

The Retreat of the Gualas Glacier



WHOI scientist Sébastien Bertrand led an expedition to Chilean Patagonia to investigate retreating glaciers. Below, the positions of the Gualas Glacier in 1898 and 1944 are superimposed on a false-color satellite image showing the glacier in 2010.

Photo courtesy of Dr. Claudia Silva

Like many mountain glaciers, the Gualas Glacier in the Patagonian region of Chile has retreated fast during the past century in the face of climate change. But not only for the reason you'd first suspect.

The glacier's retreat—5.5 miles over the past 110 years and 1.7 miles in the past 25 years—is a not primarily a result of melting caused by warming air temperatures. It is being driven by less snow falling on the glacier to replenish the river of ice flowing to the sea.

An international research team led by Sébastien Bertrand, a postdoctoral scientist at Woods Hole Oceanographic Institution (WHOI) and the University of Ghent, came to this surprising conclusion after extensive geological and historical detective work. The scientists extracted a 50-foot-long core of sediments that had settled on the seafloor after being bulldozed by the glacier into a fjord over the past 5,400 years. They painstakingly analyzed the sizes of particles and the concentrations of chemical elements in the sediments—evidence they used to reconstruct when the glacier had advanced and retreated.

The researchers then compared their glacial timeline with other records from nearby fjords and lakes not affected by the

glacier's runoff. Organic compounds preserved in fjord sediments provided a record of past ocean temperatures. Pollen counts in lake sediments indicated times when vegetation, and therefore precipitation, had changed in the past. Collating all the data, the scientists found that the glacier's shifts corresponded with trends in precipitation levels, not with temperature changes.

The study, published in March 2012 in the journal *Climate of the Past*, also incorporated research by Fernando Torrejón, a historian with the University of Concepción (Chile). He plumbed historical observations of early Spanish explorers, which confirmed the interpretation of the sediment record.

The Gualas Glacier, now 20 miles long with an area of 46 square miles, is one of 70 glaciers in the Northern Patagonian Icefield. The glaciers are fed by water that evaporates from the Pacific Ocean and is transported by westerly winds. The moist air hits the Andes Mountains and drops up to 33 feet of precipitation a year on the west side of the mountains.

Over the past 150 years, climate change has weakened snow-bearing westerly winds, causing a majority of glaciers on the Andes' western flanks to shrink, Bertrand said. Rising temperatures, however, may be



S. Bertrand et al., Neoglacial fluctuations of Gualas glacier, *Climate of the Past*

driving the retreat of glaciers on the eastern, or leeward, flank of the icefield.

Bertrand wants to investigate whether scientists can use fjord sediments to reconstruct glacial histories in other places around the globe and whether shifting snowfall patterns may be affecting glaciers in Alaska, Greenland, and New Zealand.

Understanding the fate of glaciers is not merely an academic exercise. Glaciers hold frozen water that otherwise would raise sea levels, and they are also a key source of water for drinking and agriculture for people in many parts of the world.

—Lonny Lippsett

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