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Large scale rockfall hazard mapping using land cover as proxy for soil type

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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 soil response to block impact. In the RockyFor3D model, it is taken into account as the normal coefficient of restitution during rebounds of rocks on the ground, which depends on the soil type. Soil type is usually determined by field experts, but its mapping in large areas is time-consuming, especially in mountain environments.

Land cover maps can be derived from remote sensing data, with increasing spatial and semantic details thanks to the improvements in spatial and spectral resolution and to the advances in analysis techniques. Relying on the assumption that vegetation cover can be used as a proxy for soil type, it is possible to estimate the normal coefficient of restitution based on remote sensing-derived land cover maps.

The objective of this work is to evaluate the relevance of using land-cover as a proxy for the coefficient of normal restitution in rockfall simulations. Land cover map OSO, derived from Sentinel-2 data, is used (Inglada et al., doi:10.3390/rs9010095). Two complementary aspects are investigated.
First, on a test area of 600 ha, rockfalls are simulated with RockyFor3D using either expert input for soil types, or coefficient of restitution values depending on land cover type. Rockfall frequency, energy and runnout areas are compared.
Second, the practicability of using OSO land cover map for large area rockfall simulation is tested in the valley of Chamonix (France) in order to identify problems that might arise due to data limitations and compatibility between input types.

Guidelines drawn from the results are expected to help experts figure out when remote sensing products can be safely used for cost-efficient estimation of input data in rockfall simulations.