Ocean circulation in North Atlantic at its weakest

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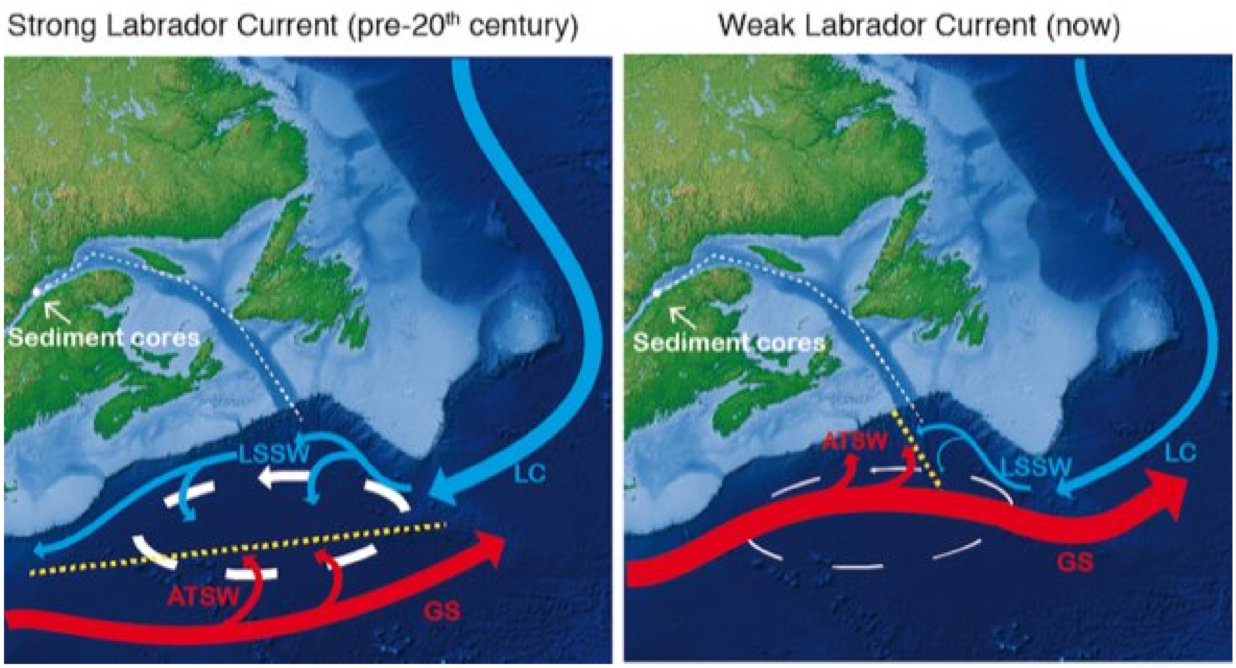

Schematic of the circulation in the western North Atlantic during episode of strong (left) and weak (right) westward transport of the Labrador Current (LC). The oceanography of this region is characterised by the interaction of water masses formed in the Labrador and moving westward (LC and Labrador Sea Slope Water (LSSW)) and the water masses moving eastward originating as the Gulf Stream (GS) and its Atlantic Temperate Slope Water (ATSW). The exact location where these two water mass systems meet (yellow dashed lines) is determined by the strength of the northern recirculation gyre (white arrows), which then control the temperature recorded by the foraminifers. The positions of the sediments cores is indicated by the white dot. Credit: The University of Hong Kong

A study led by Drs. Christelle Not and Benoit Thibodeau from the Department of Earth Sciences and the Swire Institute of Marine Science, The University of Hong Kong, highlights a dramatic weakening of ocean circulation during the 20th century that is interpreted to be a direct consequence of global warming and associated melt of the Greenland ice sheet. This is significant, as reduced circulation in the North Atlantic can yield profound changes on both the North American and European climate, but also on African and Asian summer monsoon rainfall. The findings were recently published in *Geophysical Research Letters*.

The Atlantic Meridional Overturning Circulation (AMOC) is the branch of the North Atlantic circulation that brings warm surface water toward the Arctic and cold deep water toward the equator. This transfer of heat and energy not only has direct influence on climate over Europe and North America, but can impact the African and Asian monsoon system through its effect on sea surface temperature, hydrological cycle, atmospheric circulation and variation in the intertropical convergence zone. Many climate models predicted a weakening, or even a collapse of this branch of the circulation under global warming, partly due to the release of freshwater from Greenland ice sheet. This freshwater has lower density than salty water and thus prevents the formation of deep water, slowing down the whole circulation. However, this weakening is still vigorously debated because of the scarcity of long-term record of the AMOC.

Drs. Not and Thibodeau used microfossils called foraminifera found in a sediment core to estimate the past temperature of the ocean. The sediment core used is located in the Laurentian Channel, on the coast of Canada, where two important currents meet. Thus, the strength of these currents will control the temperature of the water at the coring site, which implies that the temperature reconstructed from this core is indicative of the strength of the North Atlantic circulation. With their collaborators from the United States of America, they validated their results using instrumental data and two numerical models that can simulate the climate and the ocean.

"The AMOC plays a crucial role in regulating global climate, but scientists are struggling to find reliable indicators of its intensity in the past. The discovery of this new record of AMOC will enhance our understanding of its drivers and ultimately help us better comprehend potential near-future change under global warming," said Dr. Thibodeau.

Picture of the foraminifer specie used in this study. Credit: The University of

Interestingly, the research team also found a weak signal during a period called the Little Ice Age (a cold spell observed between about 1600 and 1850 AD). While not as pronounced as the 20th century trend, the signal might confirm that this period was also characterized by a weaker circulation in the North Atlantic, which implies a decrease in the transfer of heat toward Europe, contributing to the cold temperature of this period. However, more work is needed to validate this hypothesis.

"While we could ground our temperature reconstruction for the 20th century against instrumental measurement, it is not possible to do so for the Little Ice Age period. Therefore, we need to conduct more analysis to consolidate this hypothesis," said Dr. Not.

More information: Benoit Thibodeau et al. Last Century Warming Over the Canadian Atlantic Shelves Linked to Weak Atlantic Meridional Overturning Circulation, *Geophysical Research Letters* (2018). DOI: 10.1029/2018GL080083

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