ASSESSMENT OF COASTAL VULNERABILITY BASED ON THE USE OF INTEGRATED LOW-COST MONITORING APPROACH AND BEACH MODELLING: TWO ITALIAN STUDY CASES

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INTRODUCTION

In recent years, the use of video-monitoring techniques is significantly increased due to the diffusion of high-resolution cameras at relatively low-costs (Archetti et al., 2016; Valentini et al., 2017) and they are largely used to estimate the shoreline evolution and wave run-up, as important coastal state indicators to be monitored and predicted for the assessment of flooding and erosion risks. In this work, we present an integrated approach based on the results from the low-cost video monitoring systems and the numerical modeling chain by means of SWAN and XBeach to accurately simulate and predict the swash zone processes.

DESCRIPTION OF THE CASE STUDIES

The present study is performed in two study sites, Riccione (44°00′N 12°39′E) and Monopoli (40°57′17″N 17°10′24″E), respectively located in North and South Italy, along the Adriatic Sea. The chosen sites are monitored since they are characterized by the realization of some unconventional interventions for the coastal protection, as innovative submerged modular barriers and beach scraping from bars.
In the framework of the STIMARE Project (Archetti et al., 2019), low-cost video monitoring techniques are implemented in order to quantify the coastal erosion and flooding area through automatic and in real-time image processing of the shoreline evolution and get data to calibrate numerical models.

Fig. 1 – Automatic detection of the shoreline at Riccione (left) and Monopoli (right).

In Riccione the camera system, installed in July 2019, consists of a Raspberry Pi integrated with a camera capturing images at up to 8 MP, implemented for the first time for coastal monitoring issues. In Monopoli, a traditional webcam was installed in June 2019. Shoreline detection is the main product of the video-monitoring: example for the two sites is shown in Fig.1. In addition, the acquired frames are also processed in order to reconstruct the intertidal bathymetries.

NUMERICAL RESULTS AND DISCUSSION

A new integrated numerical approach is implemented, which combines wave measurements at Nausicaa buoy, close to Riccione with nested SWAN, SWASH and XBeach models (Zijlema et al., 2011; Vousdoukas et al., 2011).
For Riccione, the model chain is implemented to simulate the intense storm occurred on July 2019. The pre-storm intertidal bathymetry obtained from the acquired videos is used to update the original bathymetry and, after the wave propagation of buoy data towards the study site by means of SWAN, the sea-storm induced effects on the beach are computed with XBeach. The wave runup occurring at the maximum wave height occurrence is compared with the videomonitoring data in order to calibrate the model and assess its accuracy and feasibility to forecast swash processes in the area. An example of the numerical results of the simulation of the selected sea storm peak (Fig. 2).

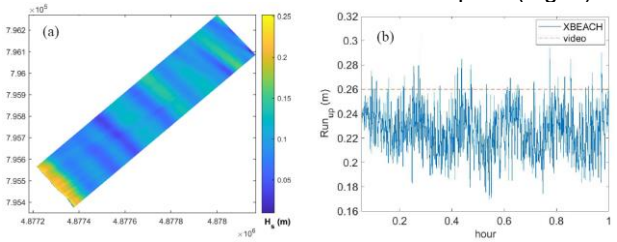

Fig. 2 - Significant wave height map (a) and the computed maximum runup compared with the video monitoring (b).

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