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Massive present-day rockfall and debris flow activity at Mount Plassen (Austria)

Joachim Götz (1) and Magdalena Krenn (2)

(1) Department of Geography and Regional Science, University of Graz, Graz, Austria (joachim.goetz@uni-graz.at), (2) Department of Geography and Geology, University of Salzburg, Salzburg, Austria (magdalena.krenn@stud.sbg.ac.at)

Parts of the inner Salzkammergut region are characterised by a sequence of soft, mechanically weak reacting rocks (salt and marls) underneath hard and rigid limestones. This “hard on soft rocks setting” causes a variety of gravitationally induced mass wasting processes and induces variable types of sediment cascades with rockfall and toppling in the uppermost parts. Such rockfall events (apart from heavy rainstorms) frequently trigger earth, mud and debris flows as a response of undrained loading. Situated within the world heritage site Hallstatt-Dachstein-Salzkammergut, Mount Plassen (1953 m) is a classic location for such a “hard on soft rocks setting”, where a series of mass movements originate and propagate along a potentially hazardous cascade towards the village of Hallstatt. Recent rockfall activity at Mount Plassen suggests lateral spreading of the limestone mass on top of salt rocks, ending up in long-lasting periods of morphodynamic activity. The last massive rockfall event in Feb 2014 and post-event rockfall activity have been analysed, quantified and monitored using multi-temporal (airborne and terrestrial) LiDAR data. We applied different approaches of topographic change modelling and uncertainty analyses – particularly with respect to variable levels of detection as a function of surface roughness.

Significant rates of average rockfall supply of 175±6 m^3/day (Feb 2014-Sep 2015) and 194±20 m^3/day (Sep 2015-Nov 2015) were observed after the event. Afterwards, conditions changed and rockfall abruptly declined to much smaller values until recently, but sediment redistribution through debris flows initiated at the hillslope underneath the rockwall. Both, single debris flows as well as coupled events of secondary rockfall input and debris flow activity with remobilized volumes of up to 2000 m^3 could be observed. The initial Feb 2014 rockfall volume is subject to uncertainties since the first TLS dataset was acquired seven months after the event. Assuming a post-event rockfall activity in this period similar to the following months, the initial event can be estimated to ca 100,000 m^3.

The presented time series demonstrate the dynamic of geomorphological process-response-systems in mountain areas and their (temporary?) relaxation. Disequilibrium rockwall conditions after the primary event have been compensated by high frequency post-event rockfall activity for 21 months - with a cumulative volume comparable to the initial event (100,000-120,000 m^3). However, during relaxation of the upper rockwall system the subsequent hillslope system was forced out of balance: The continuously growing talus cone recently reacts through debris flow activity flattening the oversteepened topography.