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COASTAL MONITORING WITH INTEGRATED APPROACH BASED ON INNOVATIVE TECHNIQUES AT RICCIONE (EMILIA-ROMAGNA, ITALY)

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1. Introduction

The integration of different techniques for coastal monitoring, taking into account the behavior of the emerged and submerged beach, is a fundamental tool to understand the coastal response to different hydrodynamic conditions (occurrence of high-energy events vs. "normal" wave regime) and to coastal protection interventions (replenishment, "hard" artificial structures).

In particular, the capability to replicate surveys with innovative, high-resolution techniques allow to verify the short-term evolution of the beach and to have a larger comprehension of coastal dynamics, integrating observations focusing on the shoreline (Archetti and Romagnoli, 2011) that is not necessarily the most representative feature to this purpose (Almonacid-Caballer et al., 2016).

In this work, we present the first results of a multi-technique survey of a coastal tract at Riccione (Emilia-Romagna, Italy). Here some non-conventional, experimental techniques of defense from coastal erosion (*WMESH*), located in the submerged beach, are currently being tested, and the surrounding seabed has been subjected to previous multibeam bathymetric surveys (by ARPAE in 2017 and 2018).

This study is part of the STIMARE project, funded by the Italian Ministry for the Environment and Protection of the Territory and the Sea (MATTM), which aims at studying the shoreline evolution in the presence of coastal defense structures with innovative monitoring techniques and strategies.

2. Methods

In our integrated approach, we propose to use different monitoring techniques, besides traditional topographic ones, to survey the emerged and the submerged beach of Riccione (Emilia Romagna). A topo-bathymetric survey has been carried out in May 2019 in the framework of the STIMARE project by using TLS (Terrestrial Laser Scanning, Fig. 1a) and ASV (Autonomous Surface Vehicle, Fig. 1b) with a multibeam system.

A very-high resolution DTM (grid at 0.01x0.01 m) has been obtained by surveying emerged beach using a FARO Laser Scanner CAM2 Focus^{3D}, a very accurate instrument based on "Phase Shift" technology for measuring distances (6 mm resolution over a range of about 20 m) (Fabbri et al. 2017). The TLS scans have been merged and georeferenced by means of vertical chessboard targets that have been georeferenced by a differential GPS Leica Viva GS14 (GNSS - NRTK positioning).

A high-resolution multi-beam bathymetric survey has been performed in the submerged beach (from 0.4 m to -7 m) through an Autonomous Surface Vehicle (ASV, Fig. 1b) equipped with a multibeam system PicoMB-120 positioned by means of a RTK station (Fig. 1c). This survey has been integrated with direct depth acquisition along transects from about -1m to the coastline, and allowed to obtain a DTM gridded at 0.10x0.10 m. It will be compared with the results of similar surveys to carry out during the project and with those previously acquired by ARPAE in the same area and operative conditions, in order to point out bathymetric variations induced by the presence

of the WMESH structure and the overall evolution of the submerged beach.

Figure 1. a) TSL survey; b) Autonomous Surface Vehicle for multibeam bathymetric surveys; c) RTK-GPS system used for positioning.

3. Results

Preliminary results from the merging of different data sets will be presented, with particular attention to the correlation between the topographic and bathymetric surveys, in order to eliminate any possible errors related to the use of the different methodologies (Giambastiani et al., 2016, Scarelli et al., 2017).

The results of the topo-bathymetric surveys constitute the topographic inputs for numerical models and will be compared with data obtained with other monitoring approaches, such as through videocameras and UAV. Low altitude photogrammetric surveys (UAV), in fact, will also be carried out in next monitoring stages for the reconstruction of the coastal morphology (shoreline and beach area and volume). Several encouraging results have been obtained in the past for this low-cost survey methodology (Mancini et al., 2013) and the objective now is to obtain similar precisions using commercial low-cost UAVs.

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