Alaska's iconic Columbia Glacier expected to stop retreating in 2020, study finds

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The wild and dramatic cascade of ice into the ocean from Alaska's Columbia Glacier, an iconic glacier featured in the documentary "Chasing Ice" and one of the fastest moving glaciers in the world, will cease around 2020, according to a study by the University of Colorado Boulder.

A computer model predicts the retreat of the Columbia Glacier will stop when the glacier reaches a new stable position—roughly 15 miles upstream from the stable position it occupied prior to the 1980s. The team, headed by lead author William Colgan of the CU-Boulder headquartered Cooperative Institute for Research in Environmental Sciences, published its results today in *The* Cryosphere, an open access publication of the European Geophysical Union.

The Columbia Glacier is a large (425 square miles), multi-branched glacier in south-central Alaska that flows mostly south out of the Chugach Mountains to its tidewater terminus in Prince William Sound.

Warming air temperatures have triggered an increase in the Columbia Glacier's rate of iceberg calving, whereby large pieces of ice detach from the glacier and float into the ocean, according to Colgan. "Presently, the Columbia Glacier is calving about 2 cubic miles of icebergs into the ocean each year—that is over five times more freshwater than the entire state of Alaska uses annually," he said. "It is astounding to watch."

The imminent finish of the retreat, or recession of the front of the glacier, has surprised scientists and highlights the difficulties of trying to estimate future rates of sea level rise, Colgan said. "Many people are comfortable thinking of the glacier contribution to sea level rise as this nice predictable curve into the future, where every year there is a little more sea level rise, and we can model it out for 100 or 200 years," Colgan said.

The team's findings demonstrate otherwise, however. A single glacier's contribution to sea level rise can "turn on" and "turn off" quite rapidly, over a couple of years, with the precise timing of the life cycle being difficult to forecast, he said. Presently, the majority of sea level rise comes from the global population of glaciers. Many of these glaciers are just starting to retreat, and some will soon cease to retreat.

"The variable nature and speed of the life cycle among glaciers highlights difficulties in trying to accurately predict the amount of sea level rise that will occur in the decades to come," Colgan said.

The Columbia Glacier was first documented in 1794 when it appeared to be stable with a length of 41 miles. During the 1980s it began a rapid retreat and by 1995 it was only about 36 miles long. By late 2000 it was about 34 miles long.

The loss of a massive area of the Columbia Glacier's tongue has generated a tremendous number of icebergs since the 1980s. After the Exxon Valdez ran aground while avoiding a Columbia Glacier iceberg in 1989, significant resources were invested to understand its iceberg production. As a result, Columbia Glacier became one of the most well-documented tidewater glaciers in the world, providing a bank of observational data for scientists trying to understand how a tidewater glacier reacts to a warming climate.

Motivated by the compelling imagery of the Columbia Glacier's retreat documented in the Extreme Ice Survey—James Balog's collection of time-lapse photography of disappearing glaciers around the world—Colgan became curious as to how long the glacier would continue to retreat. To answer this question, the team of researchers created a flexible model of the Columbia Glacier to reproduce different criteria such as ice thickness and terminus extent.

The scientists then compared thousands of outputs from the computer model under different assumptions with the wealth of data that exists for the Columbia Glacier.

The batch of outputs that most accurately reproduced the well-documented history of retreat was run into the future to predict the changes the Columbia Glacier will most likely experience until the year 2100. The researchers found that around 2020 the terminus of the glacier will retreat into water that is sufficiently shallow to provide a stable position through 2100 by slowing the rate of iceberg production.

The speediness of the glacier's retreat is due to the unique nature of tidewater glaciers, Colgan said. When warming temperatures melt the surface of a land glacier, the land glacier only loses its mass by run-off. But in tidewater glaciers, the changes in ice thickness resulting from surface melt can create striking changes in ice flow, triggering an additional dynamic process for retreat.

The dynamic response of the Columbia Glacier to the surface melt will continue until the glacier reaches its new stable position in 2020, at roughly 26 miles long. "Once the dynamic trigger had been pulled, it probably wouldn't have mattered too much what happened to the surface melt—it was just going to continue retreating through the bedrock depression upstream of the pre-1980s terminus," Colgan said.

Colgan next plans to attempt to use similar models to predict when the Greenland glaciers—currently the major contributors to sea level rise—will "turn off" and complete their retreats.

The future for the Columbia Glacier, however, looks bleak. "I think the hope was that once we saw climate change happening, we could act to prevent some irreversible consequences," Colgan said, "but now we are only about eight years out from this retreat finishing—it is really sad. There is virtually no chance of the Columbia Glacier recovering its pre-retreat dimensions on human time-scales."

More information: www.the-cryosphere.net/6/1395/2012/

Provided by University of Colorado at Boulder