Geophysical Research Abstracts
Vol. 19, EGU2017-17709, 2017
EGU General Assembly 2017

Procedure for assessing the performance of a rockfall fragmentation model

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A Rockfall is a mass instability process frequently observed in road cuts, open pit mines and quarries, steep slopes and cliffs. It is frequently observed that the detached rock mass becomes fragmented when it impacts with the slope surface. The consideration of the fragmentation of the rockfall mass is critical for the calculation of block's trajectories and their impact energies, to further assess their potential to cause damage and design adequate preventive structures.

We present here the performance of the RockGIS model. It is a GIS-Based tool that simulates stochastically the fragmentation of the rockfalls, based on a lumped mass approach. In RockGIS, the fragmentation initiates by the disaggregation of the detached rock mass through the pre-existing discontinuities just before the impact with the ground. An energy threshold is defined in order to determine whether the impacting blocks break or not. The distribution of the initial mass between a set of newly generated rock fragments is carried out stochastically following a power law. The trajectories of the new rock fragments are distributed within a cone.

The model requires the calibration of both the runout of the resultant blocks and the spatial distribution of the volumes of fragments generated by breakage during their propagation. As this is a coupled process which is controlled by several parameters, a set of performance criteria to be met by the simulation have been defined. The criteria includes: position of the centre of gravity of the whole block distribution, histogram of the runout of the blocks, extent and boundaries of the young debris cover over the slope surface, lateral dispersion of trajectories, total number of blocks generated after fragmentation, volume distribution of the generated fragments, the number of blocks and volume passages past a reference line and the maximum runout distance

Since the number of parameters to fit increases significantly when considering fragmentation, the final parameters selected after the calibration process are a compromise which meet all considered criteria. This methodology has been tested in some recent rockfall where high fragmentation was observed.

The RockGIS tool and the fragmentation laws using data collected from recent rockfall have been developed within the RockRisk project (2014-2016, BIA2013-42582-P). This project was funded by the Spanish Ministerio de Economía y Competitividad.