Setting up an alarm system in the Atlantic Ocean

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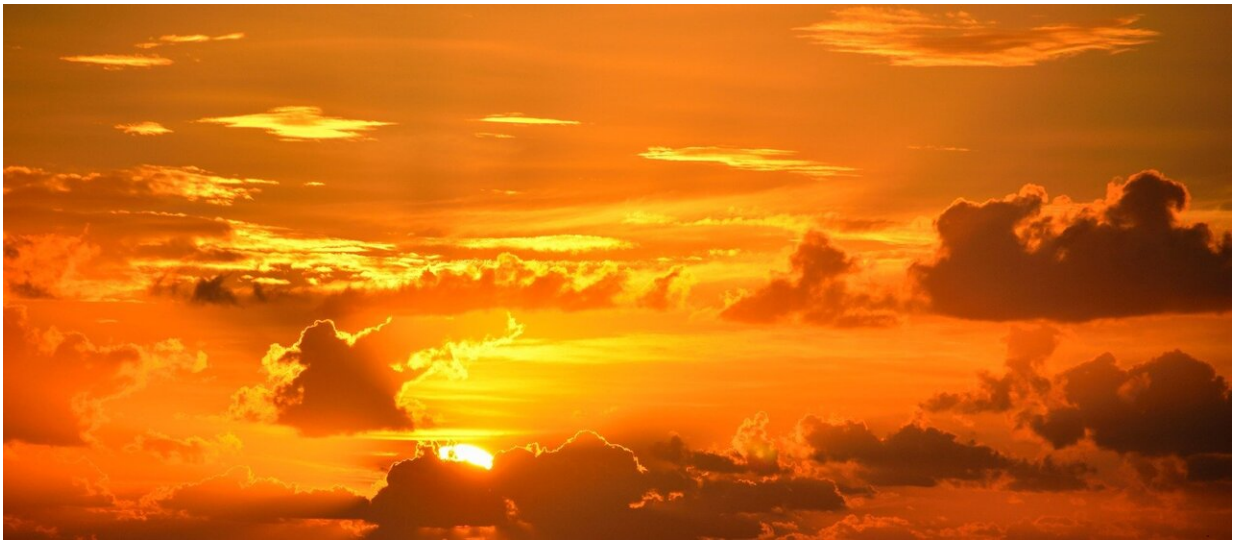

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Climate scientists Laura Jackson and Richard Wood from The Met Office, UK have identified metrics that may give us early warnings of abrupt changes to the European Climate. The work is part of the EU Horizon 2020 TiPES project which is coordinated by the Niels Bohr Institute at the University of Copenhagen, Denmark.

An important goal in climate science is to establish early warning systems—a climate alarm device, one might say—for abrupt changes to the system of sea currents in the Northern Atlantic Ocean.

These currents, known as the Atlantic meridional overturning circulation (AMOC) includes the Gulf Stream which transport upper ocean waters northwards in the Atlantic. Here, they get colder and denser and then sink. In the process, the AMOC transports heat to the coasts of North Western Europe, keeping the continent much warmer than comparable landmasses on the same latitudes.

From the study of past climates, it is well documented that large and sudden changes of temperatures have occurred in and around the North Atlantic. This is thought to be caused by the AMOC shifting abruptly between stronger and weaker states by passing over tipping points.

A collapse of the AMOC in the next century is considered unlikely, but since it would have big impacts on society we need to be prepared to identify signals of tipping in time to mitigate or prepare for abrupt shifts in the AMOC.

One question to answer in that line of work is, Which metrics should trigger the alarm system?

The scientific paper "Fingerprints for early detection of changes in the AMOC" now contributes to the clarification of this important question. The study is based on climate simulations and published in *Journal of Climate* by Laura Jackson and Richard Wood, The Met Office, UK as part of the European Horizon 2020 TiPES project.

"We show, that using metrics based on temperatures and densities in the North Atlantic in addition to continuing to directly monitor the AMOC can improve our detection of AMOC changes and possibly even provide an early warning," explains Laura Jackson.

The authors also conclude that using multiple metrics for monitoring is important to improve detection.

Two systems directly monitor the AMOC. The RAPID array runs from the Florida Strait to the west coast of Northern Africa. The OSNAP array spans from Labrador in Canada to the tip of Greenland on to the west coast of Scotland. There are also current observing systems in place which allow the temperature and density metrics to be monitored.

"Still, it is difficult from these measurements to tell whether a change in the AMOC is from natural variability that takes place across decades, from a gradual weakening because of anthropogenic climate change, or from crossing a tipping point," says Laura Jackson.

In other words, neither is the alarm fully developed, nor does anyone today know exactly which kind of changes to expect, should it go off.

More science is needed. One step in the right direction will be the evaluation of the available metrics in competing climate models to estimate the robustness of the results from the current work.

More information: L. C. Jackson et al, Fingerprints for Early Detection of Changes in the AMOC, *Journal of Climate* (2020). DOI: 10.1175/JCLI-D-20-0034.1

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