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Modelling and mapping of sediment connectivity in alpine environments (Swiss National Park)

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The transfer of sediment through alpine environments occurs along a cascade of successive storage compartments that are connected by different geomorphic processes. However, sediment transfer from hillslopes to river channels may be interrupted by buffers that cause long-term sediment storage and decouple significant parts of alpine basins from the basin outlet. Disconnection controls the propagation of environmental and anthropogenic disturbance throughout a geosystem. Considerable uncertainties exist about the internal linkages between storage landforms, both among each other and to the fluvial system. While connectivity have been traditionally analysed based on qualitative field studies, there is currently an increasing trend to use numerical modelling approaches, profoundly improved by the availability of high-resolution digital terrain models (DTM).

We studied the connectivity in two alpine basins of the Swiss National Park (Graubünden) both quantitatively and qualitatively. Therefore, we calculated a connectivity index using the numeric algorithm by BORSELLI et al. (2008), which is based on topographic parameter derived from the DTM. The modelling results have been tested against our conceptual framework, which is based on detailed geomorphological mapping and a comprehensive, qualitative investigation of the functional relationships between neighbouring storage landforms.

Although the modelling results display very well a lateral and longitudinal variability of connectivity, the method fails to model disconnectivity between neighbouring DTM-pixels. In contrast, the geomorphic mapping indicates that up to one third of the basin's surface might be currently decoupled from the sediment flux system of the two alpine valleys. Thus, the modelling approach probably overestimates the overall catchment connectivity and consequently, the capacity of land surface that actually delivers sediment to the fluvial system. These findings clearly highlight that a heuristic geomorphological mapping in the field is indispensable for the successful application of numerical approaches in geomorphology.