

A thermokarst-related debris flow event at an active rock glacier in the Ötztal Alps (Tyrol, Austria)

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On 13 August 2019, a debris flow eroded the front of an active rock glacier and dammed the main river of Radurschl Valley (Ötztal Alps, Austria). Failure initiated in ice-cemented debris, in response to the outburst of an upstream meltwater lake through newly developed thermokarst channels that transferred substantial amounts of water to the rock glacier front. Analyzing a set of potentially destabilizing factors indicates that permafrost degradation and rapid thermokarst evolution within the rock glacier initiated the sequence of cascading events, comprising lake outburst, slope failure, debris flow development, and river blockage. The critical combination of topographical and sedimentological disposition at the rock glacier front, a high-energy environment favoring permafrost degradation, as well as climate and weather patterns promoting melting processes facilitated the initiation and development of the process chain. Identification and evaluation of these factors demonstrates the potential of rapid thermokarst evolution to induce highly hazardous situations at short time scales and highlights the need to account for permafrost degradation in debris flow hazard assessment studies in periglacial, mountainous environments.