

Researchers attribute thinning of Greenland glacier to ocean warming preceded by atmospheric changes

September 29 2008

The sudden thinning in 1997 of Jakobshavn Isbræ, one of Greenland's largest glaciers, was caused by subsurface ocean warming, according to research published in the journal *Nature Geoscience*. The research team traces these oceanic shifts back to changes in the atmospheric circulation in the North Atlantic region.

The study, whose lead author was David Holland, director of the Center for Atmosphere Ocean Science, part of New York University's Courant Institute of Mathematical Sciences, suggests that ocean temperatures may be more important for glacier flow than previously thought.

The project also included scientists from the Wallops Flight Facility, Canada's Memorial University, the Danish Meteorological Institute, and the Greenland Institute of Natural Resources.

Jakobshavn Isbræ, a large outlet glacier feeding a deep-ocean fjord on Greenland's west coast, went from slow thickening to rapid thinning beginning in 1997. Several explanations have been put forward to explain this development. The scientists in the Nature Geoscience study sought to address the matter comprehensively by tracing changes in ocean temperatures and the factors driving these changes.

In doing this, they relied on previous results published by others that used NASA's Airborne Topographic Mapper, which has made airborne



surveys along a 120-kilometer stretch in the Jakobshavn ice-drainage basin nearly every year since 1991. While many other glaciers were thinning around Greenland, these surveys revealed that Jakobshavn Isbræ thickened substantially from 1991 to 1997. But, after 1997, Jakobshavn Isbræ began thinning rapidly. Between 1997 and 2001, Airborne Topographic Mapper surveys showed an approximately 35-meter reduction in surface elevations on the glacier's 15-kilomater floating ice tongue. This is far higher than thinning rates of grounded ice immediately upstream.

The researchers reported that these changes coincided with jumps in subsurface ocean temperatures. These temperatures were recorded by the Greenland Institute of Natural Resources from 1991 to 2006 over nearly the entire western Greenland continental shelf. These data indicate a striking, substantial jump in bottom temperature in all parts in the survey area during the second half of the 1990s. In particular, they show that a warm water pulse arrived suddenly on the continental shelf on Disko Bay, which is in close proximity Jakobshavn Isbræ, in 1997. The arrival coincided precisely with the rapid thinning and subsequent retreat of Jakobshavn Isbræ. The warm water mass remains today, and Jakobshavn Isbræ is still in a state of rapid retreat.

The remaining question, then, is what caused the rise in water temperatures during this period.

The researchers traced these oceanic changes back to changes in the atmospheric circulation in the North Atlantic region. The warm, subsurface waters off the west Greenland coast are fed from the east by the subpolar gyre—or swirling water—of the North Atlantic, by way of the Irminger current. The current flows westward along the south coast of Iceland. Since the mid-1990s, observations show a warming of the subpolar gyre and the northern Irminger Basin, which lies south of Greenland. The researchers attributed this warming to changes in the



North Atlantic Oscillation (NAO), which is a large-scale fluctuation in the atmospheric pressure system situated in the region. The surface pressure drives surface winds and wintertime storms from west to east across the North Atlantic affecting climate from New England to western Europe.

Specifically, they noted a major change in the behavior of the NAO during the winter of 1995?, which weakened the subpolar gyre, allowing warm subpolar waters to spread westward, beneath colder surface polar waters, and consequently on and over the west Greenland continental shelf.

"The melting of the ice sheets is the wild card of future sea level," Holland explained, "and our results hint that modest changes in atmospheric circulation, possibly driven by anthropogenic influences, could also cause future rapid retreat of the Antarctic Ice Sheet, which holds a far greater potential for sea level rise."

Source: New York University

Citation: Researchers attribute thinning of Greenland glacier to ocean warming preceded by atmospheric changes (2008, September 29) retrieved 27 April 2024 from <u>https://phys.org/news/2008-09-attribute-thinning-greenland-glacier-ocean.html</u>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.