A 50,000-year history of current flow yields new climate clues

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New research confirms the central role of a major ocean circulation system in driving sudden climate changes during the last ice age. Here an iceberg floats off of Baffin Island, Nunavut, Canada, in the North Atlantic Ocean, a region that plays a key role in ocean circulation. Credit: National Snow and Ice Data Center, CC BY 2.0

From 50,000 to 15,000 years ago, during the last ice age, Earth's climate wobbled between cooler and warmer periods punctuated by occasional, dramatic ice-melting events.

Previous research has suggested that these oscillations were likely influenced by changes in the Atlantic Meridional Overturning Circulation (AMOC), a pattern of currents that carry warm, tropical water to the North Atlantic, where it cools, sinks, and flows back south. However, the precise role played by the AMOC in ancient climate fluctuations has been unclear.

Now Toucanne et al. have reconstructed the historical flow of a key current in the upper part (the northward flow) of the AMOC, the Glacial Eastern Boundary Current (GEBC), shedding new light on how the AMOC can drive sudden changes in climate.

The GEBC flowed northward along Europe's continental margin during the last ice age (it persists today as the European Slope Current). To better understand the GEBC's role in the AMOC, the researchers collected six seafloor sediment cores off the coast of France. Analysis of grain sizes and isotope levels in the core layers revealed the current's strength when each layer was deposited, yielding the first high-resolution, 50,000-year historical record of the current.

This new historical record shows that the GEBC flowed faster during warmer intervals of the last ice age but weakened during the coldest periods. The timing of these changes aligns well with previously established records on AMOC speed and the southward return flow of deep waters to the west.

Comparing the history of the GEBC with other records also shows that major ice-melting events, in which ice age glaciers released huge amounts of freshwater into the Atlantic, correspond with periodic

weakening of the current and of the AMOC in general.

Drawing on these findings, the researchers outline a mechanism by which the GEBC could have carried cold glacial meltwater northward and contributed to changes in the AMOC that may have driven warm-cold climate oscillations in the North Atlantic.

More information: Samuel Toucanne et al. The North Atlantic Glacial Eastern Boundary Current as a Key Driver for Ice-Sheet—AMOC Interactions and Climate Instability, *Paleoceanography and Paleoclimatology* (2021). DOI: 10.1029/2020PA004068

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