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Self stabilisation and inition of motion at steep channel gradients

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For the prediction of bedload transport rates knowledge about the initiation of motion is required. Self-stabilisation by the formation of bed structures increases the resistance against erosion and is regarded as the main stabilization process in steep open channels. A laboratory flume for bedload transport experiments at the Institute of Mountain Risk Engineering at the University of Natural Resources and Life Sciences, Vienna is available. The flume is 6 m long, 0.25 m wide and the inclination can be varied up to 25 %. A systematic study on self-stabilisation has been carried out. To generate a typical grain size distribution for torrents 55 pebble counts were analysed and a typical grain size distribution with a physical scale of 1:10 is generated. To increase the existing database on the development of natural bed structures the following experimental setup is used: Flume experiments are carried out at channel gradients varying from 9 to 21 %. Therefore the bed sediment mixture is built into the flume with a constant height of 0.25 m. Then a discharge close to incipient motion conditions is applied until the bedload transport decreases. Then the discharge is increased stepwise. This is repeated until typical bed structures like step-pool sequences develop and a constant discharge is applied until the bedload transport decreases towards zero. A typical duration of the experiment is about 12 hours. A laserscan device mounted above the flume is used to produce high resolution elevation models of the channel bed before and after the experiment. Finally the discharge is increased until the bed structures are destroyed. In order to collect information of transport rates and selective bedload transport, grains size analyses are performed at the channel outlet with high temporal resolution during the self-stabilisation and destruction phase of the experiment. Finally the channel bed is scanned again to identify immobile bed structures and determine the channel slope after each experiment. The incipient of motion condition is increased significantly. During some experiments the maximum grain diameters were not transported to the channel outlet, but motion due to scouring was observed by video analysis. The results show the importance of bed structures for the self-stabilisation of steep channels.