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Terrestrial Laser Scanner for assessing rockfall susceptibility in the Cilento rocky coast (Southern Italy)

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Rockfalls and other types of landslides are the dominant processes causing a retreat of sea cliffs. The coastal areas constitute an important tourist attraction and a large number of people rest beneath the cliffs on a daily basis, considerably increasing the risk associated to rockfalls. We present an approach to assess rockfall susceptibility at the cliff scale based on terrestrial laser scanner (TLS) point clouds. The test area is a coastal cliff situated in the southern part of the Cilento (Centola Municipality, Campania Region), in which a natural arch was formed. This cliff is constituted by heavy fractured carbonate rock mass with a strong structural control. In June 2015 TLS data were acquired with long-range scanner RIEGL VZ1000®.

The structural analysis of the cliff was performed in the field and using Coltop 3D software on the point cloud. As a result, 10 discontinuity sets (joint, faults and bedding planes) were individuated and the different characteristics such as orientation, spacing and persistence were measured.

The kinematically unstable areas were highlighted using a script that computes an index of susceptibility to rockfalls based on the spatial distribution of failure mechanisms. The susceptibility index computation is based on the average surface that every joint set (or combinations of two joint sets in the case of wedge failure) forms on the topography according to its spacing, trace length, and incidence angle. This susceptibility index also depends on the steepness of the joint set (or of the intersection line in the case of wedge failure). As a result the most important discontinuity sets in terms of potential planar failure, wedge failure and toppling were individuated and an assessment of rockfall susceptibility at the cliff scale was achieved. Results show that the kinematically feasible failures are not equally distributed along the cliff but concentrated on certain areas. The most susceptible areas for planar failure are related to the discontinuity set K10 (71/097), whereas for toppling the highest susceptibility is reached with K1 (60/218). Concerning wedge failure, the combination of K10 and K1 yields the highest susceptibility values. It shows also clustering with higher density which is probably related to regional structures.

More detailed investigations of the rockfall susceptibility and failure mechanisms will be performed during the forthcoming months. The relationship with regional structures will be also investigated in more detail. Perspectives also include using the methodology on the other side of the natural arch in order to provide a global susceptibility assessment of the area.