

THE EROSIONAL RETREAT OF THE ITALIAN COASTLINE AND ITS MEASUREMENT BY GIS TECHNOLOGY

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Abstract

At the beginning of the 21st century one third of Italian beaches is subjected to erosion. The reconstruction of the historical trends of the coastline and the monitoring of actual variations is strongly facilitated by GIS technology. The adopted procedure is based on the overlay of two georeferenced time-separated images, the digitization of the two coastlines, the color distinction of areas subjected to shoreline retreat and advancement and the linear and areal measurement of coastal change.

Keywords : Beach, Erosion, Gis, Tyrrhenian Sea, Adriatic Sea.

Coastline erosion

From mid 20th century the stability of the Italian shoreline is increasingly deteriorating. In the literature two important surveys on Italian beaches stand out. The first, known as *De Marchi Report* [1] provides the national picture in the year 1968 with 600 km of eroding beaches. The second known as *CNR Atlas of the Italian Beaches* (1997) depicts the stretches of eroding beaches totalling ca 1000 km [2].

Shoreline erosion is caused by both natural and anthropogenic factors. Among natural factors subsidence may be very important especially in the northeast; the wave climate, affected by increasing storminess, is also important. Anthropogenic factors are frequently overwhelming, converging towards the reduction of river sediment transport to the coast.

Definitions

The measurement of the variation of the physical position of the coastline based on the comparison of dated maps of airphotos is a common practice. The measured change however says nothing of what happened between the considered time-frames; actually the rate of coastal retreat or advancement cannot be measured and may also vary as a consequence of coastal defence interventions.

The coastline is the expression of a dynamic equilibrium; its position in time indicates: *Retreat* (erosion) or *Advancement* in case of migration towards the mainland or the sea, respectively.

Length of the coastal stretch (km): Linear development of the coastline measured on the younger image of the couplet; the front of morphologically stable river-mouths is not measured.

Maximum retreat or advancement (m): Straight-line measurement of the distance between the two coastlines made on the transept of maximum migration.

Land surface balance (sqkm): Surface difference between the advancing and retreating portion of the considered coastal stretch. The coastal area increase or decrease is indicated by the positive and negative signs, respectively.

GIS Measurements

This research revealed that the most severe retreat of the Italian coastline is found at the tip of major deltas. This is caused by the wave exposed delta front protrusion and the concomitant reduction of river sediment flux.

The rivers and their respective drainage areas are: Arno (9.116 sqkm), Tevere (17.369), Liri-Garigliano-Volturno (11.326), Po (71.057), Adige (11.981) and Tagliamento (2.871). The analysis of airphotos of the indicated time interval using the ESRI ARC-GIS software provided the following results.

Tyrrhenian Sea - Arno delta, Tevere delta, Garigliano and Volturno delta

Duration, time interval (yr) 37, 1959-96 45, 1950-96 39, 1957-96
Length of coastal stretch (km) 18.2 33.0 38.5
Retreating shoreline (km) 10.1 (55.5%) 13,8 (41.8%) 17.0 (44.2%)
Maximum retreat (m) 273 232 712
Land surface balance (sqkm) -0.76 nc -0.63

Adriatic Sea - Po delta, Adige delta, Tagliamento delta

Duration, time interval (yr) 51, 1945-96 33, 1963-96 45, 1951-96
Length of coastal stretch (km) 71.6 10.9 16.6
Retreating shoreline (km) 37.6 (52.5%) 5.1 (46.8%) 8.7 (52.4%)
Maximum retreat (m) 1466 233 341
Land surface balance (sqkm) -7.19 nc

References

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- 2 - C.N.R.-M.U.R.S.T. 1997. *Atlante delle spiagge italiane: Dinamismo - Tendenza evolutiva - Opere umane* (G. Fierro Ed.). S.EL.CA., Firenze, 108 sheets scale 1:100.000.