Sass3D – a three dimensional rockfall simulation program

Thüring Manfred

Institute of Earth Sciences, University of Applied Sciences of Southern Switzerland

The recent availability of the Swiss high resolution digital terrain model, DTM-AV, opens the possibility to simulate natural hazard processes with a detailed topographic resolution.

Rockfall processes are determined by the interaction of individual, falling particles with the underlain topography. Sass3D is a recent development and is, at its current development, a rather simple software to simulate the three-dimensional movement of individual mass particles downwards hill slopes.

Sass3D represents falling rocks as dimensionless mass points. The rockfall processes are modeled as isolated, single simulations, so there is no interaction between particles. The types of movement are currently flying and impacting with the terrain. The behavior at the impact is currently modeled by an elastic model; energy loss is evaluated by normal and tangential restitution coefficients. The particle's physical parameters can be varied by a Gaussian distribution. The rockfall processes of rolling and sliding will be added at a later state.

The main output of Sass3D is a file which contains the rockfall trajectories, which have different attributes, such as the spatial position, time, velocity, kinetic energy and type of movement, etc.

The program accepts input data (so far digital terrain, starting points, and at a later stage also buildings and infrastructure, and protective constructions) as ASCII raster files. Where feasible, it is possible to set input parameters as constant throughout the modeling domain or by specifying them supplying a raster file, which contains the respective values. The digital terrain model is converted into the program's internal representation where all the additional topographic data (starting points, buildings, protective measures etc.) are mapped onto.

The program is written in Fortran90 and is currently a simple command line based tool. A GIS environment, such as ESRI ArcGIS is necessary for pre- and postprocessing. The conversion of ESRI Raster files to ASCII Rasters can be done using the ArcMap internal Toolbox. The rockfall trajectories are written as ASCII tables. These must be converted for post-processing and visualization to ESRI Polyline Shape Files, using e. g. the free ArcGIS utility plug-in ET Generate Wizard LT.

Sass3D is currently in an early stage of its development. Anyway, the potential of rockfall hazard assessment using a three-dimensional simulation tool, such as Sass3D, in combination with the Swiss high resolution digital terrain model, DTM-AV, is demonstrated by means of a few applications.