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Constraining erosion in debris flow models: A correlation analysis in contrasting erosional settings

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Erosion and entrainment can significantly increase the volume and hazard potential of a debris flow. Therefore, understanding those processes is crucial for creating numerical models that can accurately predict the extend of depositions and impact forces. The quantitative controls of erosion and entrainment are however still not fully understood nor implemented in predictive models. In this work, the erosivity along eight different debris flows is analysed. Data on the eroded volumes was acquired using geomorphic change detection on aerial and terrestrial laser scans from before and after the debris flow events. Flow width, flow velocity, momentum, basal shear stress, flow pressure and flow height were determined using back-calculated RAMMS Debris Flow models. Erosion was implemented in those models by successively increasing the flow volume in 20 m intervals along the debris flow channel based on the geomorphic change detection results. Additionally, channel characteristics like the average slope for each interval as well as the geologic conditions were considered. For all analysed parameters correlations with erosivity were found. However, among the observed debris flows, the parameters that correlate best differ and they have varying degrees of significance. The geological setting has a notable effect on erosivity as well as the correlations. Peaks in erosivity can be observed at transitions from a bed with lower erodibility, like bedrock, to a more easily erodible bed. Using the parameters that correlate best with erosivity for each individual debris flow, linear and multiple regression models were created, that relate erosivity to the respective parameters for each site.