Mapping of Greenland may aid understanding of sea-level mystery

January 15 2008

Martin Sharp

A University of Alberta Arctic ice researcher is closing in on some real

understanding about the process that might be feeding rising sea levels.

Using satellite microwave data, Martin Sharp, a professor in the Department of Earth and Atmospheric Sciences, has successfully mapped the summer melt extent and duration of the summer melt across Greenland for a five-year period stretching from 2000 to 2004.

"What we're interested in is the problem of explaining why the rates of global sea level rising have more or less doubled since the early 1990s compared with the early part of the 20th century," he said.

Sharp, whose findings were recently published in the *Journal of Geophysical Research*, says there is mounting evidence that indicates the increasing sea level is probably due to the substantial increase in the rate in which Greenland is generating water, both by melting and by carving ice bergs into the ocean.

While climate change is the leading hypothesis of the day, the processes that are accelerating the melting of Greenland's ice cap are still largely misunderstood.

"Some of this water is getting to the bottom of the ice sheet, even in places where it is a kilometre-and-a-half thick, and at sub-freezing temperature pretty much through the whole thickness," said Sharp. "It's kind of counter-intuitive that water would find its way through, but it looks like that is what may be happening."

He says that water at the base of the ice sheet acts as lubricant for the glaciers above to flow faster. An increased rate of glacial movement means a surge in the rate at which icebergs are being dropped into the water. This, in turn, may be contributing to rising sea levels, he suggests.

Sharp hypothesizes that this increase might very well be destabilizing the

flow of glaciers, overwhelming the natural drainage system at the bottom of the ice sheet, increasing the water pressure, and, in effect, 'floating' the ice off the bedrock, allowing it to speed up.

While it's true the speed of glacial flow has seen an increase from eight kilometres per year to 15 over the last two decades, the onset of another interesting phenomenon may be helping to shape the tale. Sharp says seismic monitoring stations have measured a substantial increase in the number of large earthquakes being reported in areas where Greenland seems to be losing mass more rapidly.

"The suggestion is those earthquakes are generated by increased slip between rock and the ice underneath," he said. "The glaciers are moving like a large landslide and causing tremors in the crust beneath it when it does."

"It's a hypothesis, but there is not a whole lot of direct evidence that says this is the case," said Sharp, who is now in search of a grad student to help compile all the data.

"We know where those earthquakes took place, so now we can ask the question: Does the occurrence of those earthquakes actually coincide with periods of unusually high melt?"

Previous attempts at mapping Greenland's ice sheet were unreliable, resulting in data points whose imagery had a resolution that covered more than 4,000 square kilometres of ice shelf.

So three years ago, Sharp began tapping into another satellite source that has been available since 1999, which produces a resolution of a more manageable 16 square kilometres.

Over that area, a satellite sends down a signal, some of which is absorbed

by the surface while some is scattered back to the satellite. If there is any water at the surface at all, a very large portion of the energy hitting the surface is absorbed and doesn't come back. The result is daily resolutions of the distribution of ice melt across the whole ice sheet.

Sharp broke Greenland down into nine different regions to better determine exactly when it was melting where in each year. For each region, Sharp says he will be able to calculate the average length of melt season and then back-calculate the air temperature. Once the inputs are created, Sharp looks forward to determining exactly what is driving these melt events.

"We are asking if it is actually true that the amount and extent of melting in Greenland has increased over the period of interest and, in particular, is it increasing in the places where it looks as if the flow of the glacier has been sped up," said Sharp.

Source: University of Alberta