Analysis of the variability of Mediterranean beaches and their environmental and social impact using remote sensing techniques

PhD student: C. Cabezas-Rabadán

Geo-Environmental Cartography and Remote Sensing Group. Dpto. Ingeniería Cartográfica, Geodesia y Fotogrametría. Universitat Politècnica de València.

PhD Program: Geomatics Engineering

carcara4@alumni.upv.es

INTRODUCTION AND JUSTIFICATION

Beaches are a natural, social and economic resources of great importance to our society. Natural processes, direct human interventions and sea level rise generate erosion processes and jepardize the functions of these areas.

Coastal management is inefficient because it works on an insufficient scale and lacks of up-to-date and continuous data. This requires greater knowledge of the key geomorphological and sedimentary parameters of the nature and state of the beaches, as well as the environmental and socio-economic impacts of changes in the beaches.

Remote sensing techniques have great potential to provide continuous data on the evolutionary dynamics of the coast in the medium term and in the short term. On the other hand, the GIS tools allow the integration of large amount of data from different sources, allowing a combined contribution of very useful information for the study of coastal problems and their management.

MAIN GOALS

Define shoreline changes

↓

Derive indicators to characterize the state of the beaches

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Integrate morphological, environmental and social data

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Cartography and prioritize actions

METHODS

-Defining shoreline position from Landsat 5, 7 y 8 and Sentinel-2 satellites using SHOREX [1].

-Characterizing the beach: width [2], sediment [3], slope, waves and tides [4] and dunes [5].

-Defining the social aspects related with the beach recreational and protective funtions: land use and land cover of coastal spaces surrounding the beach, and beach use.

-GIS integration of information from different sources allowing complex analysis at different spatial and temporal scales.

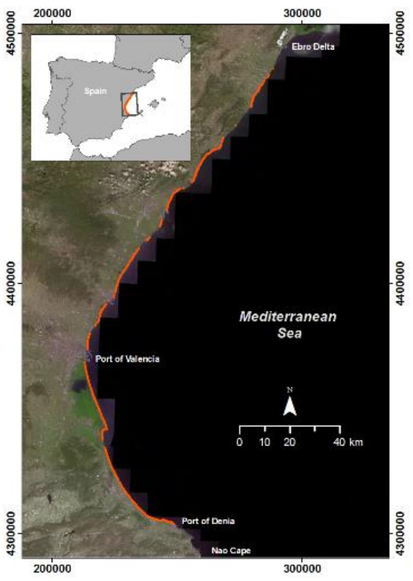

Fig.1. Studied beach segments along the Gulf of Valencia, Western Mediterranean (PNOA, UTM ETRS89 31N).

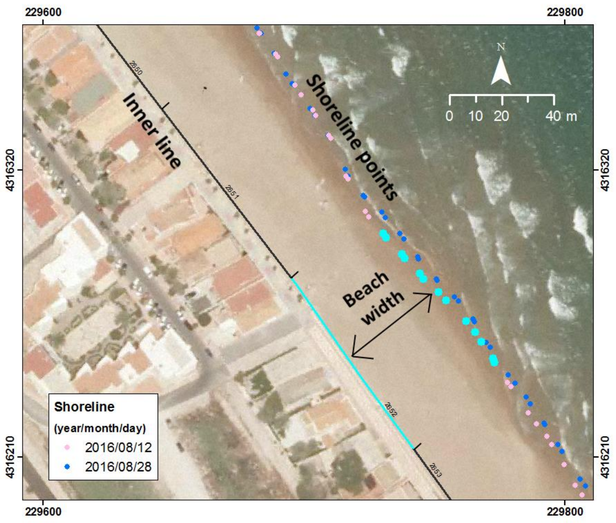

Fig. 2. Shoreline points of 12th and 28th of August, 2016 and the inner line segments used as reference. Beach width was calculated as the average distance between the highlighted segment and their associated shoreline points 2016/08/28. (PNOA, ETRS89 UTM31N)

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TASKS IN PROGRESS AND MAIN RESULTS

Development of an effective methodology for defining shoreline positions from satellite imagery. SHOREX system has been developed for automatic, large-scale data collection [1]. The data is being obtained for the whole Gulf of Valencia 1984-2018.

Taking advantage of the large amount of data available throughout the year it is possible to face different analysis:

Defining the state of the beaches according to their width [2].

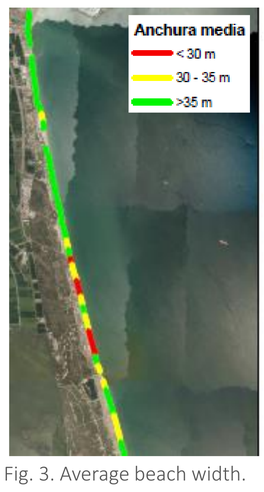

Fig. 3. Average beach width.

Establishing relations between intra-anual shoreline variability and sediment texture [3].

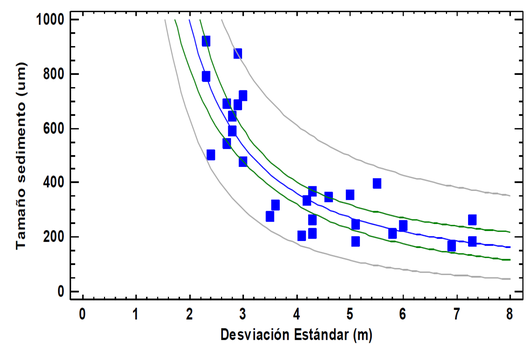

Fig. 4. Square root adjustment of Y X-inverse between the mean size of the sediment and the shoreline variability (SD), with R2=0.748.

Analyzing changes between consecutive dates in order to monitor the beaches in detail and study [4]:

-the impact of storm events and their subsequent recovery

-the response to anthropogenic actions on the coast, such as construction of jetties or nourishments

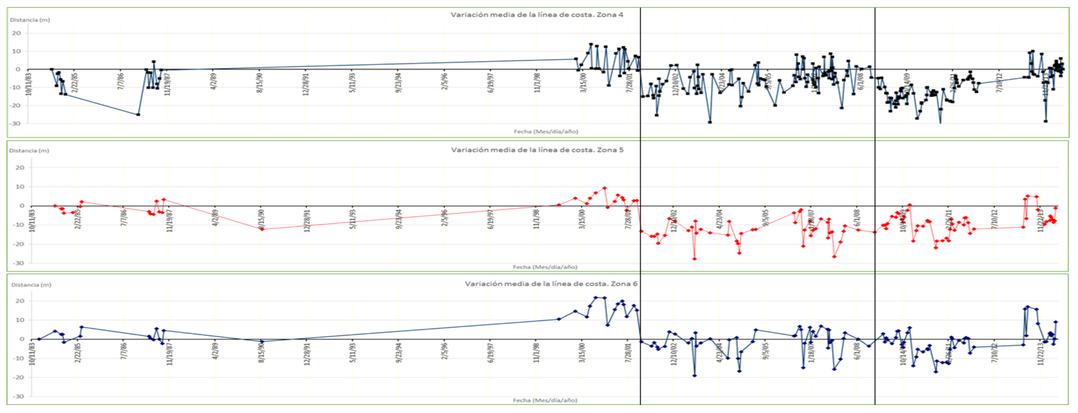

Fig. 5. Evolution of the shoreline (m) in three beaches taking as a reference their positions in 1984.

Analyzing large-scale changes over the medium term (decades) [4].

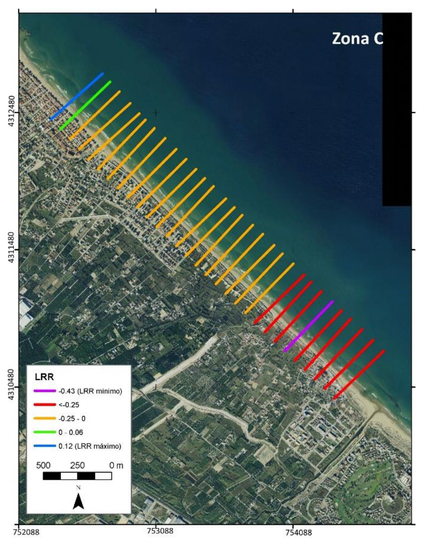

Figura 6. Evolution during the period 1984-2014 as linear regression rate, LRR (m/year) (PNOA, UTM ETRS89 30N).

Detecting problematic segments for the recreational use of the beach.

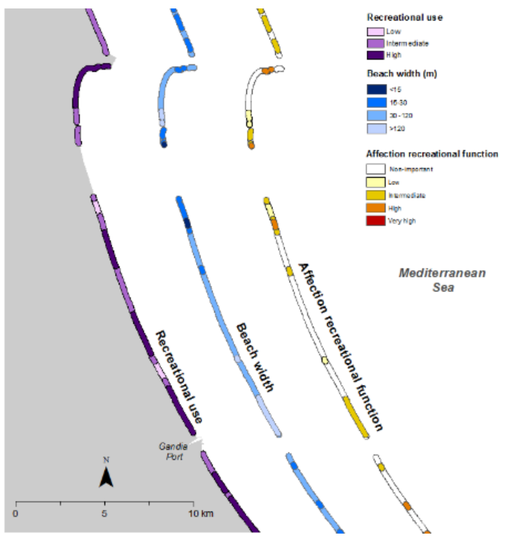

Fig. 7. Detail of the recreational use, beach width (m), and impact to the recreational function.

EXPECTED UTILITY

The proposed methodology allows a universal coastal monitoring deriving key parameters for the analysis of coastal problems on a broad scale as the beach width and its annual variability.

The integration of the parameters derived from the coastline position in GIS software allows its combination with other data of interest, such as beach use. This makes it easy to determine the effect of erosion on the recreational use of beaches, and consequently to prioritize actions and facilitate management.

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