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Modelling of sediment yield in torrent catchments in the French Western Alps using the Sediment Contributing Area (SCA) approach

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The coarse sediment yield of small mountain streams (torrents) is usually the consequence of the activity of geomorphic processes in the upper parts of their catchments. Existing studies from the northern Limestone Alps show that the size of the sediment contributing area (SCA), a subset of the hydrological catchment that effectively delivers sediment to the channel network, can be used as a predictor of sediment delivery to torrents.
The SCA is similar to the effective catchment area proposed by other studies; it is delineated on a digital elevation model using a set of rules related to the steepness and length of slopes directly adjacent to the channel network, and the steepness of the latter. Additional natural parameters, such as vegetation, precipitation or geomoprphic activity can be taken into account. The size of the SCA has been shown to correlate well with long-term average sediment yield, measured in sediment traps and check dams. In the current study the SCA model of the northern Limestone Alps was tested for torrents in the French Western Alps. The results show that the model is applicable to the conditions of this part of the Alps. Sediment transport is a product of several factors, being mainly controlled by bare areas with a minimum slope gradient threshold of 18° and assuming full longitudinal connectivity with respect to coarse material even in very flat channel reaches. The parameter of the maximum distance of potential sediment contributing areas to the channels, as implemented in the model by former studies, show little influence here. In addition, results reflect the influence of vegetation cover, different precipitation conditions as well as geomorphic process activity (e.g. debris flows) on sediment delivery from torrents. In general, the investigated torrents in the French Western Alps show high sediment dynamics with a high connectivity, resulting in significant correlations between the mean annual bedload yield of the catchment areas and the sediment contributing areas identified by the SCA model.