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Spatial distribution of sediment storage in the Upper Rhone Valley, Switzerland

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Alpine regions are characterized by steep topographic gradients and high sediment fluxes conditioned by the glacial and periglacial environment. Despite substantial transport energy in mountain environments, sediment flux in large river systems is frequently disconnected from alpine headwaters. This is due to significant storage of coarse-grained sediment along the flow path from rockwall source regions to large sedimentary sinks in major alpine valleys. Knowledge on the spatial pattern of sediment storage is therefore imperative to a better understanding of sediment routing and associated natural hazards in mountains.

In the present study, we investigate the spatial distribution of different sediment storage types in the macro-scale catchment of the Upper Rhone (c. 5400 km^2), Switzerland. Here we consider the full range of storage types including small-scale hillslope storages (e.g. talus cones, scree slopes and debris cones) and large-scale storages such as alluvial fans and valley fills. Therefore, we aim to close the gap between detailed small-scale studies (<100 km^2) and large-scale sediment budgets (>1000 km^2) that insufficiently incorporate sediment storage in the headwaters.

We mapped sediment storage in the Obergoms region in the field as well as from high-resolution remote sensing imagery. Existing studies from the Turtmann Valley were integrated into our study. Using a high-resolution digital elevation model (2 m, SwissALTI3D by swisstopo), we derived and analyzed geomorphometric attributes of different sediment storage types. The spatial distribution of these storage types was modeled for the whole Upper Rhone catchment with a geostatistical approach. Model validation was performed with high resolution remote sensing imagery.

Preliminary results indicate that different sediment storage types characterize certain spatial scales: While valley fills and large alluvial fans predominate in higher order catchments, talus cones, scree slopes and moraine deposits constitute the major sediment storage forms in the headwaters.

In the next steps, we are going to determine sediment thicknesses of selected storage forms using geophysical methods. Additional data on sediment storage thickness will be taken from published studies. Based on these data and the spatial distribution of storage forms, we will estimate scaling relationships of sediment storage in alpine environments and thus derive prominent scales of sediment connectivity and disconnectivity.