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Back-calculation of sediment transport during flood events with a bedload transport simulation model for steep channels

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A sediment routing model for steep torrent channel networks called SETRAC has been developed at the University of Natural Resources and Applied Life Sciences, Vienna. SETRAC is the acronym for Sediment TRansport in Alpine Catchments. The main purpose of the model is the simulation of bedload transport in steep channels during flood events. Flow resistance and bedload transport equations appropriate for torrents and mountain streams are implemented. To take form roughness losses into account several approaches are available to modify the calculated transport capacity to better match observations on bedload transport. Armouring effects can also be considered.
For the validation of the sediment transport model, field data are required. Most important data are flood hydrographs and sedigraphs for extreme events, however, these data are rarely available for small mountain catchments. The SETRAC model has been applied to six well documented case studies on sediment transporting flood events in mountain catchments in the Austrian and Swiss Alps. The input hydrographs for the simulation model have been generated with a rainfall runoff model and calibrated with measured or reconstructed hydrographs of nearby gauging stations if available. Flood marks at cross-sections without morphological change have been used for the back-calculation of the peak discharge since no stream flow measurements are available. The overall flow resistance has been calculated using empirical equations developed for steep channel gradients. For the calibration of the sediment transport model, data about morphologic changes along the stream channel have been obtained by field investigations or by remote sensing techniques. The simulation results show the importance of form roughness losses when computing bedload transport in torrents and mountain streams. If form roughness losses are neglected, calculated bedload transport is overestimated by a factor of about 10 on average as compared to observed bedload transport for the examined flood events.