Why are some alpine catchments debris-flow active and others not? - the influence of geomorphology on debris-flow initiation

Philipp Aigner1, Leonard Sklar2, Markus Hrachowitz3, and Roland Kaitna1
1University of Natural Resources and Life Sciences, Institute of Mountain Risk Engineering, Vienna, Austria (philipp.aigner@boku.ac.at)
2Concordia University, Dept. of Geography, Planning and Environment, Montreal, Canada
3Delft University of Technology, Civil Engineering and Geosciences, Water Resources Section, Delft, Netherlands

Processes like flash floods or debris flows, which typically occur in small headwater catchments, represent a substantial natural hazard in alpine regions. Due to the entrainment of sediment, the discharge of debris flows can be up to an order of magnitude larger compared to 100-year fluvial flood events in the same channel, which poses a great threat to affected communities. Besides the triggering rainfall, the initiation of debris flows depends on the watershed's hydrological and geomorphological susceptibility, which makes it hard to predict and understand where and when debris flows occur.

In this study we aim to quantify the influence of geomorphologic characteristics and long-term sediment dynamics on debris flow activity in the Austrian Alps. Based on a database of debris-flow events within the last 60+ years, a geomorphological assessment of active and non-active sub-catchments in different study regions is carried out. In a first step, we derive geomorphological characteristics, such as terrain roughness, Melton number as well as weathering potential of geological units found within the watersheds. Based on the findings of the terrain shape analysis, a set of representative watersheds will be selected for systematic monitoring of surface elevation changes over the project period of three years. This will be achieved by comparing digital surface models based on photogrammetric UAV surveys and monitoring of channel reaches with cameras.

In order to project these findings onto a larger regional scale, the derived terrain parameters will be used to integrate and extend a previously designed hydro-meteorological debris-flow susceptibility model (Prenner et al., 2018) with a sediment-disposition-model. This will form the basis for an advanced debris flow forecasting tool and help to better assess the impact of climate change on the magnitude and frequency of future debris flows.

References: