

# Increasing speed of Greenland glaciers gives new insight for rising sea level

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These icebergs recently calved from the front of the north branch of Jakobshavn Isbrae, a large outlet glacier that drains 6.5 percent of the Greenland ice sheet. The fact that they are upright, indicated by their dirty and crevassed surfaces, suggests they calved from the floating end of a glacier. Credit: Ian Joughin/University of Washington

Changes in the speed that ice travels in more than 200 outlet glaciers indicates that Greenland's contribution to rising sea level in the 21st century might be significantly less than the upper limits some scientists thought possible, a new study shows.

"So far, on average we're seeing about a 30 percent speedup in 10 years," said Twila Moon, a University of Washington doctoral student in Earth and space sciences and lead author of a paper documenting the observations published May 4 in *Science*.

The faster the [glaciers](#) move, the more ice and [meltwater](#) they release into the ocean. In a previous study, scientists trying to understand the contribution of melting ice to [rising sea](#) level in a warming world considered a scenario in which the Greenland glaciers would double their velocity between 2000 and 2010 and then stabilize at the higher speed, and another scenario in which the speeds would increase tenfold and then stabilize.

At the lower rate, [Greenland ice](#) would contribute about four inches to rising sea level by 2100 and at the higher rate the contribution would be nearly 19 inches by the end of this century. But the researchers who conducted that study had little precise data available for how major ice regions, primarily in Greenland and Antarctica, were behaving in the face of [climate change](#).

In the new study, the scientists created a decadelong record of changes in Greenland [outlet glaciers](#) by producing velocity maps using data from the Canadian Space Agency's Radarsat-1 satellite, Germany's TerraSar-X satellite and Japan's Advanced Land Observation Satellite. They started with the winter of 2000-01 and then repeated the process for each winter from 2005-06 through 2010-11, and found that the outlet glaciers had not increased in velocity as much as had been speculated.

"In some sense, this raises as many questions as it answers. It shows there's a lot of variability," said Ian Joughin, a glaciologist in the UW's Applied Physics Laboratory who is a coauthor of the Science paper and is Moon's doctoral adviser.

Other coauthors are Benjamin Smith of the UW Applied Physics Laboratory and Ian Howat, an assistant professor of earth sciences at Ohio State University. The research was funded by NASA and the National Science Foundation.

The scientists saw no clear indication in the new research that the glaciers will stop gaining speed during the rest of the century, and so by 2100 they could reach or exceed the scenario in which they contribute four inches to sea level rise.

"There's the caveat that this 10-year time series is too short to really understand long-term behavior," Howat said. "So there still may be future events – tipping points – that could cause large increases in glacier speed to continue. Or perhaps some of the big glaciers in the north of Greenland that haven't yet exhibited any changes may begin to speed up, which would greatly increase the rate of [sea level](#) rise."

The record showed a complex pattern of behavior. Nearly all of Greenland's largest glaciers that end on land move at top speeds of 30 to 325 feet a year, and their changes in speed are small because they are already moving slowly. Glaciers that terminate in fjord ice shelves move at 1,000 feet to a mile a year, but didn't gain speed appreciably during the decade.

In the east, southeast and northwest areas of Greenland, glaciers that end in the ocean can travel seven miles or more in a year. Their changes in speed varied (some even slowed), but on average the speeds increased by 28 percent in the northwest and 32 percent in the southeast during the decade.

"We can't look at one glacier for 100 years, but we can look at 200 glaciers for 10 years and get some idea of what they're doing," Joughin said.

Moon said she was drawn to the research from a desire to take the large store of data available from the satellites and put it into a usable form to understand what is happening to Greenland's ice.

"We don't have a really good handle on it and we need to have that if we're going to understand the effects of climate change," she said.

"We are going to need to continue to look at all of the ice sheet to see how it's changing, and we are going to need to continue to work on some tough details to understand how individual glaciers change."

Provided by University of Washington

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