

Abstract

Increased storminess associated with climate change poses a significant threat in terms of the potential to generate rapid-onset flooding in coastal areas. Vulnerability to such events is the result of a combination of natural and socio-economic factors. On the natural hazards side, the location of coastal areas at the interface between terrestrial and marine ecosystems makes them particularly vulnerable to all major flood drivers. Among these, extreme sea level change a particularly uncertain driver, with a high degree of uncertainty in its future development, which will be exacerbated by the rise in mean sea level. On the other hand, coastal areas worldwide are densely populated and contain many potentially vulnerable human assets.

The Mediterranean Sea basin is a good example of this double criticality, in that there is uncertainty about future extreme sea levels in this area on the one hand, and on the other, it has historically been very densely populated in proximity to the coasts because of its micro-tidal character.

A variety of methodologies for assessing coastal flood vulnerability have been developed in the literature, each of which raises a number of critical issues from both a theoretical and practical implementation perspective. The aim of this thesis is to analyse the potential and the scope of application of some of these methodologies for the Mediterranean Sea basin, examining their strengths and weaknesses and exploring some of their aspects that are underdeveloped in the literature. In order to achieve these objectives, the thesis is structured around three main pillars.

The first part of the thesis provides a solid theoretical and methodological foundation on the main methods for modelling and mapping rapid onset flooding in coastal areas, in order to provide a general framework within which to place the rest of the analyses.

In the second part of the thesis, an indicator-based method is used to assess coastal vulnerability to flooding, exploring in particular its potential for the development of different climate change scenarios. The results of the analysis show that this method

is suitable for obtaining first-order assessments, but that it is characterised by a number of critical issues in relation to the processes of aggregation and computation of the indicators, which may represent significant limitations in its use as a decision support tool.

In the third part of the thesis, the scope of application of data-driven methods in flood research is explored. An analysis for the assessment of coastal flood susceptibility for the study area is developed as a supervised classification method using modelled ground truth data for model training. The results of the analysis show how such approaches can lend themselves to identifying areas susceptible to flooding in coastal zones with topological characteristics similar to that of the study area. Future research directions are highlighted with regard to the need to generalise the approach for coastal zones of different conformation and obtain more precise results in the future.

This thesis contributes to the development of research in the area of vulnerability assessment to the consequences of climate change in general and coastal flooding specifically, whereby some new limitations are highlighted and some areas for potential future research developments are explored, with a focus on decision support for increasing coastal resilience to climate change.