

Geomorphological and Sedimentological Dynamic Processes at the Semi-Closed Bay Plati Gialo (Sifnos Isl.)

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Study Area

Platis Gialos Bay located at the Southern part of Sifnos Isl. and his length is determined at 1.000 m, with SE direction. The coast of Platis Gialos Sifnos has been under erosion and permanent coastal retreat for several years, especially at the central and west part of the beach. The main causes of coastal erosion are anthropogenic.

Methodology

This paper focuses most intently on the geomorphological and sedimentological dynamic processes of the Bay which forming the current situation. For this reason a number of tasks took place in order to determine the level of disturbances of this dynamic equilibrium. This study included two phases of survey for two different periods (summer/winter). The first phase deals with the geomorphological and sedimentological coast characteristics, and includes: i) long-term geomorphological evolution of the coastal zone through the analysis of satellite images (Google Earth), in order to estimate the intensity of coastal erosion. ii) topographic sections at the surface of the coastal zone, through D-GPS (Spectra Precision SP80 GNSS Receiver), perpendicular to the coastline, iii) sediment sampling in the subaerial coastal area, iv) analytical recording and mapping of the summer and winter shorelines via the D-GPS, v) the situation of the potential feeders of the shore with materials, necessary for the formation of an alluvial beach, and vi) recording of land uses (Fig. 1). The second phase, includes the geomorphological and sedimentological characteristics of the marine area, in particular: i) topographic sections of the bottom surface until the depth of 1.5 m, through D-GPS, perpendicular to the coastline ii) sediment sampling in the subaquatic marine area, iii) data of the numerical recomposition of the wind and wave conditions of the study area, iv) bathymetric eco-sonar data (Lowrance LCX-15MT), v) side-scan single beam eco-sounder (StarFish 450), to determine the seabed morphological features of the bay and, vi) substrate component mapping (Fig. 1).

Laboratory analyzes were followed by the methods of dry granulometry, in order to categorize it, in different types on the basis of Folk & Ward (1957) method through GRATISTAT (v.8) software.

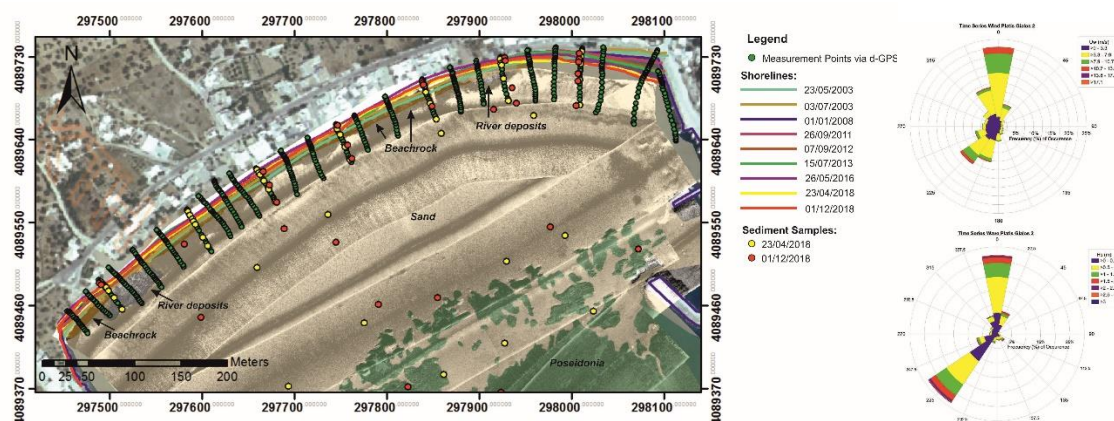


Figure 1. Thematic Map of the study area. Coastlines of different periods, sampling locations, topographic sections, and substrate component mapping are displayed. The next picture displays the time series from 1995 until 2004 for the wind and wave conditions of the study area.

Results

The results of sediment analyses were represented in thematic maps, showing the D50, Mz, Sk, Ku of the sediments. Most of the sediments from the land were characterized (by Folk & Ward, 1957) as Sand (125 – 250 µm) at the summer and as Slightly Gravelly Sand to Gravelly Sand (125 – 500 µm) at the winter, while marine sediments were characterized as Slightly Gravelly Sand (63 – 250 µm) both at summer and winter. Also, slope surface, slope orientation, the roughness of sub-bottom and substrate component mapping are illustrated. Bay presents relatively gentle slopes and shallow depths (with the maximum measured depth, -48 m), with small variations between winter and summer profile (Fig. 2).

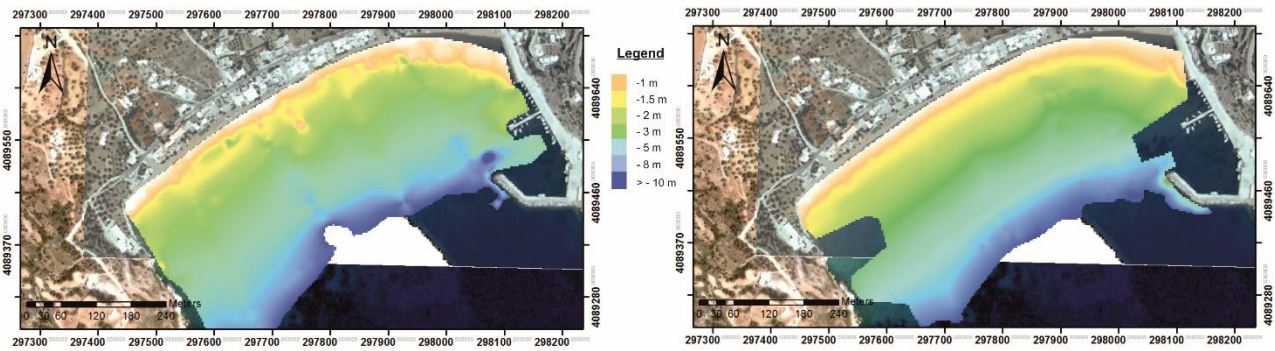


Figure 2. Bathymetric maps in two different seasonal periods. In the left image, bathymetry responds in the winter period, while the right image represents the summer period.

The interpretation of the results determines the morphodynamic condition of the study area, providing a comprehensive view of geomorphological and sedimentological characteristics of the Semi-Closed Bay Plati Gialo and the current prevailing conditions. Our ascertainment is that our study area, mainly the western and central part of it, are under erosion the last 10 years and especially due to the construction of the fishing shelter and the anthropogenic intervention in the natural mechanism of sediment supply from the torrents, in contrast with the eastern part, where the coastal deposition reaches the 26 m (Fig. 3).

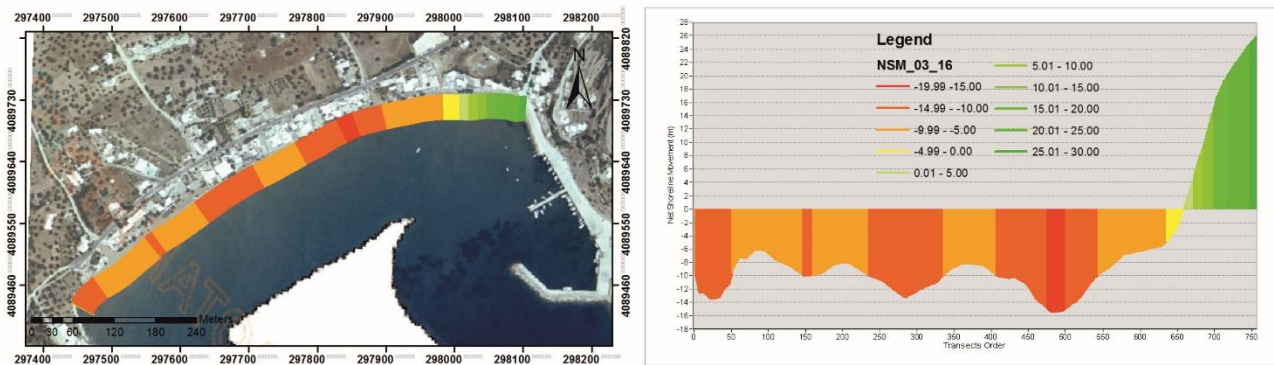


Figure 3. The picture displays the size of coastal erosion and coastal deposition at the coast of Platis Gialos from 2003 to 2016 using the add-on application Digital Shoreline Analysis System (DSAS) in the software ArcMap 10.3 (Thieler et al. 2009).

Discussion

The exposition of the coast to the southern waves, the reduced sediment supply from local fluvial network and the construction of the fishing shelter, are mainly responsible for the coastal retreat. Based on the premise that human has to adapt to nature and not nature to human, we propose "soft" shore interferences, like a gradually and monitory nourishment of the coast with appropriate sediment (quality and size - carbonate gravel of 0.5 - 4 mm in size), in order to bring back the previous morphodynamic balance of the beach of Platis Gialos. Beach nourishment preserves beach resources and avoids the negative effects of hard structures. Instead, beach nourishment creates a "soft" technique by creating a larger sand reservoir, pushing the shoreline seaward.

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