

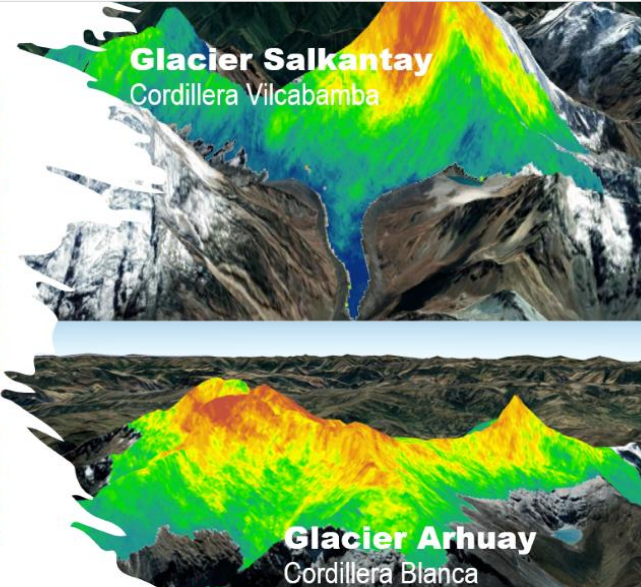
DInSAR monitoring of glacier dynamics in Cordillera Blanca and Vilcabamba

Christian Riveros Lizana, Raul Espinoza Villar, Harrison Jara Infantes, and Juan Carlos Torres Lazaro.

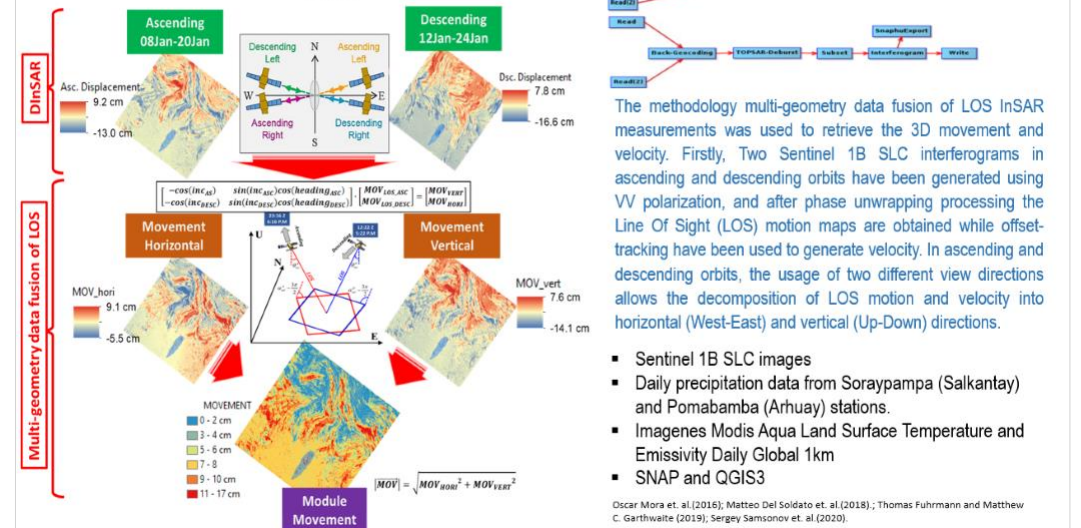
Abstract

The effects of climate change are causing atypical changes dynamics of tropical glaciers. Conventional methods and optical images were ineffective in measuring these changes periodically due to the complexity of remote mountainous regions and cloud cover. In this research, a Differential Interferometric Synthetic Aperture Radar (DInSAR) analysis has gone performed with Sentinel-1 data from February 2019 to March 2020 in the Cordillera Blanca and Vilcabamba and applying multi-geometry data fusion of LOS for Mapping movement and velocity. The measurements were compared with surface temperature and precipitation, providing zonal statistics to identify and assess regions associated with Glacial Lake Outburst Floods (GLOFs) hazards and enhanced understanding of the glacier dynamics in response to changing climatic conditions.

In complement, have been evaluated precipitation and surface temperature to understand the changes in the glacier surface where the combined analysis of both variables showed significant effects on velocity and movement. Also, the confluence of maximum values is closely related to the change in velocity, especially in the rockslide period of the Salkantay.



Methodology



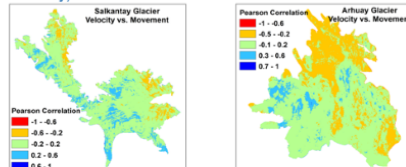
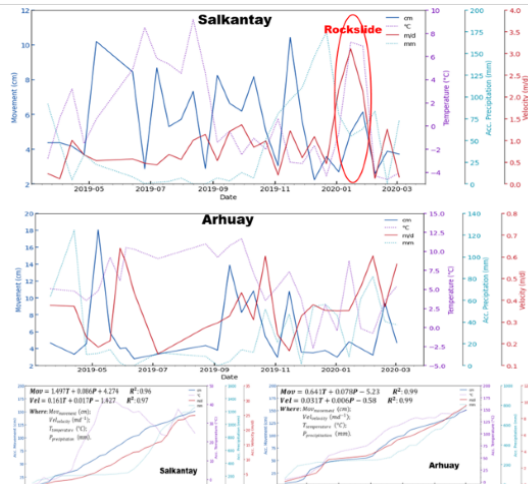
Results

Between May and August, the Salkantay glacier reached maximum surface temperature (9.2 °C) and minimum precipitation (0 mm). The movement showed no significant changes during this period, while the average velocity remained at 1.0 m.d⁻¹(-1).

Between January and February on the Salkantay glacier, precipitation reached a cumulative maximum of 175 mm, followed by the surface temperature, which reached a maximum (9.2 °C). During this period, the velocity reached its highest value reaching 3.1 m.d⁻¹(-1).

Between April and May, the Arhuay glacier reached maximum precipitation, movement, and velocity levels of 124 mm, 18.1 cm, and 0.6 m.d⁻¹(-1) respectively, while between June and September, it presented the highest levels of surface temperature with a maximum (11.7 °C). However, movement and velocity remained at their lowest values.

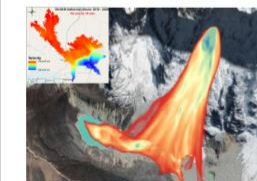
Multiple regression between accumulated values of temperature, precipitation, with dependent variables velocity and movement. Temperature showed the most significant variability, 89.2% (Arhuay) and 94.5% (Salkantay).



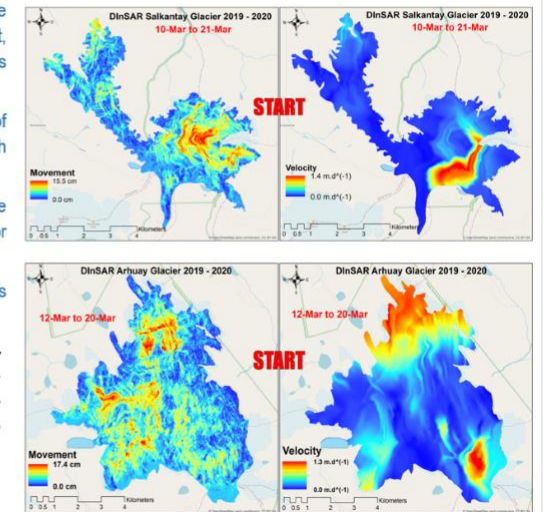
The Pearson correlation for velocity and movement is ± 0.2 over most of the glacier area, and the highest correlation values correspond to areas near the northeastern edges, with the Arhuay glacier showing the largest surface area with indices close to ± 0.6 .

Discussion and conclusion

- The individual analysis of precipitation or surface temperature does not significantly correlate with velocity and movement, respectively. However, the joint evaluation of these variables significantly explains both measurements.
- Velocity shows a significant response to the maximum values of precipitation and surface temperature for the same period for both glaciers.
- Velocity shows no significant variation in response to the maximum surface temperature values occurring in summer for both glaciers.
- The movement shows no significant response to extreme values of precipitation and surface temperature for both glaciers.



The unusual velocity recorded on January 15 was probably the trigger for the GLOF that happened due to the rockslide on February 23, 2020.



<https://christianriveros.com>