Submitted Abstract

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Abstract

The rock slope instability at Spitze Stei located in the Swiss Alps, near the village Kandersteg, might trigger one of the largest cascading processes chain in the recent history of the European Alps. The geological disposition causes a long-term retrogressive rock slope instability, whose past activity is assumed to have been influenced by climate change. In case of failure, up to more than 12 Mio m3 will impact an older rockslide deposit and may also affect the nearby Öschinensee lake, a popular tourist attraction. Immediate debris flow activity, affecting populated areas downstream, has to be expected following a rock slope failure.

We analyse possible process chains initiated at this site. This analysis will start from a high-resolution characterization of the meteorological-climatological forcing which includes both, short-term extreme weather and long-term climatological changes. Snow cover, precipitation and long-term temperature evolution are crucial factors for the initiation and progression of cascading mass wasting processes.

The destabilisation mechanism of the rock slope, considering the role of changing permafrost, will be described by a thermo-mechanical model. Laboratory experiments on rock samples collected at the instability are used to determine rock mechanical parameters. A kinematical model of the slope provides the geometrical information on the instable rock compartments. Resulting failure scenarios will be used as an input to simulate the dynamics of the following rock avalanche using two different modelling approaches (RAMMS & MPM), including entrainment of snow, and (variably saturated) sediments. The MPM approach will be further used to assess the potential impacts of the rock avalanche on the lake.

The project will also investigate the conditions leading to the initiation of debris flows following a rock avalanche event. This analysis considers the potential sediment liquefaction during the impact on all sediment deposits along the flow path. Possible debris flows scenarios will be simulated using RAMMS, with a special focus on the contribution of sediment entrainment under different weather conditions such as degree of saturation, streamflow, or snow cover along the flow path.

Our investigations are embedded within the CCAMM project cluster Cascading Processes, which addresses the hazard risk caused by process chains in alpine regions. We want to improve knowledge on the initiation, dynamics, and controlling factors of sediment cascades related to rapid mass movements. Hereby, the example of the Spitze Stei rock instability is used to establish exemplary analysis concepts and models that can be used to anticipate future cascading events.