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Medium-term shoreline evolution of the mediterranean coast of Andalusia (SW Spain)

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Coastal environment is a dynamic system in which numerous natural processes are continuously actuating and interacting among them. As a result, geomorphologic, physical and biological characteristics of coastal environments are constantly changing. Such dynamic balance is nowadays seriously threatened by the strong and increasing anthropic pressure that favors erosion processes, and the associated loss of environmental, ecologic and economic aspects. Sandy beaches are the most vulnerable environments in coastal areas.
The aim of this work was to reconstruct the historical evolution of the Mediterranean coastline of Andalusia, Spain. The investigated area is about 500 km in length and includes the provinces of Cadiz, Malaga, Granada and Almeria. It is essentially composed by cliffed sectors with sand and gravel pocket beaches constituting independent morphological cells of different dimensions.
This study was based on the analysis of aerial photos and satellite images covering a period of 55 years, between 1956 and 2011. Aerial photos were scanned and geo-referenced in order to solve scale and distortion problems.
The shoreline was considered and mapped through the identification of the wet / dry sand limit which coincides with the line of maximum run-up; this indicator - representing the shoreline at the moment of the photo - is the most easily identifiable and representative one in microtidal coastal environments. Since shoreline position is linked to beach profile characteristics and to waves, tide and wind conditions at the moment of the photo, such parameters were taken into account in the calculation of shoreline position and changes. Specifically, retreat/accretion changes were reconstructed applying the DSAS method (Digital Shoreline Analysis System) proposed by the US Geological Survey.
Significant beach accretion was observed at Playa La Mamola (Granada), with +1 m/y, because the construction of five breakwaters, and at Playa El Cantal (Almeria) and close to Garrucha harbor, with values of +2 m/y.
Erosion rates ranged from -0.4 m/y (at Playa Casarones, Rubite) and -0.7 m/y (at Playa Castillos de Baños, Granada) to c. -2 m/y (at Punta de los Hornicos, Almeria).
The analysis of coastline evolution revealed as the distribution of erosion areas is strictly related to the incorrect design of coastal structures and their negative effects on downdrift areas. Obtained results clearly evidenced as, in order to evaluate the efficiency of emplaced coastal defense structures, a continuous coastal evolution monitoring plan should be implemented.
Keywords: coast, shoreline, coastal erosion, rate-of-change, aerial photographs.