

Glacier beds can get slipperier at higher sliding speeds

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Neal Iverson developed the Iowa State University Sliding Simulator to test how glaciers slide over their beds. Credit: Bob Elbert/Iowa State University

As a glacier's sliding speed increases, the bed beneath the glacier can grow slipperier, according to laboratory experiments conducted by Iowa State University glaciologists.

They say including this effect in efforts to calculate future increases in glacier speeds could improve predictions of [ice](#) volume lost to the oceans and the rate of [sea-level rise](#).

The glaciologists - Lucas Zoet, a postdoctoral research associate, and Neal Iverson, a professor of geological and atmospheric sciences - describe the results of their experiments in the *Journal of Glaciology*. The paper uses data collected from a newly constructed laboratory tool, the Iowa State University Sliding Simulator, to investigate glacier sliding. The device was used to explore the relationship between drag and sliding speed for comparison with the predictions of theoretical models.

"We really have a unique opportunity to study the base of [glaciers](#) with these experiments," said Zoet, the lead author of the paper. "The other tactic you might take is studying these relationships with field observations, but with field data so many different processes are mixed together that it becomes hard to untangle the relevant data from the noise."

Data collected by the researchers show that resistance to glacier sliding - the drag that the bed exerts on the ice - can decrease in response to increasing sliding speed. This decrease in drag with increasing speed, although predicted by some theoreticians as long as 45 years ago, is the opposite of what is usually assumed in mathematical models of the flow of ice sheets.

These are the first empirical results demonstrating that as ice slides at an increasing speed - perhaps in response to changing weather or climate - the bed can become slipperier, which could promote still faster [glacier flow](#).

The response of glaciers to changing climate is one of the largest potential contributors to sea-level rise. Predicting glacier response to

climate change depends on properly characterizing the way a glacier slides over its bed. There has been a half-century debate among theoreticians as to how to do that.

The simulator features a ring of ice about 8 inches thick and about 3 feet across that is rotated over a model glacier bed. Below the ice is a hydraulic press that can simulate the weight of a glacier several hundred yards thick. Above are motors that can rotate the ice ring over the bed at either a constant speed or a constant stress. A circulating, temperature-regulated fluid keeps the ice at its melting temperature - a necessary condition for significant sliding.

"About six years were required to design, construct, and work the bugs out of the new apparatus," Iverson said, "but it is performing well now and allowing hypothesis tests that were formerly not possible."

More information: *Journal of Glaciology*,
www.igsoc.org/journal/61/225/j14j174.html

Provided by Iowa State University

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