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Can we use the Timing of 2003 Rockfall from Alpine Permafrost Areas to learn about their Release Mechanisms?

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During the extremely hot and dry summer of 2003 a large number of rock fall events originated from the zone of Alpine permafrost. These events are hypothesized to result from a deepening of the active layer into the underlying permafrost, thawing for the first time rock volumes that have remained frozen for long time spans. Because the maximum depth of thaw is usually retarded by several months, one would expect these events to take place in autumn or early winter. However, it is striking that many of those events occurred during the peak of the heat-wave in July and August. This fact hints at the possibly large role of advective heat transport by water in fractures. Investigating this is of importance for the capability to simulate future potential release areas because pure heat conduction can much better be simulated than heat transfer with additional advective transport. Simulated surface and subsurface temperature time series from 1982 to 2004 are used to investigate if pure heat conduction can explain the timing of observed rock fall. The uncertainty of rock thermo-physical parameters and water content are considered using a Monte-Carlo simulation of the 1-dimensional subsurface heat flow. The timing of thaw depths greater than 1982-2002 for different elevation zones is compared to the timing of observed events. Results show that a large part of the events cannot be explained by pure conduction and thus underline the importance of understanding advective fluxes in steep bedrock permafrost. This analysis is currently further constrained with transient 2-dimensional models to investigate the influence that 2-sided warming on ridges may have on the timing of 2003 active layer deepening.