

Building coastal resilience through erosion rates knowledge in the Portuguese Northern Coast

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1. INTRODUCTION

The Portuguese continental coast is approximately 980 km long facing the Atlantic Ocean to west and to the south. Such coast is mostly sandy, with 60% of dune formations, several estuaries and small river discharges. Several coastal and rocky outcrops provide a degree of natural protection. Since the 1970s, coastal municipalities have experienced a rapid economic growth that has been reflected in significant development of these coastal areas.

About 70% of the Portuguese population lives on the coast and this number is growing due to inland migration to littoral regions, leading to major impacts on estuarine and coastal areas. All these areas are included in various management plans, namely the Coastal Zone Management Plans or the current Coastal Zone Programs, where the coastal line evolution is an important component. These plans have not always been fully effective in controlling the various impacts of different coastal activities and implementing measures to protect, preserve and improve the quality of these coastal areas, namely in relation to coastal erosion. The need for coastal resilience measures is a key issue for the future and for that, a detailed knowledge of the erosion rates is needed.

2. COASTAL ZONES ADAPTATION

A large part of the Portuguese coast is still in a relatively natural state. Some specific areas have today a better management strategy in terms of conservation and development, as there has been an increasing interest from national and local authorities to protect coastal zones from anthropogenic activities, especially near beaches and urban areas, controlling the associated negative impacts and increasing resilience.

In this context, climate change is an important topic for future consideration, especially since extreme events that can be correlated are expected to have significant impacts in coastal zones (Taveira-Pinto *et al.*, 2021a). Some examples of these extreme events include the increase in frequency, variability and intensity of storms, the increase in water depths, the occurrence of greater wave heights and periods, as well as changes in the predominant direction of wave incidence, as in the case of wind, or even the increase in the average mean sea level, among others. Due to these extreme events, the safety of coastal zones is at risk in several sections, namely due to the increased potential for erosion, flooding, and other related phenomena. For these reasons, coastal zone management requires proper adaptation in order to increase its resilience and safety levels (Taveira-Pinto *et al.*, 2021b).

3. RESULTS AND CONCLUSIONS

As part of the work associated with the new Coastal Zone Program of the stretch from Caminha to Espinho (POC-CE), in the northern Portuguese coast, an assessment of erosion rates was carried out taking into account historical data related to the coastline's evolution, as well as areas prone to overtopping and flooding.

For the hazard assessment related to the erosion rates along the 120 km of this stretch, the following subsectors were analyzed:

- Minho River Mouth - Âncora River Mouth;
- Âncora river mouth - Lima river mouth;
- Lima River mouth - Neiva River mouth;
- Neiva River mouth - Cávado River mouth;
- Cávado river mouth - Ave river mouth;
- Rio Ave river mouth - Rio Leça river mouth;
- River Leça mouth - River Douro mouth;
- Douro River mouth - Barrinha de Esmoriz.

This analysis was based on the 1958 coastline and resulted in the definition of areas with low (0.00 - 0.60 m/yr), medium (0.60 - 1.30 m/yr) and high (more than 1.30 m/yr) erosion rates considering the hypothetical evolution between 1958-2012 and 1994-2012.

The areas with higher probability of overtopping for the time horizons of 2050 and 2100 were also defined, considering the mean sea level rise, which was combined with the evolution of the coastline to allow for the identification of 30 critical stretches along the 120 km extension.

In this paper some examples will be presented, as well as some data concerning the general evolution of the coastline in relation to the erosion phenomenon and the future challenges for this coastal area, highlighting the main critical areas of the Caminha-Espinho stretch, showing the need for more resilient measures for the next decades.

4. REFERENCES

- Taveira-Pinto, F., Rosa-Santos, P., Fazeres-Ferradosa, T. 2021a. Integrated coastal zone management: Preservation, adaptation and monitoring [Gestão integrada das zonas costeiras: Preservação, adaptação e monitorização]. *Journal of Integrated Coastal Zone Management*, 21 (1), pp. 5-9. DOI: 10.5894/RGCI-N442.
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