METHODOLOGIES FOR A PHYSICALLY BASED ROCKFALL HAZARD ASSESSMENT

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Rockfall hazard assessment is an important land planning tool in alpine areas, where settlements progressively expand across rockfall prone areas, rising the vulnerability of the elements at risk, the worth of potential losses and the restoration costs. Nevertheless, hazard definition is not simple to achieve in practice and sound, physically based assessment methodologies are still missing. In addition, the high mobility of rockfalls implies a more difficult hazard definition with respect to other slope instabilities for which runout is minimal. When coping with rockfalls, hazard assessment involves complex definitions for "occurrence probability" and "intensity". The local occurrence probability must derive from the combination of the triggering probability (related to the geomechanical susceptibility of rock masses to fail) and the transit or impact probability at a given location (related to the motion of falling blocks). The intensity (or magnitude) of a rockfall is a complex function of mass, velocity and fly height of involved blocks that can be defined in many different ways depending on the adopted physical description and "destructiveness" criterion. This work is an attempt to evaluate rockfall hazard using the results of numerical modelling performed by an original 3D rockfall simulation program. This is based on a kinematic algorithm and allows the spatially distributed simulation of rockfall motions on a three-dimensional topography described by a DTM. The code provides raster maps portraying the maximum frequency of transit, velocity and height of blocks at each model cell, easily combined in a GIS in order to produce physically based rockfall hazard maps. The results of some three dimensional rockfall models, performed at both regional and local scale in areas where rockfall related problems are well known, have been used to assess rockfall hazard, by adopting an objective approach based on three-dimensional matrixes providing a positional "hazard index". Different hazard maps have been obtained combining and classifying variables in different ways. The performance of the different hazard maps has been evaluated on the basis of past rockfall events and compared to the results of existing methodologies. The sensitivity of the hazard index with respect to the included variables and their combinations is discussed in order to constrain as objective as possible assessment criteria.