

Long term coastline observations and numerical modelling between the ports of Margherita di Savoia and Barletta

Elvira Armenio¹, Francesca De Serio¹, Michele Mossa¹, Antonio F. Petrillo¹

1. Department of Civil, Environmental, Building Engineering and Chemistry (DICATECh), Technical University of Bari (Italy) (elvira.armenio@poliba.it)

Abstract

In the present study, both field observations and numerical simulations are used to study the shoreline changes between the ports of Margherita di Savoia and Barletta (in the Gulf of Manfredonia, in Southern Italy).

The coastline, with a total length of about 18 km, is characterized by low sandy beaches with dunes, wetlands and salt marshes. Since middle of last century, it has experienced intense transformation, which caused considerable erosion and/or deposition processes.

In the procedure adopted, the coastline morphology was studied both in its historical evolution and through extensive field observations over the last twenty years. A series of geo-referenced aerial photographs for the years 2005, 2008, 2011 and 2013 were used for mapping the historic coastline configurations. The Digital Shoreline Analysis System (DSAS) tool of the ArcGIS© (ESRI) software, was used to examine the shoreline changes, considering its ability to calculate shoreline rates of change based on the measured differences between the shoreline positions associated with specific time periods.

The numerical modelling of the coastline evolution was carried out using the software package LITPACK (2016) developed by the Danish Hydraulic Institute (DHI). Starting from wave statistics, sediments properties and initial coastline configuration, the model was able to calculate the changes in the coastline due to the littoral transport. The numerical model was calibrated by means of field data and compared with historic shoreline position.

From the investigation of shoreline data, the analyzed coastline resulted characterized by significant shoreline variation. The causes are mostly due to human intervention both in the river basin of the Ofanto river and on the coast that made changes the beach equilibrium over the years. In particular, with the construction of the Margherita di Savoia port, between 1950 and 1952, the Eastern pier retained the sediments coming from Ofanto river and transported by long-shore currents leading to a depositing advancement area. As a consequence, the shoreline southerly of the port caused an increase of the surface of about 338.561 m² until 1992 and of about 181.866 m² from 1992 to 2013.

In the area of Ofanto's mouth, due to the hydraulic-forestry arrangements carried out in the river basin and the construction of reservoirs, there was a total erosion of 930 m of the Ofanto estuary, which transformed from a "delta" mouth to an "estuary" mouth. Such a transition is a sign of the decrease of sediment transport by the river.

In the analyzed period, the sediments of Ofanto river were transported both North-West ward and South-East ward, leading to an accretion area in proximity to the Margherita di Savoia port and the Barletta port, respectively.

From our investigation, the coastline is evolving while maintaining its concave shape.

The evolutionary trends deduced by the historical field data were confirmed by the results of the numerical model LITPACK, which was firstly calibrated and successively used for shoreline evolution analysis. The use of the Coastline Evolution module of LITPACK package software, incorporating the results of wave hind-casting, bathymetry and sediment data as input, provided good results despite the concave/convex shape patterns along the coast.

The study provides useful indications for the Integrated Coastal Zone Management in question.