Integrating acoustics and photogrammetry-based 3D point clouds for the generation of a continuous bathymetric model in coral reef environment.

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Digital terrain model (DTM) reconstruction in coral reef environments through traditional mapping methods, using either singlebeam or multibeam echosounder systems, often presents difficulties in obtaining a continuous 3-dimensional representation, due to the complex topography and the considerable extension of very shallow areas (i.e. reef flat areas). The present-day most advanced techniques used to collect high-resolution elevation data both for land surface and the seafloor, in coral reef environments, include the use of satellite-derived bathymetry, LIDAR technology, Unmanned Aerial Vehicles coupled with photogrammetry and traditional bathymetric surveys. Data processing represents in all the cases a fundamental step for ensuring the accuracy and reliability of obtained measurements, especially for allowing a precise integration of all data sources into a continuous DTM. In our work, we present a tested methodological protocol for the generation of a continuous fine-scale digital terrain model (DTM) in coral reef environments. A portion of an atoll reef (Magoodhoo reef located in the Maldivian archipelago, the southern part of Faafu atoll) has been remotely mapped from the reef flat area to the connected and deeper lagoon environment, collecting elevation data by different sources according to the surveyed depths. In particular, we acquired acoustic depth measurements using a multibeam echosounder and 3D point clouds applying the Structure from Motion (SfM) technique to RGB images, collected using an Unmanned Aerial Vehicle (UAV). All obtained data were calibrated and validated with RTK-GNSS measurements and successfully integrated in order to generate a harmonized DTM for the surveyed sector of the Magoodhoo reef.