

Universitat Politècnica de Catalunya

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Coastal Vulnerability to Storms in the Catalan Coast

Memoria presentada por

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Chapter 1

General introduction

Why, now blow wind, swell billow, and swim bark!

The storm is up, and all is on the hazard.

From Julius Caesar, William Shakespeare.

1.1 Introduction

Traditionally, coastlines have been appealing to the human kind due to the large assortment of benefits it provides, such as; the aesthetic value given by the continuous transformation of the scenery, which also acts as a big attraction for the leisure activities. It also offers vast resources of food and the means for commercial trading which set base for development. This situation has set a preference for populations to naturally migrate toward littoral areas. This has been the case of the Iberian Peninsula and specially the Mediterranean coast. In fact, historically speaking, the Catalan coast has set a precedent for coastal communities long before the Greeks settled Emporion (Empurias) and later the Romans Barcino and Tarraconensis (Barcelona and Tarragona) which have been maintained up until these days.

Numbers show that population on the coast worldwide has grown immensely in the last decades in such a way that one in every three people on the planet live within 100 kilometres of the sea (GESAMP, 2001; El-Sabh *et al.*, 1998). The Catalan coast is not an exception and has also been heavily impacted by human settlements. According to DPTOP (2006) 48% of the population of Catalonia is concentrated in the 7% of the territory, a 500 m wide strip along the coast. This without considering the tourist crowdedness in the summer season which can double or triple this density.

This population pressure is observable in crowded beaches and in the construction of seaside buildings, houses, hotels, camping and industrial constructions which alter and overwhelm natural landscapes and habitats to accommodate such infrastructure.

The shoreline also embraces inherent dangers, especially sandy beaches which are highly dynamic environments that act as natural buffers. During storm conditions, large volumes of sand are removed from the beach, therefore the beach is be less capable of serving as a buffer and coastal property damage becomes increasingly more probable. Figure 1.1.1, is an extract from the Catalan newspaper *Avui* from November 13th 2001, and shows the communities that presented damages along the Catalan coast due to the impact of a storm that occurred in November 11th. The growing concern over the loss of beaches and coastal zone is revealed in the various works and reports done by different agencies worldwide (see EuroSION, 2005; Morton *et al.*, 2004). In this sense state officials at all levels have adopted plans for the proper management of the coastal zone which aims to prevent, mitigate, protect and conserve coastal systems with particular interest in sandy beaches.



Figure 1.1.1: Locations affected by November 11th storm, along the Catalan coast (Avui, November 13th 2001).

1.2 Objectives

The main goal of this thesis is to develop a methodology to estimate a coastal vulnerability index to storm impacts to be applied in the Catalan coast.

This index has been done within the methodological framework presented in Figure 1.2.1, that can be summarised in five steps as follows:

1. Characterization of the forcing. Development of a storm classification for the Catalan coast.
2. Characterizing the response. Evaluation of the induced beach response to each storm class measured in terms of two processes: inundation and erosion.

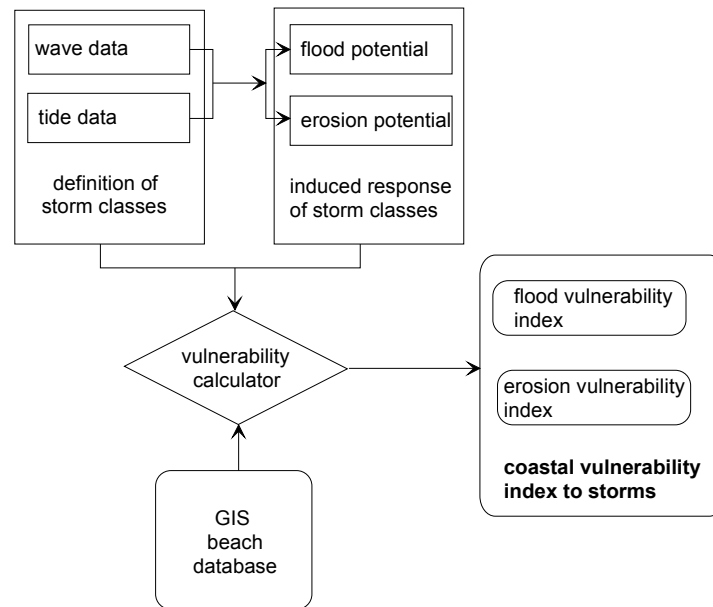


Figure 1.2.1: Methodological approach to assess the coastal vulnerability to storms.

3. Definition of a coastal vulnerability index to storms. Development of two partial vulnerability indicators for each of the considered processes and their integration into an overall vulnerability index to storms.

4. Characterization of the receptor (coastal zone). Creation of a GIS database comprising data on all the beaches along the Catalan coast.

5. Assessment of the coastal vulnerability. Evaluation and mapping of the coastal vulnerability index along with the partial vulnerability indicators.

1.3 Outline

The thesis has been covered in a progressive form through a series of contributions covering specific themes in an individual form. The contributions have been edited, put up to date and expanded, in order to have a better view of the

analyzed problem and the final document has been divided into 7 main chapters with the following contents:

Chapter 2 provides an introduction to the Catalan coast, and presents the principal sources of information available along the coast, the time extent of each of the available series as well as the measured parameters. It also contains the characteristics of the main type of beaches found in the area.

Chapter 3 describes in detail the definition of coastal storms as well as the followed methodology to obtain the storm classification for the Catalan coast and the proposed storm classes.

Chapter 4 presents an analysis of the main induced processes in the coast during the impact of a storm, the flood and erosion potential. The analysis is focused on the cross-shore dynamics since its magnitude is greater than the longshore dynamics during the high energy events. The flood potential was estimated by using the wave induced run up plus the maximum storm surge registered during a storm. The erosion potential was determined using a beach profile evolution model and a parametric method to calculate the magnitudes of the erosion.

Chapter 5 provides a brief overview of some used basic concepts such as: vulnerability, indicators and indexes. It also describes the development of the coastal vulnerability index in three steps: (1) the flood vulnerability indicator (FVI); (2) the erosion vulnerability indicator (EVI); (3) the coastal vulnerability index (CVI).

Chapter 6 contains the assessment of the coastal vulnerability at regional and local scales using a GIS framework. The regional scale includes all the beaches along the Catalan coast, where the indexes FVI, EVI and the CVI are assessed for a class V storm. At the local scale the FVI and the EVI are assessed for the five different storm classes in the Malgrat beach case study.

Chapter 7 contains the overall conclusions of this thesis. Finally, some suggestions for further research about the studied topics are given.

Chapter 8 includes the references used in the thesis.

Annex A describes the long term storm characterization using the HIPOCAS simulated data.

Annex B presents a series of maps which contain the vulnerability assessment done at a regional scale.

Annex C contains a series of maps which display the vulnerability assessment at a local scale for the case study at Malgrat beach.