

How ice apron loss and permafrost degradation promoted the Plattekogel rock slope failure: A thermo-mechanical reconstruction

Revised paper submitted to Earth Surface Dynamics

by

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The authors present an extraordinarily rich and differentiated thermomechanical modelling exercise about climate-induced effects of disappearing frozen-on surface ice (ice aprons) and permafrost degradation on the pre-failure destabilisation of a rock wall in the Austrian Alps. Their contribution received public critical-constructive feedback from two optimally qualified experts. The authors responded in detail. The manuscript was adjusted and improved accordingly.

The analysed rock slope failure relates to a moderate-size case, which was not directly observed. The main emphasis of the modelling is therefore less on the specific event itself but primarily on a discussion about possible preparative to finally triggering conditions and processes. With the integration and detailed treatment of the interacting thermo-mechanical aspects including water, the analysis is highly complex and quite difficult to read. However, it represents an important improvement of our quantitative understanding concerning a severe impact of climate change on cold mountains with their frozen rock walls: It is neither permafrost thawing alone nor permafrost warming alone but the degradation of permafrost and surface ice in its full complexity including permeability and water which has the potential to decisively affect the stability of icy peaks.

The frequency of rock-ice avalanches from permafrost rock walls in cold mountains seems to be increasing. Individual events are thereby always a combined result from topographic, geological and ice/water aspects. However, climate-induced ice and permafrost changes alone have the time scale (decades) which corresponds to the recently increasing frequency of smaller and larger events. The careful analysis in the submitted revised paper constitutes an important step forward in our understanding of this quite worrying evolution. I fully recommend its publication.

The attached annotated file contains some minor comments, to which the authors can respond in their own responsibility.