Multi-temporal Terrestrial Laser Scanner monitoring of coastal instability processes at Coroglio cliff

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The Coroglio cliff is a morphological evolution of the caldera rim of Neapolitan Yellow Tuff (NYT) in Campi Flegrei caldera (CFc) with an elevation of 150 m a.s.l. and a length of about 200 m. The lithology consists of NYT, extremely lithified, overlaid by less lithified recent products of the Phlegrean volcanism., These materials are highly erodible and, due to proximity to the sea, the sea wave and wind actions cause very strong erosion process.

In the recent years Terrestrial Laser Scanner (TLS) technique is used for environmental monitoring purposes through the creation of high resolution Digital Surface Model (DSM) and Digital Terrain Model (DTM). This method allows the reconstruction, by means of a dense cloud of points, of a 3D model for the entire investigated area. The scans need to be performed from different points of view in order to ensure a good coverage of the area, because a widespread problem is the occurrence of shaded areas.

In our study we used a long-range laser scanner model RIEGL VZ1000$^{®}$. Numerous surveys (April 2013, June 2014, February 2015) have been performed for monitoring coastal cliff morphological evolution. An additional survey was executed in March 2015, shortly after a landslide occurrence.

To validate the multi-temporal monitoring of the laser scanner, a "quick" comparison of the acquired point clouds has been carried out using an algorithm cloud-to-cloud, in order to identify 3D changes. Then 2.5D raster images of the different scans has been performed in GIS environment, also in order to allow a map overlay of the produced thematic layer, both raster and vector data (geology, contour map, orthophoto, and so on). The comparison of multi-temporal data have evidenced interesting geomorphological processes on the cliff. It was observed a very intense (about 6 m) local moving back at the base of the cliff, mainly due to the sea wave action during storms, while in cliff sectors characterized by less compact lithologies widespread small (> 50 cm wide) erosion forms have been recognized. Finally, the upper part of the cliff, characterized by loose pyroclastic deposits covered by vegetation, resulted affected by small collapses, which can involve the public gardens of Virgiliano Park, located at the top of the cliff.