UC SANTA BARBARA

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# Sunlight Has More Powerful Influence on Ocean Circulation and Climate Than Do North American Ice Sheets, Say Scientists

A study reported in today's issue of Nature disputes a longstanding picture of how ice sheets influence ocean circulation during glacial periods.

The distribution of sunlight, rather than the size of North American ice sheets, is the key variable in changes in the North Atlantic deep-water formation during the last four glacial cycles, according to the article. The new study goes back 425,000 years, according to Lorraine Lisiecki, first author and assistant professor in the Department of Earth Science at the University of California, Santa Barbara.

Lisiecki and her co-authors studied 24 separate locations in the Atlantic by analyzing information from ocean sediment cores. By observing the properties of the shells of tiny marine organisms, called foraminifera, found in these cores, they were able to deduce information about the North Atlantic deep water formation. Scientists can discern historical ocean temperature and circulation patterns through the analysis of the chemical composition of these marine animals.

Previously, scientists relied on a study called "Specmap," performed in 1992, to find out how different parts of the climate system interacted with one another during

glacial cycles. Specmap analyzed ocean circulation at only one place in the Atlantic.

"What I found was that the one site that the Specmap study used actually didn't match most of the other sites in the Atlantic," said Lisiecki. "They just happened to have a strange site that didn't behave like most of the other sites. The other sites show that the circulation is not responding to the ice volume, but that it is responding to changes in the distribution of sunlight."

Previously, scientists believed that deep ocean circulation –– the amount of water formed in the North Atlantic that goes into the deep ocean ––

varied or responded according to the amount of ice volume in the Northern Hemisphere. The prevailing idea was that when ice ages occur, with large sheets of ice over North America, the amount of North Atlantic deep water is reduced.

"That's an important part of circulation," said Lisiecki. "The Gulf Stream brings up warm water from the tropics and that water is turned into this North Atlantic deep water that then sinks and moves southward at depth so you have a cycle. Warm water moves northward and then cools and sinks. That's the North Atlantic deep water formation process."

When warm water in the Gulf Stream comes north, it brings heat to the North Atlantic and Europe and then sinks in the North Atlantic and flows back southward at a depth of 3,000 meters.

"This is fairly important for the climate because it brings this heat northward," said Lisiecki. "The Specmap study in 1992 found that circulation is reduced when you have large ice sheets –– presumably because you have less of this North Atlantic deep water forming. Our results show that this is not always true."

She explained that the new data changes our understanding about how the different parts of the climate system are interacting with one another and in particular the influence of the ice sheets on climate.

"Because the ice sheets are so large, it was a nice simple story to say that they were having the predominant influence on all the parts of the climate system," said Lisiecki. "But our study showed that this wasn't the only important part of the changes in climate. The distribution of sunlight is the controlling factor for North Atlantic deep water formation.

"Our study tells us a lot about how the ocean circulation is affected by changes in climate," she adds. "The ocean does not always follow the climate; it exerts its own impact on climate processes. In other words, the ocean circulation doesn't just follow along with the rest of the climate, it actually changes in different ways than the ice sheets during glacial cycles."

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