THE EWCOAST CONTRIBUTION TO AN EARLY WARNING SYSTEM FOR COASTAL RISKS ASSESSMENT

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ABSTRACT

Early warning systems are a fundamental tool to reduce risks in coastal areas. Nevertheless, their development and current use are still in their early stages. The EWCoast project contributed to the development, test and validation of three overwash (dunes)/overtopping (structures) and one storm-induced erosion warning system prototypes at the Portuguese coast, based on a process-based model for the impact and a risk evaluation derived from indicators (*i.e.* mean water discharge and shoreline retreat during storms).

Keywords: Overwash; Overtopping; Erosion; Risk Assessment; Storms.

1. INTRODUCTION

Storms impacting sandy coastal areas produce hazards such as erosion and overwash that, in turn, promote risk to life and property damage in occupied areas. Coastal damage and risks are expected to increase in the future not only in association with climate change but also due to the increasing human occupation in coastal areas (van Dongeren *et al.*, 2018). Since the threatened coastal areas are often densely populated, there is a need to implement measures to prevent risks. One of such measures is the use of Early Warning Systems (EWS) that can anticipate expected risks and, therefore, work as management tools to minimise or avoid disaster. The EWCoast project (Early Warning system for Coastal risks induced by storms) aims to develop, test and apply EWS prototypes to alert about potential consequences of overwash/overtopping and erosion induced by storms, at coastal areas. This work presents the common basis of the systems and the areas where the prototypes are currently under testing and validation.

2. MODELLING AND RISK ASSESSMENT

The EWS developed at EWCoast uses wave and water level data from available sources and existing or collected topo-bathymetric data as inputs for a model train. This model train includes SWAN for wave propagation and XBeach (Roelvink *et al.*, 2009) for the impact assessment. XBeach is a process-based model employed to determine both coastal erosion and flooding, and was calibrated against available data from previous storms. It is computationally demanding and, therefore, all possible storm events combinations (*i.e.* tide, surge, wave parameters) have been previously modelled and stored at a Bayesian Network. This procedure ensures that the EWS is timely providing alerts up to 3 days before the occurrence.

3. OVERWASH/OVERTOPPING

Three Overwash/Overtopping EWS prototypes were built for Praia de Faro, Quarteira and Costa da Caparica. The overwash/overtopping was predicted by using XBeach in the non-hydrostatic mode, without considering morphological changes during the event. The model provides the mean

overtopping discharge at defined points (*e.g.* roads, walkways) and the risk severity (four levels of risk) is evaluated for three coastal receptors: pedestrians, buildings and vehicles (Table 1), based on different intervals of mean overtopping discharge.

Table 1. Risk level definition used for the characterization of wave overwash/overtopping risks.

Risk level	Pedestrians	Recreational facilities & buildings	Vehicles
No risk	No injuries or threats on individuals	No damage	Safe to drive any vehicle at any speed
Low risk	Minor injuries and caution with elderly and children	Minor damage to fittings, signs, posts, etc.	Light motorbikes or bicycles become unstable
Moderate risk	Dangerous for most people	Severe damage on non-structural elements (*e.g.* windows, doors)	Unsafe to drive and standard SEDAN cars become unstable
High risk	Very dangerous for all	Severe structural damage and building collapsing	Dangerous to drive standard passengers' cars and risk to all

4. EROSION

An Erosion EWS was built for Praia de Faro. The coastal erosion induced by storms was predicted by using XBeach on the surfbeat mode and focusing on the possibility of building/infrastructure collapsing due to sand removal. It also includes four levels of risk using the vertical erosion and distance to the target as proxies.

5. CONCLUSIONS

The EWCoast project developed, tested and calibrated three overwash/overtopping and one storm-induced erosion EWS prototypes, which are currently being validated against existing data and new storms and will be incorporated at the HIDRALERTA system from LNEC. These systems aim to be the start of an expanded network of EWS prototypes for the Portuguese coast.

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