



Mass balance evolution on two glaciers in the ecuadorian Andes (0°28'S) since the mid-20th century

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The glacier mass balance evolution on two glaciers (Antisana Glacier 12 and Antisana Glacier 15 α) in the tropical Andes is presented. To this end, photogrammetry technique was applied on aerial images taken at five dates: 1956, 1965, 1979, 1997 and 2009. For each date, digital elevation models (DEMs) were generated with an average vertical accuracy of ± 2.2 m. The spatiotemporal volume variation of the glaciers is calculated through the elevations differences between DEMs and a density factor. The outcomes show that after 1970s the glaciers have experimented a strong recession even if a noticeable increase in mass was detected between 1965 and 1979. From 1979 to 1997, the ablation rates have dramatically increased and the average annual mass balance reached very negative values (-1.1 m w.e. yr⁻¹ for Antisana Glacier 15 α and -0.8 m w.e. yr⁻¹ for Antisana Glacier 12). In the last study period, from 1997 to 2009, the glaciers average annual mass balances were less negative (-0.6 m w.e. yr⁻¹ for Antisana Glacier 12 and -0.2 m w.e. yr⁻¹ for Antisana Glacier 15 α). The later matched with the period of conventional observations allowing compare the results given by both methodologies, i.e. geodetic and glaciological methods. However, some morphological constraints affecting the figures observed in the glaciological mass balance must be considered. Finally, we performed an analysis of the relationship between the glacier changes and the climate conditions over the study periods in order to understand how climate has impacted the glacier retreat in this region. For such an aim, local climate variables, i.e. temperature and precipitation, as well as regional indices, i.e. Pacific Decadal Oscillation (PDO) and Multivariate ENSO Index (MEI) have been used. The outcomes show a high correlation between the climate signals and the glacier behavior at both annual and decadal time scales.