Why are some catchments debris-flow active and others not? The influence of geomorphology on debris-flow occurence CC I Philipp Aigner¹, Leonard Sklar², Markus Hrachowitz³, Roland Kaitna¹

1. Introduction

Prenner et. al. (2018 & 2019)^{4&5} used a hydro- meterological model to calculate the probable trigger condictions for each day of the year over a 50 year period (1963-2013). Thus each day was classified as "no trigger" (NT), "long lasting rainfall" (LLR), short duration storm" (SDS)or "snow melt" (SM) and then compared with the event database of the Austrian government agency for torrent and avalanche control (WLV).

Problem: A lot of false positive values!

Hypothesis: Geomorphological pre-condition of catchments is critical for debris-flow initiation



Figure 1: Trigger classes per day from 1963-2013 (Prenner et. al, 2018)

open red circles indicate observed debris flows that were not predicted (false negative).

3. First Results & Outlook

First observations suggest that there are several mechanisms of sediment mobilisation within the studied catchments, which lead to the initiation of a debris flow. Some catchments have no obvious sediment source areas - such as scree slopes or landslide scarsbut still produce debris flows on a regular basis.

So the main questions we want to answer in the course this study are:

-Where does the material during an event originate?

-Which sediment mobilisation mechanism plays the most important role for debris-flow initiation in which catchment?

-Where and how is the channel refilled after an event?

-How is material provided that can be triggered during the next debris flow?

-Can we apply these findings on a regional scale in order to predict debris flow activity at a larger scale?

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2. Study region and Methodology



In this study we aim to quantify the importance of geomorphology for debris flow formation in the initiation zone as well as in the transit channel of small mountain catchments in Austria. We focus on regions where detailed information of hydro-meteorological trigger data is available (Prenner et al., 2018 & 2019^{4&5}, Mostbauer et al., 2018⁶).





Figure 5: Monitored processes (source: dji.com & GoogleEarthPro)



Regional geomorphologic assessment

At first an analysis of existing digital elevation, geology, historic land use and event data in the study regions to identify local and regional geomorphological features which increase debris flow susceptibility. Debris-flow active catchments will be identified with the event database of the Austrian Torrent and Avalanche Control (WLV) as well as through available satellite image time-series. A statistical comparison to neighbouring non-active catchments in terms of mean slope, area, lithology, Melton number, fan-geometry, terrain roughness, slope-area plots etc. will be carried out. This analysis will provide a set of parameters that influence the most if a catchment is debris-flow active or not.



Figure 4: slope - contributing area plot of the Wassertal-Creek, produced with *TopoToolbox*⁷

Local sediment and channel dynamics

Based on the reginal assessment a set of catchments in the regions of Pitztal, Defreggental and Gailtal will be selected for continuous monitoring of local sediment dynamics. The geomorphic changes in the different study catchments in the Austrian alps will be measured over three years. Regular UAV surveys will be carried out in the catchment areas to generate accurate digital elevation models (DEMs) using the structure-from-motion technology. Their comparison will give us a solid measure for the topographic change over time in the initiation zone as well as the transit and runout areas. At the same time discharge and debris flow activity will be monitored at the downstream end of each catchment to evaluate the activity and critical run-off conditions. For some of the catchments the necessary monitoring equipment is already installed, all others will be equipped using a simple discharge monitoring system with a camera trap and a scale to provide the necessary flow depth information time series.

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