



the coastal environment

Emilia-Romagna lies on the Adriatic Sea with a low, sandy coastline which stretches for approximately 130 km from the Goro Po mouth to the Gabicce headland. The distinctive element of this coast is the beach, produced by the interaction, over a long period of time, between sediment carried to the sea by rivers, redistribution and deposition by the waves and marine currents and the modelling action of the wind.

From the southern boundary of the region to the Volano Po, the beach is interrupted only by ports and river outlets. In some parts the beach is over 200 metres wide, while in other parts it is completely eroded and has been replaced by sea-walls. The morphology of the northern coastline, lying between the border with Veneto region and the Volano Po mouth, is closely linked to the dynamics of the Po river and the action of the Bora winds, which blow from east-north-east. In this area the beach lies offshore, forming a sand bar called spit that separates the open sea from the area behind which is characterised by lagoons of brackish water, locally referred to as sacs.

Behind the coastal system are vast reclaimed areas, which lie below sea level, consisting partly of wetlands (Bertuzzi Valley, Comacchio Valleys, Piassse di Ravenna) which are home to natural eco-systems of inestimable value.

In addition to this great naturalistic heritage, the Emilia-Romagna coast offers precious historical testimony, is one of Europe's most popular destinations and also supports a number of industrial and manufacturing concerns. Human activity has drastically interfered with the natural evolution of the coast, making this territory extremely vulnerable. Over the past fifty years the area has been highly urbanized, beach-front bathing establishments, ports, wharfs and coastal defence systems (breakwaters and piers) have been built, altering the morphodynamic characteristics of the beach. There are increasingly fewer areas today where it is possible to observe typical beach morphology with sandy dunes behind the beach, or a river outlet unconfined by man-made banks.

Improved knowledge of this environment, and the safeguarding of production activities are key themes which Emilia-Romagna Region has included in its territorial defence strategy.

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the coast

A territory we must get to know and defend

2006

a fragile balance



coastal protection
is a priority in
Emilia-Romagna's territorial
defence strategy

Beach erosion affects over 40 km of coastline in Emilia-Romagna resulting in shore-lines retreating and the sea bed lowering along the shore. This is caused by the force of the currents which, during stormy seas, move sand from the beach and deposit it offshore. If there was a **natural balance**, the continuous supply of sand from rivers and its redistribution along the coast by the longshore currents would compensate for the volume of sand removed and would thus allow the reconstruction of the eroded beach.

Along many stretches of our coastline this balance has been upset by a combination of man-made interference and natural events.

The **supply of sediment** has significantly decreased due to the dredging of gravel and sand from river beds and the trapping of sediment in hydraulic constructions (embankments and dams) along the rivers.

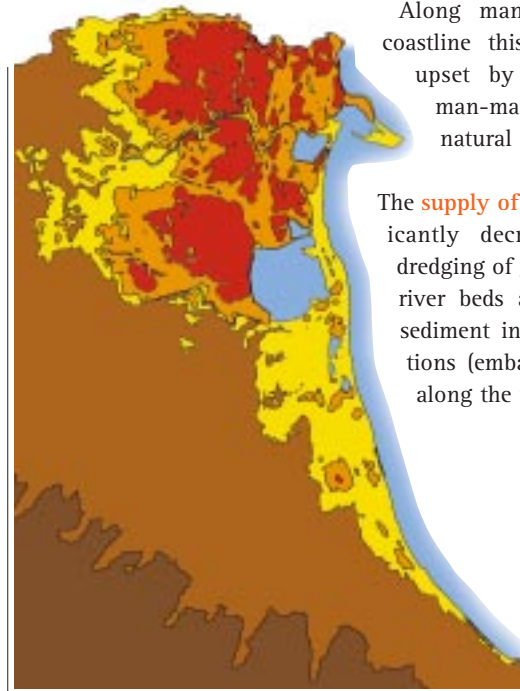
The **presence of coastal structures** (wharfs, breakwaters and piers) has changed the longshore current flows, interrupting the sand distribution along the coast.

Intensive crops and urban spread very close to the beach, led to the disappearance of the coastal dunes systems, which represent a natural defence against stormy seas and a store of sand for the beach. Such a phenomenon exposed the areas directly behind the beach (backshore), which are actually below sea level, to a greater **risk of flooding**.

The subsidence rate, has greatly increased as a result of water and hydrocarbons pumping from the subsoil of coastal and marine areas.

It is therefore evident that **intensive exploitation of the coastal plain** has deleted the vital space for the expansion and discharge of the waves' energy and has accentuated natural phenomena, rendering them a threat to human activity along the coast and the entire ecosystem.

Emilia-Romagna Region is committed to developing a defence system for urban areas and businesses that is compatible with the defence of the coastal environment.



■ up to - 2 m asl ■ from - 2 m and 0 m asl
■ from 0 m and + 2 m asl ■ + 2 m asl and over ■ hill area

knowledge-based defence

The integrated management of the coastal environment, promoted by the European Union since 1995, is based on the principle that long-term development must be founded on sustainable management of the territory and its resources, and must take into consideration the study of all processes that impact on natural systems. Emilia-Romagna Region embraces this principle and introduced an integrated coastal management process which recently culminated in the publication of **Guidelines for integrated management of coastal areas (GIZC)**. This document, jointly compiled by over a hundred experts in environmental, economic, urbanistic and social disciplines, was deliberated upon by the Regional Council in February 2005 and submitted for approval by the competent institutions, the local community and interested parties. The Guidelines represent one of the few examples at European level of an integrated territorial management approach that embraces the principles of environmental sustainability. This document identifies the mechanisms and working methods necessary to establish a dialogue between the various interested parties, and to facilitate the ongoing exchange of information between the various territorial government authorities, from local to national and European level, and vice versa.

In this process, the Geological, Seismic and Soil Survey is entrusted with the task of expanding the knowledge base related to the physical coastal system. The available information has been organized in a **Coastal Geographic Information System (SIC)**, a vital tool for land planning and management.

The SIC contains large part of information produced to date by various regional and national institutions. The data is collected, organized and geo-referenced in order to facilitate use and integrated analysis. This innovative tool, structured in accordance with the guidelines issued by the European Directorate-General for the Environment (EuroSION project, 2004), responds

new monitoring techniques
and management of data
within an integrated system
guarantee more effective
hands-on intervention

to the need to provide study results and a lot of information to all involved parties. The SIC is an effective support tool for studies and for the coordination on coastal management strategies.

The SIC main topic groups are:

- topography
- morphology, sedimentology and the geological attitude of the coast
- hydrodynamics



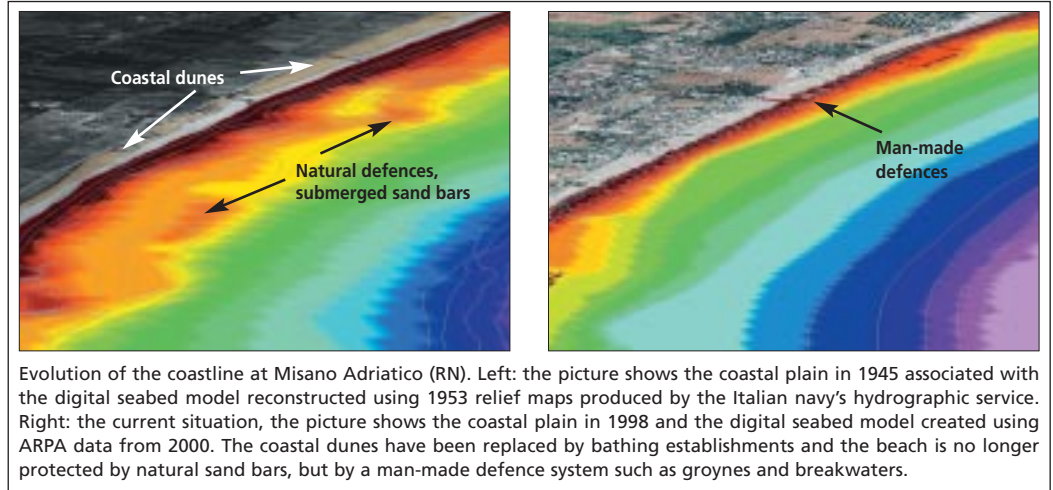
in Europe the GIZC is a rare example of an integrated approach to sustainable management of the coast

- land use
- infrastructure
- defence work.

Much of the information in the SIC has been produced in recent years by the Geological, Seismic and Soil Survey during studies and experimentation aimed at risk analysis. Complete orthophotos catalogues (since 1943) have been published, which form the basis for geomorphological and land use classification of the coast, such for their evolution. Other information includes digital seabed models using 1950 and 2000 data, topobathymetric profiles which have been applied to morphodynamic classification of beaches and reconstruction of historical and current coastline position provided by orthophotos and topographic maps from the early 1800s.

The SGSS is responsible for trying out new risk factor monitoring techniques and integrating the existing system in order to identify the territory's reaction to critical marine events.

In autumn 2004, in cooperation with the Cartographic Institute of Catalonia, remote sensing of the coastal area with airborne scanner laser (LIDAR) was carried out. This provided a high-resolution digital terrain model of the area including the beach, all the defence structures erected in the sea and the landward areas behind the beach. This new, highly detailed relief map



Digital surface model of the mouth of the river Savio, obtained with LIDAR remote sensing.

constitutes the basis for morphologic and morphodynamic studies of the beach, and for carrying out simulations and risk analysis of flooding during stormy seas.

The SGSS is responsible for providing technical-scientific support to the Region's technical services operating along the coast.

The Geological, Seismic and Soil Survey works closely with European partners in a number of EU projects focusing on coastal themes.

the GIZC project matrix

- Physical coastal system, risk factors and defence strategies
- Polluting loads, management of water resources, monitoring
- Port system, floating waste, risks associated with sea freight
- Valorization of habitats, biodiversity and the landscape
- Tourism
- Fishing and aquaculture
- Agriculture
- Energy resources
- Settlement and infrastructure system (services and mobility)