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Terrestrial laser scanner and volcanoes: the high-definition 3-D model of the Vesuvius crater (Naples, Italy) and integration with aerial digital photogrammetry.

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High-precision digital surface models of areas subjected to eruptive events, gravitative instabilities, landslides or geo-morphological variations are important to study surface deformation phenomena. The comparison of multi-temporal models, provides a continuous space-temporal description of geophysical processes and physical features.

Several techniques, including GPS kinematic, digital aerial and terrestrial photogrammetry, airborne and terrestrial laser scanning and optical satellite imagery systems, are suitable surveying methods that provide appropriate spatial resolutions. Among these techniques, the terrestrial laser scanning, measures range and reflectance of surfaces with redundant survey points (illuminated elements) and is capable to capture topographic details within a few centimetres accuracy. Here we show the results of a terrestrial laser scanning survey applied to the Vesuvius volcano crater, which was measured by means of 20 acquisitions, taken from four different points located on the top of the crater rim. The laser image alignment process, based on ICP algorithms, enabled the registration of different scans characterized by a few centimeters resolution

at sub-centimeter level, providing an accurate mosaic reconstruction. A final triangulated model was generated with a mean size of 5 cm, providing an high definition geometrical, geological and geo-morphological information of the surface.

The data points redundancy allows an easy integration between different model provided by laser, cartography or airborne surveys: in particular, the combination of terrestrial laser scanning and aerial digital photogrammetry, using images whit a mean ground pixel size of about 20-30 cm, can allow to extend the study area and check for accordance among the methodologies.

Comparing different temporal high-resolution 3-D models of the topographic surface from repeated surveys, the morphological variations, physical surface changes and mass movement, can be estimated. The accuracy and resolution obtained in the described experiment provide evidences that this approach may be a powerful technique for describing and monitoring volcanic areas.