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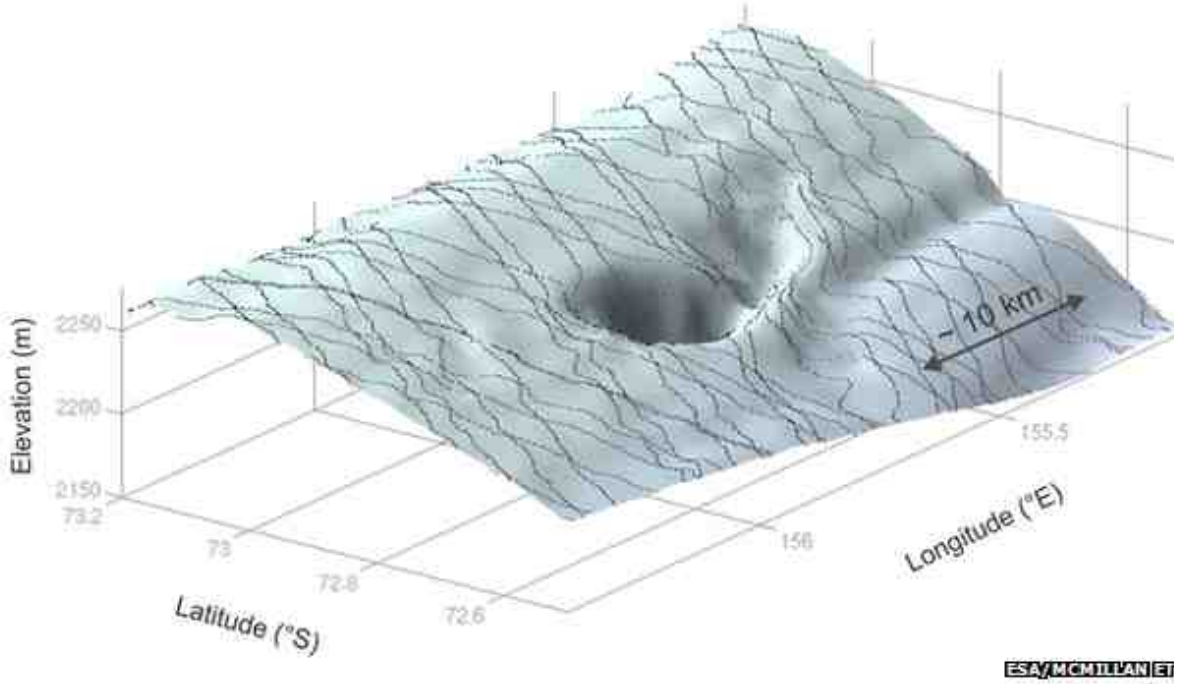
Antarctic flood produces 'ice crater'

By Jonathan Amos Science correspondent, BBC News



The ice surface slumped as the water in Cook Sub-Glacial Lake drained away (elevation exaggerated)

Scientists have seen evidence for a colossal flood under Antarctica that drained six billion tonnes of water, quite possibly straight to the ocean.

The cause is thought to be a deeply buried lake that suddenly over-topped.

Satellites were used to map the crater that developed as the 2.7km-thick overlying ice sheet slumped to fill the void left by the escaping water.

The peak discharge would have been more than double the normal flow rate of London's River Thames, researchers say.

The location of the flood was Cook Sub-Glacial Lake (SGL) in the east of the continent, and the event itself occurred over a period of about 18 months in 2007-2008.

It was detected and described using a combination of data gathered by the now-retired US Icesat mission and Europe's new Cryosat platform.

The American spacecraft's laser altimeter first noted a drop in the ice-surface height associated with the slumping.

The European satellite's radar altimeter was then employed to map the shape of the crater that resulted.

Loch comparison

Cryosat's double antenna configuration allows it to map slopes very effectively

"The crater's a big feature," said Dr Malcolm McMillan from the UK's University of Leeds and lead author of a report in the journal Geophysical Research Letters.

"It covers an area of about 260 sq km, which is about the size of Edinburgh, and was as much as 70m deep," he told BBC News.

"We knew from the Icesat data there had been a big elevation change, but it's only now with Cryosat that we've been able to appreciate the true scale of what happened."

The geometry of the crater has enabled the team to gauge the volume of water involved in the outburst and the rate at which it was dispersed.

The group's upper estimate is 6.4 cubic km - very nearly as much as is stored in Scotland's famous Loch Ness.

At the peak of the flood, water would have been flowing away from Cook SGL at a rate of 160 cubic metres per second, the team says.

This dwarfs all previously reported sub-glacial "purge" events.

Water network

Cook is one of nearly 400 SGLs now recognised on the White Continent.

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Whether all that water reaches the ocean, or re-freezes onto the underside of the ice, or even melts more ice with its heat - we just don't know”

Dr Hugh Corr British Antarctic Survey

These "ghost" lakes are kept in a liquid state by heat rising from the rockbed below and from the pressure of all the ice pushing down from above.

Many of them appear to be linked through a network of rivers, alternately filling with waters from higher up in the hydrological system and then draining to lower elevations.

Understanding this behaviour is now a key quest for glaciologists.

Water on the underside of the ice sheet will lubricate its movement. Computer models that want to simulate how Antarctica will react to future changes in the climate have to take this effect into account.

It is not clear at the moment from where Cook is being replenished - the data shows the floor of the ice cater to be rising currently - but when it over-tops, the lake's waters may run all the way to the coast to enter the ocean under the floating Cook Ice Shelf.

"Further downstream, there was an inflation of the ice," explained team-member Dr Hugh Corr from the British Antarctic Survey. "But whether all that water reaches the ocean, or re-freezes onto the underside of the ice, or even melts more ice with its heat - we just don't know. It will, though, change the lubrication."

Mass loss

Certainly, six billion tonnes of water that was previously stored on land would be a lot to lose to the ocean in a short time.

At present, Antarctica is losing mass at a rate of between 50-100 billion tonnes a year, helping to raise global sea level. This study suggests that a not insignificant fraction of this mass loss could be due to flood events like that seen at Cook SLG.

"This one lake on its own represents 5-10% of [Antarctica's] annual mass imbalance," said Leeds co-author Prof Andy Shepherd.

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The lake drainage event reported here was quite staggering in its size ”

Prof Helen Fricker Scripps Institution of Oceanography

"If there are nearly 400 of these sub-glacial lakes then there's a chance a handful of them are draining each year, and that needs to be considered," he told BBC News.

The Geophysical Research Letters paper is the first to be published with Cryosat's altimeter

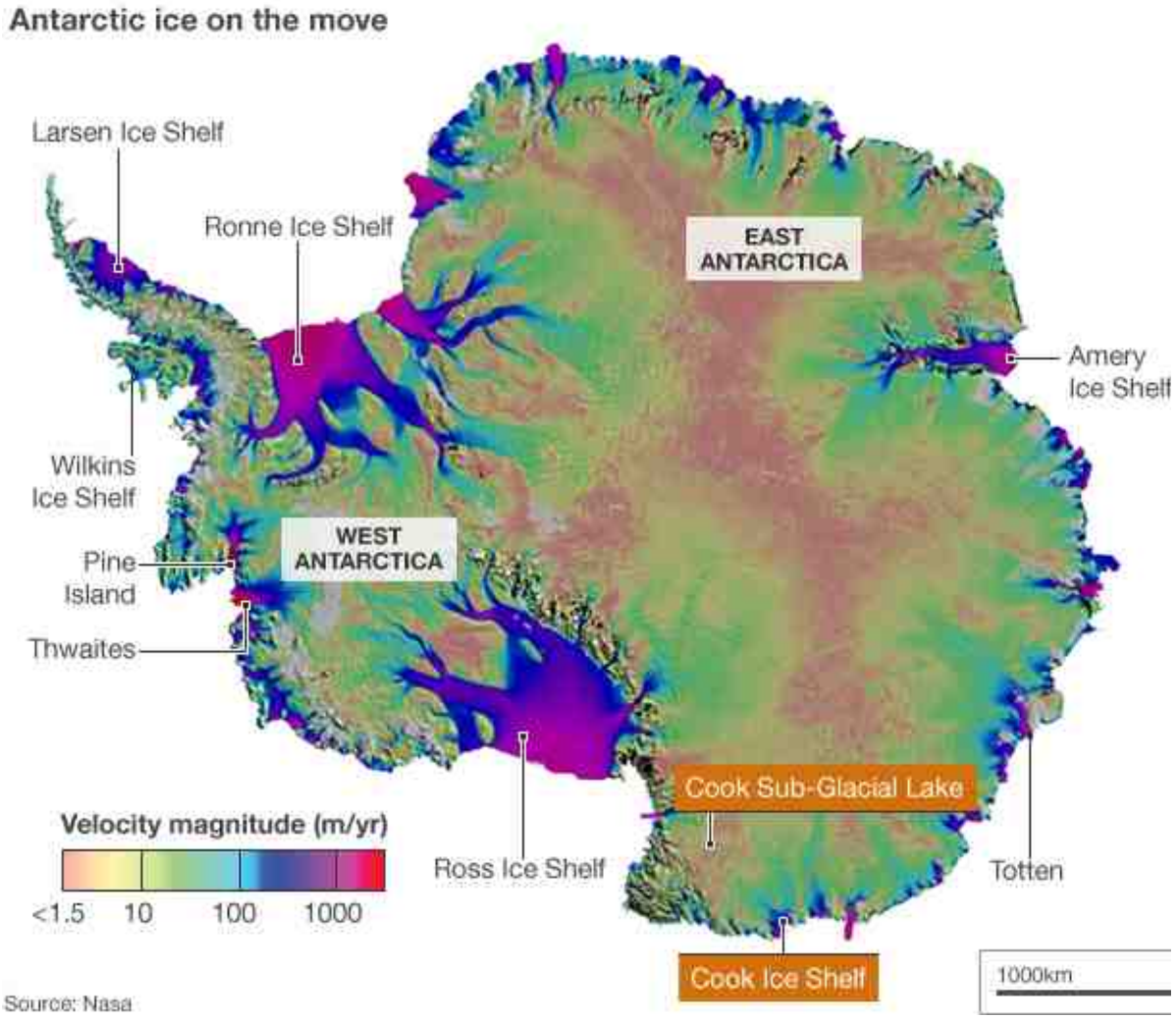
instrument operating in Synthetic Aperture Radar interferometric (SARin) mode.

This sees the spacecraft use two antennas offset by about a metre to listen for the return echo of its radar pulse.

It allows the instrument to judge the angles of return, to sense better the shape of the ice below. This provides far more reliable information on slopes and ridges.

Prof Helen Fricker from the Scripps Institution of Oceanography was not involved in the research. She told BBC News: "These exciting results show the potential of the Cryosat mission data to reveal the topography of the Antarctic ice sheet in exquisite detail, which will enable us to learn more about important ice sheet processes.

"The lake drainage event reported here was quite staggering in its size and the 3D image we got of the crater in the surface after the lake drained is unprecedented."



This map displays the velocity of the ice in Antarctica. To model this behaviour, scientists have to understand what water is doing at the base of the ice sheet