that means you have a pileup of waters along the eastern seaboard of the United States and the Gulf of Mexico," said Brenda Ekwurzel, director of climate science for the Union of Concerned Scientists, an environmental group. "That means that you have increased regional sea level rise just from that ocean circulation change. So that's not good for New York City, Norfolk or along Florida."

"Your cooling mechanism to get that water to the north is slowing down," she said. "This slowing down of your natural air conditioning, by getting that hot water from the Gulf Stream flowing northward, means that you have that hotter water sticking around and not getting out of

your region as fast."

It's unclear the extent to which any weakening has reached the system's southern leg off Florida, also known as the Florida current. That current is driven partly by winds and partly by the pull from the sinking of cold water in the north. While less visible than beaches and sunshine, the current plays a powerful role in establishing Florida's identity.

"It's one of the things that makes fishing so good here, the ability of the Gulf Stream to bring in migratory fish," said R.J. Boyle, a well-known swordfisherman who runs a Lighthouse Point fishing store. "It's a funnel. We benefit because the Gulf Stream is so close to land. We catch swordfish, mahi-mahi, blue marlin and sailfish. The reason you catch all these fish in one area is because the Gulf Stream is here."

The Gulf Stream helps keep summers from getting too hot and winters from getting too cold. Its warm water provides a ready supply of fuel to hurricanes crossing its path.

The role of climate change in hurricanes is the subject of extensive scientific inquiry, with some research suggesting we may see fewer hurricanes, with the ones that do form tending to be stronger and rainier. A weaker Gulf Stream system could weigh in as a factor that reduces the number of hurricanes because it would tend to produce cooler water along the storms' Atlantic path.

"If the overall overturning circulation in the Atlantic Ocean weakens, in general it would mean overall generally weaker Atlantic hurricane seasons just because you tend to have cooler water and higher pressure in the deep tropics," said Philip Klotzbach, research scientist for Colorado State University's Tropical Meteorology Project. "So that would tend to reduce hurricane activity, all else being equal."

Counteracting the cooling influence on the Atlantic, in a warmer world, would be the tendency of oceans to be warmer in general.

A weaker Gulf Stream could lead to higher sea levels along the Florida coast. Sea level worldwide is currently rising at a rate of about one inch every eight years, partly because of melting ice sheets and partly because water expands as it warms. But for local sea level, an important role is played by currents.

"If the Gulf Stream strengthens, you can think of that sort of sweeping the water away from the coast more rapidly and that tends to suppress sea level," said Ben Kirtman, professor of Atmospheric Sciences at the University of Miami's Rosenstiel School of Marine and Atmospheric Science. "So a strong Gulf Stream is a good thing. And if the Gulf Stream weakens, just the opposite happens. It's not sweeping away the water as much, and so sea level rises. If the Gulf Stream weakens, it will exacerbate sea level rise."

Research into the fate of the Gulf Stream system, known as the Atlantic meridional overturning circulation, illustrates a broad truth about climate science. While there's a consensus that the climate is warming and that this is happening largely because of human activities, scientists disagree on the likely impacts.

No one knows how fast glaciers will melt or how much sea level will rise and how quickly this will happen. There's intense research into the potential impact on the frequency and strength of hurricanes and into the possible impact on plants, wildlife and human health.

With the Gulf Stream, scientists attempting to determine the role of climate change have to separate out natural factors, such as multi-decade temperature cycles in the Atlantic Ocean, that have strengthened or weakened the system for thousands of years.

"Detecting the climate change signal on top of the natural variability has really been a challenge," Kirtman said. "There are articles saying it's not weakening, articles saying it's weakening. There's a lot of debate about it. I think the scientific consensus is that the jury's still out."

A key piece of evidence for a possible weakening of the current is a strange patch of cold water—dubbed by scientists the "cold blob"—south of Greenland. While other parts of the earth have warmed, this area has cooled, and many scientists have concluded that this reflects a decline in the quantity of warm water reaching the area from the Gulf Stream.

"We see a cooling southeast of Greenland, although everywhere else on the globe you see a warming," said Levke Caesar, a scientist at the Potsdam Institute for Climate Impact Research in Germany and co-author of a study that found the current to be 15% weaker. "When the circulation slows down, we have less heat transport to that region."

Normally, the current is driven by the cooling of water as it travels to the northern part of the Atlantic. As water cools, it becomes denser and sinks. This pulls warm water from the south to replace it. But with climate change, melting glaciers and Arctic sea ice are overwhelming the system with fresh water, which is less dense and therefore less heavy than salt water, so less water sinks and less [warm water](#) is drawn from the south, disrupting the entire system.

Another study, published last year in the journal *Nature*, found the system to have reached its weakest point in 1,600 years, although it says the loss of strength probably began from natural factors.

The Fourth National Climate Assessment, published last November by a group of federal agencies, says there's insufficient data to conclude that the system has lost strength but says weakening over the next few

decades is "very likely."

Whatever the causes, the possibility of a slowdown has caused concern on both sides of the Atlantic. We don't think of Ireland, Great Britain and Germany as particularly warm countries, but they would be a lot colder without the Gulf Stream. Ireland, for example, stands as far north as polar bear habitat in Canada. But thanks partly to the Gulf Stream, water warmed by sunshine at the Equator flows up to Europe and moderates its temperatures.

"Gulf Stream slowing down is bad news for Ireland," reads a headline from The Irish Times.

Unlike other [climate change](#) phenomena, such as sea level rise, the collapse of the current could happen suddenly if it reaches a tipping point. Scientists think that has taken place in the distant past.

"It's also possible that this will happen in the future, but it's really difficult to say when," said Caesar, of the Potsdam Institute. "I think it's very likely that it won't happen in the next few decades. There are a few climate models that say it could happen."

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