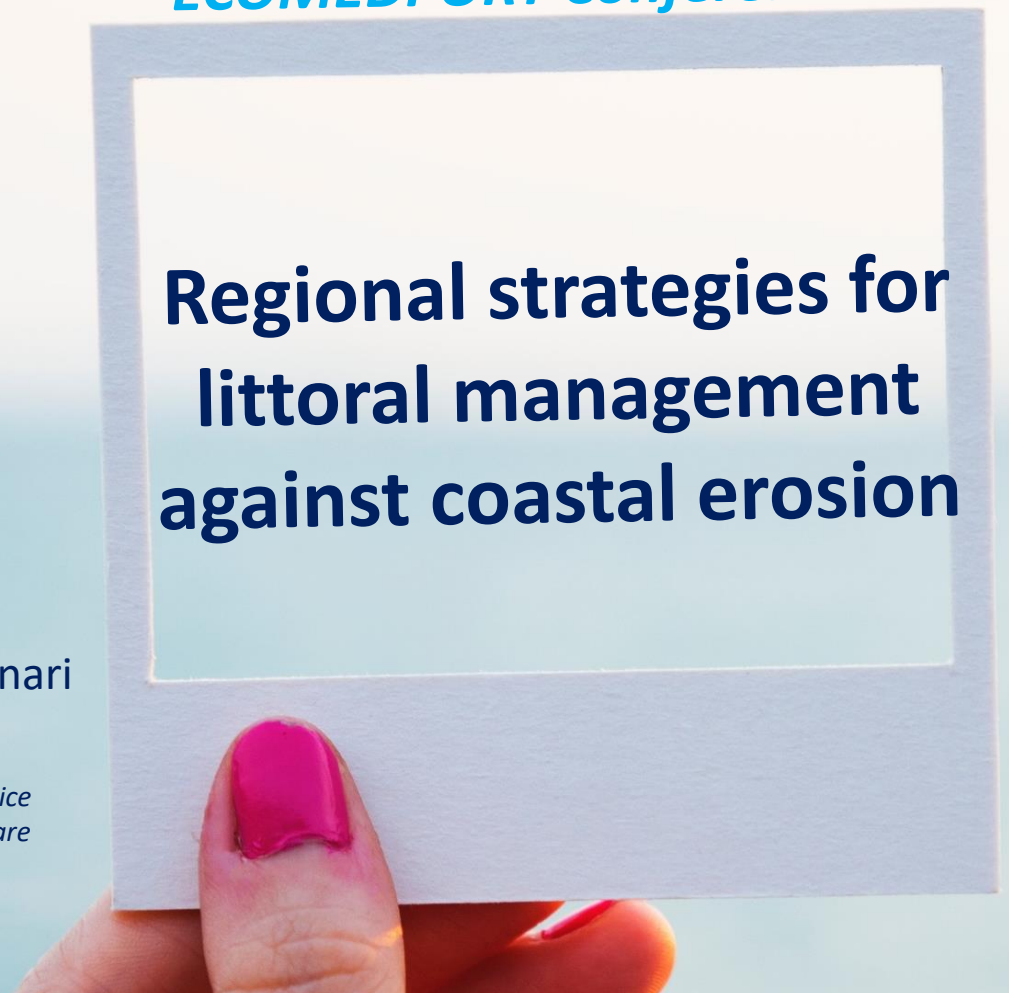
blueMed
ECOMEDPORT
Start-up Action

ALMA MATER STUDIORUM
UNIVERSITÀ DI BOLOGNA

Project co-financed by the European Regional Development Fund

ECOMEDPORT Conference

Regional strategies for littoral management against coastal erosion



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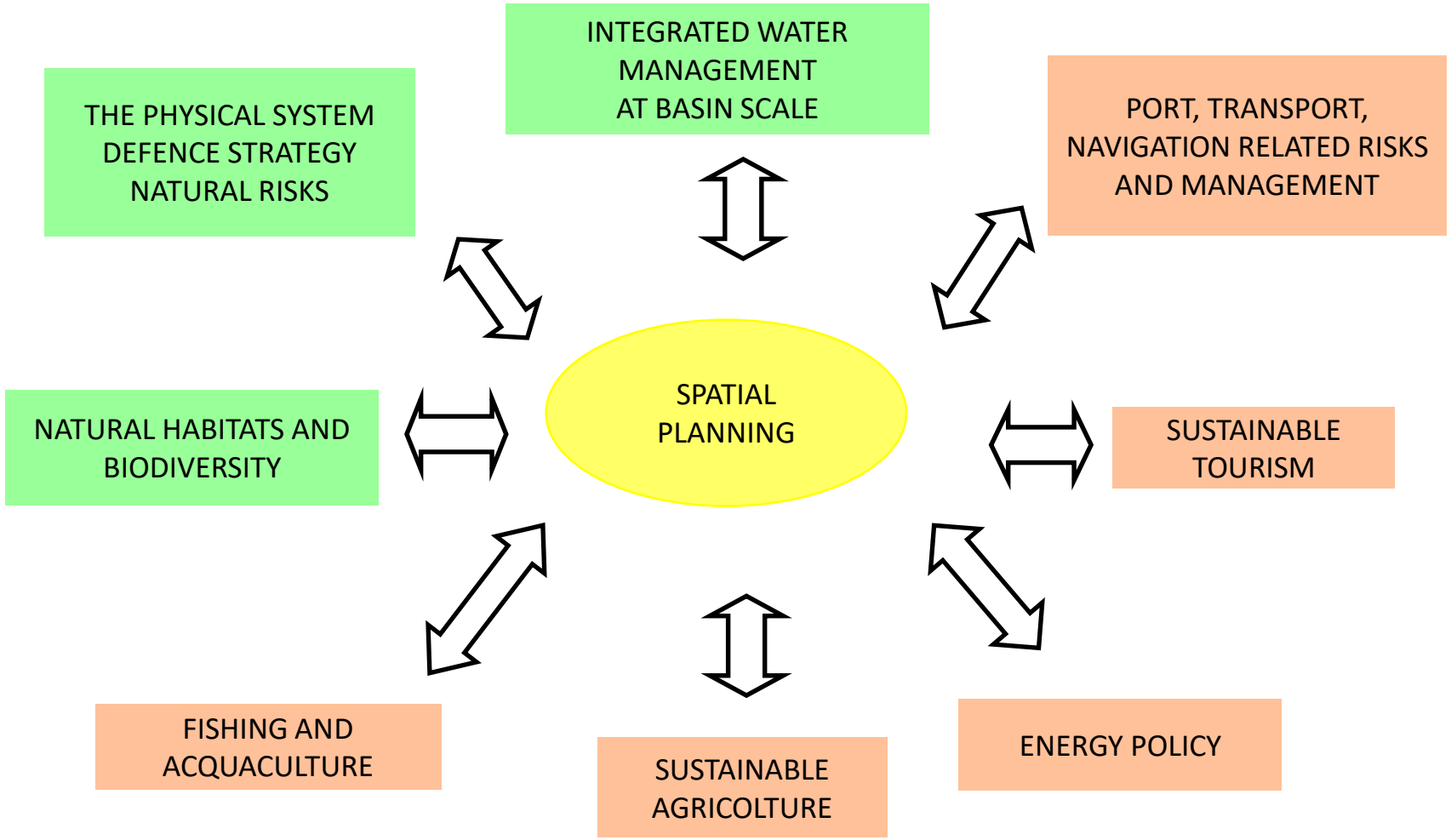
Regione Emilia-Romagna

Soil and Coast Protection and Land Reclamation Service
Directorate General for Territory and Environment Care

ECOMEDPORT 1st meeting
Bologna, 26-28 September 2019

Sectoral interactions analysis



Tourism and Coastal system urbanization

Resident population

Coastal Municipalities		residents
RN	Bellaria-Igea Marina	19.092
RN	Cattolica	16.679
RN	Misano Adriatico	12.157
RN	Riccione	35.545
RN	Rimini	141.501
FC	Cesenatico	25.375
FC	Gatteo	8.649
FC	San Mauro Pascoli	10.959
FC	Savignano Sul Rubicone	17.329
RA	Cervia	28.861
RA	Ravenna	157.459
FE	Codigoro	12.615
FE	Comacchio	23.084
FE	Goro	3.976
	total	513.281

Coastal Tourism

44 Millions of presences per year (average)

3.300 Hotels + 1.200 complementary structures

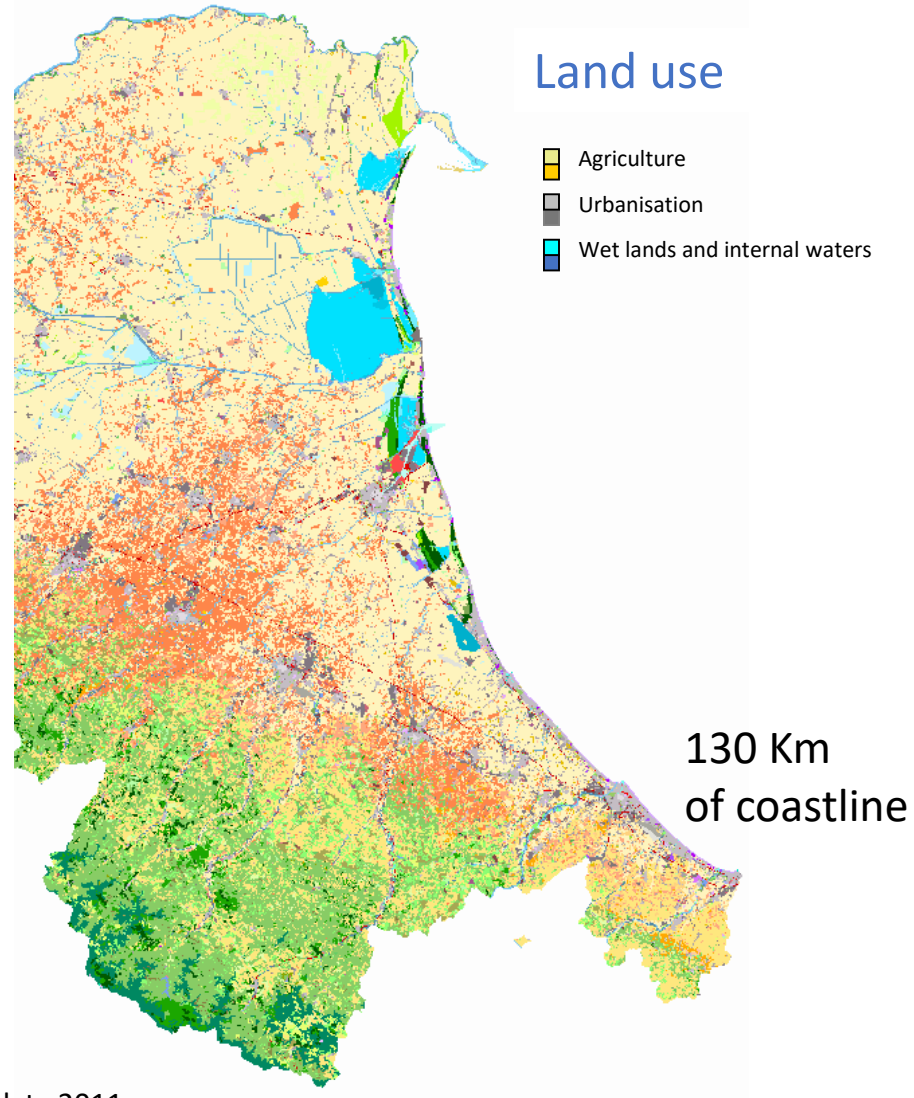
64.000 private accommodations

6.000 restaurants and similar

1.400 bathing establishments

65.000 employees (mainly seasonal)

about 8% of regional GDP



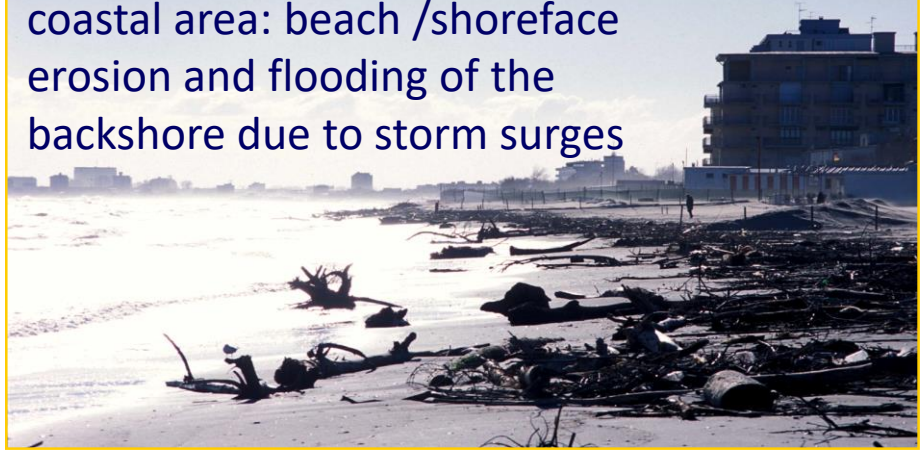
130 Km
of coastline

historical data 2011

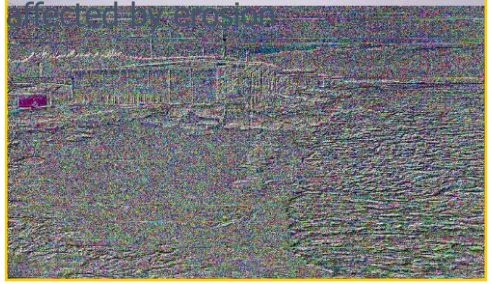
The ICZM process in Emilia-Romagna

Criticalities affecting E-R coastal system

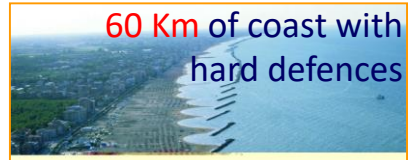
High natural dynamic of the coastal area: beach /shoreface erosion and flooding of the backshore due to storm surges



The 40% of the coastline is affected by erosion

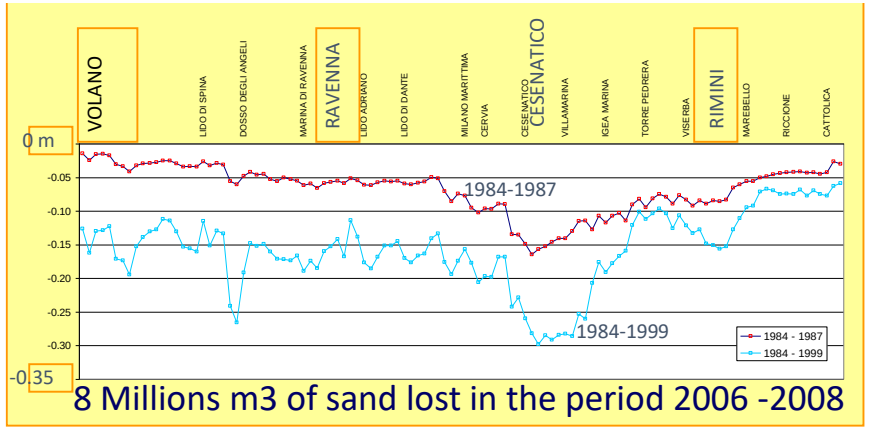


60 Km of coast with hard defences

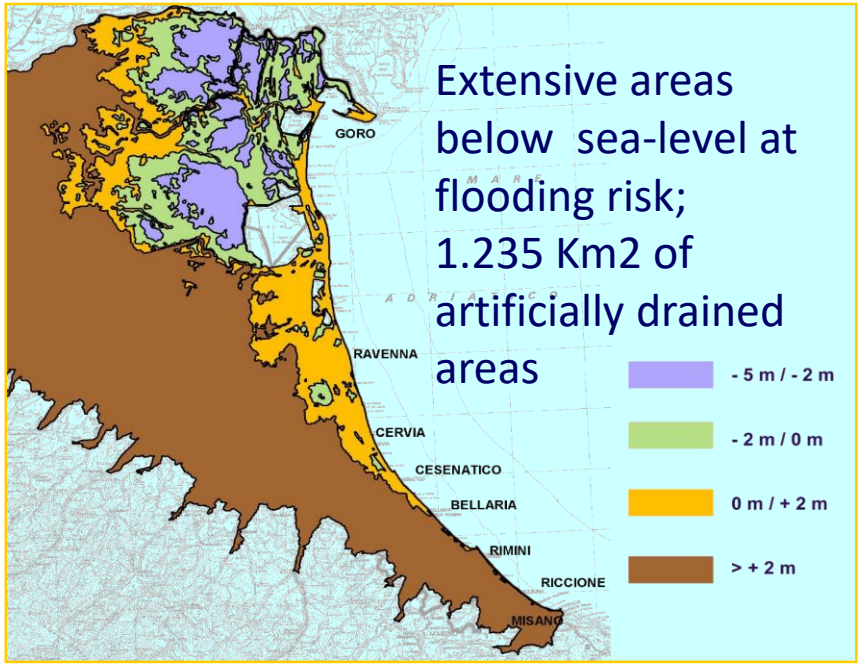


Almost total absence of natural defense system (dunes); and extensive urbanization

Land subsidence (up to 1 cm/y) due to intensive groundwater and natural gas pumping



8 Millions m3 of sand lost in the period 2006 -2008



Ports and maritime transports

Boats present in the 13 regional ports
- 825 Fishing boats
- 8.000 Recreation boats
- 35 Passengers boats

historical data 2005-2006

The whole port system represents the 1% of RER total GDP

Ravenna National Port (2006)
- 25 Millions t/y Total goods enlivened
of which potentially dangerous 7 Mtons
- 4,8 Mtons hydrocarbons
- 1,4 Mtons chemicals
- 0,6 Mtons fuels

historical data 2006

Fishing and aquaculture

Fishing

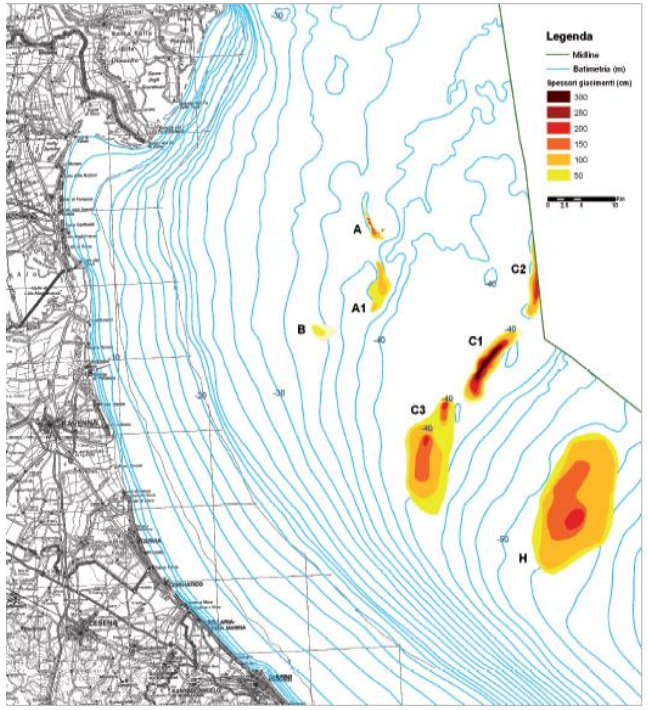
825 Boats in 2005 (1.279 in 2001)
1.600 employees
31.000 tons Fishing

Aquaculture

70 mussels and clams cultures
1.400 employees
1.700 tons production

Fishing sector decreasing in the period 1991-2001 (about 25%)
Aquaculture sector increasing in the period 1991-2001 (about 560%)
The ichthyic economy represents the 0,1% of RER total GDP (2005)

Offshore sediments exploitation (2002-2016)



Offshore sand deposits exploration between 1984 and 2008:

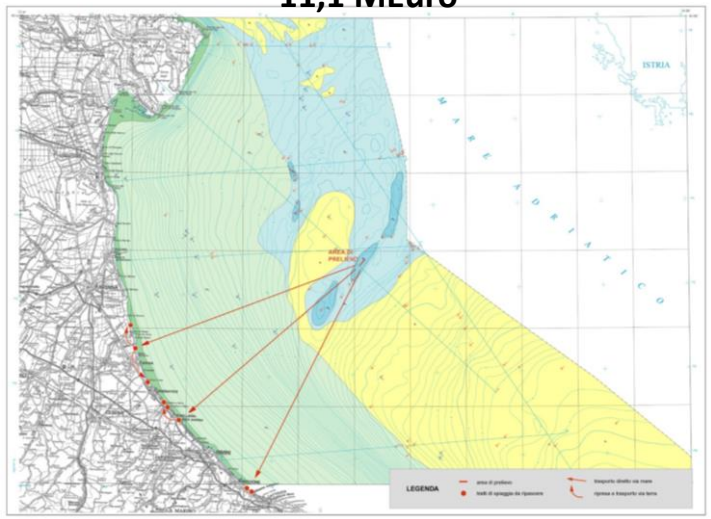
Former Idroser, today ARPAE, in collaboration with ISMAR-CNR in Bologna, realised several research and survey campaigns (also with EU projects) on the Adriatic sea bottom off-shore of Emilia-Romagna region

identified 7 sandy bodies offshore to the regional coasts (relict beaches 10-12.000 y. a.)

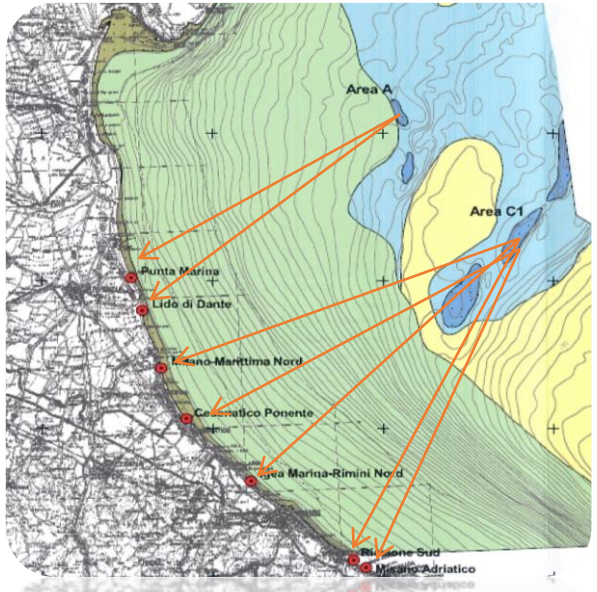
about 300 Mm^3 overall volume of sand (of which 150 Mm^3 of very fine sand)

about 220 Mm^3 of "useful volume" of sand

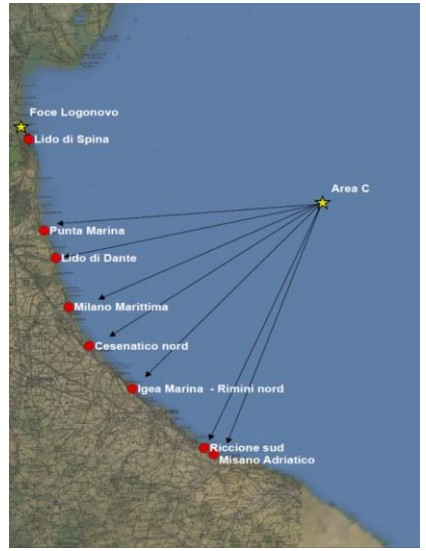
Year 2002: 1st intervention
880.000 m^3 of sand
on 8 sites overall 9 km,
11,1 MEuro



Year 2007: 2nd intervention
815.000 m^3 of sand
on 7 sites overall 9,5 km,
13,5 MEuro

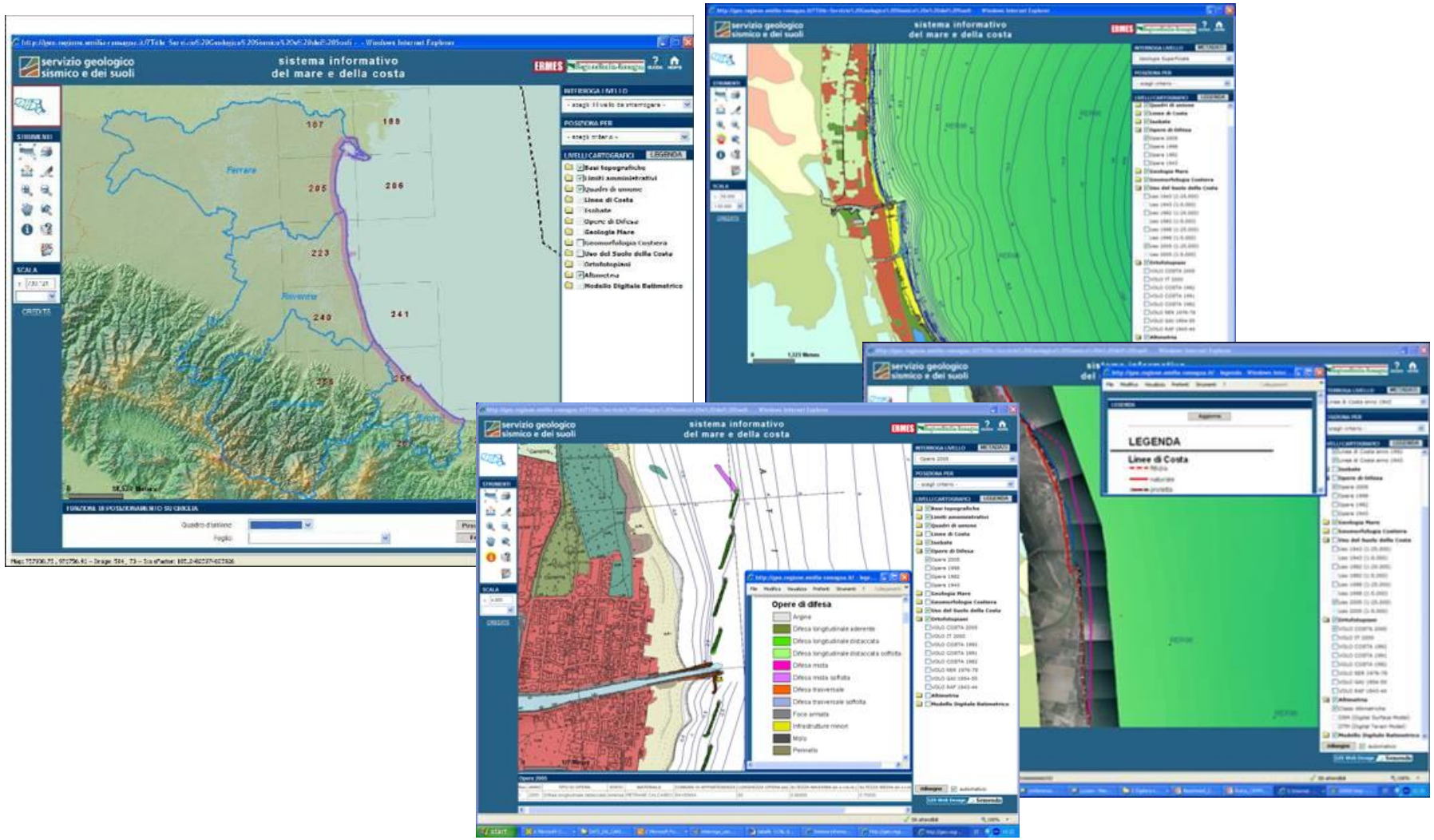


Year 2016: 3rd intervention
1.400.00 m^3 of sand
on 8 sites overall 11 km,
20 MEuro



The ER data framework

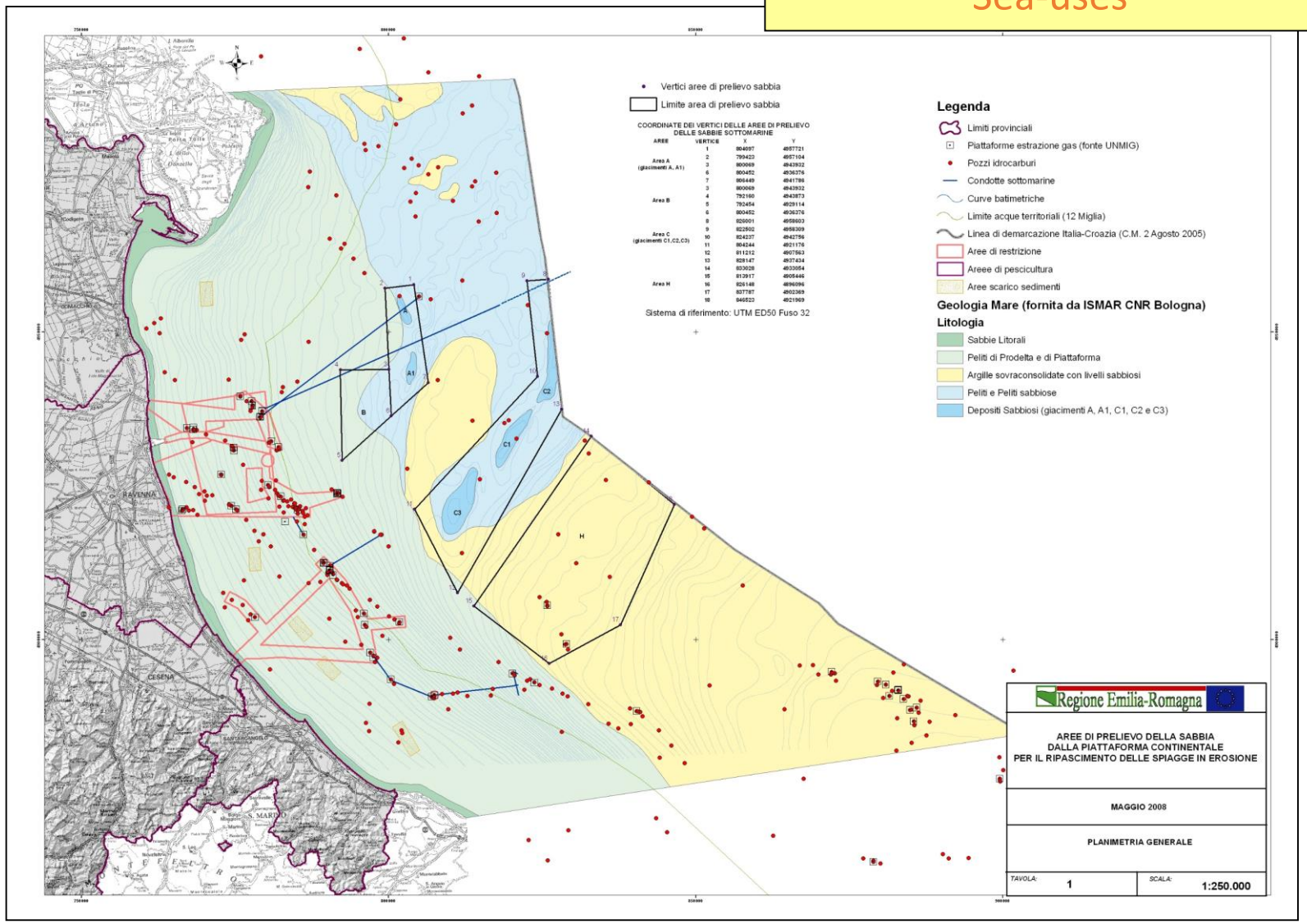
SIC - the sea and coast information system collects, organizes and updates data collected by the Region and other bodies over the last 30 years



The ER data framework

Map of sea uses

Sea-uses



The ER data framework

Topobathymetric network

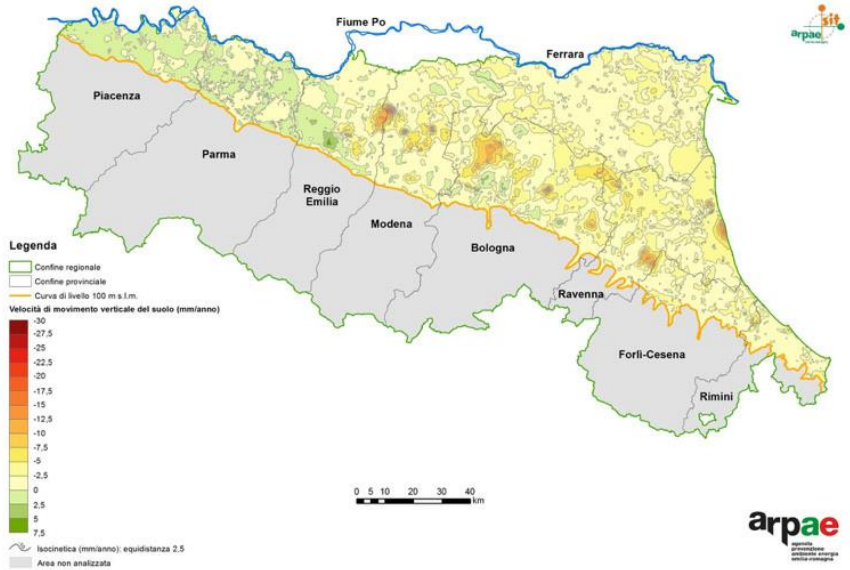
Since 1984. Monitored on 1993, 2000, 2006, 2012, 2018

251 section 500 m equidistant for more than 400 km of cross-beach profile and 200 km of long-beach profile

11 bathymetric sheets at 1:10.000 scale

Sedimentology network

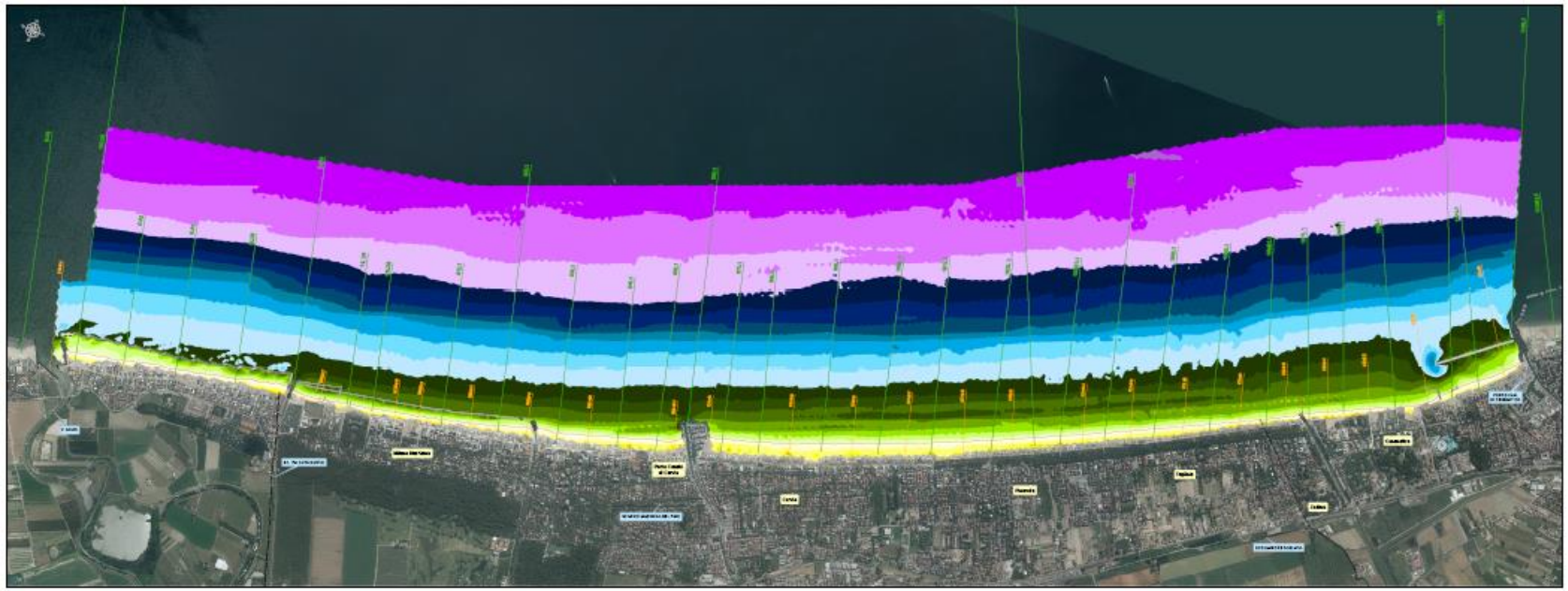
Measured in the 1993, 2012, 2018
In the 2012, 300 sampling points in correspondance with the topobathymetric network sections.
Deep of sampling (m): +1 , 0 , -1, -2.5, -4, -6

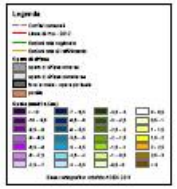


Subsidence monitoring network

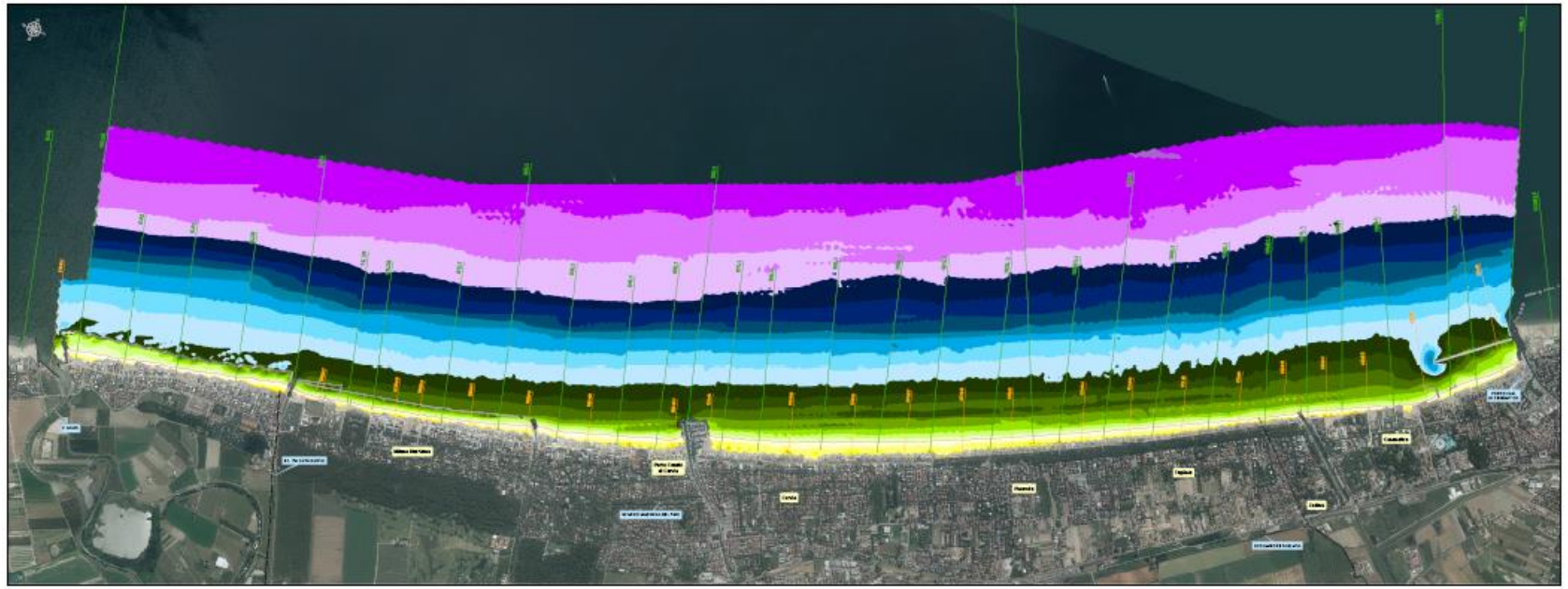
Since 1984. Monitored on 1987, 1993, 1999, 2005, 2011 and 2016

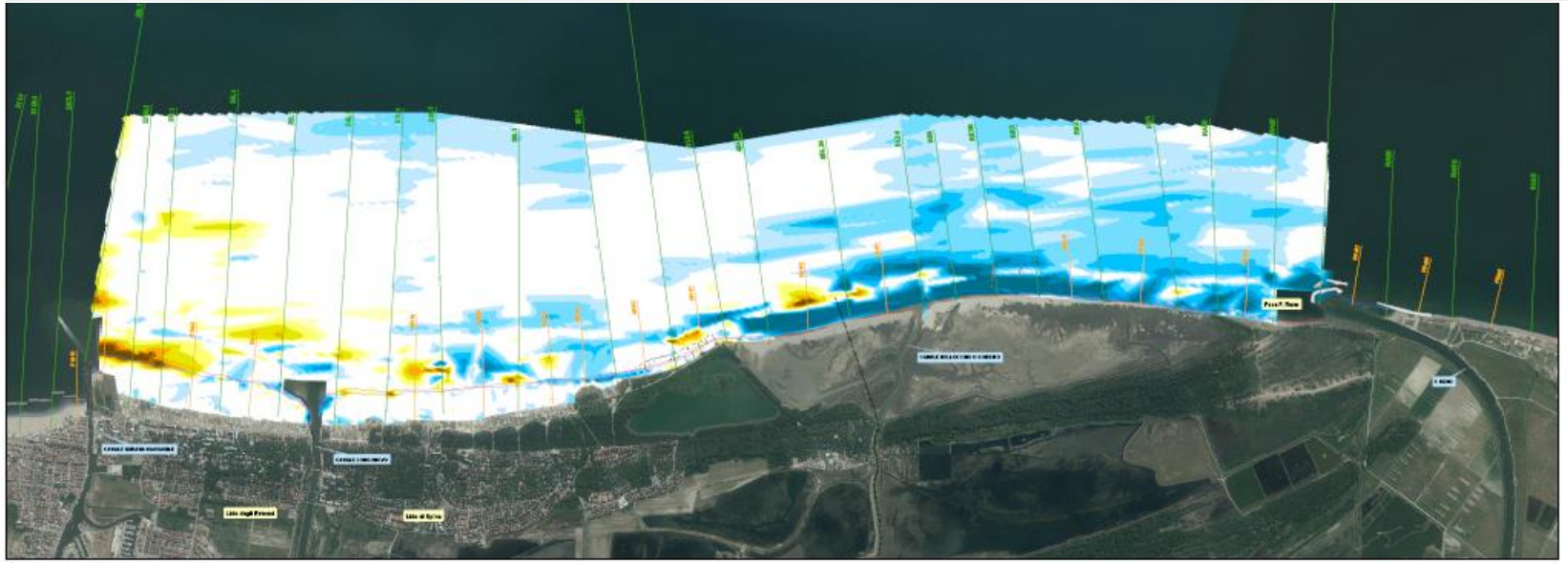
The ER data framework

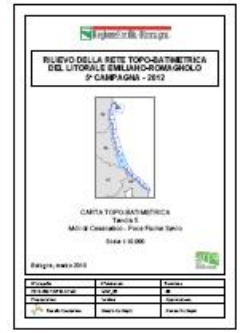


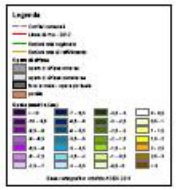


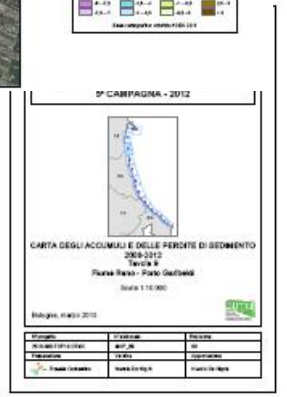
The ER data framework









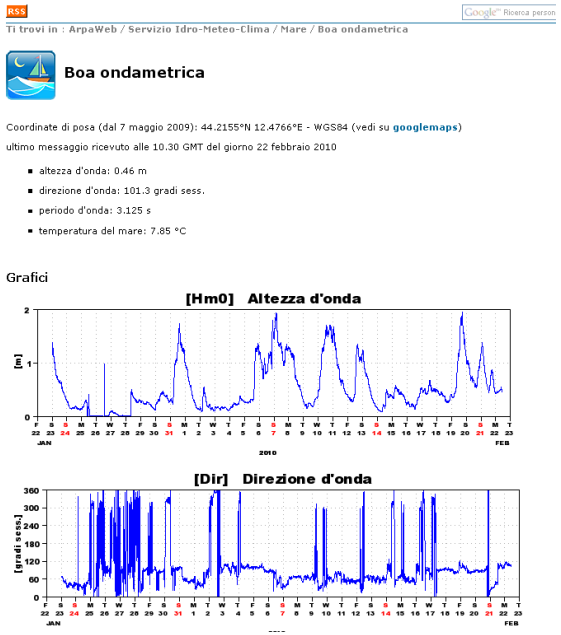


The ER data framework

SEA monitoring system – the wavemeter boa

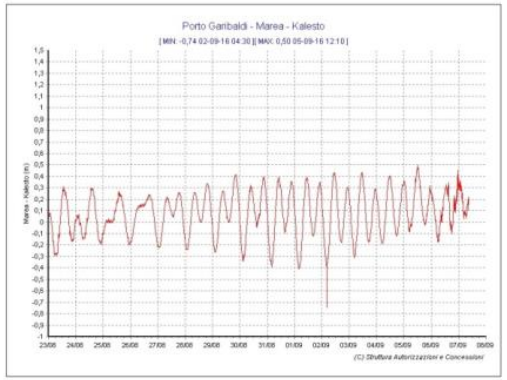
The boa is located 8 km far from Cesenatico coast, on 10 m deep zone where navigation and fishing are prohibited. The receiving system is located on the DAPHNE oceanographic service in Cesenatico city.

This system was set-up by Emilia-Romagna Region within the Beachmed-e European project and it's maintained by MICORE project.

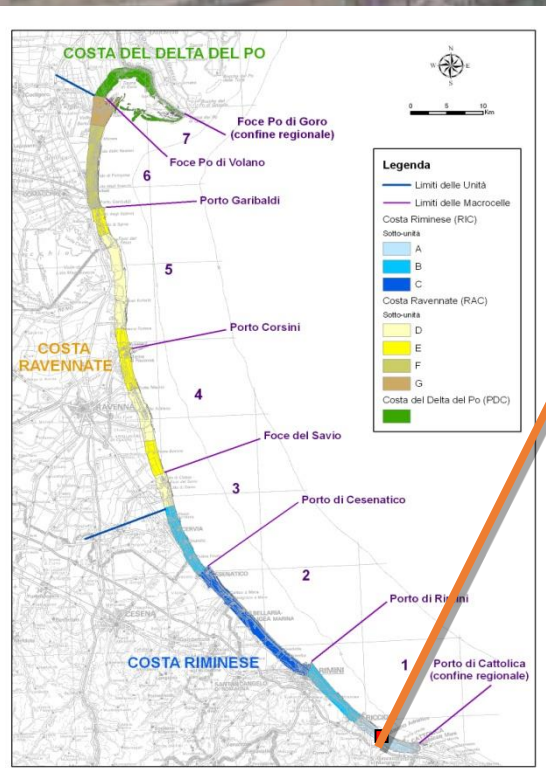


SEA monitoring system – the sea level station

Since 2009, Porto Garibaldi has 2 station for the measure of the sea level and one GPS to calculate the exact altitude of the station



The ER data framework



For a **detailed** analysis:

•80 **elementary cells** defined by ARPA (length range 0,05-10 km)
Defined as:

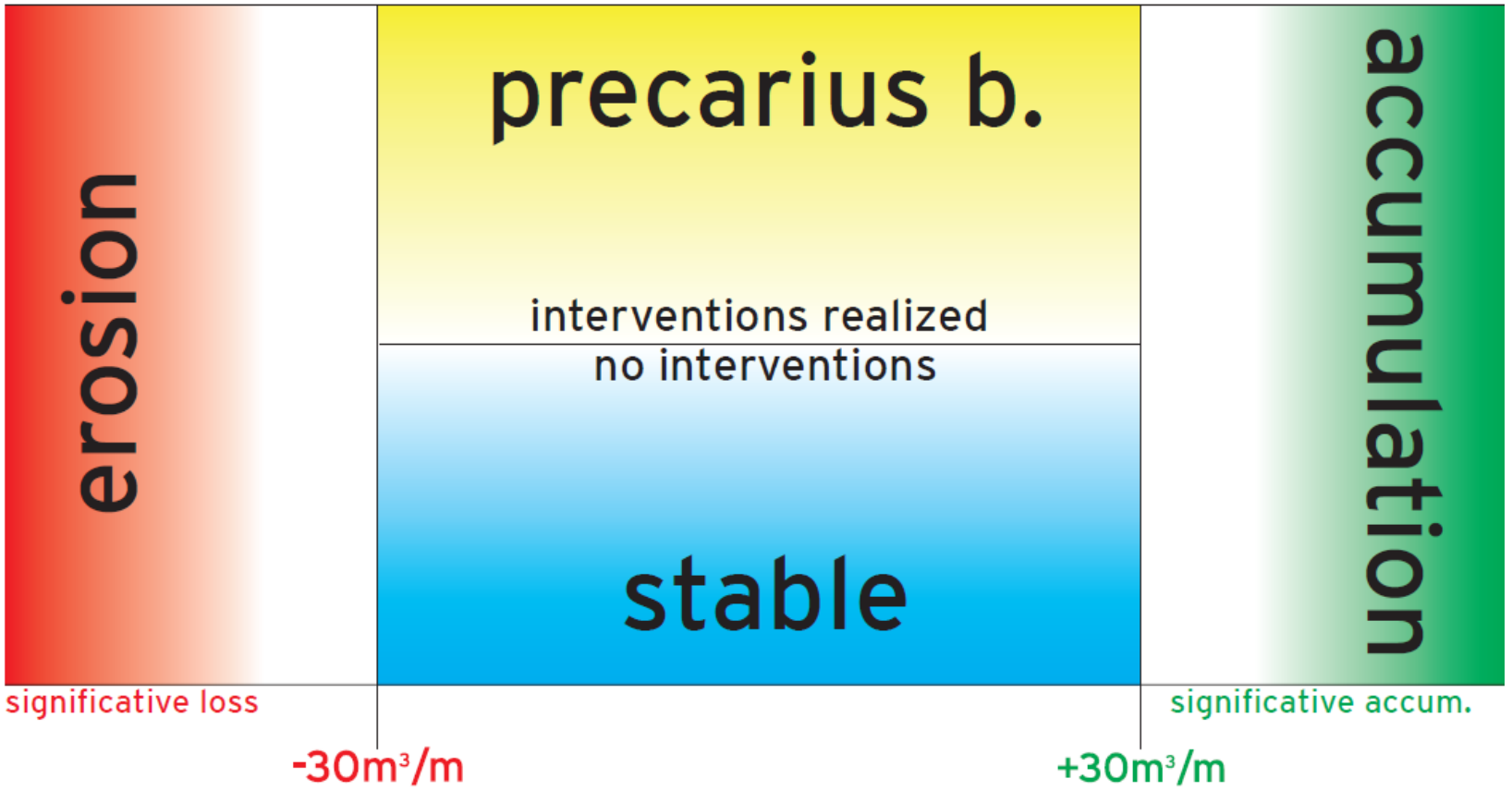
littoral stretches characterized by homogeneous evolution of the backshore and shoreface different from adjacent cells

After the workgroup review the cells became 118

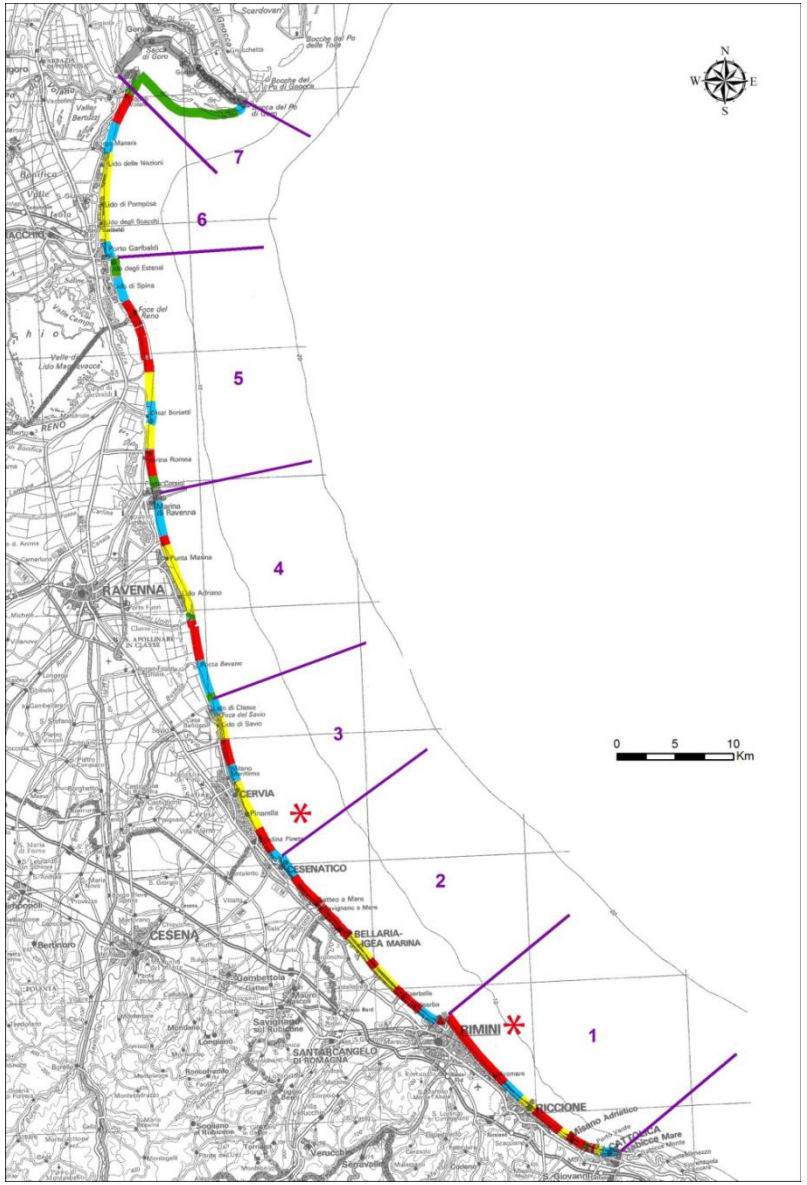
Apart from a few cases in which cells are grouped together or subdivided, the increase in the number of cells is due to management reasons: to create additional cells into river mouths, docks and harbour entrances.

The SICELL

Accumulation or loss of sand **> 30 m³ /m** occurred in the considered period (in the first edition was 2000 and 2006, in the new one will be 2007-2013) are considered **significant.** This value is flexible in relation to in the field

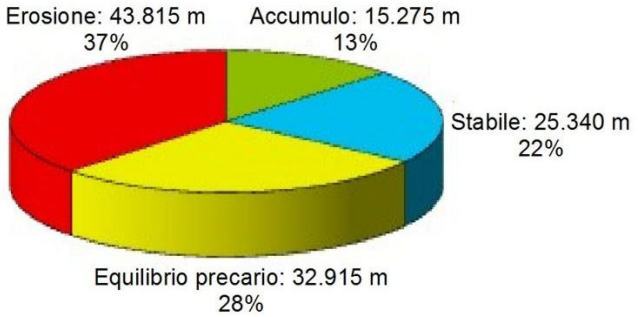


The LITTORAL STATE



Dataset 2006-2012

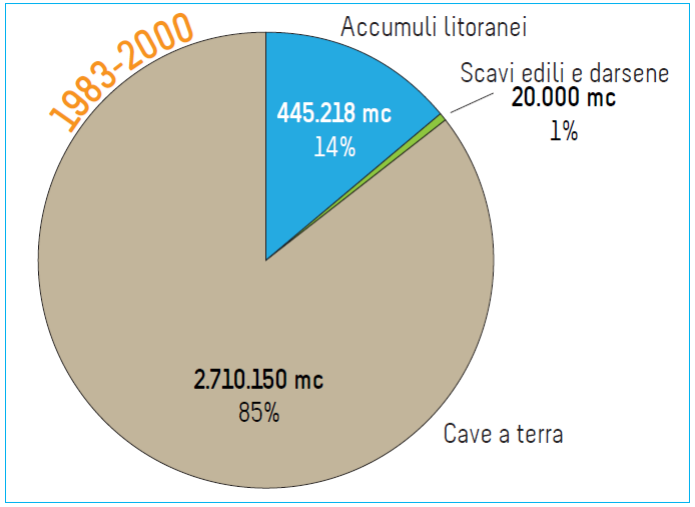
- the 35% (40 km) of beaches is in a «good conditions» (accumulation+stable)
- The 65% (77 km) of littoral has different level of criticity. 44 km are beaches in erosion, the remaining 33km are in di spiagge in erosione e 33 km in precarious balance

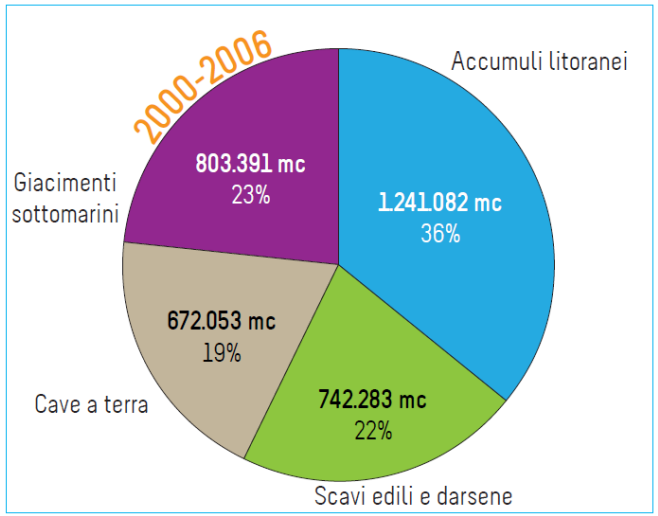


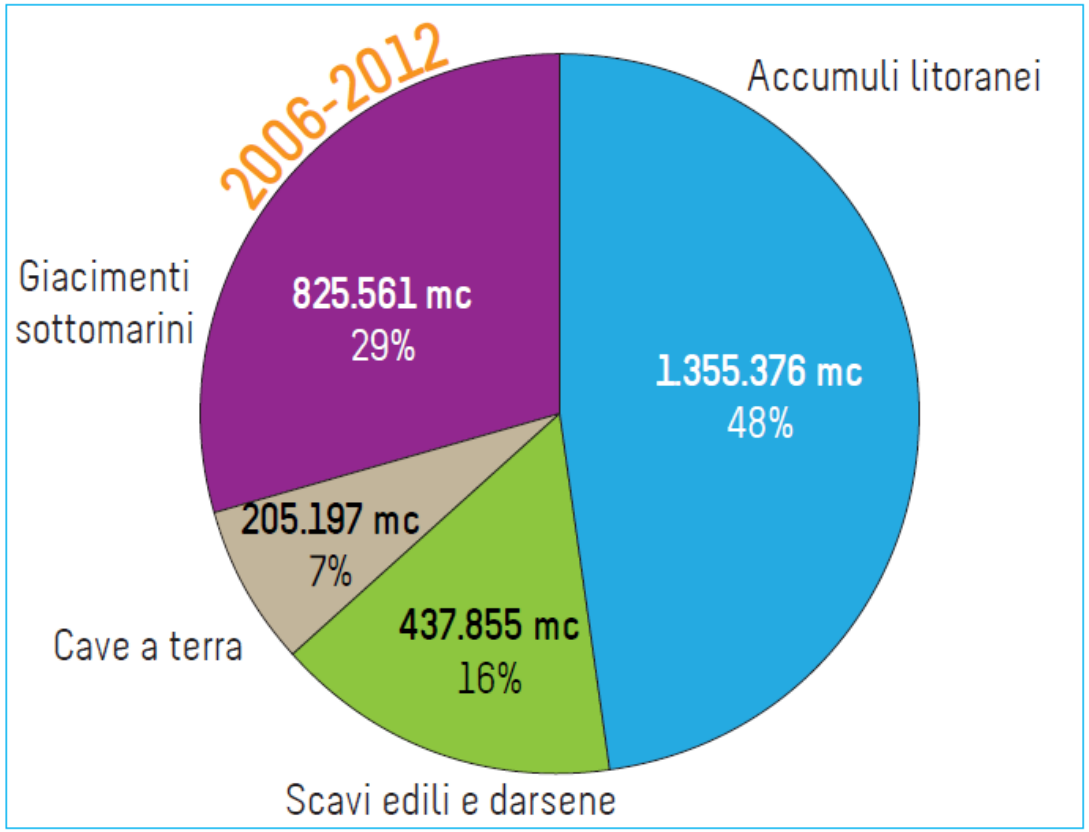
The LITTORAL STATE

Sand sources

- Quarries on land
- Littoral accumulation
- Buildings and docks escavations
- Offshore deposits





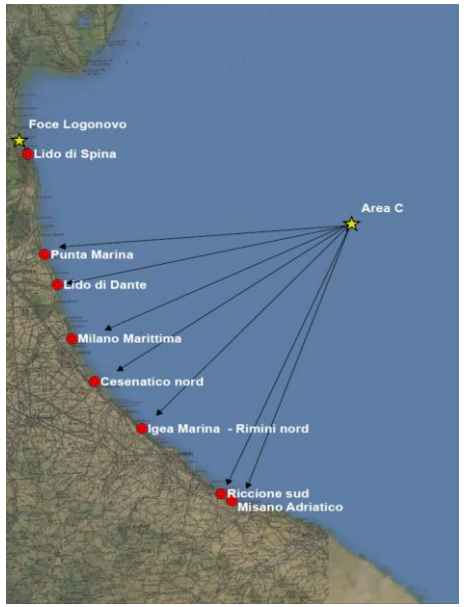


The LITTORAL STATE

	Differenza tra i 2 DTM	
Misano Adriatico	V netto (m3)	% dopo 2,5 anni
1aP-2aM	104.040	41%
1aM-2aM	-4.890	
2aP-1aM	-112.570	
1aP-2aP	221.500	
	Differenza tra i 2 DTM	
Riccione	V netto (m3)	% dopo 2,5 anni
1aP-2aM	114.890	50%
1aM-2aM	-31.600	
2aP-1aM	-65.710	
1aP-2aP	212.200	
	Differenza tra i 2 DTM	
Igea M	V netto (m3)	% dopo 2,5 anni
1aP-2aM	124.660	59%
1aM-2aM	-18.380	
2aP-1aM	-77.140	
1aP-2aP	220.200	
	Differenza tra i 2 DTM	
Cesenatico	V netto (m3)	% dopo 2,5 anni
1aP-2aM	80.730	55%
1aM-2aM	-43.560	
2aP-1aM	-16.750	
1aP-2aP	141.040	
	Differenza tra i 2 DTM	
Milano Marittima	V netto (m3)	% dopo 2,5 anni
1aP-2aM	61.920	26%
1aM-2aM	-23.390	
2aP-1aM	-143.220	
1aP-2aP	228.530	

Monitoring of the last offshore sand nourishment

	Differenza tra i 2 DTM	
Lido Dante	V netto (m3)	% dopo 2,5 anni
1aP-2aM	-13.985	-11%
1aM-2aM	-23.800	
2aP-1aM	-112.235	
1aP-2aP	122.050	
	Differenza tra i 2 DTM (esclusa l'area centrale)	
Punta Marina	V netto (m3)	% dopo 2,5 anni
1aP-2aM	64.530	25%
1aM-2aM	-60.290	
2aP-1aM	-118.700	
1aP-2aP	243.520	
	Differenza tra i 2 DTM area rip grande sud - Bagno Jamaica	
Lido Spina - a	V netto (m3)	% dopo 2,5 anni
1aP-2aM	103.600	45%
1aM-2aM	-23.090	
2aP-1aM	-42.100	
1aP-2aP	175.645	
	Differenza tra i 2 DTM area rip piccola a nord del Bagno Jamaica	
Lido Spina - b	V netto (m3)	% dopo 2,5 anni
1aP-2aM	17.120	71%
1aM-2aM	11.220	
2aP-1aM	-16.810	
1aP-2aP	23.995	



TNEC Guidelines

REDUCTION OF LOSSES

AMBITS OF ACTION	POSSIBLE ACTIONS / MEASURES
RP - REDUCTION OF COASTAL SEDIMENT LOSSES FROM THE SYSTEM	
RP-1 Managing beach sediments	RP-1.1 Beach cleaning operation
	RP-1.2 Construction of wind traps
	RP-1.3 Construction of winter embankment defense works
RP-2 Reduction of subsidence	RP-2.1 Reduction in groundwater withdrawals, water supply infrastructures
	RP-2.2 Hydrocarbon Extraction Control, regulation
	RP-2.3 Mitigation measures, regulation
RP-3 works to reduce losses and retreating of the coastline	RP-3.1 Interventions and works to reduce the energy of incident waves
	RP-3.2 Interventions and works for the reduction of coastal sediment transport

SCHEME FOR AN INTEGRATED APPROACH IN COASTAL PROTECTION MANAGEMENT

To deal with coastal erosion in a overall integrated strategy, 2 set of practices and policy measures are considered :

1. **feed the coastal system** and the critical coastal stretches, through inputs from out of the system and through a correct management of littoral sediments, the diversification of sources of sediments and the optimization of sampling and nourishment practices;
2. **integrate the management strategy** with all those good practices, actions, measures, interventions and works, aimed at reducing sediment losses from the coastal systems.

http://www.erosionecostiera.isprambiente.it/

FEEDING THE SYSTEM

AMBITS OF ACTION	POSSIBLE SOURCES / MEASURES
AS - COASTAL SYSTEM NOURISHMENT	
AS-1 Contributions from external sediments to nourish the coastal system	AS-1.1 Offshore Deposits management and cultivation for beach nourishment
	AS-1.2 River sediment transport enhancement (actions aimed at restoring) for natural beach nourishment
	AS-1.3 Excavations in the coastal hinterland, using sediments for nourishment
AS-2 Contributions from internal sediments to the coastal system *(Management of coastal sediment accumulations)*	AS-2.1 Surface Coastal Deposits along the littorals of the coastal system
	AS-2.2 Submerged coastal Deposits, submerged fans, accumulation nearby coastal protection works or harbor works
	AS-2.3 Hydraulic management, dredging for and navigation safety

TNEC Guidelines

BEACH SEDIMENT MANAGEMENT AND BALANCE [RP-1]

reducing losses due to beach cleaning

- **On-site direct mechanical screening** during beach cleaning, with waste separation and collection, in autumn - winter, creating in beach backward areas sandy mounds available for successive beach nourishment;
- **transport in authorized storage areas** during beach cleaning operations in the spring - summer period, with subsequent sand screening and recovery and quality control, for transport to the beach to be nourished or for the development of winter protection embankments;
- **adoption of selective cleaning methods** and indication of appropriate technical specifications for handling machines to reduce the removal of sand amounts;
- **no removal of stranded wood logs,** wherever possible in the autumn – winter season, so that they can fight against sea storms and wind effects and act as sand traps;
- **stranded biomass management** giving priority to its on-site maintenance to protect the beach against erosion, keeping it on site or repositioning it to reinforce the dune line, if any, or through its removal, accumulation or repositioning on the beach at the end of the bathing season;
- **estimate of on-site unmanageable stranded biomass quantities** and assessment of their different production destination (composting, energy, bio refinery, or other production types) or landfill disposal, after sorting on-site sediments.

reducing the wind effects

- **creation of seasonal windbreak barriers,** coupled with any winter protection embankments, in the beach stretches exposed to wind;
- **creation of permanent barriers,** where possible and appropriate for the conditions of the sandy shore;
- **sizing of barriers,** in terms of height and supports, mesh opening, geometry and orientation, depending on the specific wind conditions, the morphology and grainsize of the beach sediments;
- **study and monitoring of local wind transport** aimed at a more in-depth knowledge and assessment of the most suitable site-specific technical solutions.

realization of protection dykes or dunes

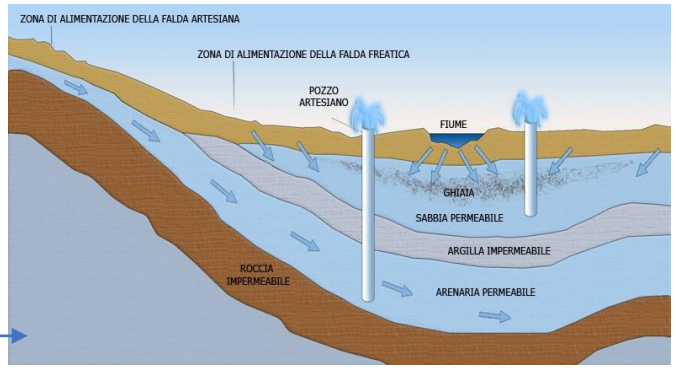
- **ban the use of shoreline sand** and/or sand located in front of the winter protection dyke line, for seasonal protection dykes building operations;
- **ban to extend seaward the beach surface,** during seasonal operations, lowering the existing beach level;
- **use of sands external to the coastal system,** for example deriving from dredging or excavation operations of various kinds,
- **use of sands coming from the recovery of on-site sand sifting** during beach or backshore cleaning operations;
- **use of alternative handling solutions,** such as the installation of temporary windbreaks and barriers.

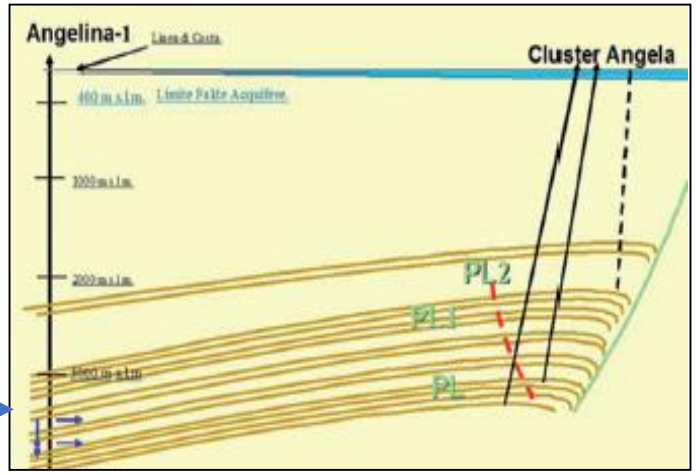
TNEC Guidelines

SUBSIDENCE REDUCTION IN COASTAL ZONES [RP-2]

reducing fluids withdrawal near the coasts

- **regulate, reduce or ban the extraction of underground water,** in particular from the most superficial coastal aquifers and in the most critical areas;
- **supplement the regulatory measures with water saving policies** aimed at improving procurement in the various urban, agricultural, industrial sectors, and identifying any abusive withdrawals;
- **infrastructural interventions for the water supply** of the various sectors to constitute, where necessary;
- **implement studies and monitoring of coastal aquifers,** also in relation to the phenomenon of saline wedge intrusion;
- **implement studies and monitoring of subsidence** in the coastal area also through the use of remote sensing techniques;
- **regulate, reduce or ban the extraction of hydrocarbons,** in particular from onshore and offshore deposits close to the coastal strip;
- **economic compensatory measures** in agreement with the operating companies, for the financing of subsidence mitigation or coastal defense interventions in the territories affected by exploitation.
- **experiment and launch fluid re-injection projects in exploited reservoirs** or in suitable deep geological units in order to counteract the effects of induced depressurization and consequent terrain compacting and subsidence phenomena;





TNEC Guidelines

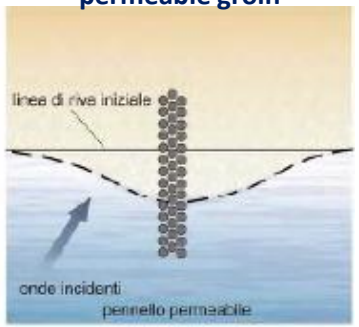
INTERVENTIONS AND WORKS AIMED AT REDUCING SEDIMENT LOSSES AND COASTAL RECESSION [RP-3]

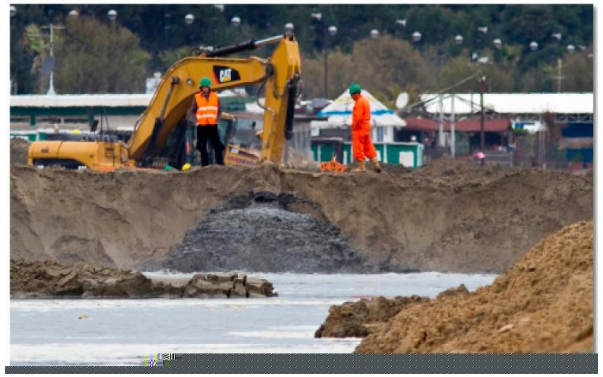
aware choice of type of interventions & works

- **detailed knowledge framework on the environmental, geological and sedimentary aspects** of the coastal stretch and of the reference physiographic unit;
- **in-depth knowledge of the dynamic conditions** and set-up of the specific coastal site and of the neighboring areas;
- **definition of a clear and somewhat quantifiable objective,** (e.g. "project beach") in relation to the specific problems to be addressed and the expected performance of the intervention;
- **use of models, powered by available or specifically acquired data** in order to simulate the behavior of the different design options hypothesized in relation to specific site conditions;
- **impact assessment of works,** both in environmental and cost/benefit terms, acceptability, temporariness or permanence, possible reversibility, need for any necessary mitigation, in the construction and life cycle of the work, as well as for any necessary maintenance;
- **any preferential choice of interventions with minor impacts,** or that may have characteristics of reversibility or substantial reduction of the impacts, if it is subsequently necessary to modify or remove all or part of the work itself;
- **a monitoring of the work carried out** and of the effects generated on the specific site and in the neighboring areas, according to the evaluation of its actual performance according to the given objective;

impermeable groin

permeable groin





TNEC Guidelines

BEACH NOURISHMENT USING SEDIMENTS EXTERNAL TO THE BEACH SYSTEM [AS-1]

use of sediments from submarine stocks

- **characterization of deposits** and advanced data representation and management system;
- **verification of the physical and chemical parameters of sediments** and their compatibility with the destination areas;
- **verification of deposits and dredging activities** during planning and execution of interventions;
- **dredging impact assessment in the sampling areas,** neighboring areas and fishing areas;
- **planning of interventions** on a regional or even macro-regional scale for optimization purposes;
- **evaluation of possible multi-year management solutions** with project finance modalities.

smart management of excavation materials

- **preparation of an excavation material utilization plan,** including a material treatment, selection or screening protocol;
- **characterization of the material in relation to a nourishment project** (grainsize, wear resistance, metal content, color, compatibility with the destination site);
- **preparation of a nourishment project in connection with a utilization plan** (project grainsize, volumes, nourishment method, execution times and temporary storage);
- **implementation of nourishment monitoring activities**;
- **drafting of a sedimentological and biological monitoring plan;**

restoring / improving river solid transport

- **geomorphological framing of watersheds and riverbeds** of water courses, geological formations, land use, morphology, profiles and sedimentology of riverbeds;
- **knowledge, quantification of the fluvial solid transport,** through direct monitoring, or indirectly through appropriately calibrated hydraulic models;
- **experimentation of sediment bypass interventions,** where appropriate, in correspondence with hydraulic works and barriers;
- **revision of hydraulic works,** embankments and crossbars, in particular where over-flooding effects are found in the upstream areas;
- **maintenance and management measures for riparian vegetation,** accompanied by any necessary re- insertions of riverbeds and floodplain areas, aimed at reducing the sediment holding capacity;

evaluate dams accumulations potentiality

- **carry out a survey of artificial reservoirs**, to estimate sediment volumes trapped, in particular for those closest to the coastal strip;
- **define or study agreements with managers** in relation to possible management of sediments, if proven to be compatible (characterization and technical feasibility) for nourishment purposes;
- **launch experimental or demonstrative projects**, for situations with the highest technical and economic feasibility, in beach nourishment.

TNEC Guidelines

BEACH NOURISHMENT USING INTERNAL SEDIMENTS [AS-2]

use of littoral sediment accumulations

- **taking stock of the resources available**, including emerged and submerged coastal stocks, in relation to distances and compatibility with the erosion stretches to be managed (dedicated information-management tool);
- **planning of interventions on erosion areas according to dredging needs** of ports or port mouths, river mouths, lagoon mouths, also with the **installation of sediment transfer fixed devices**;
- **streamlining of the authorization procedures for recurrent operations**, such as port dredging or port mouths, river mouths, lagoon mouths, for a constant sediment quality monitoring;
- **evaluation of the possible use of any fine materials deriving from dredging,** with the necessary qualitative characteristics for nourishment of near shore in compatible bathymetric ranges, as an alternative to their discharge in offshore areas;
- **use of sediments accumulated in the outer breakwaters of the rear port area within the same coastal stretch or cell,** in relation to the seasonal coastal management practices;
- **evaluation of the possible use of materials to be removed from the terminal stretches of watercourses**, to restore their hydraulic functionality, in relation to technical and economic feasibility assessment, for their transfer to the coastal erosion stretches.

compatibility of sediments with the destination areas

1. **Chemical characterization:** assessments of the chemical characteristics of sediments intake (presence of potentially hazardous contaminants for environment and human health) must be carried out during the impact assessment phase in view of their collection and handling.
2. **Microbiological characteristics:** with regard to the microbiological quality, the characterization criteria differ in particular for the diverse sediment resources (submarine deposits, sediments derived from dredging in the port area, other sediments accumulated along the coast).
3. **Particle size characteristics:** the physical aspects related to particle size differences between external and on-site sediments are related to the nourishment effectiveness in terms of different balance profile of the beach and its different response to longshore and cross-shore transport.
4. **Mineralogical characteristics:** starting from the assumption that in nature there are no two identical sediments and therefore any nourishment will lead to an alteration of the characteristics of the nourished beach, it is necessary to analyze the mineralogical component to minimize these alterations.
5. **Colorimetric characteristics:** sand color is an important landscape and ecological component of the coast, which must be carefully evaluated in cases of nourishment, especially in the presence of beaches with high, social, environmental and ecological value.

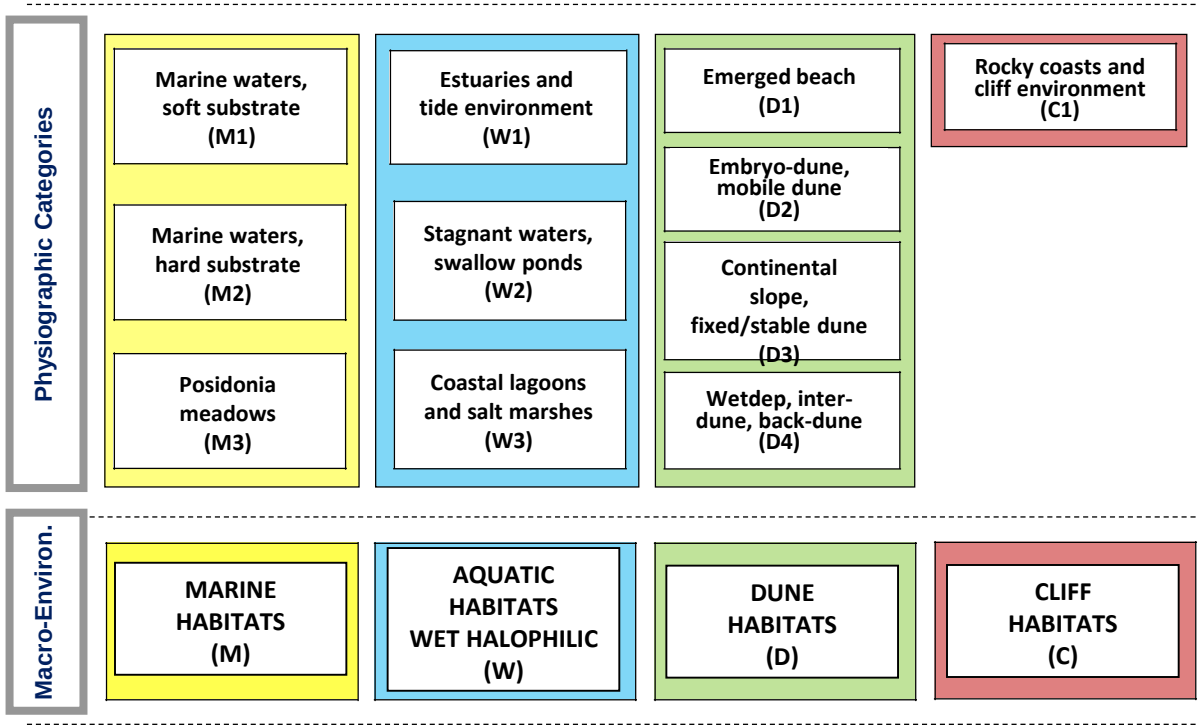
TNEC Guidelines

ENVIRONMENTAL ASPECTS RELATED TO COASTAL DEFENSE WORKS

creating a MATRIX “work/impact Vs habitat/species” for environmental study

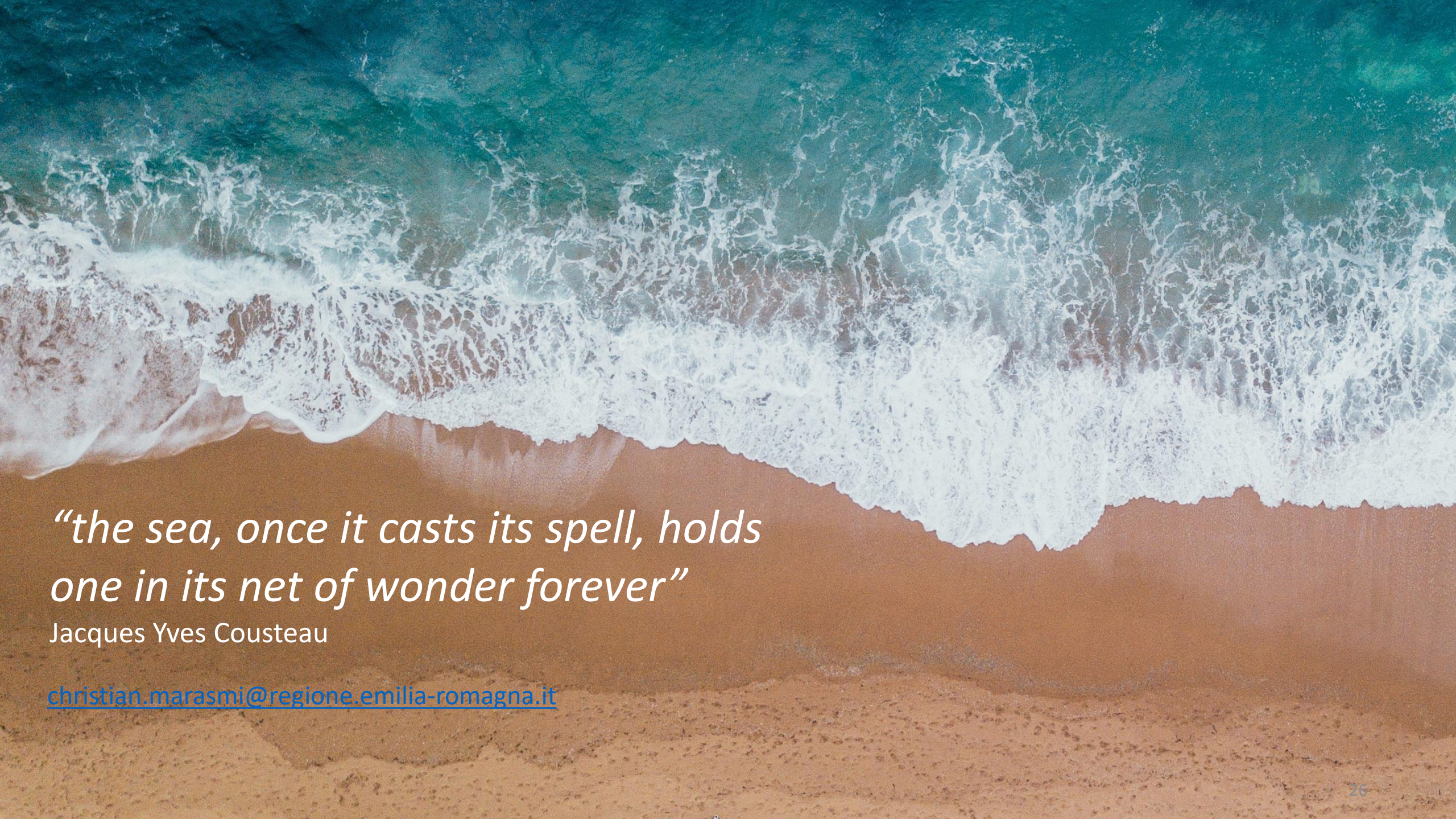
- **Identification of the reference area**. A preliminary investigation, based on the technical and environmental information acquired during the design phase of the intervention, area affected by the direct and indirect effects of the intervention, near shore/on shore.
- **Identification of protected habitat types**. An accurate bibliographic survey and appropriate field surveys to identify the physiographic categories in the reference area and to identify for each of them the types of protected habitats. All the physiographic categories present in the reference area must always be kept into account in the matrix. **Identification of protected flora species and their attribution to habitat types**. Through an accurate bibliographic survey and specific flora investigations to be carried out in the field, the flora species present in the reference area must be identified, including species directly related to the habitats present and species protected by current regulations.
- **Identification of protected fauna species**. Census of the species of fauna present in the reference area, through an accurate bibliographic survey and specific field surveys, taking into account regulations and conventions concerning fauna protection.
- **Attribution of protected fauna species to "physiographic categories”**. Each protected fauna species, registered in the area of reference, must be attributed to one or more habitat use categories, specifying the scale of use (local or wide) and the time frequency (perennial or seasonal), also in order to be able to identify proper "time windows" in which the interventions should be carried out minimizing the impact.

Example of “Macro-environments”, “Physiographic categories” and “Marine-coastal habitat Types”



Seawalls/ Breakwaters/ Groins/ Composed Groins/ Headlands/ Beach Nourishment/
Drainage systems/ Coastal Dunes reconstruction/
Break wind realization, restoration and consolidation of Dunes with vegetation/

specific coastal works categories on which a MATRIX is created



“the sea, once it casts its spell, holds one in its net of wonder forever”

Jacques Yves Cousteau

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