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Climatological and meteorological conditions associated with rain-induced periglacial debris flows in the Cascade Range, USA

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In November of 2006 an intense rainstorm of tropical origin, known colloquially as “Pineapple Express,” inundated the Pacific Northwest region of the United States, initiating numerous periglacial debris flows on several of the stratovolcanoes in the Cascade Range of Oregon and Washington. Rain-induced periglacial debris flows are the result of the over-saturation and subsequent collapse of steep moraine in formerly glaciated valleys. These debris flows rapidly aggrade channels, deposit thick sediments in their path, and severely damage infrastructure.

Here we focus on Mount Hood, Oregon and Mount Rainier, Washington in the investigation of meteorological and climatological conditions surrounding rain-induced periglacial debris flow events and their variability over time. Both anecdotal and observational evidence suggest that the Pineapple Express storms are a likely triggering mechanism for these rain-induced debris flows on the stratovolcanoes. Dates for the debris flow events for each mountain were linked with corresponding Pineapple Express storm events. Preliminary analysis suggests that one or more particular climatological or meteorological conditions may be central to the initiation of debris flows, though these conditions may not always be present during Pineapple Express storms. Antecedent snowpack conditions are also hypothesized to play an important role in periglacial rain-induced debris flow initiation as the presence of snow cover on the moraines and glaciers is thought to reduce the likelihood of a debris flow.

Radiosonde and precipitation data from Salem, Oregon (KSLE) and Quillayute, Washington (KUIL) data are used to determine if freezing levels and precipitation amounts have changed over time for all documented Pineapple Express events. Particular focus is placed on those events associated with debris flows. Additionally, Snowpack Telemetry (SNOTEL) data are used to examine the antecedent snowpack conditions for each debris flow event.

These results will ultimately be coupled with research concerning the geomorphological mechanisms behind debris flows on stratovolcanoes in the Cascades, and may lead to improved understanding and future projections concerning the timing, frequency and intensity of rain-induced periglacial debris flow events.