

Assessing glacial lake outburst flood hazard in the Bolivian Andes

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This study assesses the potential hazard posed by glacial lake outburst floods (GLOFs) in the Bolivian Andes. Tropical glaciers of the Andes are shrinking rapidly in response to climate warming. Our mapping from satellite imagery reveals glacier areal shrinkage of ~40% between 1986 and 2014 across the Bolivian Andes. Many such glaciers recede into rock basins or behind terminal moraines where meltwater can pond (Figure 1). These lakes burst if moraine dams fail and/or if water is displaced by ice or rock avalanches from surrounding valley walls. Resultant floods can cause fatalities and damage to homes and infrastructure. GLOFs in Bolivia represent an emerging threat, but have received almost no research attention. In 2009, a glacial lake above the village of Keara burst. Fortunately, this GLOF did not result in human casualties, but cultivated fields were flooded, a local dirt road was destroyed, leaving Keara without road communication for several months, pedestrian bridges were washed away, and several farm animals were killed.

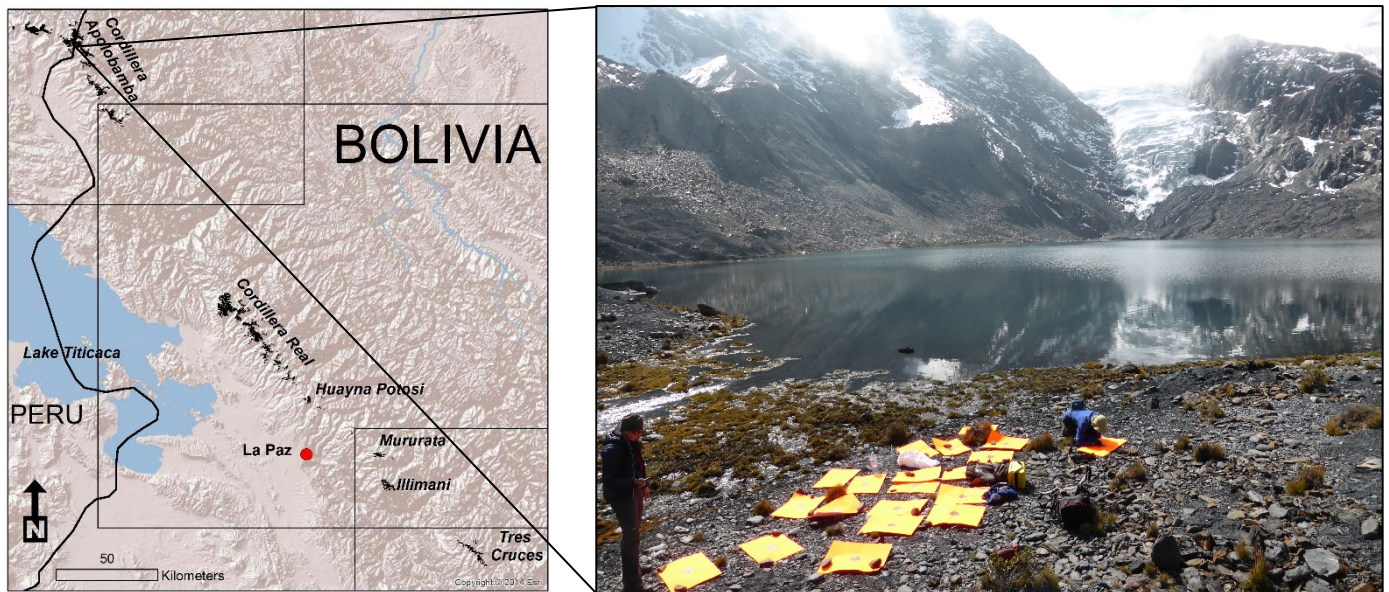


Figure 1: Left - Location of the study site, Pelechuco, within the Bolivian Andes. Dark areas indicate current glacier cover. Right – setting up a structure-from-motion survey at Pelechuco lake.

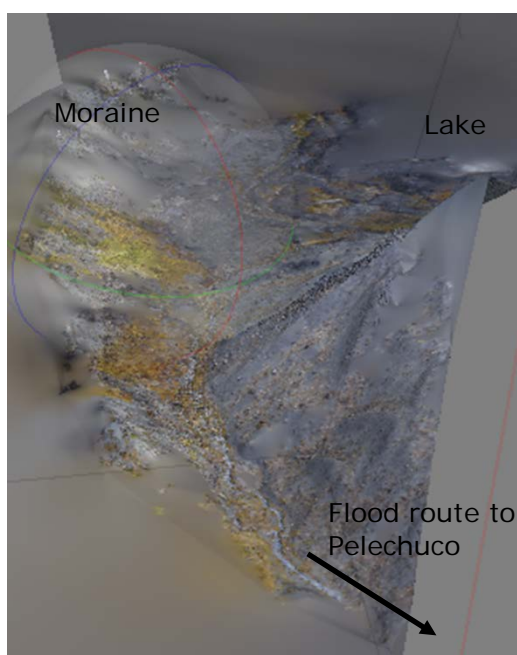


Figure 2: SfM model of Pelechuco lake and the immediate proglacial zone.

Funding from the BSG facilitated a field visit to a potentially dangerous glacial lake near the villages of Agua Blanca and Pelechuco in the Apolobamba region, northern Bolivia (Figure 1). The principal objective of the field campaign was to obtain survey data using Structure-from-Motion (SfM) in order to construct a digital elevation model (DEM) of the proglacial area and potential flood route, as well as investigate the nature of the moraine dam. Ground control for the survey was provided by using a dGPS system to record the positions of brightly coloured cardboard targets that were distributed across the proglacial zone (Figure 1). Imagery was acquired from a consumer-grade digital camera from high points around the proglacial zone and loaded into Agisoft Photoscan to generate a topographic model (Figure 2). Inspection of the impounding moraine revealed that it was ice-cored, and the valley slopes surrounding the lake had the potential to shed ice, snow and rock into the lake.

Our BSG-funded field visit has been instrumental in securing a funded PhD studentship from Manchester Metropolitan University to model potential GLOF risks, and to use the results of this study to understand GLOF risks to Pelechuco and other settlements in Bolivia.