Geophysical Research Abstracts, Vol. 9, 07087, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-07087

RockSim3D - a three dimensional rockfall simulation program

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Rockfall processes are determined by the interaction of individual mass movements and the underlying topography. RockSim3D is a software to simulate the three-dimensional movement of individual mass particles on hill slopes. Rocks are represented as dimensionless mass points. The rockfall process is an individual simulation, with no interaction between particles. The program currently considers free trajectory movements and terrain impact. The rockfall processes of rolling and sliding are to be added at a later stage. The impact behavior of the particles is modeled using two approaches: the energy loss at impact is either determined by surface specific restitution coefficients, or by an elasto-plastic model.

The program accepts input data (so far digital terrain, starting points, and at a later stage also buildings and infrastructures, and protective constructions) as ASCII raster files. Topographic attributes (e. g. restitution coefficients at impact) can be set constant throughout the modeling domain or variable according to raster files, which contain the corresponding values. The physical parameters of the particles can be varied by a Gaussian distribution. At program start the digital terrain is read and converted into the program's internal representation and all the additional topographic data (starting points, buildings, protective measures etc.) are mapped onto. On this topographic representation the rock particles follow their trajectory downhill according to the surface characteristics. The main output of RockSim3D are rockfall trajectories with attributes, such as the spatial position, type of movement, time, velocity, kinetic energy and elevation over ground.

A GIS environment, such as ESRI ArcGIS is necessary to prepare the input data. For postprocessing and visualization in a GIS environment, the modeled trajectories are

converted into ESRI polyline Shapefiles. For high quality images, the output is visualized using the open-source software ParaView. The program is written in Fortran90 and runs in a command line environment. The next steps of development include the improvement of the physics of the process and the output interface, and a graphical user interface.

Applications from the Swiss Southern Alps are presented to illustrate the potential of rockfall hazard and risk assessment using the three-dimensional simulation tool RockSim3D, taking advantage of the recently available Swiss high resolution digital terrain model DTM-AV.