Marine scientists are decoding the mechanism for long-term climate fluctuations in the Atlantic

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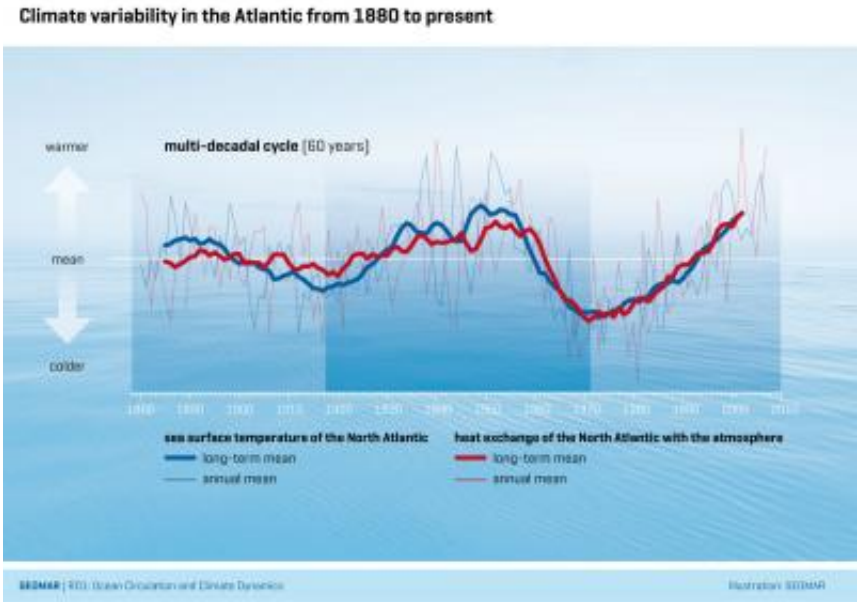


This shows time series of the sea surface temperature (blue) and the heat flux (red) in the North Atlantic from 1880 to 2010. Credit: C. Kersten, GEOMAR.

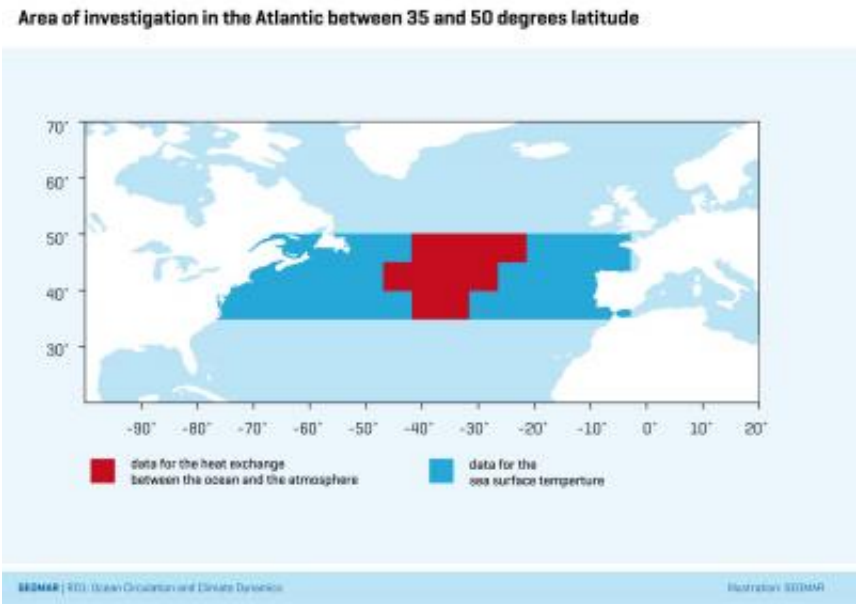
Why does hurricane activity vary from decade to decade? Or rainfall in the Sahel region? And why are the trans-Atlantic changes frequently in sync? A German-Russian research team has investigated the role of heat exchange between ocean and atmosphere in long-term climate variability in the Atlantic. The scientists analyzed meteorological measurements and

sea surface temperatures over the past 130 years. It was found that the ocean significantly affects long term climate fluctuations, while the seemingly chaotic atmosphere is mainly responsible for the shorter-term, year-to-year changes. The study appears in the current issue of the prestigious journal *Nature*, and provides important information on the predictability of long-term climate fluctuations.

How do the ocean and atmosphere communicate? What information do they exchange, and what are the results? These are questions that climate scientists must ask, especially if they want to understand the cause of natural climate fluctuations of varying duration. These fluctuations superimpose the general global warming trend since the beginning of industrialization and thus complicate the accurate determination of human influence on the climate. The causes and mechanisms of natural climate variability, however, are poorly understood. A study led by scientists at the GEOMAR Helmholtz Centre for Ocean Research Kiel shows that the ocean currents influence the heat exchange between ocean and atmosphere and thus can explain climate variability on decadal time scales. The study, which appears in the current issue of the renowned journal *Nature*, also references the potential for predicting such phenomena.

The presumption of such predictability potential has been around for more than half a century. In 1964, the Norwegian climate researcher Jacob Bjerknes postulated different causes of climate variability on different time scales. While the atmosphere is mainly causing climate variations on shorter time scales, from months to years, the longer-term fluctuations, such as those on decadal time scales, are primarily determined by the ocean. The first part of this hypothesis has been well studied by now, but the second part still required some verification. "In the current study, we can utilize a new analysis of shipboard measurements, taken since the end of the 19th century, to verify the second part of the Bjerknes hypothesis," says Prof. Mojib Latif of

GEOMAR, co-author of the study. "In particular, for the long-term climate variability in the Atlantic sector, the Gulf Stream circulation is of vital importance," said Latif.



This shows the North Atlantic region, dark blue area was used for temperature data, red area for the heat flux. Credit: C. Kersten, GEOMAR.

Ocean currents affect the surface temperature of the oceans and thus the heat exchange with the atmosphere - eventually causing climate variations on the adjacent continents. The most evident is an oscillation with a period of 60 years. "Such decadal climate fluctuations are superimposed on the general warming trend, so that at times it seems as if the warming trend slowed or even stopped. After a few decades, it accelerates once again," explains Prof. Latif. "It is important for us to understand these natural cycles, so that we can finally provide better climate predictions as well." One of the major problems, as Latif explained, is that there are just very few long-term oceanic

measurements, thereby complicating the analysis and interpretation of climate change signals. Therefore, scientists are using increasingly refined statistical methods to extract more and more information from the available data sets.

"We need both, realistic model simulations and long-term data records, and really sophisticated analysis methods to produce reliable climate predictions. Our work is an additional piece in the giant puzzle of global climate variability, but I am confident that we will be able to extract the secrets underlying the natural climate fluctuations," says Prof. Latif.

More information: *Nature*, 499, 464-467. doi: 10.1038/nature12268

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