Geophysical Research Abstracts
Vol. 19, EGU2017-14202, 2017
EGU General Assembly 2017

Toward a better integration of roughness in rockfall simulations - a sensitivity study with the RockyFor3D model

Jean-Matthieu Monnet (1), Franck Bourrier (1), and Milutin Milenkovic (2)

(1) Université Grenoble Alpes, Irstea, UR EMGR, Saint Martin d'Hères, France (jean-matthieu.monnet@irstea.fr), (2) Vienna University of Technology, Department of Geodesy and Geoinformation, Austria (milutin.milenkovic@geo.tuwien.ac.at)

Advances in numerical simulation and analysis of real-size field experiments have supported the development of process-based rockfall simulation models. Availability of high resolution remote sensing data and high-performance computing now make it possible to implement them for operational applications, e.g. risk zoning and protection structure design. One key parameter regarding rock propagation is the surface roughness, sometimes defined as the variation in height perpendicular to the slope (Pfeiffer and Bowen, 1989). Roughness-related input parameters for rockfall models are usually determined by experts on the field. In the RockyFor3D model (Dorren, 2015), three values related to the distribution of obstacles (deposited rocks, stumps, fallen trees,... as seen from the incoming rock) relatively to the average slope are estimated. The use of high resolution digital terrain models (DTMs) questions both the scale usually adopted by experts for roughness assessment and the relevance of modeling hypotheses regarding the rock / ground interaction. Indeed, experts interpret the surrounding terrain as obstacles or ground depending on the overall visibility and on the nature of objects. Digital models represent the terrain with a certain amount of smoothing, depending on the sensor capacities. Besides, the rock rebound on the ground is modeled by changes in the velocities of the gravity center of the block due to impact. Thus, the use of a DTM with resolution smaller than the block size might have little relevance while increasing computational burden.

The objective of this work is to investigate the issue of scale relevance with simulations based on RockyFor3D in order to derive guidelines for roughness estimation by field experts. First a sensitivity analysis is performed to identify the combinations of parameters (slope, soil roughness parameter, rock size) where the roughness values have a critical effect on rock propagation on a regular hillside. Second, a more complex hillside is simulated by combining three components:
a) a global trend (planar surface),
b) local systematic components (sine waves),
c) random roughness (Gaussian, zero-mean noise).
The parameters for simulating these components are estimated for three typical scenarios of rockfall terrains: soft soil, fine scree and coarse scree, based on expert knowledge and available airborne and terrestrial laser scanning data.
For each scenario, the reference terrain is created and used to compute input data for RockyFor3D simulations at different scales, i.e. DTMs with resolutions from 0.5 m to 20 m and associated roughness parameters. Subsequent analysis mainly focuses on the sensitivity of simulations both in terms of run-out envelope and kinetic energy distribution. Guidelines drawn from the results are expected to help experts handle the scale issue while integrating remote sensing data and field measurements of roughness in rockfall simulations.