EGU21-15399
https://doi.org/10.5194/egusphere-egu21-15399
EGU General Assembly 2021

Multi-sensor approach towards understanding debris-flow activity in the Lattenbach catchment, Austria

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Debris flows (DFs) pose a severe risk to Alpine communities and infrastructure. The Lattenbach catchment (basin area 5,3 km², relief 2134 m) in Tyrol, Austria, is an example for an active DF-site with several DFs occurring per year. To improve our understanding of the DF-process cascade in this catchment, we raise the questions: where does the sediment originate, are hillslope processes the drivers for DF-activity, and how is the relationship of rainfall amount and DF-magnitude?

We employ an approach that makes use of the data richness of this study site: High resolution ALS and TLS terrain models and aerial photographs are considered to locate significant elevation differences. Furthermore, we performed an in-detail UAV-based surveying campaign of the active channel reaches for the 2019 and 2020 DF-season. Additionally, we use datasets captured by a DF monitoring station (discharge, volume, timing, precipitation) at the catchment outlet to assess triggering rainfall as well as DF-frequency and magnitudes.

We find that in the last fifteen years up to three events occurred annually. A single location, where all DFs originate from, is not detectable, indicating a variety of sediment sources is relevant for DF-initiation, including bank failures and channel incision, partly driven by deep-seated landslides that continuously feed the channel with sediment. Between the years 2005 and 2018 the DF-volumes recorded at the catchment outlet varied between about 5.000 m³ (small) and 46.000 m³ (large). A first analysis suggests that there is a prevailing “background noise“ pattern of relatively small DF-events that happen regularly during every DF-season. We hypothesize that rare, very large events represent a tipping point in the catchment system, which leads to a period of increased large-scale DF-activity over following seasons.