Flood Risk Assessment to Enhance Territorial Resilience in the Ria de Aveiro Region

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Overview

The Ria de Aveiro region is highly vulnerable to flooding, frequently experiencing severe events. These events' environmental and socioeconomic consequences have worsened over the past few decades. The InundaRia project thoroughly analysed flood dynamics in the Ria de Aveiro and the effectiveness of structural measures in reducing flood extent. This provides users and policymakers in the region with reliable forecasts, which are essential for preparing the territory for extreme events and the impacts of climate change, thereby enhancing resilience to future threats.

Methodology

Data collection

- Flood events
- Climate variables
- Territorial information
- Problems and needs of end users
- Public policies

Definition of scenarios

Climate scenarios

- Astronomic tides
- Storm surge
- Mean sea level
- Waves
- Fluvial discharge

Structural measures

- Defence of agricultural fields
- Retaining walls
- New harbour terminals
- Sand dune breaching

Risk assessment

Source - Characterization of flooding drivers

Pathway - Inundation extent

Receptor - Elements exposed to flooding

Flood map validation

- Workshops

Recomendations

- Analysing results
- Identifying needs

Main results

1. The rise in tide and mean sea levels will intensify extreme sea levels

The statistical analysis of the tide gauge record at the mouth of the Ria de Aveiro revealed an increasing trend in both the high tide levels during spring tides and the mean sea level. These levels are rising at rates of 6.7 mm per year and 3.4 mm per year, respectively. Furthermore, due to the effects of climate change, the mean sea level is projected to rise by 0.2 m by 2045.

2. Marine-origin floods threaten artificial territories and agricultural fields along the lagoon's channel margins

The largest flooded area (see Fig. 1) is located in the agricultural regions of Baixo Vouga Lagunar. To a lesser extent, artificial territories in the northernmost part, near the lagoon's mouth and close to the city of Aveiro, are also affected by flooding. It is estimated that 2450 residents are currently directly impacted by marine-origin events with a return period of 100 years. This number is expected to rise to 4437 by 2045 due to increases in mean sea level.

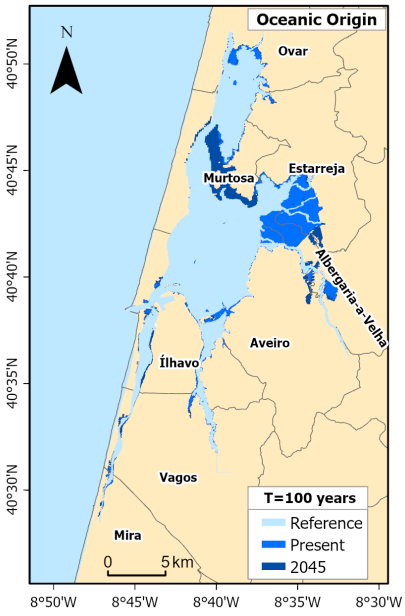

Figure 1.
Flood extent map for events originating from marine sources.

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3. River-origin floods pose a threat to areas near river mouths

The effects of river-origin events are largely limited to agricultural areas and pastures near the river mouths that flow into the lagoon (Fig. 2), while these events have minimal impact on artificial territories.

4. The tide defence system effectively mitigates marine-origin flooding in the Baixo Vouga Lagunar region

The agricultural lands of Baixo Vouga Lagunar will be protected from floods of marine origin with the completion of the tidal defence system (Fig. 3).

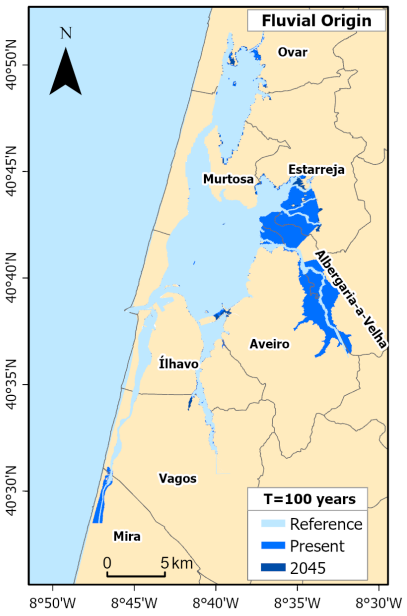

Figure 2.
Flood extent map for events originating from fluvial sources.

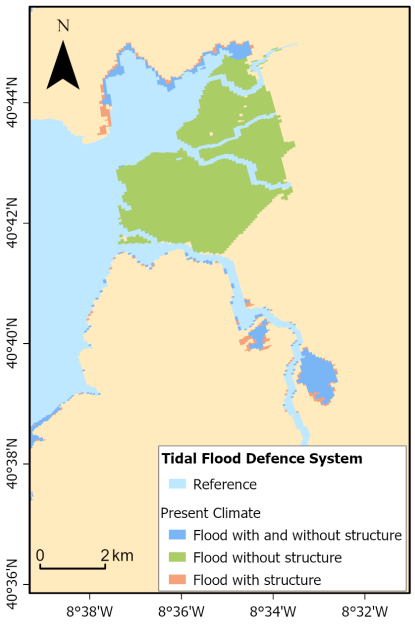

Figure 3.
Flood extent map showing the implementation of defence measures for the Baixo Vouga Lagunar region.

Recommendations

1. Use the developed methodology to assess Portuguese estuarine systems that are at risk of flooding

The developed methodology has demonstrated efficiency in the thorough assessment of flood risk and should be adopted for Portuguese estuarine systems identified as Areas of Potential Significant Flood Risk (ARPSI). Involving civil protection agents, land managers, and the local community in the creation and validation of flood maps has enhanced confidence and acceptance of the results obtained.

2. Use flood maps to enhance land use planning

Flood maps need to be included in territorial planning instruments, such as land use plans, land use regulations, emergency plans, and flood risk management strategies.

3. Enhance the spatial resolution of flood maps for at-risk areas

Understanding the vulnerability of areas susceptible to flood hazards with greater precision and spatial detail will improve the development of more effective risk management plans tailored to local characteristics.

4. Enhance the quality and resolution of the baseline data

It is essential to establish a continuous and systematic monitoring plan to accurately track freshwater inflows in the Ria de Aveiro and other ARPSI areas. Furthermore, conducting current, high-resolution topographic and bathymetric surveys will improve the accuracy of flood maps.

5. Use hydrodynamic modelling to assess the effectiveness of protective measures

Hydrodynamic modelling is a crucial tool for designing, evaluating, and optimizing flood protection measures. It enables the simulation of flood paths under various scenarios, which aids in more accurate and effective decision-making.

6. Establish an early warning system for extreme flood events

A hydrodynamic modelling-based warning system will provide advance flood predictions, assisting civil protection agencies in managing extreme events and improving community safety.

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