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Rockslide susceptibility and hazard assessment for mitigation works design along vertical rocky cliffs: workflow proposal based on a real case-study conducted in Sacco (Campania), Italy

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The work here presented concerns a case study in which a complete multidisciplinary workflow has been applied for an extensive assessment of the rockslide susceptibility and hazard in a common scenario such as a vertical and fractured rocky cliffs. The studied area is located in a high-relief zone in Southern Italy (Sacco, Salerno, Campania), characterized by wide vertical rocky cliffs formed by tectonized thick successions of shallow-water limestones.
The study concerned the following phases:
a) topographic surveying integrating of 3d laser scanning, photogrammetry and GNSS;
b) gelogical surveying, characterization of single instabilities and geomecanichal surveying, conducted by geologists rock climbers;
c) processing of 3d data and reconstruction of high resolution geometrical models;
d) structural and geomechanical analyses;
e) data filing in a GIS-based spatial database;
f) geo-statistical and spatial analyses and mapping of the whole set of data;
g) 3D rockfall analysis;
The main goals of the study have been a) to set-up an investigation method to achieve a complete and thorough characterization of the slope stability conditions and b) to provide a detailed base for an accurate definition of the reinforcement and mitigation systems. For this purposes the most up-to-date methods of field surveying, remote sensing, 3d modelling and geospatial data analysis have been integrated in a systematic workflow, accounting of the economic sustainability of the whole project.
A novel integrated approach have been applied both fusing deterministic and statistical surveying methods. This approach enabled to deal with the wide extension of the studied area (near to 200.000 m2), without compromising an high accuracy of the results. The deterministic phase, based on a field characterization of single instabilities and their further analyses on 3d models, has been applied for delineating the peculiarity of each single feature. The statistical approach, based on geostructural field mapping and on punctual geomechanical data from scan-line surveying, allowed the rock mass partitioning in homogeneous geomechanical sectors and data interpolation through bounded geostatistical analyses on 3d models. All data, resulting from both approaches, have been referenced and filed in a single spatial database and considered in global geo-statistical analyses for deriving a fully modelled and comprehensive evaluation of the rockslide susceptibility.
The described workflow yielded the following innovative results: a) a detailed census of single potential instabilities, through a spatial database recording the geometrical, geological and mechanical features, along with the expected failure modes; b) an high resolution characterization of the whole slope rockslide susceptibility, based on the partitioning of the area according to the stability and mechanical conditions which can be directly related to specific hazard mitigation systems; c) the exact extension of the area exposed to the rockslide hazard, along with the dynamic parameters of expected phenomena; d) an intervention design for hazard mitigation.