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Bed Load Transport and Debris Flow Processes in Torrential Watersheds of Low Mountain Ranges of Germany

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During the past decades runoff events that triggered considerable bed load discharges to the point of debris flows repeatedly occurred in small drainage areas of the European low mountain areas. In general the processes were triggered by closely localised rainstorms. The present investigation is focused on the northern Hesse and Lower Saxony low mountain ranges (Germany). Torrential discharge in these areas arise from short branch valleys of the Fulda, Werra and Oberweser river catchments, where torrential watersheds are frequently used by farming, and are superficial sealed. The drain channels run in solid bedrocks, alluvial fills of Quaternary gravel, allochthonous talus deposits, slide masses and overburden of stone quarries. Along close gully sections incision was found as well in bedrock, showing amounts of 0.5 - 1 meter per event in vertical.

On the occasion of runoff processes bed load up to 16.000 m^3 per event in additional to wood debris and suspended load in large masses were shifted to the alluvial fans and receiving streams. Based on historical studies about 50 runoff events could be documented during the past 140 years - with a maximum frequency of 10 events in 1965. Frequently a substantial discharge of sediment and debris happened. Farmland, infrastructure facilities and buildings were buried in several cases.

In order to mitigate loss or damage through bed load discharge torrent regulations constructed as bank protection, dams, bed load sampler etc., started already 100 years ago in several torrential catchments. The measures resulted in different succes as the maintenance of the equipment was not consequently carried out anywhere. In the course of renaturation measures regulation buildings in some areas have been removed recently, devour a lot of public money.

In view of hazard mitigation current investigations aims at the registration and evaluation of factor structures and the modelling of bed load discharge. However, models for torrent simulation, as they are applied in high mountain areas, are not self-explanatory usable in low mountain ranges - particularly due to the deviating catchment area characteristics. In special the transportation strength for block material is determined by the supply of fine sediment from the areas of arable land. In this context experiments using the EROSION 3D-model show that classical runoff and erosion models are partially applicable for the simulation of torrent processes in low mountain areas.

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