Coastal Vulnerability of Eastern Saronikos Gulf to intense natural events

Takvor H. Soukissian, Manolis C. Ntoumas, Christos Anagnostou, Chara Kiriakidou
Hellenic Centre for Marine Research, Institute of Oceanography
Anavyssos, Attica, Greece

ABSTRACT

Hardly any area in the world is undergoing such powerful environmental and social changes as the coastal regions. Storms, storm surges, extreme waves, sea level rise as well as coastal flooding put the safety of the coastal population and the integrity of the coastal zone at risk. The aim of the paper is to present a Coastal Vulnerability Index (CVI) referring to the eastern coasts of Saronikos Gulf, an area which is characterized by the largest population density in Greece. The approach that is adopted combines the coastal system's susceptibility to change with its ability to adapt to changing environmental conditions, yielding a quantitative, yet relative measure, of the coast’s natural vulnerability (IPCC 2007).

KEY WORDS: Vulnerability; Saronikos Gulf; sea waves; sea level; CVI; erosion.

INTRODUCTION

During the last decade it was clearly understood beyond any doubt, that the coastal regions of the world are continuously under increasing pressure from their neighboring sea environment. Intense natural events such as hurricanes and floods indicate that the coastal systems are already experiencing the first impacts due to the undergoing environmental changes. Uncontrolled human activities also contribute to the disturbance of the coastal zone health, equilibrium and safety. Defining the term vulnerability is not a trivial task. Prominent amongst definitions is that of the Intergovernmental Panel on Climate Change (IPCC): vulnerability defines “the extent to which climate change may damage or harm a system; it depends not only on system sensitivity but also the ability to adapt to new climatic conditions” (IPCC 2007). In order to be ready to cope with the challenges and the results of forthcoming changes, it is an urgent need to first determine and then quantify the vulnerability of the coastal zone.

In an attempt to quantify a coast’s natural vulnerability, coastal indices are firstly used to classify the shorelines into uniform entities having similar features. This classification can contribute to the rationalization of coastal management policies. To fulfill this, reliable and long-term data for the environmental and socioeconomic factors included in the index are a prerequisite. Though it is difficult to rank socioeconomic data on an interval, the inclusion of socioeconomic variables (apart from the environmental ones) in the classification procedures is also important, cf. Hegde, Reju (2007). Various vulnerability indices have been introduced so far in the relevant literature, giving importance to a variety of factors as e.g., sea-level rise, human and off-spill impacts or wave erosion. Sea level rise is expected to influence particularly coastal recreational and highly populated areas provoking extended social and economic changes. In this connection, regarding the risk and vulnerability to sea-level rise the Coastal Zone Management Sub-Group (CZMS) of the IPCC suggested a common methodology based on a seven step process (IPCC, CZMS 1992, Pethick, Crooks 2000):

1) delineate the case study and specify the sea-level rise boundary conditions;
2) inventory the study area characteristics;
3) identify relevant development factors;
4) assess physical changes and natural system responses;
5) formulate response strategies and assess their cost and effects;
6) assess vulnerability profile and interpret results; and
7) identify relevant sections to determine long-term ICZM planning.

The aim of this paper is to produce a Coastal Vulnerability Index (CVI) and a map of relative vulnerability to future sea-level rise with reference to the east coasts of Saronikos Gulf, using one of the most commonly accepted methods worldwide (Gornitz et al., 1990). As concerns the degree of physical contribution to sea-level rise-related coastal change, the following parameters have been assessed during the determination of CVI: i) geomorphology, ii) regional coastal slope, iii) rate of relative sea-level rise, iv) shoreline change rates, v) mean tidal range and vi) sea-state intensity expressed through significant wave height. Data analysis involves in situ data, statistical analysis of wave height time series obtained from a 10-year numerical simulation wave spectral model and the assessment of historical aerial photographs, satellite images and existing GIS data. All this information has been depicted in a thematic map of the eastern Saronikos shoreline. Using in addition an appropriate classification, the spatial distribution of each of the above parameters and the obtained integrated results for the CVI are also presented.

STUDY AREA

The total coastline of Greece measures approximately 15000km being