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Application of terrestrial scanning LIDAR to study the evolution of surface change of Quisoquipina Glacier in the Cordillera Vilcanota, Cusco – Peru

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Tropical glaciers are highly sensitive to alterations in climate and therefore good indicators for global climate change. Glaciers located in Peru represent more than 71% of all tropical glaciers in the world, and have shown a significant area reduction of about 43% within the last 40 years mainly due to the increase in surface temperature. Tropical glaciers play a particular role as freshwater reservoirs and buffers to river discharge variability and water scarcity within a pronounced wet and dry season. Their monitoring is extraordinarily important.
The Cordillera Vilcanota, at the origin of the Rio Vilcanota - Urubamba, contains about 25% of all glaciers in Peru. In recent decades, glacier shrinkage has accelerated in this mountain range. Between 1988 and 2010, glacier area was reduced at an annual rate of about 4 km2 (1.1 %) from some 360 km2 to about 270 km2 (25%). A total volume loss of 40-45% (from 17-20 km3 to 9.2-12.4 km3) can be estimated for the period 1962-2006, with an accelerated rate since the 1980s.
Terrestrial scanning LIDAR (Light Detection And Ranging) surveys represent nowadays the most powerful tool to accurately map its inaccessible glacier surfaces. A laser scanner enables researchers to capture laser range data at a rate of thousands of x, y, z and laser-intensity points per second; such data can be used to construct a very accurate 3D model of the surveyed surface.
In this study we used a terrestrial LiDAR scan and an airborne laser scan from 2013 for intensively monitoring the changes occurred at volume and front glacier of the Quisoquipina glacier. In August and October 2015, August and December 2016, and May 2017 five terrestrial scanning LIDAR surveys have been carried out in order to monitor the evolution of the glacier. The comparison between repeated surveys showed significant retreats in the front, area and volume at the glacier (lost volume 465000 m3 between April 2013 and May 2017, in 80812 m2 of area of study).