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Digital elevation models in numerical rockfall simulations

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The current state of the art in rigid body rockfall modelling permits full three-dimensional simulation of real rock shapes and their interactions with the terrain. The terrain is represented by digital elevation models DEM, providing the geometric terrain information on which the spatial model parameters are assigned. This is fundamental to numerical simulations of mass movements. DEM's can be obtained from a number of sources and offer spatial resolutions ranging from centimetres up to 90m. The spatial resolution representing the terrain morphology can have a strong bearing on modelling results. In particular if finer scale morphologies (centimetres to meters) such as the terrain roughness of a scree slope or boulder field are included in the DEM. The issue occurs if the meso- to micro- scale roughness is included that would normally be loose surface material, because in the modelling domain the terrain surface is a rigid body. It is at these scales a crossover between representing terrain properties as either model parameters or terrain geometry occurs. Little is known about the optimal resolution to represent terrain in rockfall simulations.

In this contribution we present the results of numerical simulations with different DEM resolutions. We sampled the terrain morphology of a highly rockfall active area in Matter valley in Switzerland using LiDAR with a maximum resolution of 50cm. The DEM was resampled at resolutions of 1m, 5m and 20m and rockfall simulations were performed where the model ground impact parameters were held constant. To induce the naturally stochastic initial conditions of rock fall release we vary the rock shapes and release orientation, while the potential energy was held constant. We compare the different simulation results and discuss the influence of the DEM resolution on fully three dimensional rockfall simulations. We find the DEM resolution has a strong influence on the simulation results demonstrating that the selection of the DEM is a crucial step in numerical simulation of rockfalls.