Seventy years of changes in the Gran Cachapoal glacier and its relationship with surge events.

Poster

Glaciología general

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The Gran Cachapoal Glacier is the second-largest glacier with ice cover and the sixth-largest and longest in the central Chilean Andes. It is a mostly ice-covered, active mixed glacier, with recent surge episodes (Lliboutry in Williams & Ferrigno, 1998; Iturrizaga & Charrier, 2013; Falaschi et al., 2018). It has small-scale inventories without delineation of surface cover. Surging in mountain glaciers is not a widely studied topic, making the development of surge event indicators particularly relevant, starting with a literature review of scientific articles and research on these processes in mountain glaciers of the humid Andes of Chile and Argentina. To build evidence of surge episodes in the glacier, this research comprised five stages, a design that enabled the acquisition of an extensive dataset (1955–2025) from aerial photographs, airborne SAR missions, and satellite imagery. Thru analysis using GIS techniques, it was possible to determine values for changes in area, volume, and mass, as well as the proportion of ice-covered and ice-free areas, and the mean surface velocity for the period 2013–2024. Unlike other studies in the humid Andes, the historical analog aerial photographs were processed using rigorous orthorectification techniques based on little-known optical parameters. Twenty-three inventories of outlines, fronts, and surface cover types were obtained. Unlike most mountain glaciers in the central Chilean Andes, which exhibit significant frontal retreat and mass loss, the Gran Cachapoal Glacier tends to advance at its front (on average 4.9 m/year) and gain mass (0.3 ± 0.9 m w.e./year), primarily in the ice-covered zone (2.1 ± 1.2 m

w.e./year) and, to a lesser extent, in the uncovered zone (0.4 ± 0.5 m w.e./year). Over a 64-year period, the glacier has accumulated a total volume of +63.2 × 10^6 tons per year, a trend that has been reversed in the subsequent five years. Moderate changes in surface elevation are accompanied by changes of similar magnitude in the ratio of ice-covered to ice-free areas on the glacier and in the position of the frontal moraine arc. Both processes can be indicative—but not conclusive—of surge episodes whose acceleration, stability, and deceleration cycles are reflected in the glacier's mass and volume balance. Regarding surface velocity, the accumulation zone with exposed ice always exhibits higher velocities (~0.28 m/day) compared to the ablation zone (0.23 m/day). However, the covered area exhibits greater variability, indicative of higher instability. The year 2014 was particularly interesting, with a maximum advance of 3.13 m/day and an average velocity of 3.4 m/day, where acceleration was concentrated in the ice–rock interaction zones of the accumulation area, coinciding with anomalous surface temperature values. This baseline of temporal changes in a mountain glacier proposes, as a projection of this work, the implementation of intensive monitoring based on GNSS observation plans and photogrammetric flights with UAS-VANT platforms equipped with LiDAR instruments to obtain surface cover and elevation data with sub-metric horizontal and vertical accuracies, inputs for modeling the glacier's trajectory.

Palabras Clave

(1) surge evidence, (2) geodetic mass balance, (3) glaciar Gran Cachapoal.