

Evolution of the Coastal Environment of the Marathon Bay Based on the Shoreline Displacement Rate for the Last 80 Years

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Introduction

The purpose of the study is the determination of the shoreline changes and the sediment processes along the beach of Marathon Bay, which is located at northeast Attica. In the wider on shore area the Schinias National Park, at the northeast of the bay, the Olympic Rowing Centre, military bases, archeological sites, museums etc. are encountered. The area is also characterized by high touristic activity during summer. In the area there are specific locations and constructions endangered due to coastal retreat. A lagoon was established in the study area 3.500 years BP (Pavlopoulos *et al.*, 2006) as it is characterized by low elevations, gentle slopes and fine sediments.

Methods

A survey of the coastal and marine geomorphology was carried out by acoustic scanning of the seafloor with an echo sounder and sonar side scan topographical sections perpendicular to the shoreline along with collection and analysis of surface sediments. The quantification of long-term shoreline displacements was carried out by comparing historical and contemporary aerial photographs (1945, 1960, 1969, 1988, 1996, 2001, 2010) along with very high resolution satellite imagery (2012, 2014, 2015, 2016, 2017, 2018), not to mention the tracing of the coastline (2013) with Real Time Kinematics equipment (RTK-GNSS). The quantification of long-term shoreline displacements was made with the use of the add-on application of Digital Shoreline Analysis System (DSAS) within the GIS platform ArcMap 10.6 (Thieler *et al.*, 2009). This was accomplished by drawing 261 transects (every 50 meters), except those neighboring anthropogenic structures, perpendicularly to the historical shorelines from a stable baseline (Tsokos *et al.*, 2018). At each transect the rate of displacement was measured.

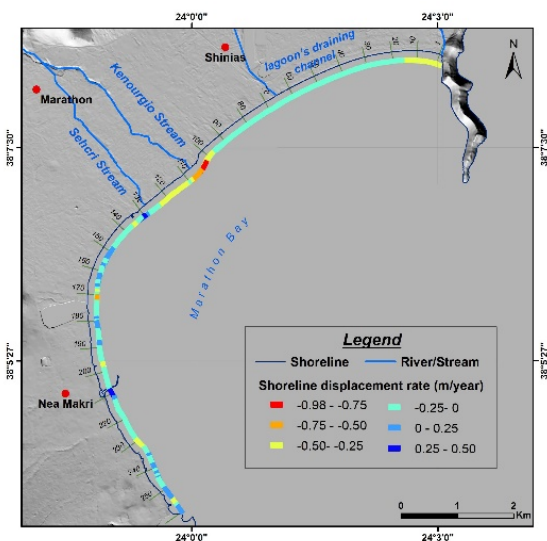


Figure 1. Shoreline displacement rates at Marathon Bay

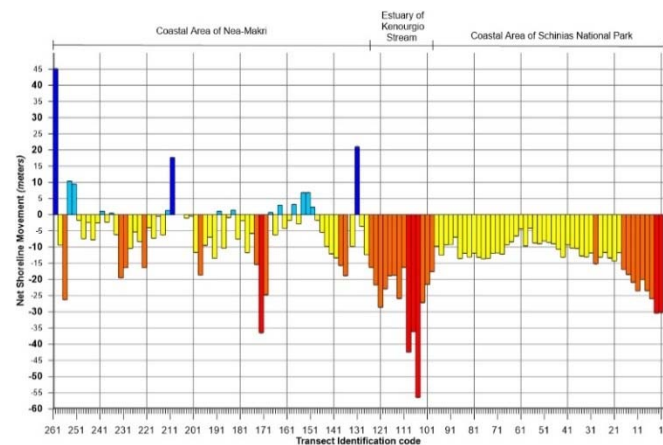


Figure 2. Distance between oldest and youngest shorelines

Results

Throughout the Marathon Bay relatively gentle slopes are formed onshore, combined with shallow depths not exceeding the maximum measured depth of 40 m. An extended submerged alluvial fan seems to have been created mainly by Oinoi River (which is divided into Kenourgio and Sechri streams). The types of substrate and habitats were mainly constructed by non-cohesive materials (mainly sand). An extended meadow of *Posidonia Oceanica* is observed (from 5 to 27 m depth) and *Penicillus capitatus* from 2 to 15 m depth as patches and as beds from 27 to 35 m depth. From 35 to 40 m, mud is mostly prevailed. Specific locations with coarse sand, gravel and rock are noticed at the westernmost section of the Bay (north and south of Nea Makri marina), mostly by the human structures along the shoreline and by destroyed beachrocks. The estuary of Kenourgio stream consists mainly of sand and pebbles. At the coastal area of Nea Makri, several zones of beach rocks were found from 1 to -3 m depth (Koutsomichou *et al.*, 2009). Also an intense underwater berm is observed,

about 50 meters from the shore, along the part of the coastline which is mostly exposed to south waves. The biggest part of Marathon Bay seems to be subjected to coastal erosion (Figure 1). At the center of the Bay, at the estuary of Kenourgio stream, the maximum rates of coastal retreat is noticed (-0,35m/yr) from the mid-40's to 70's. At Nea Makri, a variation of displacements occurs due to anthropogenic structures which affect the nearshore sedimentation (Dimou *et al.*, 2014).

Conclusions

The exposition of the coast to the southern waves, the reduced sediment supply from local rivers, due to the Marathon's Dam and finally the morphology of their riverbeds, they have been filled because of the sea level rise, the sediment's composition and the sediment transport from the beach to the submerged berm due to Marathon coastal hydrodynamic regime are mainly responsible for the coastal retreat. A lower and steady rate of retracement seems to have prevailed since the 1970s and beyond.

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