QUANTIFICATION OF RIVER VALLEY MAJOR DIVERSION IMPACT AT KYLLINI COASTAL AREA (W. PELOPONNESUS, GREECE) WITH REMOTE SENSING TECHNIQUES

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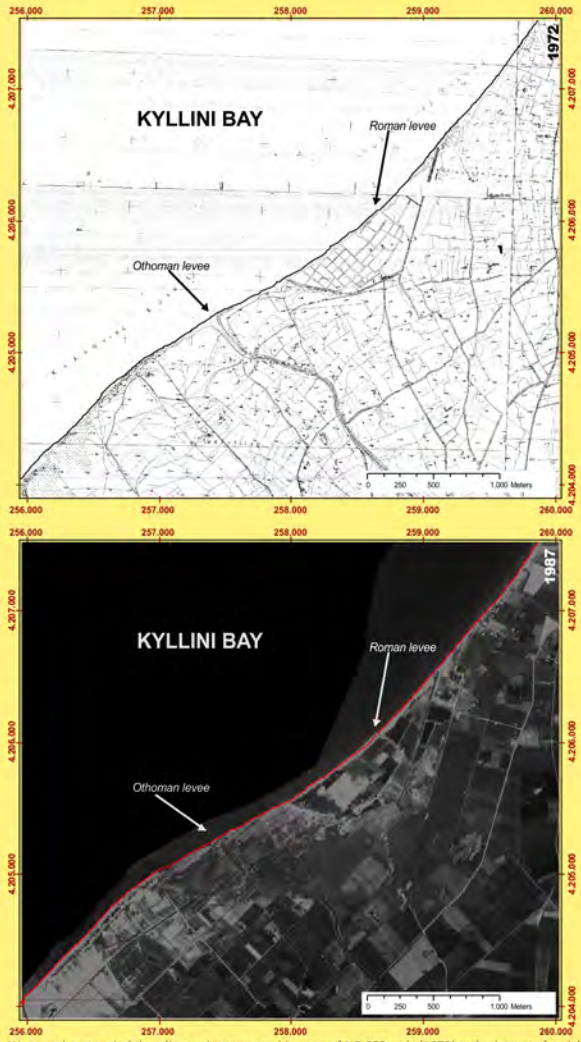
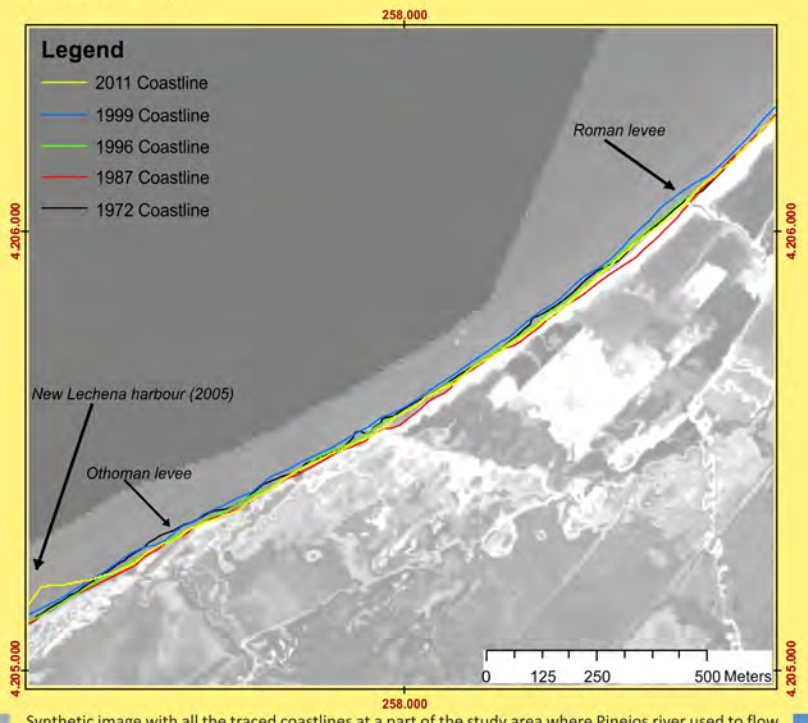
ABSTRACT

The effects of the geological, tectonic and neotectonic structure and the impact of the human presence and activity on the drainage network of Pineios river are presented here in order to determine the causes of its diversion and the implications to the shoreline. We used, analyzed and evaluated (a) geomorphological, geological, tectonic and neotectonic data of the study area, (b) historical information and archaeological findings from buried and eroded archaeological sites of the wider study area, (c) published data related to drill cores and radiocarbon dates, and (d) remote sensing datasets, as satellite and aerial photos of different capturing periods, as well as real-time kinematic differential GPS measurements for the definition of the current shoreline. It is concluded that the detected shoreline displacements and drainage diversions are the result of the combination of active tectonics and human activity during the last 100 kyrs.

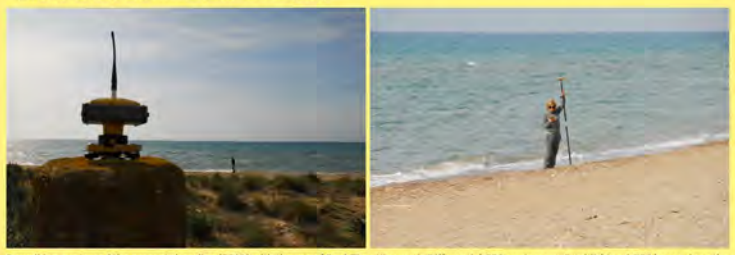


We traced past period shorelines using topographic maps of 1:5.000 scale (1972) and a dataset of aerial photos which were orthorectified and mosaicked (1987).



Synthetic image with all the traced coastlines at a part of the study area where Pineios river used to flow into the sea before 1800's. The combination of all the traced coastlines on the remote sensing data with the RTK GPS recorded coastline have shown that both the former and the current delta fronts of Pineios River are divided into various sub-areas characterized by different type, phase and rate of shoreline displacement. Moreover, there is no systematic progradation or retrogradation in these delta fronts according to the data covering the last 40-year-period from 1972 to 2011. Nevertheless, there are parts of the coastline, especially where the Roman and Othoman levees used to function, that most of 50 meters of the beach have been eroded.

We traced past period shorelines using a dataset of aerial photos which were orthorectified and mosaicked (1996) and the panchromatic band of Landsat-7 ETM+ (1999)..



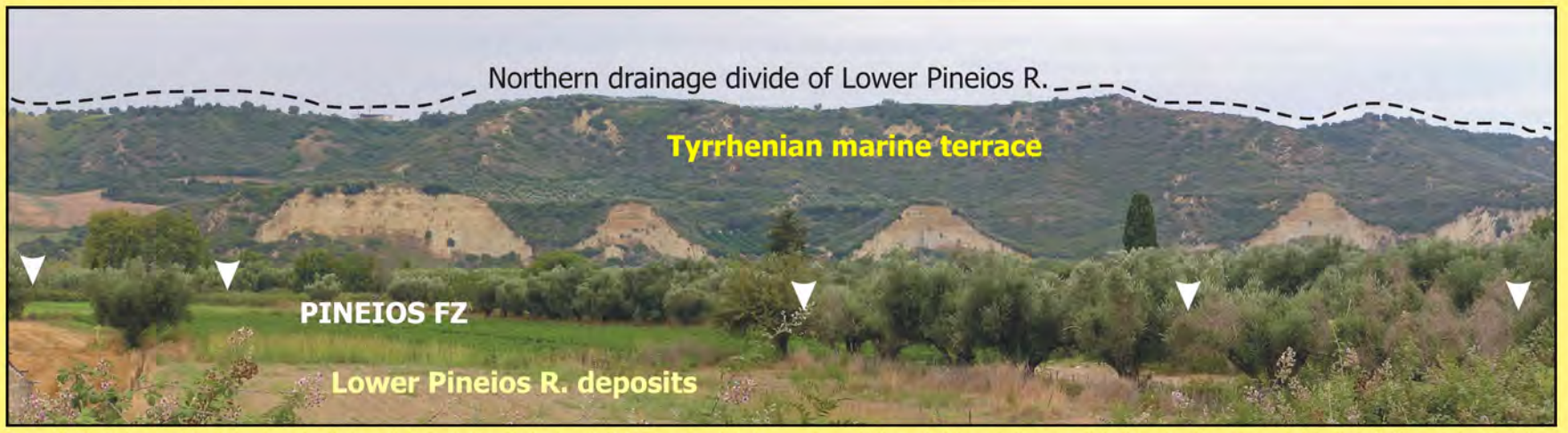
By walking, we traced the present shoreline (2011) with the use of Real-Time Kinematic Differential GPS equipment. Establishing 4 GPS bases along the shore and using the technology of RTK GPS point acquisition completed the methodology. The accuracy of the present coastline was satisfactory as the specifications of the equipment give less than 10cm.

Since walking can waste precious time we also used vehicles on which we set up the Real-Time Kinematic Differential GPS equipment for tracing the present shoreline (2011).

The remnants of the Othoman levee can be distinguished as fresh water can be seen while flowing into the sea. It seems that since Pineios river was diverted, the transported sediment amount decreased and the erosion impact on the beach are pretty obvious.

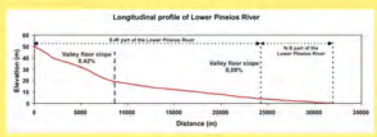
The area of the recently constructed harbour of Lechena (2005).The eastbound coastline has changed dramatically by the deposition of coastal sediments and algae. This progradation at this part reached the 50 meters and was mapped very accurately with the RTK-GPS methodology.

Characteristic type of beach under severe and recent erosion.

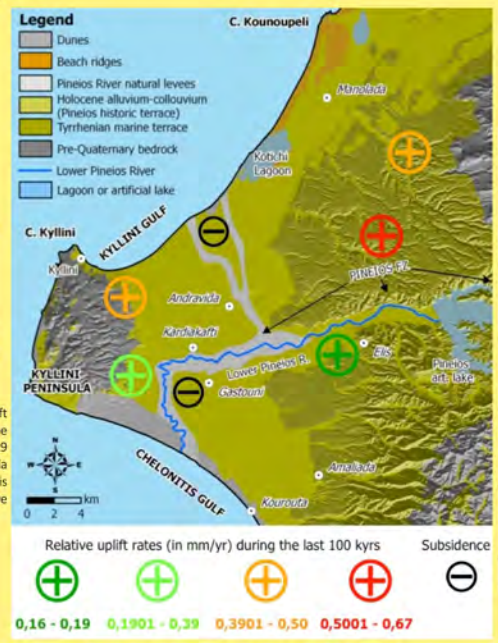


A view of the Pineios fault zone from the hanging wall and facing north. Impressive triangular facets on the Tyrrhenian sediments imply that it is an active structure and the geochronological data reveal an uplift rate of 0.48mm/yr for the last 100kyrs. This normal fault zone's activity seems to be responsible for the diversion of Pineios river from Kyllini gulf to Chelonitis gulf. The diversion of Pineios River to the south of Kyllini peninsula during the 18th century is a case of fluvial antecedence upon the slightly uplifted margin of the Gastouni graben and is the result of the gradually increase of the throw along the western part of the Pineios fault zone during historic times marked by strong and destructive earthquakes during the late 18th or early 19th century A.D. This natural process and trend is supported and enforced by the human activity in the study area during historic times as it is revealed by significant human constructions in the area.

Sketch map of the contemporary Pineios river deltaic area (at the hanging wall of the Pineios fault) and the former deltaic area at the footwall of the same fault. The estimated shorelines for the Roman and Neolithic periods are shown. The archaeological sites and the sampling sites of the geochronological analysis are also noted, along with the calculated uplift rates for the last 100kyrs.



The study area is divided to three subareas that uplift with different rates: (i) the footwall of Pineios fault zone (0,39-0,67 mm/yr), (ii) the Gastouni graben (0,19 mm/yr), (iii) the eastern (inland) part of Kyllini peninsula (0,36-0,48 mm/yr). The western part of Pineios basin is corresponding to the subarea with the lowest relative uplift rate (0,19 mm/yr, Gastouni graben).



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