INTERNATIONAL

Greenland's ice cap melting at accelerating rate

By Finfacts Team
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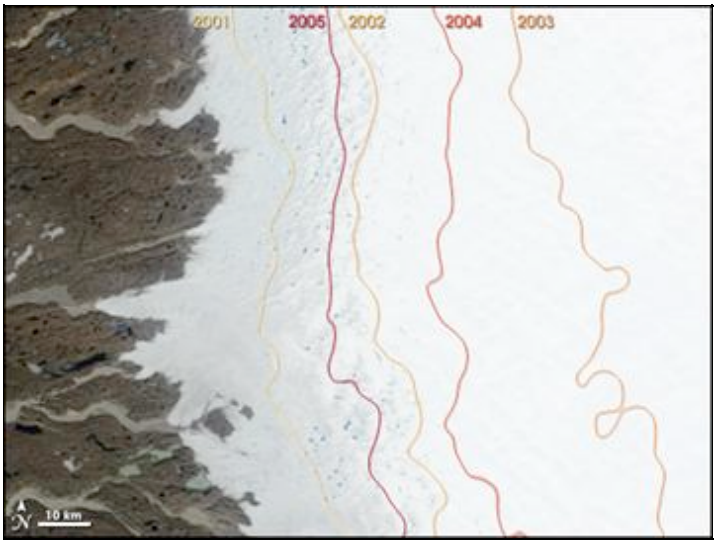

The Greenland ice sheet experienced record melting in September 2002, as did much of the Arctic. A comparison of images from 2001 through 2003 and 2004 shows the changes in Greenland's ice sheet over the past few years.

In this image, the melt zone appears along the western edge of the ice. In this zone, water has saturated the ice, darkening its color from white to blue-gray. The colored lines indicate the approximate melt zone extents for June 2001 through June 2005. Between June 2001 and June 2003, the melt zone increased substantially, then shrank somewhat in June 2004. The melt zone for June 2005 appears roughly equivalent to that of June 2002, the same year that later set a record in Greenland Ice Sheet melting. These images show the Greenland Ice Sheet midway through the seasonal melt. Summer melting begins in late April and reaches its maximum in late August or early September.

As in previous years, blue melt ponds liberally dot the surface. Though they may look pretty, too many ponds spell trouble for the ice sheet. These ponds serve as reservoirs of water that can speed the ice's journey to the sea. Melt water travels downward through the ice and once it reaches the bottom, it can loosen the bond between the ice and the underlying rock, quickening the ice flow. **Photo Credit: NASA image by Jeff Schmaltz, MODIS Rapid Response Team; and Robert Simmon, Earth Observatory**

According to a new study by a US-based research group team led by Chinese scientist Chen Jianli, Greenland is currently losing 240 cubic kilometers of ice each year since 2004, and the rate of melt is accelerating. The researchers estimated the loss after assessing ice mass changes over Greenland between 2002 and 2005. The study is published in the current issue of the journal Science.

An earlier study showed that the annual loss of the Greenland ice sheet was nearly 90 cubic kilometers between 1997 and 2003.

"Our result confirms that the island's ice is melting at an accelerated pace," Chen, a geophysicist at the Centre for Space Research at the University of Texas, said.

The ice sheet is approximately five kilometers thick in some parts of Greenland and the area holds enough snow and ice to raise sea levels by 21 feet or 6.5 metres, were all of it to melt.

According to the new satellite measurements from images produced by the US National Aeronautical and Space Administration (NASA) , surface melting of Greenland's ice cap reached 57 cubic miles a year or 239 cubic kilometers, between April of 2002 and November of 2005, compared to about 19 cubic miles a year between 1997 and 2003.

These measurements came from the US space agency's Grace (Gravity Recovery and Climate Experiment) satellite, launched in 2002.

Dr Chen and colleagues partly attribute its results to increased melting in the past one-and-a-half years and partly to better processing of the data.

"Acceleration of mass loss over Greenland, if confirmed, would be consistent with proposed increased global warming in recent years," the authors wrote in Science.

This would amount to a contribution to global sea level rise from Greenland of about half a millimetre (0.02 inches) each year.

The group's findings coincide with a study released last February that used data from other satellites to estimate mass changes in the Greenland ice.

The loss of ice from Greenland doubled between 1996 and 2005, as its glaciers flowed faster into the ocean in response to a generally warmer climate, according to a NASA/University of Kansas study.

The study also was published in the journal Science. It concludes that the changes to Greenland's glaciers in the past decade are widespread, large and sustained over time. They are progressively affecting the entire ice sheet and increasing its contribution to global sea level rise.

Researchers Eric Rignot of NASA's Jet Propulsion Laboratory and Pannir Kanagaratnam of the University of Kansas Center for Remote Sensing of Ice Sheets, Lawrence, used data from Canadian and European satellites. They conducted a nearly comprehensive survey of Greenland glacial ice discharge rates at different times during the past 10 years.

"The Greenland ice sheet's contribution to sea level is an issue of considerable societal and scientific importance," Rignot said. "These findings call into question predictions of the future of Greenland in a warmer climate from computer models that do not include variations in glacier flow as a component of change. Actual changes will likely be much larger than predicted by these models."

The evolution of Greenland's ice sheet is being driven by several factors. These include accumulation of snow in its interior, which adds mass and lowers sea level; melting of ice along its edges, which decreases mass and raises sea level; and the flow of ice into the sea from outlet glaciers along its edges, which also decreases mass and raises sea level. This study focuses on the least well known component of change, which is glacial ice flow. Its results are combined with estimates of changes in snow accumulation and ice melt from an independent study to determine the total change in mass of the Greenland ice sheet.

Rignot said this study offers a comprehensive assessment of the role of enhanced glacier flow, whereas prior studies of this nature had significant coverage gaps. Estimates of mass loss from areas without coverage relied upon models that assumed no change in ice flow rates over time. The researchers theorized if glacier acceleration is an important factor in the evolution of the Greenland ice sheet, its contribution to sea level rise was being underestimated.

To test this theory, the scientists measured ice velocity with interferometric synthetic-aperture radar data collected by the European Space Agency's Earth Remote Sensing Satellites 1 and 2 in 1996; the Canadian Space Agency's Radarsat-1 in 2000 and 2005; and the European Space Agency's Envisat Advanced Synthetic Aperture Radar in 2005. They combined the ice velocity data with ice sheet thickness data from airborne measurements made between 1997 and 2005, covering almost Greenland's entire coast, to calculate the volumes of ice transported to the ocean by glaciers and how these volumes changed over time. The glaciers surveyed by those satellite and airborne instrument data drain a sector encompassing nearly 1.2 million square kilometers (463,000 square miles), or 75 percent of the Greenland ice sheet total area.

From 1996 to 2000, widespread glacial acceleration was found at latitudes below 66 degrees north. This acceleration extended to 70 degrees north by 2005. The researchers estimated the ice mass loss resulting from enhanced glacier flow increased from 63 cubic kilometers in 1996 to 162 cubic kilometers in 2005. Combined with the increase in ice melt and in snow accumulation over that same time period, they determined the total ice loss from the ice sheet increased from 96 cubic kilometers in 1996 to 220 cubic kilometers in 2005. To put this into perspective, a cubic kilometer is one trillion liters (approximately 264 billion gallons of water), about a quarter more than Los Angeles uses in one year.

Glacier acceleration has been the dominant mode of mass loss of the ice sheet in the last decade. From 1996 to 2000, the largest acceleration and mass loss came from southeast Greenland. From 2000 to 2005, the trend extended to include central east and west Greenland.

"In the future, as warming around Greenland progresses further north, we expect additional losses from northwest Greenland glaciers, which will then increase Greenland's contribution to sea level rise," Rignot said.

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