Geophysical Research Abstracts
Vol. 19, EGU2017-5256-2, 2017
EGU General Assembly 2017

Glacier inventory and 1945-2016 area changes of Cloue Icefield in southernmost South America

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Due to the extreme remoteness and poor weather, scarce in-situ observations have been reported for the glaciers and icefields in southern South America, with most studies relying exclusively on aerial and satellite imagery. In this study, we combine field surveys of recent glacial landforms with analyses of archived aerial and contemporary satellite imagery to document the patterns of glacier change for the southernmost icefield in the Americas.

We visited the Cloue Icefield (55º10' S, 69º43' W) on Hoste Island (Chilean Tierra del Fuego) in March-April 2016, surveying glacier terminus positions, select terrestrial LIA moraines and recent recessional moraine systems. One glacier showed a well-preserved set of landforms indicating a recent glacial lake outburst flood (GLOF), which we surveyed and dated. In addition, we explored three undocumented fjords, conducting extensive bathymetric surveys to determine submarine moraine positions. Foul weather limited the research prospects during a ski-traverse across the icefield, but exemplified the extreme precipitation and wind-driven snow redistribution for which Tierra del Fuego-Patagonia is known.

We contextualise the observed glacial landforms with a multidecadal analysis of glacier change 1945-2016, using Trimetrogon (1945) and CORONA (1966) aerial images as well as the Landsat archive (1979-2016).

The icefield area was 255.9 km2 in 1945 and decreased in area by 16.3% by 2016 to cover 214.2 km2. One system of marine-terminating glaciers showed extensive retreat during 1945-1979, revealing entire new fjords, but exhibited static frontal positions for 1979-2016. Other marine-terminating glaciers showed static or oscillating terminus positions heavily influenced by local geometry. The icefield's land-terminating glaciers instead showed gradual shrinkage for the early period, and more enhanced retreat after 1979. During the later period, five glaciers formed large proglacial lakes, one of which experienced an outburst in 1998 to develop the landforms observed in the field.

The areal shrinkage rate for these glaciers (0.2% per year on average since 1945) and later acceleration in retreat is similar to changes observed for the Cordillera Darwin and Patagonian Icefields. This similarity occurs despite Cloue's very low altitudinal distribution (maximum altitude ∼1360 m), suggesting a very high balance flux sustaining the icefield. Importantly, much of Cloue's recent enhanced retreat is controlled by ice dynamics at marine or lacustrine boundaries. Future shrinkage for the icefield will likely be dominated by several major outlet glaciers, which have thinned extensively but have not initiated significant retreat due to geometry.