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Very high resolution Digital Terrain and Marine Model for Lipari island: flooding scenario induced by land subsidence and sea level rise

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Multibeam bathymetry combined with aerial digital photogrammetry, play a crucial role in the generation of ultra-high resolution digital terrain models (DTMs) of land and submarine areas. Integrating these survey techniques can be realized accurate and homogeneous DTMs along narrow coastal zones that often cannot be adequately surveyed owing to logistical limitations on collecting bathymetric data in very shallow water. Here we show results from the merging of high resolution multibeam bathymetry and aerial photogrammetric surveys, the latter also performed locally by drone surveys, integrated in the same reference system, to generate the first 3D high resolution Digital Terrain and Marine Model (DTMM) of the Lipari island (Aeolian islands, Italy). This active volcanic area is located between the Southern Tyrrhenian Sea back arc basin (Marsili basin) and the Calabrian Arc, an orogenic belt affected by a Late Quaternary extensional tectonics and uplift. In this tectonic and volcanic framework, at Lipari geodetic and archeological data show a continuous rapid land subsidence at velocities >10 mm/yr, which is the highest value among the Aeolian island.
The obtained DTMM at the average resolution of 0.5 m and locally at about 0.1 m, will significantly improve geophysical and geomorphological studies of this volcanic island. Particularly, it will assist in reducing future hazards related to flooding scenario, due to the combined effect of continuous land subsidence and sea level rise. Relative sea level rise at Lipari is already causing a diffuse submersion of the coast and by the year 2100 is expected a significant flooding of the land with large impacts on the environment and the coastal installation, representing a significant hazard factor for the local population living near the shore.