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# Landslides as climate indicators in the Central Andes

S. Moreiras, R. Villalba, V. Olmedo and A. Diaz

Consejo Nacional de Investigaciones Científicas y Tecnológicas (CONICET). Instituto Argentino de Nivología, Glaciología y Ciencias Ambientales (IANIGLA) - CRICYT. Av. Dr Ruiz Leal s/n. Parque (5500). Mendoza. ARGENTINA. Casilla Correo 330. Tel: +54-061-5244234/4200. Fax: +54-0261-5244201. moreiras@lab.cricyt.edu.ar

In the Central Andes of Argentina, summer rainstorms are a major forcing of landslide occurrence. Although landslides are also triggered by earthquakes, more than 480 rainfall-induced events have been identified along the Mendoza river (32º S) in the past century. Debris-flows and rockfalls due to water crack filling or saturation are the most common processes.

Daily precipitation records suggest a relative low rainfall threshold (6.5 – 12.9 mm) for landslide occurrence. This low threshold could partially be explained by the reduced amount of annual precipitation (300 mm) and the abundant generation of debris in these mountain areas. However, meteorological records are scarce in the region limiting a precise determination of the threshold values. Moreover, antecedent precipitation is important. If a 5-day precipitation window previous to the landslide events is taken in account, the mean values of accumulated rainfall reach to 28 mm.

Temporal variations in landslide occurrence are related to climatic anomalies linked to the Pacific (ENSO) and Atlantic Oceans. In the Cordillera Frontal, landslides triggered by rainfall are common during El Niño years, decreasing in number during La Niña events. In contrast, slope instability in the Precordillera, located east of the Cordillera Frontal, rises during wet periods induced by the incursion of wet air masses from the Atlantic. Not significant differences were recorded between cold-warm ENSO events in the Precordillera.

The relationships between landslide occurrence in the Cordillera Frontal and Precordillera with climatic anomalies induced by the Pacific and Atlantic oceans respectively, suggest the possibility of using the landslide chronologies in the Central Andes as a geo-indicator of global climate change. Rockfall and debris-flow recurrence

has increased during the last three decades due to both precipitation and temperature increases. In addition, higher temperatures have increased the proportion of rain in relation to snow precipitation, which in turn affect hill-slope instability.

General Circulation Models (GCM) simulate an increased summer influence of the Atlantic wet air masses on the Precordillera during the XXI century. In contrast, for the same interval, the GCMs predict a reduction of winter snow across the main Cordillera (Principal and Frontal). According with our findings, landslide frequency would increase in the Precordillera during the XXI century, whereas the number of event may decrease in the main Cordillera. However, changes in the snow/rainfall ratio need also to be evaluated across the region to improve our understanding on landslide regimes along the XXI century. Future changes in regimes should be considered to properly evaluate the impact of landslides on regional socio-economic activities.