A multi-hazard WebGIS platform to share coastal observatories data and model predictions

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ABSTRACT

The adequate emergency and risk management of flood and erosion in coastal areas requires a combination of comprehensive monitoring networks, accurate prediction tools and information platforms that can convey data and predictions in a timely and user-friendly way. Herein, we present a novel web GIS platform for coastal flood and erosion management targeted at areas subject to the combined action of waves, surges and tides. Information for each coastal region is organized through a coastal observatory concept, and the information is tailored to the specific characteristics of each observatory. Many data types were implemented, including historical and real-time sensor data and processed remote sensing information obtained from local cameras or satellites. Predictions are based on a chain of high-resolution models that operate from the ocean to the coast, simulating wave and current hydrodynamics and their interactions, as well as morphodynamics, based on models FES2014, WW3, SCHISM and XBEACH. The WebGIS platform provides both spatial and temporal information aiming at characterizing hazard, vulnerability and risk. The platform is demonstrated through the application to a complex observatory in the central West Portuguese coast, Cova Gala, to address both flooding and erosion concerns.

1. Introduction

Coastal erosion and flooding are among the major hazards in areas exposed to energetic wave conditions, storm surges and high spring tides. The consequences of hazardous events depend on the characteristics of the coast, requiring detailed monitoring and forecast tools for an adequate prediction of events (Freire et al., 2020). Web platforms, integrating GIS capacities and tailored to the needs of end users, are becoming a valuable asset in coastal management (Khalid and Ferreira, 2020; Rocha et al., 2021). Herein, we present and apply a WebGIS platform that integrates the multiple dimensions of risk assessment, from vulnerability to hazard, from regional to local scales, and provides a one-stop-shop access to historical and real-time data as well as models predictions. The present deployment of the WebGIS platform includes a coastal observatory located in the west coast of Portugal. At Cova Gala, flooding due to wave overtopping and/or dune erosion is the major concern and a very complete observatory was built, including real-time sensor data, satellite processed images and a complex prediction modeling system.

2. The MOSAIC WebGIS platform and its components

The MOSAIC WebGIS platform is a generic tool to support flood risk assessment (Rocha et al., 2021), developed with Django, a Python-based free and open-source web framework, focused on modularity and reusability. It includes a frontend and a backend, with a shared repository for data upload, storage and sharing. A complex data model ensures the integration of multiple sources of information, either from models, sensors or remote sensing (Fig 1).

Coastal predictions are provided through the OPENCoastS service (Oliveira et al., 2021) and its underlying Water Information Forecast Framework (WIFF, Fortunato et al., 2017). WIFF provides a fully flexible customization for the integration of new models through the concept of building blocks required to assemble

custom forecast systems. A model workflow was implemented in WIFF comprising regional waves using WW3, global tidal levels using FES2014, both forcing SCHISM simulations (Fig. 2), which in turn force a local deployment of XBeach. Data sources include historical, targeted field campaign and real-time data and remote sensing images from Sentinel 2, processed to determine the water/land interface.

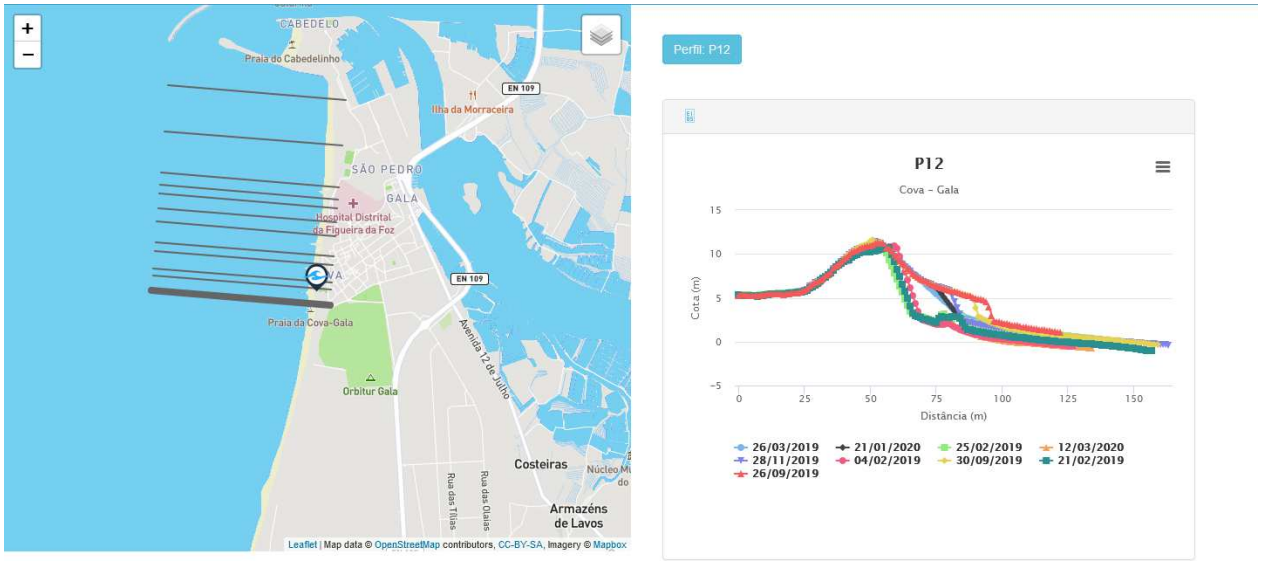

Fig. 1. Field campaigns: beach profiles over 1 year

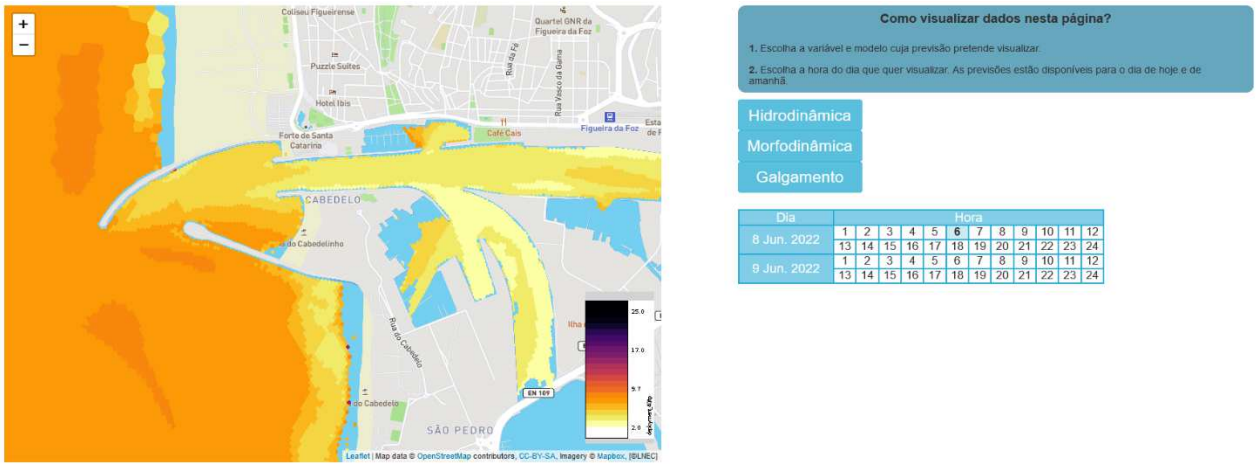

Fig. 2. Cova Gala: SCHISM hydrodynamic model predictions - water levels.

3. Conclusions

A WebGIS platform for coastal flood and erosion risk management is presented and illustrated in a complex coastal observatory, aiming at supporting emergency actions. The next steps will entail integrating data into the forecasting procedure through assimilation techniques. Morphodynamic predictions are being integrated in WIFF, but accuracy issues require the definition of an intelligent procedure for bathymetry update.

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