TerraSAR-X-image of the month: Calving icebergs on Queen Maud Land

08 February 2011

By Manuela Braun

If the city of Bonn were located on the edge of the Fimbul Ice Shelf, in the Antarctic, its inhabitants would now be embarking on a journey through the Antarctic Circumpolar Current. An iceberg with a surface area of 120 square kilometres – the size of Bonn – has calved in the Atlantic. Glaciologists at Hamburg University's Climate Campus have been using the German Aerospace Center (Deutsches Zentrum für Luft- und Raumfahrt; DLR) radar satellite, TerraSAR-X, to observe the area from an altitude of 500 kilometres and gain a better understanding of how icebergs like this will calve in the future.

A small island obstructs the constant flow of the ice shelf on Queen Maud Land – it can be seen as a lighter area at the bottom left of the image. “The ice shelf gets caught here as if trying to pass over a bed of nails," explains glaciologist Angelika Humbert from the Climate Campus. "Once the ice passes the island, the tension on its surface is extraordinarily high." At the same time, the ice front pulls on the ice shelf; if the tension is high enough, a fissure forms. "But we are still unsure about the exact mechanism of the calving process." How does an iceberg form? What factors are involved? Forces such as tides, ocean currents and storms gently but constantly pull on the edges of the ice. At the same time, the ice is flowing under its own weight. "It's almost like honey spreading itself over a slice of bread." The masses of ice take their time in this process; the ice shelf slowly moves forwards for decades before calving occurs. "We do know that the way in which the ice creeps forward has a significant influence on the formation of icebergs, but the extent to which break-offs from the edge of the ice depend on tides or various material parameters is still not clear."

Cracks on both sides

From September 2010 until it broke off, Iceberg A 62 was connected to the Fimbul Ice Shelf by a mere 800-metre-wide bridge. Two fissures in the ice, one on each side, approached one another until the break occurred. The images obtained by TerraSAR-X over an extended period of time should enable researchers to achieve a better understanding of how icebergs calve. Until now, glaciologists have not been able to predict how much ice will break off each year or where. "Calving is a long process culminating in one single event," explains Angelika Humbert. "We can't derive a general pattern from it." It is for this reason that the satellite data is fed into computer simulations of the fracture mechanics and flow mechanisms of ice masses. A fissure is then triggered in the virtual ice shelf, and its expansion and calving simulated. The researchers then compare these with more up-to-date satellite data to determine how close the simulation is to reality. The aim is to develop a bigger and improved basis for simulated scenarios.

Alerting the local team

The Fimbul Ice Shelf is perfect for the glaciologists' research: "This ice shelf has a very large number of fissures. The ice moves approximately 800 metres a year in this part of the Antarctic. It’s not a risk-free research subject," says Angelika Humbert. She used the TerraSAR-X images to schedule field measurements to be carried out by a team from the Norwegian Polar Institute. In October 2010 these researchers were finally able to explore the ice shelf, while Angelika Humbert analysed the latest radar images and alerted her colleagues in the Antarctic all the way from Germany: “All those involved were on the edge of their seats – is this thing going to calve or not?" The glaciologist was worried about the iceberg breaking off then and there, and the

team quickly getting to safety if the calving caused other fissures to spread. "The worst fissures are the very narrow ones," says Angelika Humbert. "It's hard to see these on most satellite images, but they show up very clearly on TerraSAR-X images. The radar satellite operates with an incredibly high resolution, crucial for the study of ice dynamics."

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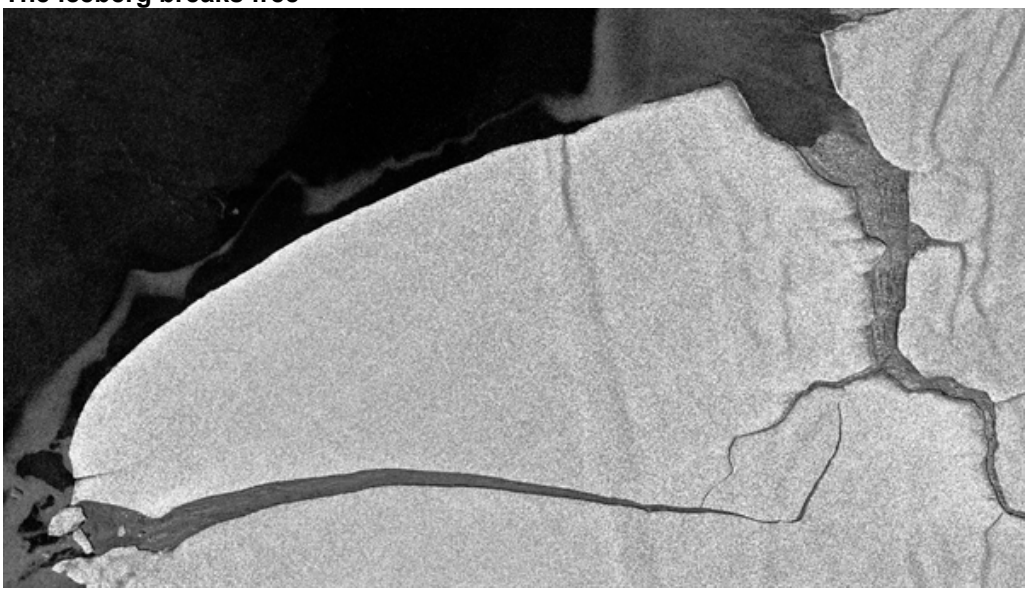
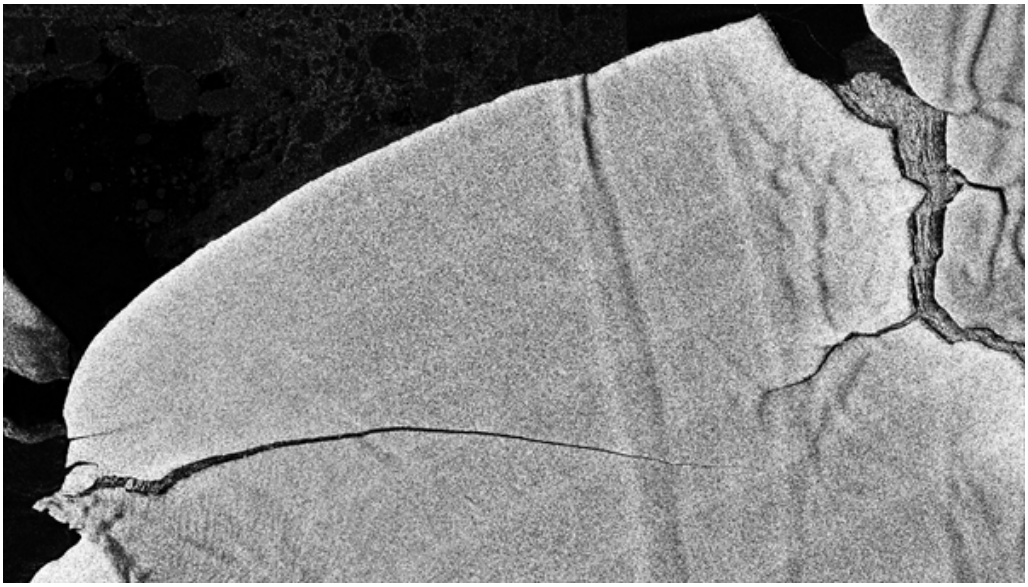
The iceberg breaks free



A small island obstructs the constant flow of the ice shelf on Queen Maud Land – it is the lighter area at the bottom left of the image. From September 2010 until it broke off, Iceberg A 62 was connected to the Fimbul Ice Shelf by a mere 800-metre-wide bridge. Two fissures in the ice from different sides of the bridge approached one another until the break occurred. The images transmitted by the radar satellite TerraSAR-X over a long period of time should enable researchers to achieve a better understanding of how icebergs calve. Until now, glaciologists have not been able to predict where and how much ice will break away each year.

Credit: DLR.

The Fimbul Ice Shelf on 21 December 2009



To better understand the calving of icebergs, glaciologists from the University of Hamburg Climate Campus have been monitoring the Fimbul Ice Shelf from an altitude of 500 kilometres using the German Aerospace Center (DLR) radar satellite TerraSAR-X. Until now, they have not been able to predict how much ice will break away each year or where. This image was obtained on 21 December 2009, when the fissures had not yet advanced far enough into the interior for calving to occur.

Credit: DLR.

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