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Development of slope-type debris flows regarding frequencies and magnitudes based on aerial images since 1947 in Horlachtal, Austria

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The future development of debris flow processes regarding frequency and magnitude in terms of climate change is currently the subject of intensive research. One reason for this is that datasets that extend over decades are often incomplete and biased towards high magnitude events based on the poor data availability in text records, for example.

Within this study, we investigate the development of slope-type debris flows in Horlachtal, a small catchment (~ 55 km²) within the Stubai Alps, Austria. Here, aerial images are available from 2018 back to 1947, which enables the creation of orthoimages. These allow a detailed mapping of debris flow processes even with smaller magnitudes. The resulting large dataset of debris flow process zones from 1947 to 2018 (10 time steps) can give some hints about the development of the frequencies of slope-type debris flows for the last 71 years. Due to their high spatial resolution and accuracy, two LiDAR datasets from 2006 and 2017 were used to calculate the volumes of debris flow deposits and thus the magnitude of debris flows within this time. Using a volume-area relationship on the base of the LiDAR data, we are able to estimate the volumes of debris flow deposits even for the older time steps, which can give an idea of changes in the magnitude of debris flow deposits for the last 71 years.

The results show a highly active time period between 1990 and 2010 as well as a high number of debris flows between 1953 and 1974. An increasing trend in numbers per year and volume per year is recognizable, but some uncertainties remain due to mapping issues, which include resolution of aerial images, shadow effects, snow cover etc.