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Investigating sediment budgets and pathways using LiDAR DEMs of difference and a geomorphological map

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In alpine catchments sediment is moved from one landform to another as long as they are coupled by the activity of geomorphic processes. The spatial and functional interaction of these processes forms sediment cascades reaching from sediment sources or stores to sediment sinks, and ultimately to the catchment outlet.

In study presented here, multitemporal high-resolution LiDAR datasets are used to establish morphological sediment budgets. These can be calculated on the raster cell scale, i.e. by differencing digital elevation models (DEM), and on the landform scale, by establishing the net balance of eroded and accumulated material; in the latter case, the spatial unit is a polygon identifying a particular landform on a detailed geomorphological map. The flow of mobilised sediment can be estimated on a DEM using a variety of flow routing algorithms, and the net balance (sediment eroded – sediment deposited) is accumulated along specific pathways. The results of landform-based sediment budgets can be used to validate the flow routing algorithms and to assess functional connectivity between landforms that are arranged along a toposequence.

Graph theory is used to store and investigate resulting sediment pathways on different aggregation levels. The incorporation of the geomorphological map highlights potential advantages of object-based over pixel-based approaches to generating graph nodes and analysing sediment cascades.