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An assessment of the influence of active volcanism on the glacier equilibrium line altitude in the Andes

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Volcanic activity beneath the ice poses a great socioeconomic hazard and its hydro-glaciological response may drastically influence the security and livelihood of mountain communities, enforcing the pronounce impacts on the ongoing climate change. Clearly volcanic activity might have a profound influence on glacier retreat, stability and viability and until recently the impact of active volcanoes on modern glaciers has been very poorly understood. Direct human access to ice-clad volcanoes is logistically difficult and hazardous, thus remote sensing techniques for undertaking monitoring programs are highly relevant. Understanding the relative sensitivity of the glacier equilibrium line altitude to subglacial volcanic forcing across different climatic regimes along South American Cordillera is investigated. Volcanic activity may have has significant impact on glacier stability. It is hypothesized that the ELA of glaciers situated on volcanos (VG) will be higher than non-volcanic glaciers (NVG) in a region due to the higher geothermal heat flux. In this study 51 out of 69 glacio-volcanic centers in the Andes have been analyzed along a latitudinal transect of the Andean Volcanic Arc (AVA). The methods used for this project combine various remote-sensing techniques applied in a GIS utilizing the recognized volcanic (Global Volcanism Programme), glacier outlines (Randolph Glacier Inventory 6.0), and heat-flow (American Association of Petroleum Geologists) datasets and eruption activity information in order to determine ΔELA variation between VGs (<1km from the vent) and NVGs (<10km from the vent). This regional study analysed 1001 glaciers (of size greater than 0.3 km^2) and calculated their ELA based on assumed BR ratios (1.75), allowing a regional comparison. The ELA has been calculated using RGI outlines and freely available DEMs, using an ELA-calculation-toolbox in ArcGIS. This study presents the regional variation of glacier ELA and volcanic-nonvolcanic ΔELA across Andean Mountain Range (4°N-41°S). The ELA on VGs shows a significant increase from the regional ELA exceeding 800m in north and centre of the region. Regional change of ΔELA is cross-plotted against eruption history geothermal heat flux, in order to determine the controls on ΔELA parameter. This study quantifies the influence of volcanic activity on the ELA of glaciers in the Andes.