Geophysical Research Abstracts
Vol. 17, EGU2015-6299-3, 2015
EGU General Assembly 2015

Validation of a short-term shoreline evolution model and coastal risk management implications. The case of the NW Portuguese coast (Ovar-Marinha Grande)

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Coastal zones are fragile and dynamic environments where environmental, economic and social aspects are interconnected. While these areas are often highly urbanised, they are especially vulnerable to natural hazards (e.g. storms, floods, erosion, storm surges). Hence, high risk affects people and goods in several coastal zones throughout the world. The recent storms that hit the European coasts (Hercules, Christian and Stephanie, among others) showed the high vulnerability of these territories. Integrated Coastal Management (ICM) deals with the sustainable development of coastal zones by taking into account the different aspects that affect them, including risks adaptation and mitigation. Accurate mapping of shoreline position through time and models to predict shoreline evolution play a fundamental role for coastal zone risk management. In this context, spaceborne remote sensing is fundamental because it provides synoptic and multitemporal information that allow the extraction of shorelines' proxies. These are stable coastal features (e.g. the vegetation lines, the foredune toe, etc.) that can be mapped instead of the proper shoreline, which is an extremely dynamic boundary. The use of different proxies may provide different evolutionary patterns for the same study area; therefore it is important to assess which is the most suitable, given the environmental characteristics of a specific area.

In Portugal, the coastal stretch between Ovar and Marinha Grande is one of the greatest national challenges in terms of integrated management of resources and risks. This area is characterised by intense erosive processes that largely exceed the shoreline's retreat predictions made in the first Coastal Zone Management Plan, developed in 2000. The aim of this work was to assess the accuracy of a new model of shoreline evolution implemented in 2013 in order to check its robustness for short-term predictions. The method exploited the potentialities of the Landsat archive; selected images, ranging from 1984 to 2011, were processed in order to extract two different vegetation-related proxies (i.e. the Stable Dune Vegetation Line and the Seaward Dune Vegetation Line) and to quantify their uncertainty. The proxies' rates of advance/retreat were calculated by exploiting the Digital Shoreline Analysis System (DSAS), an ESRI ArcGIS software application. Subsequently, it was used a recent Landsat 8 image to extract the 2014 observed shoreline proxies' positions. The latter were compared with the ones predicted for the same year adopting the rates previously obtained from DSAS. Statistical analyses based on the differences between predicted and observed values were calculated in order to i) study the coastal evolution of the study area, ii) predict short-term scenarios (3 years), iii) assess the predictions accuracy and iv) identify the more reliable proxy for the study area. Finally, results were interpreted in terms of coastal planning and management perspectives. This was achieved by taking into account the official coastal risk management framework implemented in 2012 to promote a flexible, integrated and adaptive approach. This new generation of Coastal Zone Master Plans had inspired this research because it reinforced the need for mechanisms of risks prevention and environmental safeguarding.