Probing Question: How fast are the polar ice sheets melting?

April 1 2010, By DeLene Beeland

The massive ice sheets that blanket Greenland and Antarctica are shrinking. According to the National Snow and Ice Data Center, summer melt on the Greenland ice increased by 30 percent from 1979 to 2006. Though the situation in Antarctica is less clear, scientists are also seeing loss of mass there, particularly in the fragile West Antarctic Ice Sheet.

Part of the reason, said Sridhar Anandakrishnan, a geophysicist in Penn State's College of Earth and Mineral Sciences, is rising ocean temperatures attributable to global warming. The melting ice, in turn, raises the specter of rising sea levels. While the current rate of rise is calculated at only about an inch per decade, Anandakrishnan said, the big question is how this rate may increase over the next 50 years with continued warming.

"To predict how glaciers will respond, we need to know more about their dynamics, he said.

Anandakrishnan has traveled to Antarctica 17 times in the past 25 years to study glacial ice streams, frozen rivers of ice that flow from the center of an ice sheet and out to sea. These streams can be up to 100 miles in length, a mile deep and 50 miles wide, and most of the melting ice flows through them.

An ongoing puzzle has been the varying speed of the streams: what makes them flow faster sometimes and at other times slow down. In 2003, using seismographic instruments they designed and deployed,

Anandakrishnan and his colleagues found one important clue. Their measurements showed that streams in the West Antarctic Ice Sheet flow faster in response to the fluctuations of the tides. "It was not a result we expected," he said.

In 2008, the same team showed that these tidal responses trigger slow motion "earthquakes," as the stick-slip rhythm of the moving ice sends seismic signals the equivalent of 7.0 on the Richter scale.

"The data look a lot like an earthquake," said Anandakrishnan's co-author Douglas Wiens, a seismologist at Washington University in Saint Louis, "but the slip lasts for 10 minutes, while an earthquake of this size would last for just 10 seconds."

Other research points to further complicating factors. Anandakrishnan cites a study just published by scientists at the Scripps Oceanographic Institute which posits that wave energy originating from storms in the North Pacific Ocean is being transferred thousands of miles and destabilizing ice shelves in Antarctica. The study's authors suggest this as an important mechanism spurring the creation or widening of crevasses on Antarctica's ice shelves. Crevasses, Anandakrishnan explains, are deep fissures that can speed melting by shuttling melt-water to the glacier's base, lubricating an ice stream's movement.

"The take-away message from all this," he said, "is that the oceans and the glaciers speak to each other, if you will, more often and more strongly than we'd expect. They are not separate systems. If we're going to understand melting and predict sea-level rise, we'll need to understand the rhythms of their complex dance."

Provided by Pennsylvania State University

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