Atlantic Ocean may get a jump-start from the other side of the world

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A key question for climate scientists in recent years has been whether the Atlantic Ocean's main circulation system is slowing down, a development that could have dramatic consequences for Europe and

other parts of the Atlantic rim. But a new study suggests help may be on the way from an unexpected source—the Indian Ocean.

Think of it as ocean-to-ocean altruism in the age of climate change.

The new study, from Shineng Hu of the Scripps Institution of Oceanography at the University of California-San Diego and Alexey Fedorov of Yale University, appears Sept. 16 in the journal *Nature Climate Change*. It is the latest in a growing body of research that explores how global warming may alter global climate components such as the Atlantic meridional overturning circulation (AMOC).

AMOC is one of the planet's largest water circulation systems. It operates like a liquid escalator, delivering warm water to the North Atlantic via an upper limb and sending colder water south via a deeper limb.

Although AMOC has been stable for thousands of years, data from the past 15 years, as well as computer model projections, have given some scientists cause for concern. AMOC has showed signs of slowing during that period, but whether it is a result of global warming or only a short-term anomaly related to natural ocean variability is not known.

"There is no consensus yet," Fedorov said, "but I think the issue of AMOC stability should not be ignored. The mere possibility that the AMOC could collapse should be a strong reason for concern in an era when human activity is forcing significant changes to the Earth's systems.

"We know that the last time AMOC weakened substantially was 15,000 to 17,000 years ago, and it had global impacts," Fedorov added. "We would be talking about harsh winters in Europe, with more storms or a drier Sahel in Africa due to the downward shift of the tropical rain belt,

for example."

Much of Fedorov and Hu's work focuses on specific climate mechanisms and features that may be shifting due to global warming. Using a combination of observational data and sophisticated computer modeling, they plot out what effects such shifts might have over time. For example, Fedorov has looked previously at the role melting Arctic sea ice might have on AMOC.

For the new study, they looked at warming in the Indian Ocean.

"The Indian Ocean is one of the fingerprints of global warming," said Hu, who is first author of the new work. "Warming of the Indian Ocean is considered one of the most robust aspects of global warming."

The researchers said their modeling indicates a series of cascading effects that stretch from the Indian Ocean all way over to the Atlantic: As the Indian Ocean warms faster and faster, it generates additional precipitation. This, in turn, draws more air from other parts of the world, including the Atlantic, to the Indian Ocean.

With so much precipitation in the Indian Ocean, there will be less precipitation in the Atlantic Ocean, the researchers said. Less precipitation will lead to higher salinity in the waters of the tropical portion of the Atlantic—because there won't be as much rainwater to dilute it. This saltier water in the Atlantic, as it comes north via AMOC, will get cold much quicker than usual and sink faster.

"This would act as a jump-start for AMOC, intensifying the circulation," Fedorov said. "On the other hand, we don't know how long this enhanced Indian Ocean warming will continue. If other tropical oceans' warming, especially the Pacific, catches up with the Indian Ocean, the advantage for AMOC will stop."

The researchers said this latest finding illustrates the intricate, interconnected nature of global climate. As scientists try to understand the unfolding effects of climate change, they must attempt to identify all of the climate variables and mechanisms that are likely to play a role, they added.

"There are undoubtedly many other connections that we don't know about yet," Fedorov said. "Which mechanisms are most dominant? We're interested in that interplay."

More information: Indian Ocean warming can strengthen the Atlantic meridional overturning circulation, *Nature Climate Change* (2019). DOI: 10.1038/s41558-019-0566-x , nature.com/articles/s41558-019-0566-x

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