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Spatially distributed rockfall activity inferred from talus deposits and corresponding rockwall areas in the Gradenbach catchment (Schober Mountains, Austria)

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The analysis of alpine sediment cascades requires the identification, differentiation and quantification of sediment sources, storages, and transport processes. This study deals with the origin of alpine sediment transfer and relates primary talus deposits to corresponding rockwall source areas within the Gradenbach catchment (Schober Mountains, Austrian Alps).
Sediment storage landforms are based on a detailed geomorphological map of the catchment which was generated to analyse the sediment transfer system. Mapping was mainly performed in the field and supplemented by post-mapping analysis using LIDAR data and digital orthophotos. A fundamental part of the mapping procedure was to capture additional landform-based information with respect to morphometry, activity and connectivity. The applied procedure provides a detailed inventory of sediment storage landforms including additional information on surface characteristics, dominant and secondary erosion and deposition processes, process activity and sediment storage coupling.
We develop the working hypothesis that the present-day surface area ratio between rockfall talus (area as a proxy for volume, backed by geophysical analysis of selected talus cones) and corresponding rockwall source area is a measure of rockfall activity since deglaciation; large talus cones derived from small rockwall catchments indicate high activity, while low activity can be inferred where rockfall from large rock faces has created only small deposits. The surface area ratio of talus and corresponding rockwalls is analysed using a landform-based and a process-based approach. For the landform-based approach, we designed a GIS procedure which derives the (hydrological) catchment area of the contact lines of talus and rockwall landforms in the geomorphological map. The process-based approach simulates rockfall trajectories from steep (>45°) portions of a DEM generated by a random-walk rockfall model. By back-tracing those trajectories that end on a selected talus landform, the 'rockfall contributing area' is delineated; this approach takes account of the stochastic nature of rockfall trajectories and is able to identify, for example, rockfall delivery from one rockwall segment to multiple talus landforms (or from multiple rockfall segments to the same deposit, respectively).
Using both approaches, a total of 290 rockwall-talus-subsystems are statistically analysed indicating a constant relationship between rockfall source areas and corresponding areas of talus deposits of almost 1:1. However, certain rockwall-talus-subsystems deviate from this correlation since sediment storage landforms of similar size originate from varying rockwall source areas and vice versa. This varying relationship is assumed to be strongly controlled by morphometric parameters, such as rockwall slope, altitudinal interval, and aspect. The impact of these parameters on the surface area ratio will be finally discussed.