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Regional potential rockfall mapping using LiDAR-based slope frequency distribution and conefall modelling

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A factor limiting potential rockfall mapping at regional scale is often the lack of knowledge of potential source areas. Nowadays, LiDAR digital elevation model (LiDAR-DEM) can represent the relief in detail, even over large areas. With such a fine-scale morphologic variability, a quantitative geomorphometric analysis becomes a relevant approach for the detection of rockfall source areas.

Using DEM-based slope angle statistic as well as rocky outcrops and scree zones available from the 1:25'000 Swiss topographic vector map, a potential rockfall map was obtained over the canton of Vaud (3200 km^2), Switzerland, in order to provide an approximate overview of the relevant hazard zones. Slope surfaces over morphometric-defined thresholds angles were considered as rockfall source zones. The major pick of the slope angle frequency histogram was taken as the internal friction angle. Rocky outcrops available from the topographic map steeper than this angle were considered as source areas, because cliffs available from the 1:25'000 topographic map are not necessarily cliffs when they are compared to the LiDAR-DEM (e.g. flat areas are included within cliff zones). In addition, the slope angle frequency histogram is assumed to be composed of several Gaussian populations that are distinctive for different morphologies. For instance, those distributions can correspond to alluvial plains, U-shaped valleys, rock cliffs, etc. Therefore, thresholds for potential rockfall source areas were defined by the angle for which the population with the higher average is dominant. This last population is then considered as the "cliff population". Such procedure was

applied distinctly to each main geological unit.

The runout area was simulated in a simple way using the shadow angle method in 3D and applied on each of the source areas delineated previously. Cones apertures were defined by means of orthophotos visualization.

Comparison of the results with known events and another rockfall hazard assessment are in good agreement, confirming that it is possible to develop susceptibility hazard map for rockfall activity over large areas from LiDAR-DEM based parameters and slope analysis.