UNIVERSITY of TASMANIA

NEWS FROM THE UNIVERSITY OF TASMANIA, AUSTRALIA

Media Release

Chiefs of Staff, News Directors

Thursday 4 June 2015

New discovery cracks glacier lake mystery

New research published in *Nature* has discovered a surprising mechanism that triggers cracks in supraglacial lakes that could help scientists predict sea-level rise as the climate changes into the future.

Supraglacial lakes form on the tops of glaciers. They can stay there for long periods of time or melt quickly, allowing glaciers to speed up and increase sea-level rise.

In 2008 scientists revealed how the icy bottoms of lakes atop the Greenland Ice Sheet can crack open suddenly—draining the lakes completely within hours and sending torrents of water to the base of the ice sheet thousands of feet below.

Scientists had theorised that the sheer weight of the water in these supraglacial lakes applied pressure that eventually cracked the ice, but they could not explain why some lake bottoms cracked while others did not.

An international research team, including scientists from the University of Tasmania, Massachusetts Institute of Technology, the University of Washington and Woods Hole Oceanographic Institution, deployed a network of 16 GPS units around North Lake, a 1.5-mile-long supraglacial lake in southwest Greenland, where the scientists first documented large-scale cracks and lake drainages. The GPS enabled them to record movements of the ice before, during, and after three rapid lake drainages in the summers of 2011, 2012, and 2013.

Their study found that in the six to 12 hours before the lake cracked and drained, the ice around the lake moved upward and slipped horizontally. The scientists say that meltwater had begun to drain through a nearby system of moulins (vertical conduits through the ice), which connected the surface to the base of the ice sheet 3,215 feet below.

The accumulating water creates a bulge that floats the entire ice sheet, creating tension at the surface underneath the lake. The stress builds up until it is relieved by a sudden large crack in the ice below the lake.

"Our discovery will help us predict more accurately how supraglacial lakes will affect ice-sheet flow and sea-level rise as the region warms in the future," said lead author Laura Stevens, a graduate student in the Massachusetts Institute of Technology-Woods Hole Oceanographic Institution Joint Program in Oceanography.

“In some ways, ice behaves like Silly Putty—if you push up on it slowly, it will stretch; if you do it with enough force, it will crack,” said Stevens.

“Ordinarily, pressure at the ice sheet surface is directed into the lake basin, compressing the ice together. But, essentially, if you push up on the ice sheet and create a dome instead of a bowl, you get tension that stretches the ice surface apart. You change the stress state of the surface ice from compressional to tensional, which promotes crack formation.”

Once the tension initiates the crack, the volume of water in the lake does play a critical role, surging into the opening, widening and extending it, and keeping it filled with water all the way to base of the thick ice sheet. These are called hydrofractures, and the scientists have documented how they can drain more than 11 billion gallons of water out of North Lake in about 90 minutes. At times, water flowed out of the lake bottom faster than the water goes over Niagara Falls, the scientists estimated.

“You need both conditions—tension to initiate the crack *and* the large volume of water to amplify it—for hydrofractures to form,” Stevens said.

“The key finding of this study is that without the former, even large supraglacial lakes will retain their water.”

At the base of the ice sheet, the water that drains from the lake lubricates the interface between ice and rock, allowing the ice sheet to slide faster toward the coast. That in turn accelerates the outflow of ice from land to sea and causes sea levels to rise faster. So understanding the mechanisms that trigger the drainages will help scientists predict more precisely how supraglacial lakes will affect sea level rise as climate conditions shift in the future.

The University of Tasmania’s Professor Matt King, co-author of the study, said people are using GPS for SatNav to position themselves to metres, but for years surveyors and geophysicists have been using the same technology to position things to millimetres.

“Using that technology, we can now not only measure how the Earth changes shape during an earthquake, we can measure the Greenland Ice Sheet as it changes shape when one of these lakes drains.

“But the big advance in this study has come from measuring the relatively tiny change that occurs just before the ice cracks – we’ve been able to nail down the trigger and that gives us a better view as to how Greenland will influence sea level in the future.”

Read the paper here: http://dx.doi.org/10.1038/nature14480

Information released by:
University of Tasmania, Communications and Media Office
Phone: (03) 6226 2691 or 0447 537 375
Email: Media.Office@utas.edu.au