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Identification of sediment contributing areas in alpine torrent catchments using field mapping, aerial images and DEM-based predictive modelling

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The aim of the EU Alpine Space Project SedAlp (Sediment management in Alpine basins: integrating sediment continuum, risk mitigation and hydropower) is to develop basic principles for a better management of sediment-related problems in alpine river systems. The catholic University Eichstätt-Ingolstadt contributes the German part to this project on behalf of the Bavarian Environment Agency, and in collaboration with the Authority of Water Resources Weilheim.

Sediment connectivity is an important issue in the project framework: Lateral connectivity governs the delivery of sediments from sediment sources on hillslopes to the channel network; the bedload potential of torrent catchments is an important factor of natural hazards such as debris-rich flooding and debris flows. Longitudinal connectivity, on the other hand, influences the sediment transfer within the channel network and sediment delivery to the main rivers.

This study is being conducted in six small torrent catchments tributary to the river Isar between the Sylvenstein reservoir and the city of Bad Tölz, Bavaria, Germany. The main aim of the activities is to improve the quantification and understanding of the bed load potential within these catchments that are characterised by different lithologies. One major methodological step lies in the identification or areas that are relevant for sediment (specifically bed load) delivery to the channel network. Here, we compare two approaches to this aim. First, sediment contributing areas are identified using geomorphological mapping in the field and with the help of aerial images taken in 2009 and 2012. Second, a GIS-based model is applied that uses a high-resolution airborne LiDAR digital elevation model (DEM) acquired in 2010 and 2011. According to this model, sediment contributing areas are i) steep, ii) directly adjacent to the channel network, and iii) characterised by longitudinal connectivity. These characteristics are implemented through a set of user-specified thresholds that are applied to the DEM and a digital representation of the channel network. The results of the two methods are compared in order to assess the potential of automated mapping approaches for the delineation of sediment contributing areas, and to check whether the automated approach has to be adjusted in catchments of different lithology.