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An integrated statistical and physically-based approach for rockfall susceptibility assessment

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A complete rockfall susceptibility assessment requires the incorporation of both the onset susceptibility and the reach probability of rockfalls. For this task, we developed an integrated statistical and physically-based approach that we applied to Val di Fassa (Dolomites, Eastern Italian Alps, 300km2). First, through field checks and multi-temporal aerial photo-interpretation, we prepared a detailed inventory of both rockfall source areas and associated scree slope deposits. Grid-cells appertaining to the geomorphologically-defined source area polygons were classified as active and inactive using a new technique based on GIS tools and a 3D rockfall simulation code (HY-STONE). By means of discriminant analysis, we then identified the mix of environmental characteristics that better discriminate grid-cells with low and high rockfall susceptibility. Among the variables, the structural setting, land-use, and morphology resulted to be the most important factors leading to rockfall initiation. We developed 3D simulation models of the rockfall runout distance, intensity and frequency whose source grid-cells corresponded either to the geomophologically-defined source polygons (geomorphological scenario), or to the study area grid-cells with a slope angle greater than an empirically defined value (37°) (empirical scenario). For each scenario, source grid-cells were assigned an either fixed or variable onset susceptibility, the latter as derived from the discriminant model group (active / inactive) membership probabilities. The comparison of these four models indicates that the geomorphological scenario with variable onset susceptibility appears the most realistic model. Despite, political and legal issues seem to guide local administrators in selecting the more conservative empirically-based scenario.