

New insight into Greenland's melting glaciers

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Credit: NASA

New research into Greenland's glaciers will help bring accurate sea level rise forecasts – which are crucial in preparing for the impacts of climate change—a step closer.

The Greenland Ice Sheet, which contains enough water to raise sea levels by around seven metres if it melts completely, is expected to be a major

source of [sea level rise](#) over the coming centuries.

However, predicting how quickly the [ice sheet](#) will shrink, as the climate warms, has proved difficult due to a poor understanding of the rapid changes where the ice sheet meets the ocean. Scientists, led by the University of St Andrews, have now taken an important step towards improving these predictions.

Their study, carried out in collaboration with the Universities of Sheffield, Edinburgh, Cambridge and California San Diego, examined the behaviour of ten large glaciers in east Greenland over a 20-year period (1993 –2012) using satellite imagery to track their retreat.

The resulting research, published in the *Proceedings of the National Academy of Sciences (PNAS)* found that, while the retreat of these glaciers could appear erratic and unpredictable when studied over just a few years, a clear relationship between the rate of retreat and climatic warming emerged when observed over longer timescales.

Crucially, the research (which was supported by the Natural Environment Research Council) discovered that variations in ocean temperature help to explain key discrepancies in glacier retreat along Greenland's east coast.

In southeast Greenland, major glaciers retreated by several kilometres as regional air temperatures warmed rapidly between 2000 and 2005. Contrastingly, glaciers in the northeast remained much more stable despite air temperatures warming by a similar amount.

The team attributed this disparity to the presence of very cold ocean waters along the coast of northeast Greenland. Warmer ocean waters melted the submerged parts of marine-terminating glaciers, encouraging undermined blocks to tumble into the sea as icebergs. Colder waters

suppress this process, which may then make the glaciers more resilient to the warming air temperatures.

These findings will be crucial in helping predict the rate of mass loss from the Greenland Ice Sheet over the coming century.

Dr. Tom Cowton of the School of Geography and Sustainable Development at the University of St Andrews, who led the study, said: "While we cannot predict the detailed retreat of individual glaciers, our findings enable us to approximate likely retreat rates based on air and ocean warming scenarios. This information can then be fed into the large scale ice sheet models that are used to predict sea level rise."

Greenland is ringed by fast-flowing outlet glaciers, which drain from the slow-flowing interior of the ice sheet. The largest of these outlet glaciers reach the coast, where they discharge vast quantities of icebergs into the surrounding ocean.

In recent years, these marine-terminating [outlet glaciers](#) have attracted attention as hotspots of ice-loss around the ice sheet margin. However, their behaviour has proved difficult to explain, with some glaciers undergoing episodes of rapid retreat whilst others appear comparatively stable.

The paper, Linear response of east Greenland's tidewater [glaciers](#) to [ocean](#)/ atmosphere warming, by T. R. Cowton, A. J. Sole, P. W. Nienow, D. A. Slater and P. Christoffersen is published in the (16 July) issue of *Proceedings of the National Academy of Sciences*.

More information: T. R. Cowton et al. Linear response of east Greenland's tidewater glaciers to ocean/atmosphere warming, *Proceedings of the National Academy of Sciences* (2018). [DOI: 10.1073/pnas.1801769115](https://doi.org/10.1073/pnas.1801769115)

Provided by University of St Andrews

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