ROCKFALL RUNOUT MODELLING FOR SUSCEPTIBILITY EVALUATION: A MULTI-SCALE COMPARISON AT DIFFERENT SITES

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Worldwide, many regions are affected by rockfall processes which pose a considerable risk to settlements and infrastructure. Hence, a reproducible assessment and delineation of possibly endangered areas plays an important role when it comes to sustainable landuse planning, as well as the design of protective measures to minimise the consequences of rockfall hazards.

Several approaches exist to determine rockfall travel distances of single blocks varying from empirical models to two-dimensional and three-dimensional process- based models.

Empirical models are based on straightforward geometrical relationships between the source area/apex of talus slope and the longest accumulated boulder. Required input parameter maps are limited to spatially-continuous information on topography and the location of potential source areas.

Most commercial available process-based models use a two-dimensional approach to simulate the kinematics of boulders along a slope profile. The variety of relevant input parameters, such as surface elasticity and roughness, has to be mapped in the field along a pre-defined profile. Spatially-continuous assessments for larger areas require multiple profiles, preferentially in predefined homogeneous areas, of which the results need to be interpolated on basis of expert knowledge.

Most of the existing three-dimensional process-based models are non commercial software and can therefore only be used for assessments in terms of commissioned work or within the frame of cooperation projects with the software developers' themselves. Exceptions are the softwares Rockyfor3D, which is being distributed to members of the international association ecorisQ (see www.ecorisq.org), CRSP-3D, PIR3D and Rockfall Analyst. These model types use different codes to simulate the different modes of movement of the boulders along a slope ranging from kinematic modeling or the adoption of lumped mass, rigid body or hybrid schemes. In contrast to the two-dimensional models, all necessary input parameter maps (such as topography, surface roughness, surface elasticity, dynamic friction coefficients, vegetation etc.) need to be spatially-continuous.

The present study compares the capacity of some empirical models, 2D (Rockfall 7.1) and respectively 3D process-based models (Rockyfor3D, STONE) to predict rockfall runouts at various spatial scales. Three highly rockfall prone areas in Austria with different area extents and settings were chosen for this model comparison. In all three areas, a large amount of field

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data about past rockfall events and rockfall determining factors was already available. This allows an evaluation of the different model types and a more accurate validation of the different modeling results in respect to the real conditions of the study area.

Both three-dimensional process- based models STONE and Rockyfor3D are tested at regional, local and slope scale. The results, which include kinetic energies, passing heights and travel distances, will subsequently be compared, as well as with the results obtained by the empirical models (regional and local scale) and the two-dimensional model Rockfall 7.1 (at local and slope scale).

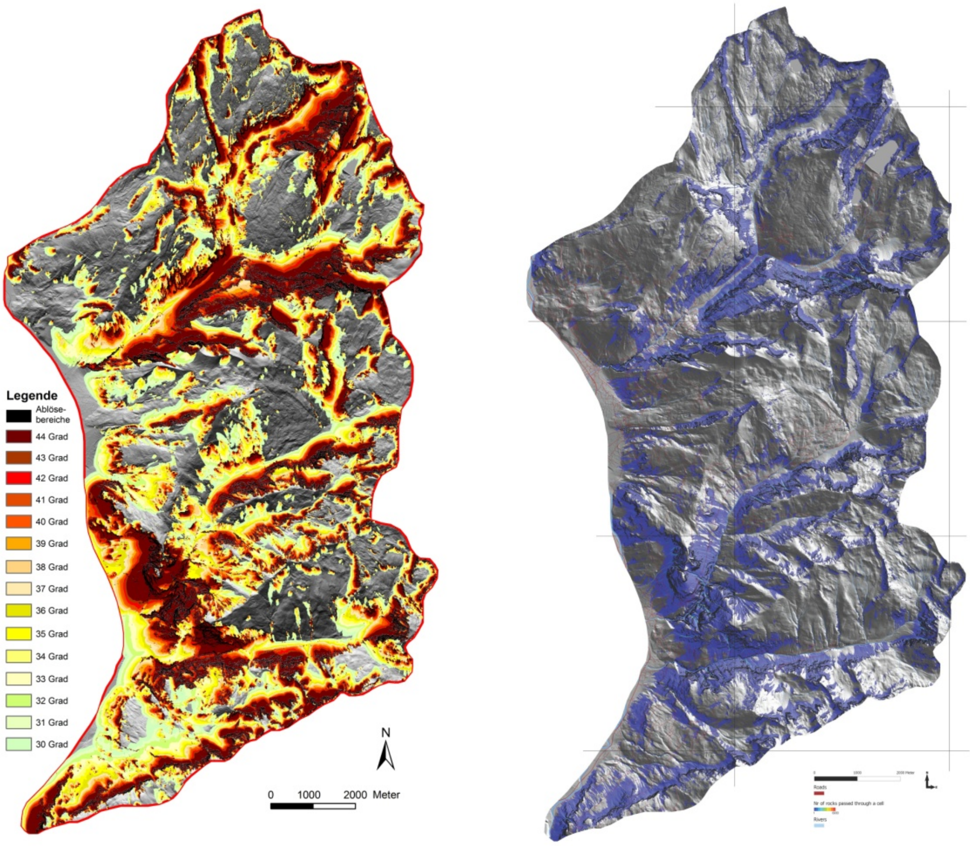

Figure 1: Comparison of preliminary results of different runout approaches: empirical model (left) versus three-dimensional process based model (right) (examples taken from the INTERREG IVA project *MASSMOVE*, Project Code 1381-08-1).

The objective of this work is to provide decision makers with a transparent overview of the limitations and advantages of the tested models. This will be done, both in terms of their application and even more important the applicability of the model results in land planning issues. The discussion about the model application includes required model input parameters, as well as required time and costs for model set-up and data collection in the field. The evaluation of the applicability of model results is focused on the model sensitivity to the scale-dependent accuracy of input data and on the quality of the simulated travel distances and kinematics (energies and passing heights).