COASTAL OVERTOPPING RISK ASSESSMENT AT PRAIA DA VITÓRIA BAY

P. Poseiro[1], C.J. Fortes[1], Maria Teresa Reis[1], João Alfredo Santos[2], Rui Capitão[1]
Anabela Simões[3], Eduardo Brito Azevedo[4], Maria da Conceição Rodrigues[5]

Paper topic: Coastal risks and management, including climate changes

1. Introduction

Overtopping risk assessment is an important issue to the safety and management of port operations, since the consequences of these disasters may go up to losses of human lives, including disturbances in cargo operations and environmental impacts.

The present paper is a contribution to evaluate the overtopping risk at coastal and port areas using a Geographical Information System (GIS) environment. The main goal is to produce reliable risk maps along the Praia de Vitória bay, located at the Terceira Island of the Azores Archipelago.

LNEC (Neves et al., 2012) is developing a methodology to built risk maps that consists in three major parts: 1) Sea wave characterization; 2) Overtopping determination; and 3) Risk assessment. All these parts are included in the integrated system for coastal engineering modeling code-named GUIOMAR (Neves et al., 2009). GUIOMAR allows the use of wave propagation models for sea wave characterization in coastal or port areas, the use of overtopping neural network-based tools to compute mean overtopping discharges, as well as the use of all the GIS software functionalities to perform risk assessment and to produce risk maps. This is of great help in the decision making process in coastal areas.

The GUIOMAR system is made of four major components: a commercial GIS software (ARCGIS™); a set of wave propagation numerical models and neural network-based tools to compute wave overtopping; some pre and post-processing programs written in FORTRAN™ and a Graphical User Interface (GUI). The modular nature of the system allows its expansion and easy upgrade, such as including more advanced models or different ones that contemplate other physical processes.

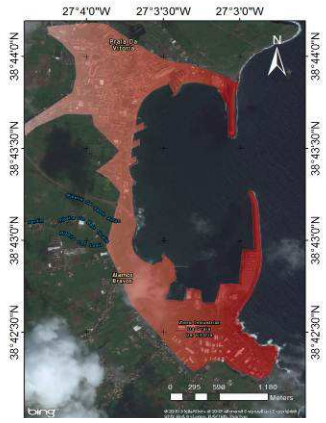

Figure 1: Praia da Vitória bay

GUIOMAR has already been used in Praia da Vitória bay to predict overtopping at three structures: the south breakwater and two groins of the coastal defense structure. The aim of this paper is to build upon the already developed work, increasing the complexity and reliability of the risk assessment with the support of the GIS to understand the temporal and spatial complexity of natural hazards near the coastline. All different coastal structures in the Praia da Vitória bay will be studied and risk maps will be produced for different scenarios.

2. Case Study

The bay of Praia da Vitória is located at the east coast of the Terceira Island, which is one of the nine Azores islands, Portugal. It is protected by the south and north breakwaters. The south breakwater is 1280 m long and it directly protects quay 12 of the port. The north breakwater is 560 m long and protects both the US air-base fuel terminal and a marina with 210 berths. Opposite to the port entrance, the coastline is protected with a revetment seawall and five groins.

[1] LNEC - National Laboratory for Civil Engineering, Av. do Brasil, 101, 1700-066 Lisbon, Portugal. pposeiro@lnec.pt, jfortes@lnec.pt, treis@lnec.pt, rcapitao@lnec.pt
[2] ISEL - Instituto Superior de Engenharia de Lisboa, Rua Conselheiro Emídio Navarro, 1, 1959-007 Lisbon, Portugal jasantos@lnec.pt
[3] Universidade dos Açores, Praia da Vitória, Portugal. anabela@uac.pt
[4] Universidade dos Açores, Terras-Chã, Angra do Heroísmo, Portugal. edubrito@uac.pt
[5] Administração dos portos dos Açores, Praia da Vitória, Avenida Gago Coutinho e Sacadura Cabral, Portugal. mrodrigues@portosdosacores.pt

3. Application

The application of the overtopping risk methodology is made for each structure through the GUIOMAR system. By using the wave data from WAVEWATCH-III model (Tolman, 1999) and the wind data provided by MM5 model (Tolman, 1999), the SWAN (Booij et al., 1999) and the DREAMS (Fortes, 2002) modules compute the wave conditions in front of the different bay structures.

The mean overtopping discharge over the coastal structures is calculated using the neuronal network-based model NN_OVERTOPPING2 (Coeveld et al., 2005).

Finally, to assess the overtopping risk, one has to: a) define a set of thresholds of mean overtopping discharge for each location; b) determine the probability of exceedance of those pre-set threshold values; c) quantify and qualify the consequences of the overtopping occurrence; d) calculate risk through the product of the probability of a pre-set threshold being exceeded by the corresponding consequences; e) produce the risk maps. All of these steps use the GUIOMAR system and show how this tool permits an automatic building and interactive visualization with the huge potentialities of the GIS.

Figure 2 presents an example of the time series of mean overtopping discharge at the south breakwater and the risk map.

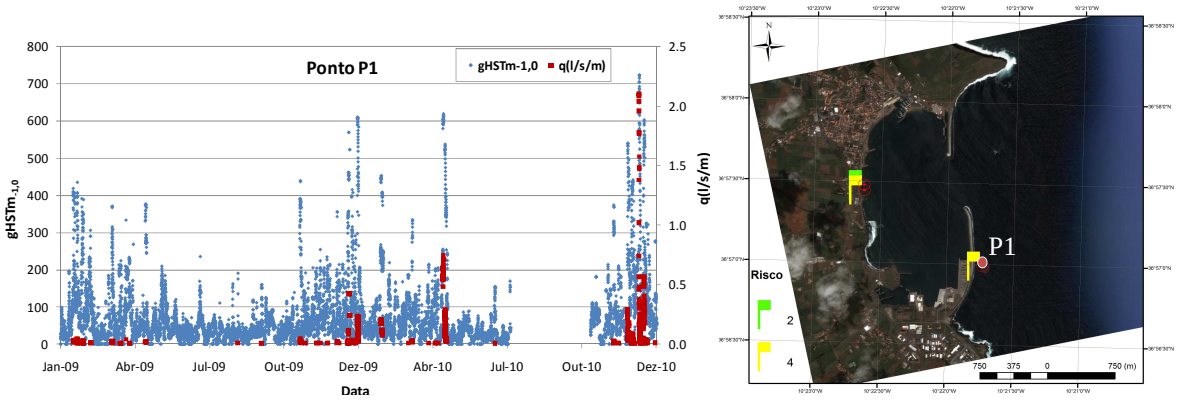

Figure 2: Time series of mean overtopping discharge q (red) at point P1. Risk map (Green flag: Negligible Risk; Yellow flag: Acceptable Risk).

Acknowledgements

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