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JEFFREY SACHS, DIRECTOR

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No Longer Anchored, Antarctic Ice Stream Surges to Sea

Under-Ice Sub Finds Ridge That May Have Held Back Pine Island Glacier

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Satellite tracking has shown that the Pine Island Glacier, one of Antarctica's largest ice streams, is accelerating and thus contributing a growing share of the melt water raising sea levels worldwide. A team of scientists visiting the region last year discovered one reason for the speed-up: warm ocean water eating away at the glacier's base has lifted the ice off a rocky underwater ridge that once slowed the glacier's advance into the sea.



below
Antarctica's Pine Island Glacier.
Credit: British Antarctic Survey.

Discovery of the submarine ridge, standing about 300 meters tall, and 30 kilometers from where the glacier currently meets the sea floor, is detailed in a [paper](#) published this week in [Nature Geoscience](#). It is the initial result from a two-month expedition to western Antarctica's Amundsen Sea in early 2009. Aboard the research ship [Nathaniel B. Palmer](#), the team of British and American scientists took water measurements to track how West Antarctica's thinning glaciers are affecting the ocean and sent a robot submarine, Autosub 3, into the deep cavity beneath Pine Island Glacier's floating ice shelf to chart the seafloor's hidden contours.

The ridge came as a surprise, the scientists say, and helped explain why the glacier has accelerated, and its grounding line—the place where the glacier stops being anchored to land and becomes an ice shelf, floating in the sea—has retreated over recent decades. The glacier used to scrape across this ridge, which probably slowed it down, said [Stan Jacobs](#), an oceanographer at Columbia University's [Lamont-Doherty Earth Observatory](#). "Once the thinning glacier moved off the ridge, the relatively warm ocean water in this region began to melt deeper ice on the back side of the ridge," he said. Unlike the ice sheets of Greenland and eastern Antarctica, much of West Antarctica's ice sheet lies below sea level, and so may be particularly vulnerable to fast erosion by seawater.

The scientists indicate that the glacier's grounding line has retreated into the interior of the West Antarctic Ice Sheet by more than 30 kilometers (about 19 miles) since it lifted off the ridge sometime before the 1970s. Because the grounding line is below sea level, the amount of ice shelf now exposed to the sea has doubled, researchers say, further hastening the glacier's



erosion. "This adds to our concern that this region is indeed what glaciologist Terry Hughes once called the 'weak underbelly' of the West Antarctic Ice Sheet," said Jacobs.

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"Increased melting of continental ice also appears to be the primary cause of persistent ocean freshening and other impacts, both locally and downstream in the Ross Sea."

Globally, sea levels are currently rising at about 3 millimeters (.12 inches) a year. While estimates vary, total collapse of the Pine Island Glacier and its tributaries alone could raise sea levels a total of 24 centimeters (9 inches). Other ice shelves in the Amundsen region have also thinned or widened, and their glaciers have sped up. Satellite images show that the PIG's advance into the sea has increased nearly 50 percent from the 1970s, to about 4 kilometers (2.5 miles) a year.

"The discovery of the ridge has raised new questions about whether the current loss of ice from Pine Island Glacier is caused by recent climate change or is a continuation of a longer-term process that began when the glacier disconnected from the ridge," said the paper's lead author, [Adrian Jenkins](#), a scientist at [British Antarctic Survey](#) and an adjunct at Lamont. "We do not know what kick-started the initial retreat from the ridge, but we do know that it started some time prior to 1970."

"Since detailed observations of Pine Island Glacier only began in the 1990s, we now need to use other techniques such as ice core analysis and computer modeling to look much further into the glacier's history in order to understand if what we see now is part of a long term trend of ice sheet contraction," said Jenkins. This work is vital for evaluating the risk of potential wide-spread collapse of West Antarctic glaciers." "We also need to keep track of and better understand the evolving ocean properties and circulation in the Amundsen Sea," adds Jacobs.

The research was funded by the U.S. National Science Foundation and the British National Environmental Research Council; Autosub was developed and built by the National Oceanography Centre in the U.K. Copies of the paper, "Observations beneath Pine Island Glacier in West Antarctica and implications for its retreat," are available from the study authors.

Read a news account of the study: [Glaciology: Beneath a floating ice shelf](#).

