# Glacier change in the Andes

**Study of surface elevation change and velocities at Tapado glacier complex in Chile between 2012-2020. Study showed decrease in surface elevation and noticeable movement after eight years.**

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## ABSTRACT

The Tapado glacier complex in Chile is located 30 $^{o}$ South in the Andes around 5500 meters (m) above sea level. The area consist of the Tapado glacier, debris covered glaciers and rock glaciers. Study by Poussier *et al.,* (2014) showed that the complex provides lower areas with water during the summer season. Therefore, it is important to investigate the surface elevation change and velocity of the complex.

## Methods and Data

The results of this study were obtained using DEM comparison for surface elevation changes and use of high-resolution satellite data for feature tracking. The 2012 data is from Geoeye (1$^{st}$ of March) and the 2020 data comes from Pléadis (1$^{st}$ of March) and came from Airbus. It is raw tri-stereo data with included RCP files. The workflow is outlined in figure 1.

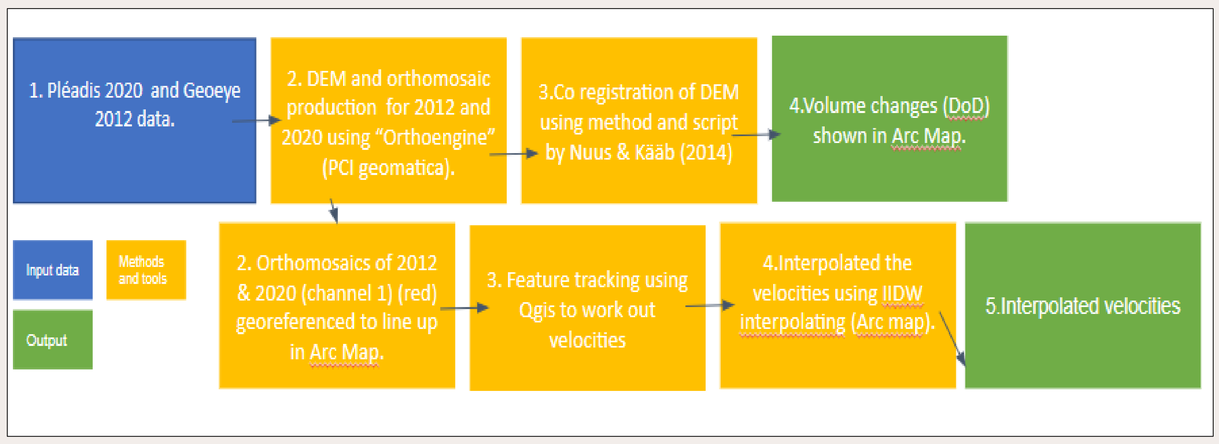


**Figure 1.** The methods and data used for velocity and surface elevation changes.

## Results

Figure 2 shows how the displacement was reduced in the co-registration process. The elevation changes the most. Figure 3 shows a negative surface elevation change , figure 4 the velocity of the glacier complex. Histogram in figure 5 explains the velocities in figure 4 and shows a displacement of mean 5.68 m and a standard deviation (SD) of 3.32 m during an eight-year period.

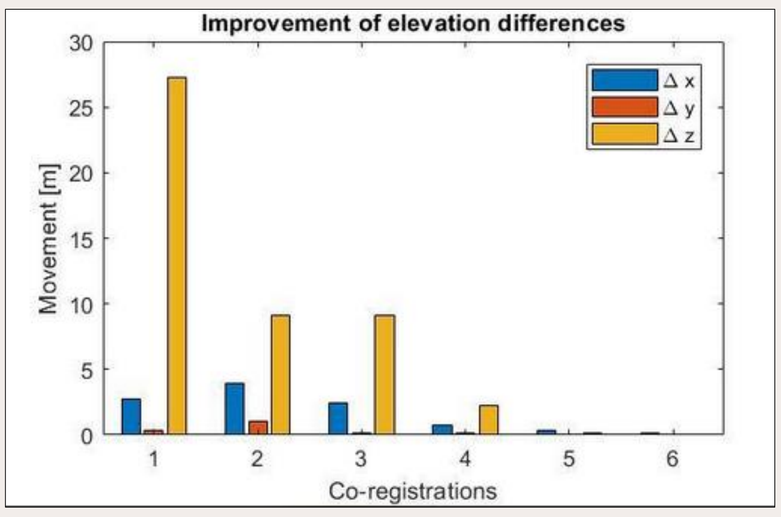


**Figure 2 .** Improvement after co-regetration 6 times. Elevation difference is the Δ z value.

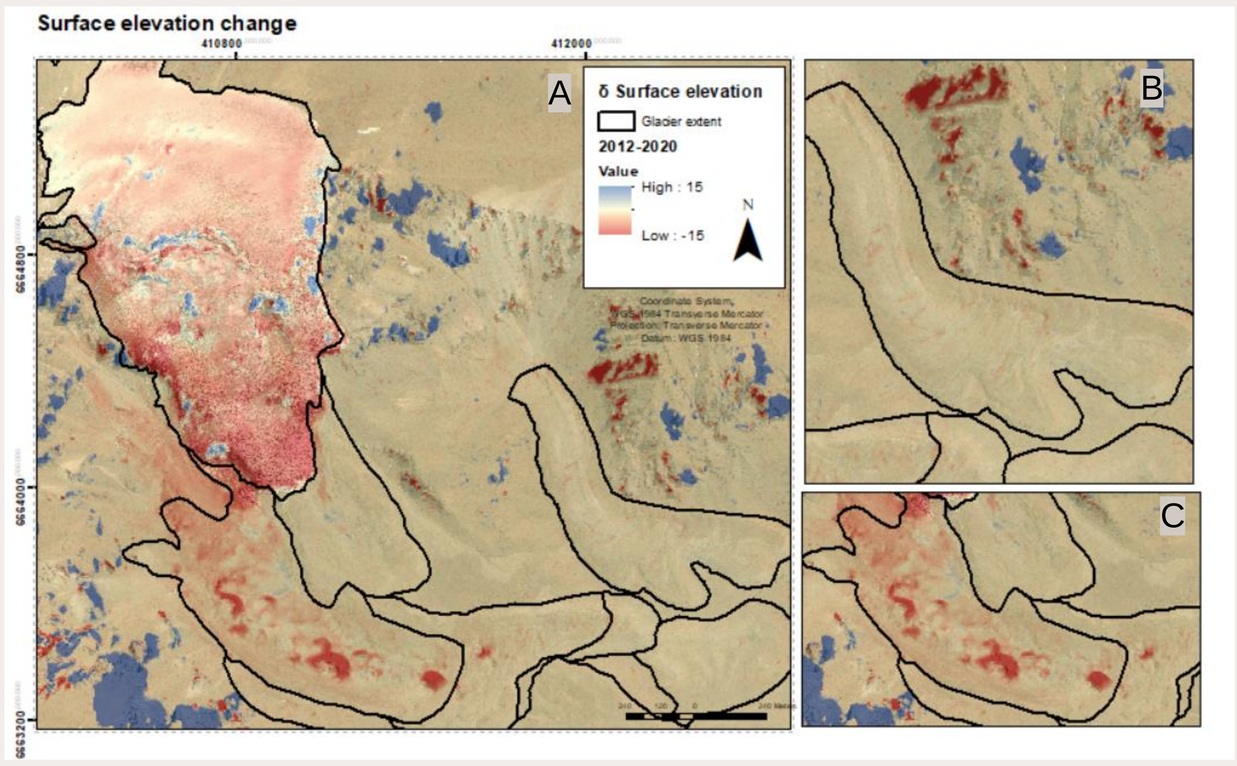


**Figure 3.** Surface elevation change over Tapado glacier complex. Red areas indicate loss and blue gain. A) Tabado glacier, B) Rock glacier and C) Debris coverd glacier.

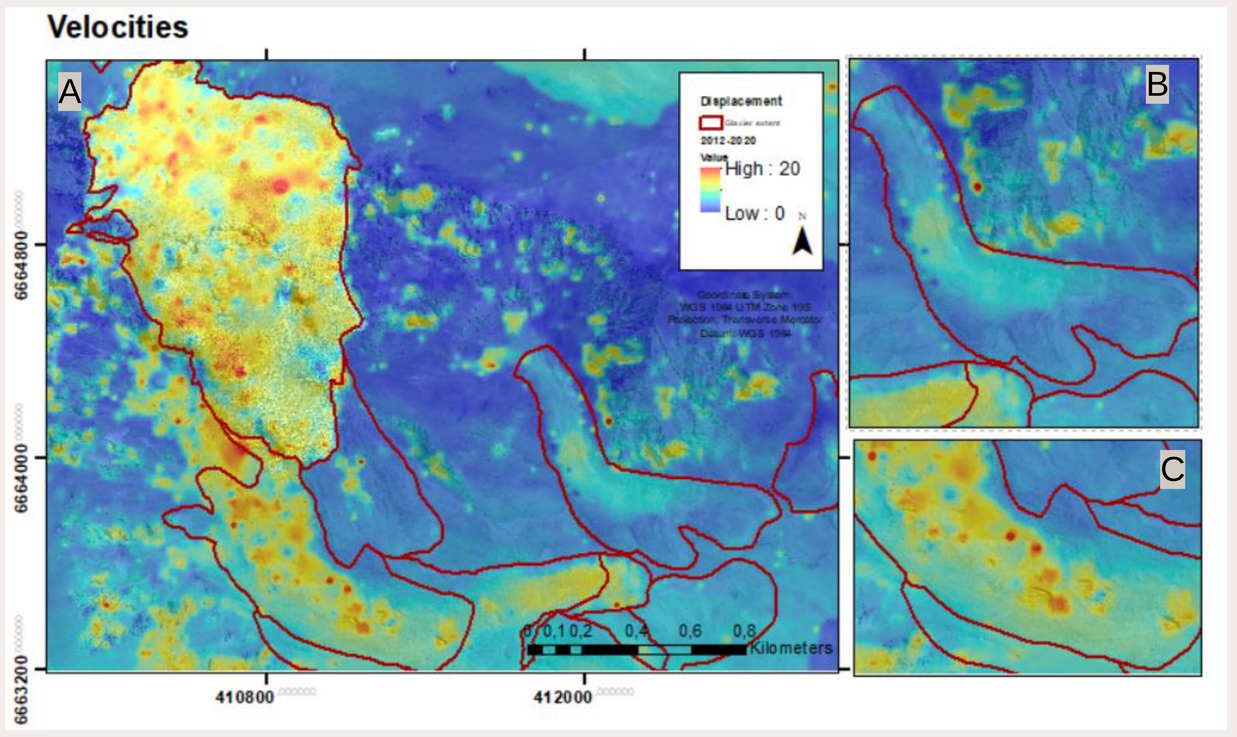


**Figure 4.** Velocities over Tapado glacier complex. Red areas indicate loss and blue gain. A) Tabado glacier, B) Rock glacier and C) Debris covered glacier- Red raster indicate the highest velocities.

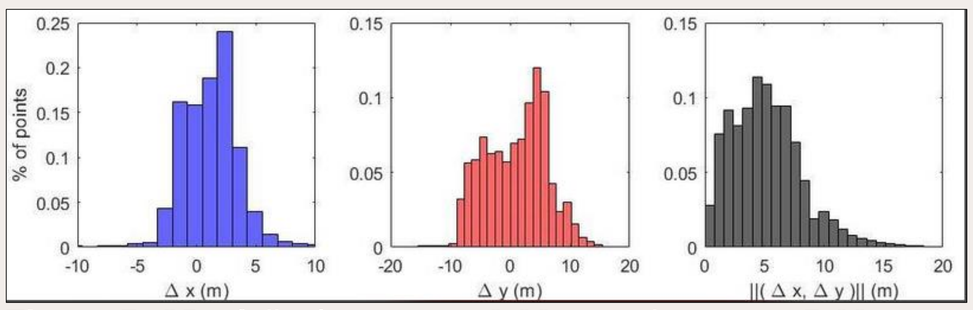


**Figure 5**. SD of displacement : 3.32 m and a mean: 5.68 m.

## Discussion

Some areas in figure 3 have been misinterpreted as areas with increase which is inaccurate due to their positions. These are likely areas where the satellites failed to acquire data. Figure 4 is probably biased towards overestimating the velocities due to the precision of the georeferencing. The accuracy of fig 3 is relatively high due to good co-regisrtation (figure 2).

## Conclusion and future studies

Though some uncertainties about the absolute values the glacier complex is shrinking. More accurate georeferencing should be made when extracting the velocity points. The data could be compared to InSAR- or ground data or data acquired in the field to estimate the accuracy of the velocity data method.

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**REFERENCES**

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