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Backward-moving glacier helps scientists explain glacial earthquakes



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New insight into glacier behaviour will improve our ability to predict future sea-level rise in a warming climate.

The relentless flow of a glacier may seem unstoppable, but now 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.

Published in [Science Express](#), 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. 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.

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.

[Dr Stuart Edwards](#), lead Scientist for Newcastle University's team based in the [School of Civil Engineering and Geosciences](#), said: "When we saw the fit of our GPS observations to the scaled laboratory data during "iceberg" capsize we knew we were on to something rather special. Our network of GPS sensors delivered everything we could have hoped for."

Professor Tavi Murray, lead author of the study based at Swansea University, added, "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."

This research was supported by the UK [Natural Environment Research Council](#), the [US National Science Foundation](#) and the Climate Change Consortium of Wales and Thales UK.

Source information: Reverse glacier motion during iceberg calving and the cause of glacial earthquakes. T. Murray, M. Nettles, N. Selmes, L. M. Cathles, J. C. Burton, T. D. James, S. Edwards, I. Martin, T. O'Farrell, R. Aspey, I. Rutt, and T. Baugé. *Science Express* June 2015

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Key Facts:

- Newcastle University is a [Russell Group University](#)
- Ranked in the top 1% of universities in the world (QS World University Rankings 2014)
- Ranked 16th in the UK for global research power (REF 2014)
- Ranked 10th overall in the UK and 3rd for quality of staff/lecturers in the [Times Higher Education Student Experience Survey 2015](#)

- Winner: [Outstanding Leadership and Management Team and Outstanding Procurement Team](#), Times Higher Leadership and Management Awards 2015
- Amongst our peers Newcastle is:
 - Joint 6th in the UK for [student satisfaction](#)
 - Ranked 1st in the UK for Computing Science research impact, 3rd in the UK for Civil Engineering research power and 11th in the UK for Mathematical Sciences research (REF 2014)
 - Ranked 8th in the UK for Medical and Life Sciences research quality (REF 2014)
 - Ranked 3rd in the UK for English, and in the top 12 for Geography, Architecture and Planning, and Cultural and Media Studies research quality (REF 2014)
 - Engineering and Physical Sciences Research Council (EPSRC) top 20 strategic partner
- 94% of our students are in a job or further training within six months of [graduating](#)
- We have a world-class reputation for research excellence and are spearheading three major [societal challenges](#) that have a significant impact on global society. These themes are: Ageing, Sustainability, and Social Renewal
- Newcastle University is the first UK university to establish a fully owned international branch campus for medicine at its [NUMed Campus in Malaysia](#) which opened in 2011
- 90% Satisfaction level from our international students ([ISB 2014](#))
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