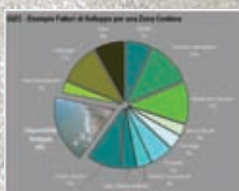
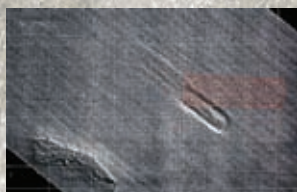
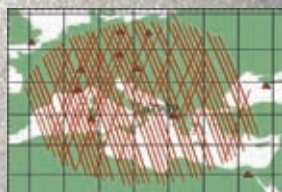


Regional Framework Operation



Strategic management of beach protection measures for the sustainable development of Mediterranean coastal areas

## SUBPROJECTS



Sandy coastal stretches of the industrial countries are territory of special interest for sustainable strategic development. In these areas social and economic interests and the protection of natural ecosystems must meet the target of Integrated Coastal Zone Management (ICZM).

However, beaches are delimited along the coastline, by a demarcating line (shoreline). From the morphologic point of view this line is an area of delicate equilibrium between sea action and availability of sand along the coast.

This territory is especially delicate in respect of phenomenon that have now achieved global relevance and that are structurally linked to our modern development model:

- *Vulnerability to the consequences of CO<sub>2</sub> increasing in the atmosphere* (increasing mean sea level, greater intensity of meteoric marine events);
- *Vulnerability to reduced river sediment load transport* (dams, river defence & river training measures, erosion control measures, extensive presence of paved area in river catchments);
- *Vulnerability to the loss of natural protection areas due to uncontrolled urban development* (posidonia fields, dune systems, autochthon coastal vegetation);
- *Vulnerability to coastal infrastructures affecting sediment transport along the coastline* (ports, piers, dams, breakwaters, reefs).

It is necessary to define global strategies and long term measures in regards to each of the above issues of vulnerability, each one involving remarkable erosion to the coastline and consequent economic and environmental damage.

The erosion phenomenon of low coasts is still more exalted by the request of coastal spaces that, for the high potentialities of development, is more and more strong and pressing, putting in evidence a sensibility also regarding the coast periodic or seasonal regressions.

The BEACHMED-e Operation has been structured in three lines of action:

- *design & construct technical instruments to characterise erosion at European scale and for the sustainable use of resources* (Component 2);
- *set up of management instruments - for relation between urbanland development and morphologically fragile areas, related to ordinary and exceptional sea storms* (Component 3);
- *set up of normative and organisational instruments – to define, regulate and manage coastal defence by all parties involved* (Component 4).

### Phenomenon, vulnerability and the Operation actions

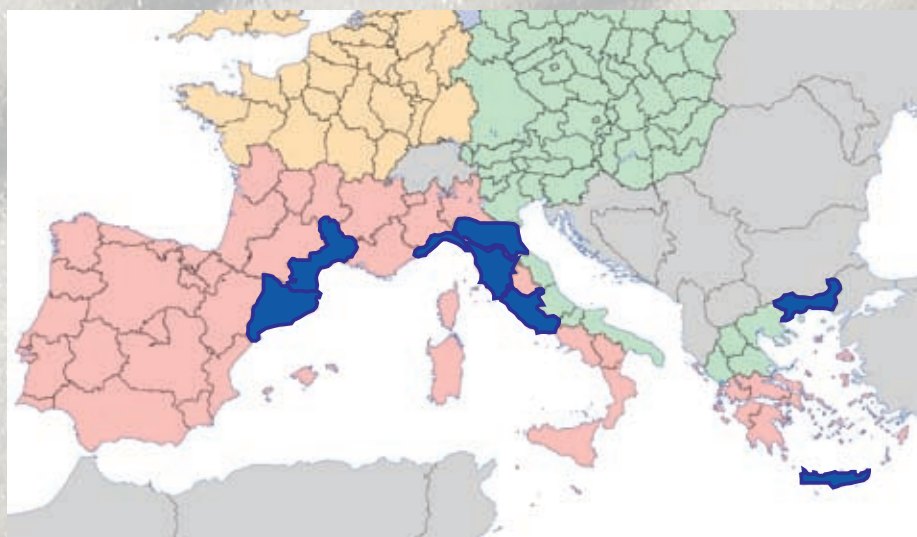
Phenomena linked to the development	Vulnerabilities on the coastal zones	ACTIVE TYPES OF ACTIONS	PASSIVE TYPES OF ACTIONS
CO <sub>2</sub> increase	- increase of medium sea level - meteo-marine event of major intensity	NOT CONSIDERED IN BEACHMED-e	Increase of coastal areas due to sand nourishment
Diminished contribution of the rivers transport load	- coastal erosion - deepening of sea bottom - sea bottom denaturalisation along the coastline	Total or partial restoration of natural solid load transportation	Total or partial restoration of natural solid load transportation
Breaking down of natural defence structures	- sea bottom erosion - denaturalisation of sea bottom	Reconstruction of dune zones and of sea-grass prairies	Protection measures for dune zones and seagrass prairies
Construction of coastal infrastructures	- coastal erosion - denaturalisation of the coastal sea bottom	Planning with special attention to the induced erosive phenomenon	Coastal protection by means of soft and protected nourishment Re-use of intersected sandy material

### The Operation functioning

The BEACHMED-e Operation has been conceived as Regional Framework Operation (RFO) based on the fixed criteria from the INTERREG IIIC Program. The Administrations that have joined the Operation and that currently constitute the RFO (Regional Framework Operation) partnership, have to define and specify themes of greater interest on the topic (Measures), therefore to make executive the corresponding studies (Subprojects) from partners such as Publics Subjects (Universities, local Institutes of research, Administrations, etc). In particular, once the RFO Administrations define the Measures and objectives they wish to pursue, they proceed with a Public Call in order to choose and characterise specific proposals to achieve the prefixed objectives of each Measure.

The RFO BEACHMED-e provides for the development of nine sub-projects with the participation of the Universities, Institutes and local Administrations that have applied for a Public Call expired on the 9<sup>th</sup> of December 2005. The nine sub-projects refer to the measures of the three Components of the Operation.





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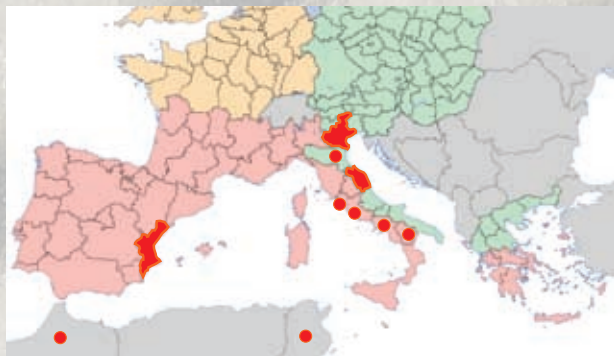
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Instituto de Ciencias del Mar  
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 Consortium El Far

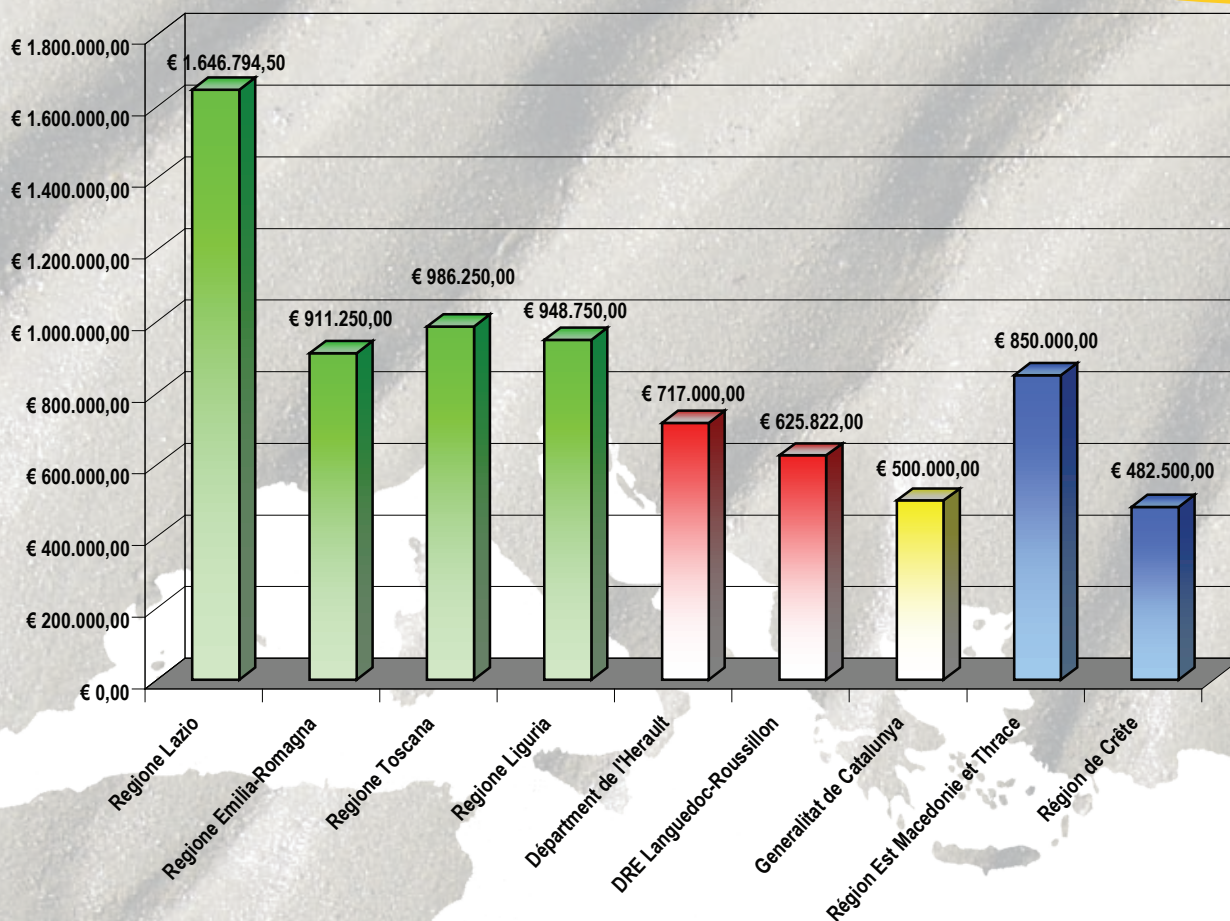
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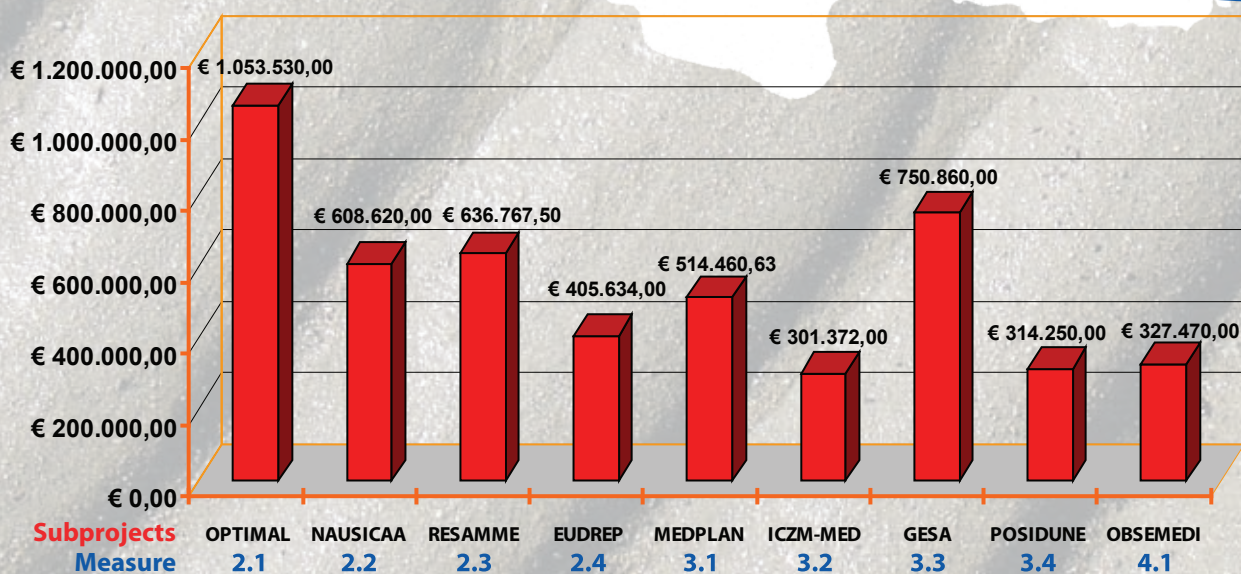
## BUDGET TABLE

6

### RFO PARTNERS



### SUBPROJECTS



**Optimisation of Integrated Monitoring Techniques Applied to Coastlines**

Quantitative analysis of the morphological and sedimentary evolution of coastlines plays an essential part in the integrated management of coastal zones, and is especially critical when planning the implementation of future conservation initiatives and in assessing their effectiveness. The observation of phenomena has to take place within a limited timeframe and therefore requires the use of extremely accurate and high quality data gathering and processing procedures. Spatial and temporal data resolution of data has to adapt to all its possible variables in order to obtain a low cost/benefit ratio, which is also required for effective management to take place. Data has to be standardised and managed in order to be widely applicable to Europe. Methodologies based on remote sensing of data (aerial and via satellite using optical sensors and LIDAR), validated by singlebeam and multibeam bathymetric systems and video cameras with high spatial and temporal resolution, will be developed to deal with data gathering. This will fulfil the need to monitor coastal evolution on a regional scale and assess the effectiveness of local interventions. A method will also be developed that will be able to define the coast according to its morphological and sedimentary characteristics. The project will develop, certify and then implement these methodologies to specific pilot zones until a monitoring prototype model has been created which local authorities in the Mediterranean can directly apply to both natural and protected areas, as well as areas undergoing artificial beach nourishment. Special care will be taken with procedures relating to the control of both land and sea related data. The creation of an extended team of partners will enable cross validation of the methodologies that will be applied to the various types of coastal zones.

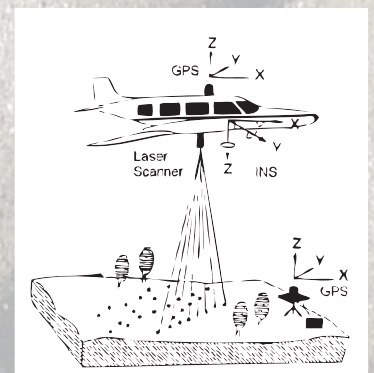
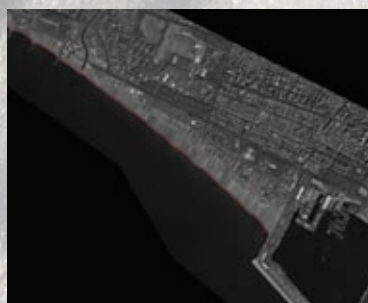
- (Lead partner) DST- Università degli Studi di Firenze
- DISTART - Università di Bologna Alma Mater Studiorum
- DIPTERIS - Università degli Studi di Genova
- DST - Università degli Studi di Roma "La Sapienza"
- ARPA - Ingegneria Ambientale - Emilia Romagna
- EID Méditerranée
- OANAK - Eastern Crete Development Organisation
- FORTH/IACM - Institute of Applied Computational Mathematics
- Laboratoire de l'Hydraulique et des Travaux Hydrauliques - Université Democritus de Thrace
- ICM - Instituto de Ciencias del Mar

**General objectives**

*Development of morphological beach survey methodologies aimed at monitoring their evolution based on various timescales, and assessing precision based on sample sites which are characterized by different morphological and sedimentary dynamics.*

*Define, verify and illustrate new methods for the assessment, of coastal sand movements on a scale which uses several sedimentary cells.*

*Tools for determining coastline operational position after beach nourishment interventions and distribution of dumped sediments on emerged and underwater beaches have taken place in relationship with sand granulometry characteristics.*



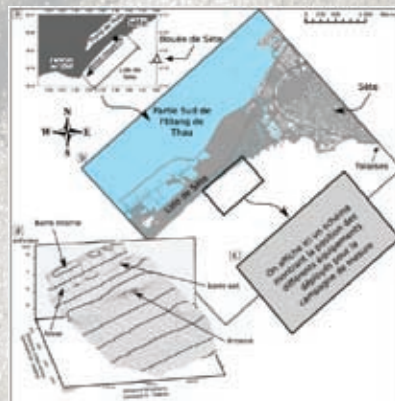


(Lead partner) **Université de Montpellier II**  
 Università di Bologna - DISTART  
 Fondation Nationale de Recherche Agronomique  
 Agenzia Regionale Prevenzione Ambiente della  
 Regione Emilia-Romagna - ARPA SIM  
 Università di Roma "La Sapienza" - BAU

**General objectives**

*Development of systems for wave climate awareness in proximity of coastlines in order to obtain models of erosive phenomena.*

*Study, determine and assess the Posidonia grasslands' ability to mitigate the wave climate along the coast.*



**Characterisation of hydrometeorological conditions of coastlines, analysis of risks to coastlines, behaviour of protective measures and dynamics of *Posidonia oceanica* grasslands**

The proposal for measure 2.2 of the BEACHMED-e project includes five public research bodies, belonging to three countries within the European Union, and four different regions which will work together for 24 months. This project aims to study the dynamics of the coastlines and their consequences by focusing on the four scientific research areas shown below:

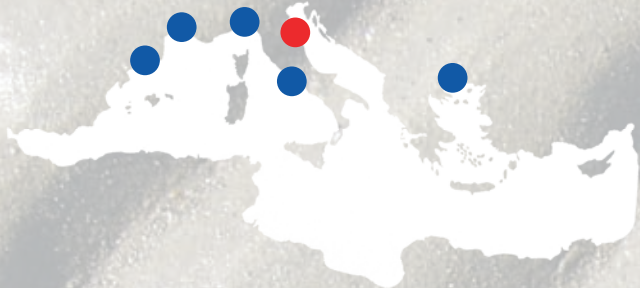
1. *Characterisation of wave climates and hydrodynamic and weather conditions based on measurements and modelling.*
2. *The study of erosion and sea storms in coastal zones.*
3. *The study of deterioration processes of artificial coastal protection mechanisms and the development of methods for the monitoring and prediction of their behaviour.*
4. *The study of interaction between wave movement and marine biotopes (samples of *Posidonia oceanica* grasslands).*

These features will be studied in a number of sites located throughout the various partner regions. The sites that will be studied will mainly consist of sandy coastlines, along with any artificial coastal protection structures and/or *Posidonia oceanica* grasslands. The management of these features will be mainly based on the valid assessment of coastal hydrodynamic factors for the zones under analysis. Work carried out by the research team will therefore all have to be carried out using numeric modelling and on-site measurement of coastal hydrodynamic and hydrosedimentary processes. Partners have also adopted the same methodology which has been summarised below:

1. *Selection of study sites based on issues being analysed and bibliographical summary of hydrodynamic data and other data available at these sites.*
2. *Organisation and implementation of campaigns aimed at hydrodynamic measurement based on various temporal and spatial scales at these sites.*
3. *Modelling of hydrodynamic, hydrosedimentary and/or hydrobiological processes validated and adjusted according to existing measurements and/or measurements gained at the sites taking part in the project.*
4. *Implementation of ad hoc products for the various issues being analysed: Hydrodynamic atlas of the coastline (erosion and sea storms), establishing CSI (Coastal State Indicators), maps showing *Posidonia oceanica* dynamics and summary documents.*
5. *Implementation (or updating) of databases and websites, in order to allow for archiving of obtained data and modelling results. This will create core documentation which can be quickly accessed by those in charge of managing the coastlines.*







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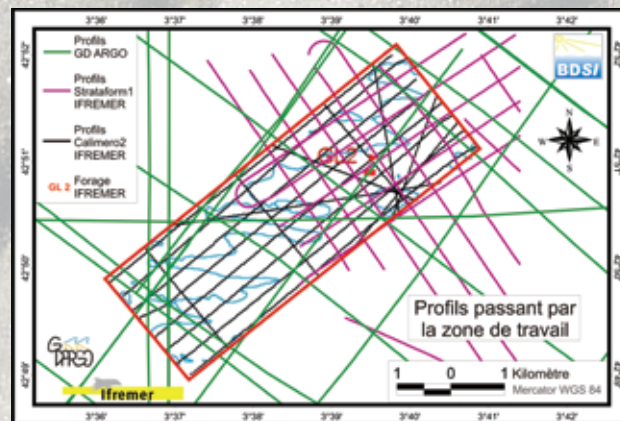
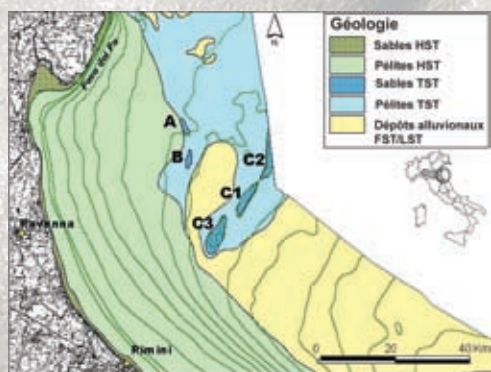
**Search for submarine sand in the Mediterranean Sea.**

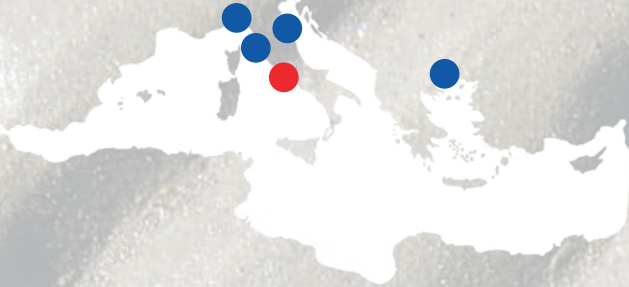
The ResSaMMè project was set up by six European partners (Italian, French, Spanish and Greek) who decided to pool together their experience. The goal is to exploit the technical tools available when analysing the characteristics and potential use of natural sand resources on the continental shelf within their regions, therefore slowing down erosion along the Mediterranean coasts. This should result in the guidelines required to develop a common protocol which will define the standards and terminology and also take research strategies into account. The project, based on the outcome of the European BEACHMED (Interreg IIIb – Medocc) and the «Ipotesi di linee-guida per la ricerca in mare di masse sabbiose da utilizzare per il ripascimento dei litorali soggetti ad erosione» (Guideline Options for research at sea of sand masses to be used for the beach nourishment of eroding coasts) paper written by "La Sapienza" Rome University together with Genoa University, aims to evaluate the potential availability of sand and gravels in the submarine deposits of participating countries. This includes new and existing sources whose main characteristics are to be analysed in order to verify their suitability for beach nourishment activities for the various coastal areas. Finally, a summary of partners' experience in this field will contribute to the creation of a methodological protocol which can be used for this type of research and analysis (main results). Coastlines of countries involved will benefit directly from the project. Thanks to the sustainability of results and the opportunity to transfer initiatives to other European coastal zones with similar problems the project will have a positive impact on the future, and will create the foundations for further research and development.

**General objectives**

Assess the potential of sub-marine sand deposits on the continental shelf and search for new deposits.

Improve and circulate guidelines to all partners involved in the field concerning search of sea sand to be used in beach nourishment activities along the coasts





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Provincia di Livorno

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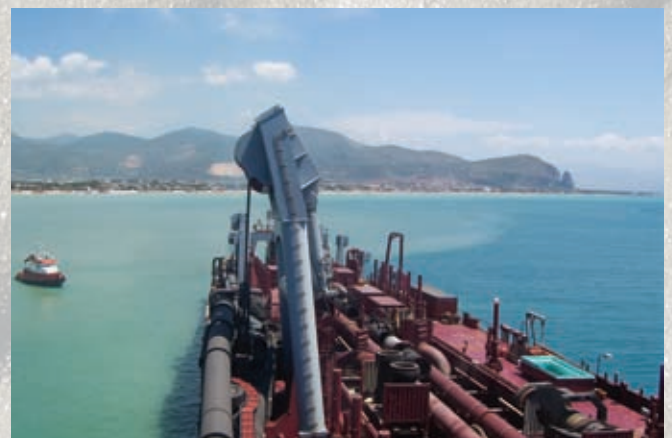
Agenzia Regionale per la Protezione dell'Ambiente Ligure – ARPAL

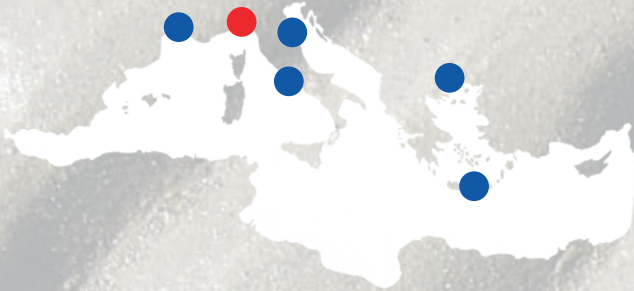
**European Environmental Protocol for Dredging and Beach Nourishment.**

The European Beachmed (Interreg IIIb-Medoc) project, which ended in December 2004, created the ENV1 protocol which has been shared by some of the regions that are taking part in the project. The subproject aims to share this protocol with other European regions (with an interest in the dredging of sand collected for beach nourishment of areas affected by erosion) and also verify whether it can be applied to other geographical areas. The subproject also aims to focus on the problems created by variations in turbidity levels and/or sedimentation rates which can be caused by the movement of relict sand (dredging and nourishing), by identifying specific methodologies which can estimate and monitor these parameters out at sea and near the coasts. Specific pilot projects will also be carried out to cover these scenarios. The variation in sedimentation rates in the coastal areas affected by beach nourishment activities will then be studied, under natural conditions and for scenarios taking place during these initiatives, including sensitive ecosystems such as Posidonia oceanica (species protected by European Habitat directive). The variation in turbidity levels caused by dredging will be studied in areas out at sea that possess this type of sand deposit based on the characteristics of the different types of deposits (at surface or covered by a layer of pelitic sediment).

**General objectives**

*Improvement of Protocol ENV1 with specific programs (turbidity, pelitic coulter) to evaluate the feasibility of interventions in this sector.*





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**General objectives**

*Assessment of the risks of coastal flooding caused by meteo-marine phenomena, climate change, morphological variations and criteria for pinpointing the areas at risk. Verification of integrated planning systems aimed at reducing or eliminating flood risk*

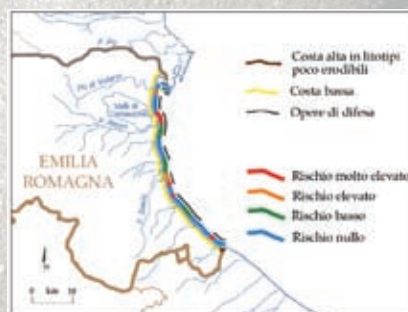
*Integrate concerns and criteria for coastline erosion defence into territorial and urban plans. Verify the necessity of specific solutions based on characteristics of the various territories.*

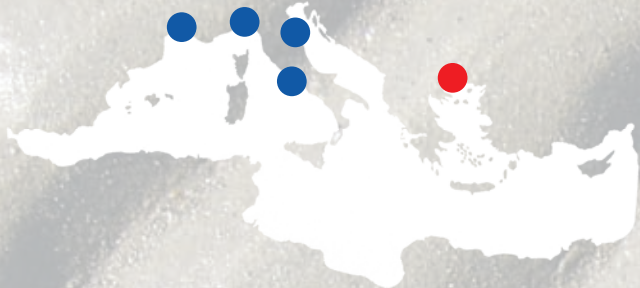
Evaluate risks and establish integrated plans for Mediterranean coastlines.

The littoral coast plays a central role in human life: the sea shore provides the right conditions for human settlements and the development of various activities to take place. Human pressure on the coasts has grown around the world and is expected to increase further, threatening coastal and marine environments. The cities that interact with the coasts suffer from the impact of harbour infrastructures and activities linked to the sea and are faced with scenarios which are destroying the coasts. The boundaries between land and sea have become areas associated with risk and conflict.

Any attempts to defend and regenerate the coast have to be part of a global management structure of the area which takes into account the vulnerability of the coastal areas and enables resources to be planned in the medium and long term. Management strategies have to include all decision making parties and be based on an integrated knowledge, skills and tools base. Management and organisation of the area needs to take place via local and urban planning and laws that regulate land exploitation have to be adhered to. Sustainable development, combining the local area's characteristics and socio-economic make up have to be encouraged, thus protecting the local and regional environment which provide an important resource to the entire Mediterranean basin.

The proposed project aims to integrate the various components constituting a typical coast management programme within a coherent operational context. This includes: build short and long term coastal risk scenarios, identify methods to be used in the analysis and intervention for the protection of the environment and coastal settlements, operational strategies aimed at the urban management of the coasts, participate in a scheme that is actively involved in conservation practices and the sustainable development of coastal areas.





(Lead partner) **Fondazione Nazionale per la Ricerca Agronomica**  
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 ICCOPS  
 Université de Montpellier 1  
 BRL

**General objectives**

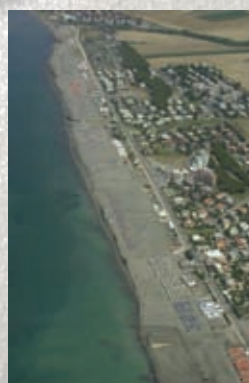
*Collection of existing studies in this sector in order to create a structure for integrated coastal zone management on a regional level.*

*Development of a cost-benefit analysis model for the comparison of different types of coastline defence interventions and economic value of beaches resulting from specific socioeconomic analyses.*

*Verify applicability of the Recommendation and Protocol at a local level using a pilot zone which includes more than one local authority and that corresponds to at least one physiographic unit.*

**Agreed actions, tools and criteria for the implementation of Mediterranean Integrated Coastal Zone Management (ICZM).**

Eight partners are taking part in the ICZM-MED subproject which aims to promote integrated coastal zone management in pilot zones belonging to the five candidate regions from the three Mediterranean countries (Greece, Italy and France) involved, and encourage the creation of an integrated management strategy on a Mediterranean and national level. It is common knowledge that the main obstacle to successfully tackling the European Union's environmental problems is the lack of administrative structures which can facilitate common interventions to take place. Integrated Coastal Zone Management (ICZM) is now in its advanced development stage as some of its theoretical concepts/principles have already been included in numerous coastline planning programmes, at various levels. Reference documents for the European Union are 2002/413/CE Recommendation issued by the Parliament and the European Council and the Barcelona Convention (specifically for Mediterranean countries) via the project which has recently been kicked off by PAP/RAC (Programme for priority actions/ regional centre initiatives) within the protocol for the integrated management of Mediterranean zones. This subproject aims to bring together any studies conducted in this field in order to create a structure for the integrated managements of coastal zones at a regional level and select one or more pilot zones from each participating regions, or alternatively apply different approaches to ICZM. This subproject has resulted in the following actions: outline pilot sites in detail, describe coastal evolution and how ICZM principles are to be applied, develop range of scenarios as part of integrated coastal zone management, assess parameters which show the status of the coasts as well as public policies, establish intervention criteria and recommend or make use of appropriate tools. Procedures for agreed actions carried out by the different bodies will also be assessed. Conclusions for all initiatives described above and good international practices, as well as conclusions for policies and experience gained in the regions being studied will contribute to the creation of an integrated management strategy at a Mediterranean and national level.





(Lead partner) Instituto de Ciencias del Mar  
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 Università di Bologna DISTART  
 Università degli Studi di Firenze  
 Registro Italiano Dighe  
 Université de Perpignan  
 Dhmokriteion Panepisthmio Thrakhs  
 FORTH-IACM

**General objectives**

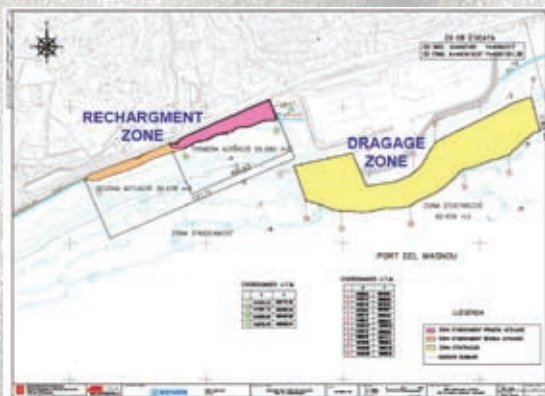
Identify sand, sedimentary deposits and geographical units along the coast in order to effectively manage sand reserves along the coast using controlled beach nourishment processes.

Quantify the volumes of sediments which can be retrieved from the sedimentary cycle and define the recovery timescales and implementation costs as well as best intervention methods.

**Management of sand deposits collected by coastal and river infrastructure.**

Eight partners will take part in the GESA subproject: it aims to carry out a multidisciplinary study of the way sand deposits and sand collected by coastal infrastructure is managed as well as the recovery of sediment transports in river beds. This study will be carried out along various coastal sections of four European countries: 1) Spain, 2) Italy, 3) France and 4) Greece. These European coastal areas are faced with the problem that defence mechanisms (dams) placed in harbours act as barriers to longitudinal movement of sedimentary deposits when they intercept the sand that is naturally moving along the coast. This effect is especially significant in the regions in which the littoral sedimentary drift seems to mainly flow in one direction, which then creates areas strongly affected by erosion which are no longer reached by sand masses. In order to improve sand deposit management it is necessary to assess the volumetric size of sand reserves along the coast, the sedimentary processes that are responsible for the deposits and the average annual exchange rate between hydro-sedimentary cells. These volumes can be estimated by assessing thickness of sediments recorded via seismic surveys. Sedimentary cycle analysis has to be extended to the river system, reaching the river mouths from which longitudinal sand movements originate. The GESA subproject will take advantage of advanced coastal study techniques, such as:

- Numeric modelling to simulate wave motion, induced currents or entrainment which results from sediments from a well defined section.
- Aerial photographs which will extend the study's temporal scope.
- Physical models, representing the normal status of a section in a laboratory, or land analysis to define a case study and validate results obtained from modelling, which can then be used on a wider scale.





**Interaction of Sand and *Posidonia Oceanica* with the environment of Natural Dunes.**

The subproject aims to promote an exchange of experience and technical knowledge concerning the management of the beach-dune system. Along with monitoring initiatives this will allow the description of physical and biological characteristics of the coastal environment, assessment of the effectiveness of morphological reconstruction interventions of dunes and, possibly, identification of innovative technology which make use of *Posidonia oceanica* remains (or other marine phanerogams or algae) on the beaches. The first phase of the subproject will consist in bibliographical research and the archiving of information drawn from scientific publications and sector specific technical reports in order to identify existing issues, define the methodological guidelines for the management of beach biomasses, and the protection and recovery of dune systems. The second phase aims to define methodologies for the recovery and consolidation of coastal dunes using innovative bioengineering techniques via the planting of autochthonous plant species, in order to stabilize aeolic deposits and use remains of *Posidonia oceanica* on the beaches as a fertiliser, helping coastal vegetation to survive. This will encourage focus on environmental and socioeconomic factors when planning interventions on the beaches. (a similar approach has the twofold advantage of reducing the masses of plant residues on the beach and fertilising sand sediments. Positive feedback may also occur between the biological and sedimentary components such as an increase in flexibility, resilience and dynamic stability of the beach-dune system). The third phase will enable chosen pilot sites to take advantage of some the developed methodologies and, via monitoring activities that will follow these interventions, verify the effectiveness of the techniques applied.



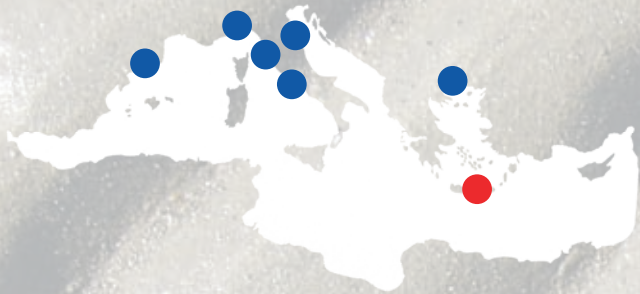
(Lead partner) ICRAM Istituto Centrale per la Ricerca scientifica e tecnologica Applicata al Mare

- Provincia di Pisa
- Università degli Studi di Ferrara
- Università di Bologna CIRSA
- EID Méditerranée
- FORTH-IACM

**General objectives**

*The restoration of the dunes as a technical instrument in the fight against coastline erosion and sharing of the "soft " methods of coastline defence between the different partners.*





(Lead partner) FORTH-IACM  
 ICRAM  
 Università degli Studi di Ferrara  
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 ICCOPS  
 Camera Tecnica greca  
 Comune di Follonica  
 Università degli Studi di Firenze  
 ARPA Liguria  
 Consortium El Far  
 OANAK

**General objectives**

*Proposal for a protocol/procedure at European level to regulate the exploitation of the continental shelf's underwater sand deposits which are used for beach nourishment.*

*Definition of tools useful for implementation of observatories, national archives and European systems with the aim of data production for the integrated coastal management of the Mediterranean at European level.*

**Regulations and Promotion of an European Observatory for the Defence of the Mediterranean Coast.**

Coastal erosion is a phenomenon that engenders significant effects on the sea-land area of the Coastal Zone. The full destruction or deterioration of coasts have repercussions on the sea and land environment, fishing, the exploitation of the sea region and the social and economic conditions of the inhabitants of the region. The problem becomes even more serious in the event of co-management by several authorities, at a central and local level, with the overlapping of different competencies for coast and coastal use management.

In the light of these considerations, Obsemedi takes into account the regulatory framework for the exploitation of underwater deposits and nourishment and supports the setting up of a European Observatory for the Defence of Mediterranean Coasts. More specifically, the following objectives are pursued:

- drafting of European rules and regulations for the exploitation of underwater deposits and nourishment according to a global use and defence perspective of coastal areas, with a special accent on regulatory measures and technical and scientific knowledge. The study will focus on two main Community initiatives (Beachmed, Eurosion) and on other European and international regulatory frameworks, the specific survey on the regulation interpretations and on the role played by the above mentioned systems and by European rules and regulations, the study of the functional and organisational feasibility of a regulatory system of coastal functional and environmental management and defence activities.
- a study for the creation of a European Observatory for the Defence of Mediterranean Coasts, including the registration of all the institutions involved in the management and protection of Coastal Areas, the description of the control systems and methods of each region and the assessment of these systems. The proposal is intended to design a modern system for the recording and observation of the coastal erosion phenomenon, in order to manage and exploit the coastal zone through the setting up of an Observatory. Specific indicators and parameters must then be envisaged including a related database. Finally, in view of a more thorough study of the coastal erosion phenomenon, the proposal is expected to provide a well-structured IT data management and retrieval system, the modelling and simulation of dynamic processes in Coastal Areas, by means of a geographical information system (GIS) that will disseminate the statistic and cartographic information processed within the Coastal Area.





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