



Monitoring rock glacier dynamics and ground temperatures in the semiarid Andes (Chile, 30°S)

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Rock glaciers and mountain permafrost are widespread in the high semiarid Andes of Chile, where they concentrate greater amounts of ice than glaciers. Rock glaciers are of particular interest because in some cases the permafrost they contain might be in a degrading in response to climatic warming. This could result in increased dynamics and even to destabilization, which has been observed on some rock glaciers in the studied area. Displacement rates and active-layer temperatures of two rock glaciers as well as ground surface temperatures of the periglacial environment in the upper Elqui valley have been monitored since summer 2009/10 with funding from the Chilean Dirección General de Aguas.

Differential GPS measurements of 115 points on the surface of two rock glaciers since April 2010 showed horizontal displacements of up to 1.3 m/a on the Llano de las Liebres rock glacier and up to 1.2 m/a on the Tapado rock glacier. General velocity patterns are consistent with the morphological evidence of activity (e.g., front slopes, looseness of debris) and for the Tapado complex, a clearly distinct activity from the debris-covered glacier was observed. Temperature measurements in four boreholes indicate active-layer depths of about 2.5 m at the highest locations on the Tapado rock glacier (~4400 m a.s.l.) and about 8 m near the front of the Llano rock glacier (3786 m a.s.l.).

Spatial patterns of mean ground surface temperature (MGST) were analyzed with regards to influences of elevation, potential incoming solar radiation, location on ice-debris landforms (rock and debris-covered glaciers), and snow cover duration using linear mixed-effects models. While accounting for the other variables, sites with long-lasting snow patches had ~0.4°C lower MGST, and ice-debris landforms had ~0.4-0.6°C lower MGST than general debris surfaces, highlighting important local modifications to the general topographic variation of ground thermal conditions.