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Human effects on estuarine shoreline decadal evolution

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Due to their sheltered conditions and natural resources, estuaries were always attractive to human activities (industrial, agriculture, residential and recreation). Consequently, the complex interactions between anthropogenic and natural drivers increase estuarine shoreline vulnerability to climate changes impacts. The environmental sustainability of these systems depends on a fragile balance between societal development and natural values that can be further disturbed by climate change effects. This challenging task for scientific community, managers and stakeholders can only be accomplished with interdisplinary approaches.

In this context, it seems clear that estuarine management plans should incorporate the concept of change into the planning of policy decisions since these natural dynamic areas are often under human pressure and are recognized as sensitive to climate change effects. Therefore, the knowledge about historical evolution of estuarine shoreline is important to provide new insights on the spatial and temporal dimensions of estuarine change.

This paper aims to present and discuss shoreline changes due to human intervention in Tagus estuary, located on the west coast of Portugal. Detailed margins cartography, in a 550m fringe (drawn inland from the highest astronomical tide line), was performed based on 2007 orthophotos (spatial resolution of 0.5 m) analysis. Several classification categories were considered, as urbanized areas, industrial, port and airport facilities, agriculture spaces, green areas and natural zones. The estuarine bed (area bellow the highest astronomical tide line) was also mapped (including human occupation, natural habitats, morpho-sedimentary units) based on the geographic information above and LANSAT 7 TM+ images using image processing techniques. Aerial photographs dated from 1944, 1946, 1948, 1955 and 1958 were analyzed for a set of pilot zones in order to fully understand the decadal shoreline change.

Estuarine bed presents an extensive intertidal area (146 km^2), that includes 13% of salt marshes and 1% of beaches. Anthropogenic structures such as salt pans, old tide mills or aquaculture installations cover 15% of the intertidal zone.

Margins cartography indicates that natural areas (i.e regions that still preserve their natural characteristics) correspond to 1% of margins total area (130 km^2), indicating that Tagus estuary has undergone great anthropogenic change. The most important occupation types are the agriculture parcel (35%) and the urban area (34%). Industrial zones, ports and airports facilities cover 24% and green spaces (areas with vegetation in urban and non-urban zones, gardens, and leisure facilities) extend for 6%.

Preliminary results confirm that estuarine shoreline changes during the last 60 years are mainly related with the direct effect of human activities in the intertidal zone, which promoted the loss of natural areas such as beaches and salt marshes. Nevertheless, few examples of natural recovery of abandoned areas by salt marshes can occur within the studied period.

This paper brings to light the knowledge about the anthropogenic role in Tagus estuarine shoreline decadal evolution, providing valuable information in future climate change effects since it indicates that human occupation can be a barrier to the estuarine system natural response. Furthermore it points out the relevance of planning occupation strategies in these areas.