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Editorial

Thresholds for storm impacts along European coastlines: Introduction

Coastal zones are of strategic importance for the European Union (EU) with almost half of its population living within 50 km of the oceans and seas and with many activities of vital economic, social, environmental and cultural importance competing for vital space along its estimated 89,000 km of coastline. Hence, it is not surprising that research underpinning Sustainable Coastal Zone Management and Protection has been given high priority in the European Union's research agenda. Since 1989, all EU Research and Technological Development (RTD) Framework Programmes have funded research on the coastal zone through, originally, three successive Marine Science and Technology (MAST) Programmes, the 6th RTD Framework Programme (FP6) and, at present, the Sustainable Marine Ecosystem Key Action of the 7th RTD Framework Programme (FP7). Additionally, in FP7 in the Environment Theme research has been funded to address the issue of marine storms in Europe in the context of assessing climate change impacts. As recently pointed out by Quevauviller (2011), climate change will require the implementation of risk reduction strategies, to decrease water-related risks such as marine flooding.

This publication is another contribution to and proof of the beginning of a new era for the European research landscape through the upcoming "construction" of the European Research Area (ERA). The concept of the ERA is indeed very ambitious and challenging and aims at the development of a coherent European research policy through enhanced concentration, cooperation and synergies between the national policies and the actions undertaken at Community level. The Framework Programme FP6 and its present follow-up FP7 are designed to support the realisation of the ERA. It will endow the scientific community with a wider range of instruments enabling a bigger mobilisation of the resources to reach the critical mass of expertise that is necessary to achieve its ambitious objectives. Newly devised instruments such as integrated projects, networks of excellence, joint implementation of national programmes, together with the more "traditional" ones, are expected, in addition, to promote a further "structuring" and integration of the fabric of European research in order to make the latter the most competitive in the world.

The present special issue reports on the achievements of the Collaborative Project (small or medium-scale focused research projects) MICORE, an acronym that stands for Morphological Impacts and COastal Risks induced by Extreme storm events. The project aimed to analyse and map storm related risks in sensitive European regions taking into account intensity, spatial extent, duration and hazard interaction effects (Ciavola et al., 2011a, 2011b). The topic of storms and their significance in costal morphodynamics was tackled previously in the paper collection edited by Stone and Orford (2004) which presented several worldwide examples.

The papers presented in this volume address the various facets of the "impacts and risks by extreme storm events" based on the amalgamation of the experience and practices of several European countries. The 1953 storm surge event in the North Sea that resulted in over 2000 deaths and extensive flooding across The Netherlands, England, Belgium and Scotland is a pertinent reminder that Europe is not immune to coastal threats. With approximately 89,000 km of coastline, Europe encompasses a diverse range of coastal environments, including pristine natural habitats, large coastal, low-lying sandy dune fields, exposed oceanic coastlines and enclosed sea basins. In a rapidly-changing global climate there is a considerable degree of uncertainty as to how extreme events will behave in the future, particularly with regards to the intensity, magnitude and duration of coastal storms. Although it is widely recognised that coastlines, especially those suffering from long-term erosion, are particularly susceptible to the impact of storms, the definition of thresholds for coastal morphological change remains only partially understood in recent scientific literature.

In the MICORE project, assessing coastal vulnerability to damage by storms, has been approached by linking past events that have caused significant morphological change and/or damage to infrastructure, with the wave and tidal conditions observed during that event. Often datasets for wave and tide observations were not available for given storms: gaps were filled and time-series were extended using reanalysis of time series from the HIPOCAS database (see for example papers in this Special Issue by Almeida et al., Del Río et al., Jiménez et al.) or using hindcast data from local area models (Armaroli et al.; Esteves et al.; Furmanczyk et al.; Gervais et al.; Trifonova et al.). By examining a number of events reported in historical records and using topography, bathymetry, aerial photographs, field reports, it was possible to define critical threshold conditions for each specific level of coastal impact. Proxies used to define threshold conditions include overwash and overtopping, erosion, damage to infrastructure, flooding and dune erosion. Perhaps not surprisingly, given the limitations imposed by data availability and to differences in coastal types (e.g. natural and urban areas), the definition of a universal threshold condition for all sites was not possible. However, it was possible to define two fundamental proxies that must be considered in any assessment of storm thresholds: a) significant wave height (or energy); and b) tide plus surge water levels. Note that this is just a general conclusion, local hydrodynamic regime is important and a general threshold could not be identified. For example, for sites normally exposed to low-energy waves and with limited tidal excursion, the role of increased water levels was crucial (cf. Armaroli et al.; Furmańczyk et al.). In addition, for some coastal types, it was concluded that a role was played by storm direction and duration, peak wave period, wave set-up, storm return periods, and joint probability of extreme waves and water levels. Moreover, it is important to consider single storms and storm groups, since it is believed that a sequence of

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moderate storms can result in as much morphological change or damage as that from a single high-magnitude event. It was also clear that natural and urbanised coastlines should be analysed separately with respect to thresholds for damage (Armaroli et al.). For some cases storm duration did not seem significant (e.g. Del Río et al.) while in other cases (Almeida et al.; Furmańczyk et al.) storm clustering and duration jointly controlled the storm impact. A common point to all sites was the role played by the combination of high waves and surges, so that many authors considered joint probability methods for calculating their thresholds (Esteves et al.; den Heijer et al.). A noticeable aspect common to many of the papers presented in this volume is that the threshold for erosion/damage often corresponds to events with a high probability of occurrence (e.g. 1 year return period), revealing a low resilience of the coastlines examined (see Armaroli et al.; Haerens et al.). Finally, the den Heijer et al. paper showed the limitations in applicability of the standard methods for risk evaluation in The Netherlands using off-the-shelf modelling software. The authors clearly outline where other approaches based on more physically sound models are required.

In closing, we would like to take this opportunity to congratulate all the MICORE partners for their dedication, commitment and excellent work throughout the project and thank them for widely disseminating their research results through this Special Issue. They have proven in an emphatic way that the European Coastal Engineering and Geoscience communities are ready to undertake the new challenges offered by the RTD Framework Programmes and avail themselves as prime candidates to contribute to the realisation of the "European Research Area" for the benefit of the entire society.

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