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How close is the tipping point?

New studies on the Atlantic current system

With a new publication in the scientific journal Nature Climate Change, climate researchers from Kiel and Warnemünde once again contribute to the understanding of changes in the Atlantic Meridional Overturning Circulation (AMOC) – also known as the “Gulf Stream System”. It is important both for the global climate as well as for climate events in Europe. The authors focus on the question, whether human-induced climate change is already slowing down this global oceanic circulation. According to the study, natural variations are still dominant. Improved observation systems could help detect human influences on the current system at an early stage.

Is the Atlantic Meridional Overturning Circulation (AMOC) slowing down? Is this system of ocean currents, which is so important for our climate, likely to come to a halt in the future? Are the observed variations a natural phenomenon or entirely caused by human-induced climate change?

Using observational data, statistical analyses and model calculations, a joint research team from GEOMAR Helmholtz Centre for Ocean Research Kiel and the Leibniz Institute for Baltic Sea Research Warnemünde (IOW) led by GEOMAR climate expert Mojib Latif has examined changes in the current system over the past one hundred years in great detail. The results have now been published in the scientific journal *Nature Climate Change*. According to the researchers, part of the North Atlantic is cooling – a striking contrast to the majority of ocean regions. All evaluations indicate that since the beginning of the 20th century, natural fluctuations have been the primary reason for this cooling. Nonetheless, the studies indicate that the AMOC has started to slow down in recent decades.

“The AMOC provides Europe with a mild climate and regulates seasonal rainfall patterns in many countries around the Atlantic. If it weakens over the long term, this will also affect our weather and climate. Other consequences could be a faster rise in sea levels at some coasts or a reduction in the ocean’s ability to take up carbon dioxide and mitigate climate change”, explains Mojib Latif, Head of the GEOMAR research unit ‘Marine Meteorology’. “We depend on the AMOC in many ways – but so far, we can only guess how it will develop, and whether and how strongly we humans ourselves will push it towards a tipping point where an unstoppable collapse will take its course.”

Climate models consistently predict a significant slowing of the current system in the future as carbon dioxide emissions continue to rise, the ocean continues to warm, and the melting of the Greenland ice sheet accelerates. “Our study, however, provides additional evidence that internal climate variability played a significant role in climate changes since 1900 and also highlights a wide range of plausible future climate trends,” co-author and IOW physical oceanographer Hadi Bordbar points out. “But the question remains, how long we will remain in the realm of natural variability and when climate change will take control of the AMOC. Then the trend would only be in the direction of weakening and risks could increase significantly,” GEOMAR meteorologist an co-author Jing Sun adds.



Better observational data are needed to determine the critical limit, the authors conclude. “At the moment, we do not see any clear signs that the system is slowing down dramatically – rather, it is fluctuating. But since the latest climate models agree that a significant reduction will occur, we should know how much longer we are on the relatively safe side of natural change,” sums up Martin Visbeck. The head of the research unit Physical Oceanography at GEOMAR is also co-author of the new publication.

Original publication: Latif, M., Sun, J., Visbeck, M., Bordbar M. H. (2022): Natural variability dominates Atlantic meridional overturning since 1900. Nature Climate Change, [doi 10.1038/s41558-022-01342-4](https://doi.org/10.1038/s41558-022-01342-4)

Scientific contact at the IOW:

Dr. M. Hadi Bordbar | Tel.: +49 (0)381 – 5197 148 | hadi.bordbar@io-warnemuende.de
Leibniz Institute for Baltic Sea Research Warnemünde, Germany

Contact to the IOW press officers:

Dr. Kristin Beck | phone: +49 381 – 5197 135 | kristin.beck@io-warnemuende.de
Dr. Barbara Hentzsch | phone: +49 381 – 5197 102 | barbara.hentzsch@io-warnemuende.de

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