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Rockfall risk assessment for a road along the coastal rocky slope of Maratea (Basilicata Region, Italy)

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The rockfall risk has been evaluated for the Tirrena Inferiore State Road SS18 between 220+600 and 243+670 Kilometers in the coastal area of Maratea (Basilicata, Italy) through a specific multilayer technique. These results are particularly significant as validated in field through the occurrence of rockfall events after the study.

The study part of "Tirrena Inferiore" SS18 road is often affected by rockfalls, which periodically (coinciding with abundant rainfalls, earthquakes and temperature lowering) cause large amount of damage and traffic interruptions. In order to assess the rockfall risk and define the countermeasure needed to mitigate the risk, an integrated index-based and physically-based approach was implemented.

The roadway is subject to slopes with steep rocky vertical or sub-vertical faces affected by different systems of discontinuities, that show a widespread fracturing. The superficial parts of slopes are characterized by gaping fracturing, often karstified. Several historical rockfall events were recognized in the area and numerous geomechanical analyses, finalized to the stability analysis of rock walls, were carried out.

The localization of the potentially unstable areas and the quantification of relative rockfall risk were evaluated through three successive phases of analysis. First, a map based on SMR (Slope Mass Rating) Index of Romana (1985) was produced, through a spatial analysis of both geomechanical parameters, such as the RMR Index of Bieniawski, and the distribution of the discontinuities. This approach therefore allowed the estimation of the potentially unstable zones and their classification on the basis of the resulting stability degree. Subsequently, an analysis of the rockfall trajectories in correspondence to the most unstable zones of slope was carried out by using ROTOMAP, a 3-dimensional rock-fall simulation software. The input data for computing the rockfall trajectories are the following: (1) digital terrain model (DTM), (2) location of rock-fall release points (source areas), (3) geometrical parameters of block rolling, such as limit angle of flight, impact and rebound, and (4) geomechanical parameters of block rolling, such as the coefficients of normal and tangential energy restitution. For each DTM cell the software calculates the number of blocks passing through, the maximum rock-fall velocity and the maximum flying height. These information were used in order to verify the efficiency of the existing rockfall protection systems. Finally, the rockfall risk map was realized through the evaluation of the spatial distribution of the following three parameters: (i) lithology, (ii) kinematic compatibility, and (iii) historical rockfall events. After quantifying the risk, the most suitable typologies of rockfall protection systems were identified for the most unstable sections of slopes.

The importance and usefulness of this study derives from the validation of the obtained results, in terms of risk, through the occurrence of new rockfall events in those areas for which the highest level of rockfall risk was defined in previous study.