Climate change disruption of Atlantic currents reaching dangerous tipping point

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A new study published by Utrecht University in the Netherlands warns that the "conveyor belt of the ocean" is approaching a tipping point due to climate change that would result in major environmental changes which would affect millions of people.

The Atlantic Meridional Overturning Circulation (AMOC) is a major system of currents throughout the Atlantic Ocean, spanning from the Labrador Sea just south of Greenland, to the Southern Ocean near Antarctica. It works by transporting large masses of warm water north at the surface of the ocean and moving cooler water south toward the bottom of the ocean.

Professor Matthew England at the University of New South Wales described the AMOC as "an overturning circulation that's been there and steady for thousands and thousands of years. And so, if it were to slow down or collapse, it would be a major disruption to our climate system." He is regarded by the Australian Academy of Science as "Australia's leading ocean modeler."

The northward flow of warmer water—which includes the Gulf Stream—is driven mostly by wind. But when it reaches the high latitudes of the Atlantic near Europe that water sinks to deeper layers of the ocean due to temperature loss and salinity increase. This sinking process is crucial to what is known as thermohaline currents, where the flow of ocean water is caused by differences in water density. If this sinking of water is interfered with, the entire AMOC system is at risk of slowing or even shutting down.

Climate change, caused by over a century and a half of fossil fuel greenhouse gas (GHG) emissions, results in processes that can severely disrupt that sinking process. Two major mechanisms that can cause this are increased rainfall and increased melting of ice sheets, both of which dilute the salt content of the ocean water. This decrease in salinity caused by climate change—as explained by ocean physics professor Stefan Rahmstorf from Potsdam University—"makes the water lighter and, therefore, unable to sink—or at least less able to sink—which, basically, slows down that whole engine of the global overturning circulation."

The dangerous impact of climate change on the AMOC has already been observed. As reported by the WSWS, study published in February 2021 using proxy indicators suggested that the AMOC was already in its weakest state in over a thousand years. Another study from 2021 by researcher Niklas Boers provided evidence that the AMOC was close to a critical transition from its strong to weak modes of circulation. Such a transition if it were to occur, would have "severe impacts on the global climate system."

While this is concerning enough, scientists have warned that in addition to the weakening trend of the AMOC, a "tipping point" could be reached that could rapidly result in major climate changes around the world. One research paper from 2022 explained: "Tipping points occur when change in part of the climate system becomes self-perpetuating beyond a warming threshold… leading to substantial and widespread Earth system impacts."

Put another way, and in the context of the AMOC, if the circulation strength is weakened beyond a critical threshold, those changes will become self-reinforcing by the AMOC itself, and lead to further drastic changes for multiple climate systems worldwide that will become increasingly more difficult to halt.

Until now, such a tipping point event for the AMOC has only been modelled using idealised climate models. Such models, while still a vital tool in modern climate science, do not generally consider many of the

complexities and interactions between different climate systems. Therefore, there was plausible doubt until now in the scientific community as to whether a tipping point was merely a theoretical concept, and that perhaps if more complex data was included in these projections, a future tipping point for the AMOC may not be a likely occurrence.

The new study, published in *Science Advances* on February 9, addresses this concern by using the Community Earth Systems Model (CESM) for the first time to perform a "targeted simulation to find an AMOC tipping event." This type of model—sometimes referred to as a global climate model (GCM)—is better able to capture the complexity of the Earth's climate by using high-resolution simulation of the various systems that comprise it, such as the atmosphere, oceans and land. The model also accounts for the interactions between these systems, allowing for more holistic representations of the climate to project the likelihood of an AMOC tipping point event.

The grim results show that taking into account the intricacies and complexities of various climate systems, the Earth is heading for a AMOC tipping point. As explained by one of the study's authors, Rene M. van Westen said: "We are approaching the tipping point, but we cannot deduce the distance to the tipping point."

The researchers outline an early warning system for an AMOC collapse, based on fresh water-induced overturning sensitivity (FovS). Defined in the study as "the minimum of the AMOC-induced freshwater transport at 34°S in the Atlantic," this observable quantity decreases as the circulation system weakens. The report notes that currently the FovS is already at a negative value, and is trending further downward, indicating that the AMOC is on course for a tipping point.

Referencing the FovS value, van Westen stated: "We know under climate change that this AMOC will gradually weaken and this parameter will become more negative, so it will destabilize the AMOC further."

The authors warn that one major effect of such a tipping point would be rapid cooling in the northern hemisphere, particular in Europe. This could be as drastic as 3 degrees Celsius of cooling per decade for Europe. The authors note that "no realistic adaptation measures can deal with such rapid temperature changes under an AMOC collapse."

A study from 2021 warned that AMOC shutdown would result in harsher winters in the United States. If a tipping event is reached, the US is likely to see more events similar to the freezing temperatures of December 2022, which, as the WSWS reported, resulted in at least 57 deaths.

No doubt right-wing media outlets will seize on such events to further spew climate denial nonsense, as Fox Business host Larry Kudlow recently did. "What about all the subfreezing, subzero record temperatures we're talking about?" he asked. "The immediate danger from global warming is a hoax."

In fact, scientists have explained that, counterintuitively, increasing global average temperatures can lead to harsher and more extreme winters in the northern hemisphere. This is due to the warming of the Arctic, which can weaken the polar vortex stream and send cold air south into Europe and the US. The current study provides another mechanism in which climate change can lead to harsher winters—the breakdown of the AMOC.

The study also projects that under an AMOC collapse, drastic changes to the rainfall patterns in the Amazon rainforest are likely, to the extent that the wet and dry seasons in the region may even reverse. This could potentially lead to further cascading tipping points.

The warnings issued by scientists about the dire effects of climate change on humanity have been ignored by governments and fossil fuel corporations around the world for decades now. The impending AMOC tipping point is one such warning.

The immediate halting of GHG emissions from fossil fuel operations is necessary to stave off the climate catastrophes. Such action can be achieved only with the overthrow of the capitalist profit system that has created and perpetuated these disasters.