

Backward-moving glacier helps scientists explain glacial earthquakes

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The surface of Helheim Glacier is incredibly rough and large. Credit: Nick Selmes, Swansea University

The relentless flow of a glacier may seem unstoppable, but a team of UK and US researchers have shown that during some calving events - when an iceberg breaks off into the ocean - the glacier moves rapidly backward and downward, causing the characteristic glacial earthquakes which until now have been poorly understood.

This new insight into glacier behaviour should enable scientists to measure glacier calving remotely and will improve the reliability of models that predict future sea-level rise in a warming climate.

The research is published today in *Science Express*.

The Greenland Ice Sheet is an important contributor to global sea-level and nearly half of the ice sheet's annual mass loss occurs through the calving of icebergs to the ocean. Glacial earthquakes have increased seven-fold in the last two decades and have been migrating north suggesting an increase in rates of mass loss from the ice sheet through calving.

Helheim Glacier is one of the largest [glaciers](#) in southeast Greenland and at 6 km wide and over 200 km long it can flow as fast as 30 m per day. Icebergs calving from Helheim Glacier can be very large and have been measured up to 4 km across and with a volume of about 1.25 km³.

During the summer of 2013, researchers from Swansea, Newcastle and Sheffield Universities installed a robust wireless network of Global Positioning System (GPS) devices on the chaotic surface of Helheim in order to measure velocity and displacement of the glacier surface. With US collaborators from Columbia University's Lamont-Doherty Earth Observatory, the University of Michigan and Emory University, earthquake data from the Global Seismographic Network and scaled-down models in water tanks were used to explain the unexpected movements of the glacier in the minutes surrounding the calving events.



One of the 20 GPS sensors deployed on Helheim Glacier. Credit: Alistair Everett, Swansea University

Swansea University's Professor Tavi Murray, lead author of the study said, "We were really surprised to see the glacier flowing backwards in our GPS data. The motion happens every time a large iceberg is calved and a glacial [earthquake](#) is produced. A theoretical model for the earthquakes and the laboratory experiments have allowed us to explain the backwards and downwards movement."

Understanding this glacier behaviour and the associated glacial earthquakes is a crucial step towards measuring calving events and their contribution to sea-level change remotely. This tool has the potential to

provide unprecedented, global and near real-time estimates of iceberg loss from the [ice sheet](#).

More information: "Reverse glacier motion during iceberg calving and the cause of glacial earthquakes," www.sciencemag.org/lookup/doi/10.1126/science.aab0460

Provided by Newcastle University

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