PHASE B REPORT

Interreg III C – Sud
Project Beachmed-e
Sub-project MEDPLAN (BMe-3S0155R-3.1

"PROCESS OF ANALYSIS AND MANAGEMENT OF THE COASTAL ZONES. METHODS OF RISK EVALUATION, IMPACTS REDUCTION AND TERRITORY DEVELOPMENT"

1. Presentation

The maritime coast is one of the most dynamic natural environment and a very attractive location for people and any kind of activities. Today, the land/sea interface is increasingly a sensible field of interactions: a stronger human pressure erodes the coastal ecosystems and jeopardizes the natural equilibriums; the frequency and the dimension of the extreme natural events (storms, floods) and the acceleration of long term transformations (erosion, land subsidence) affect the coastal line and threaten human goods and lives.

The MEDPLAN sub-project wants to integrate the coast management with the land planning, in order to link the protection of the littoral with the sustainable development of the coastal regions. The sub-project is based on the principle that the studies and the actions for protecting the littoral, reducing the risk and preserving the natural environment in the coastal zone, should be connected with the process of planning and decision making, at different levels, in order to implement more comprehensive and responsible land policies.

An interdisciplinary team of seven partners carries on thematic studies that consider the different aspects and phases of a circular process of analysis and intervention for the protection of the coast, aimed to the overall sustainable development of the coastal territories (see organization chart, table 1).

In this process either the physical phenomenon of the coastal dynamics and the human reactions to it are taken under consideration. The evaluation and the perception of the risk, considered under different points of view, play a fundamental role. ICZM acts as a medium between the study of the sea/land interface and the spatial planning, that is articulated into different levels, from the strategic to the local one. As a result of the planning approach, projects are directed to create new, desirable settings that modify the sea/land interface and restart the process.

The program of the MEDPLAN sub-project includes:

- methods for analyzing the extreme events that effect the coast and for calculating and modelling the coastal dynamics;
- the evaluation of effects of the coastal dynamics, the forecasting and the prevention of the risk;
- techniques for testing the perception of the risk among the users and the policy makers;
- the implementation of land use planning for the coast in a local context;
- the implementation of strategic planning in a coastal territory.

The Phase B has been dedicated to analyze and experiment the theories and the techniques selected in the Phase A. Field surveys have been carried on and methods of planning have been applied in the pilot sites chosen in the Phase A.

The following chapters contain synthetic reports of the results achieved by each partner.

2. Submersion Risk Assessment on Coastal Zones

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2.1. The evaluation of the risk

In the present study a method for the evaluation of the sea storm risk, based on the one proposed by by Gornitz *et al.* (1994) will be used at the regional scale. The applied method allows the definition of the vulnerability (**V**) and the risk (**R**) through the creation of a territorial database and simple calculation procedures; it may be a valid support to optimise the participation strategies because it is based on objective and univocal criteria for the classification of littoral stretches and also because it provides scenarios useful in the ICZM. A specific "informative level" provides scenarios of coastal submersion related to the recurrence of extreme events and to the forecasts of a sea level rise at the year 2100.

2.2. Analysis of the submersion risk

The proposed method is based on the parameterisation of the submersion trend of the coast and on the evaluation of its spatial distribution through the identification of similar sector.
The submersion trend or the vulnerability may be synthesised by the use of indexes; in particular the real vulnerability (Vr) is the interaction of:

- index of potential vulnerability (Vp), that describes the geo-morphological, sedimentological and anthropic trends to the submersion, considering the littoral unprotected;
- index of efficiency of the defences (IED) that corresponds to the passive efficiency of the coastal structures (natural and artificial) to the submersion.

The logical pattern is therefore given by:

Potential Vulnerability (Vp) ⇨ Structures Efficiency (IED) ⇨ Real Vulnerability (Vr)

For homogeneous stretch, the risk (R) will depend on the value of Vr and of the evaluation of the socio-economical value of the considered zone:

Real Vulnerability (Vr) ⇨ Socio-economical Value (E) ⇨ Risk (R)

2.2.1. Subdivision of the coast in homogeneous stretches

A delicate step for the risk definition consists in the subdivision of the coast in sufficiently homogeneous stretches in which the submersion trend can be considered a constant. The approach used in the present study is semi-quantitative. A first subdivision may be done in correspondence with the harbours jetties and the principal fluvial mouths. Successively the subdivision is based on the extension of the defence structures since they condition the natural evolution of the coast. A multidimensional procedure may also be applied. It consists in a Principal Components analysis, followed by a Cluster one, in order to obtain a more effective subdivision in homogeneous stretches, considering the large number of environmental and human parameters taken in consideration.

2.2.2. Identification of the environmental parameters

The criterion to identify the coastal zones more vulnerable to the marine ingression is based on an objective evaluation of the characteristics of the different coastal stretches, represented by a set of variables related to 5 compartments, which constitute the base for a zoning of the littoral, expressed in terms of vulnerability.

1. Marine weather conditions
2. Geological-morphological conditions and pressure of use of the beaches:
    - shoreface width

- emerged beach width
- emerged beach height
- mean diameter of the sediments
- pressure of the use of the beach

3. Evolutive trend of the beach
   - shoreline evolution (recent / historical)
   - shoreface evolution
4. Subsidence of the coastal territory
5. Typology of the defence structures along the coast and in the hinterland:
   - Soft protection
   - Rigid protection: marine structures, adherent structures and hinterland structures.

The weather conditions have a significant influence on hazard. For such reason, the occurrence of flooding events at medium-long term period and the extension of the flooded inland will be estimated through a mathematical model considering the wave climate data and the geometry of the shoreface. The results will be useful for the risk assessment and especially for the identification of the zones at risk. The geological-morphological parameters and the pressure of the beach use characterise the beach system in terms of accommodation and mitigation capacity against the submersion. The trend provides an evaluation of the beach system behaviour for a short and long term period. The subsidence enhances the phenomenon of the coastal submersion. Finally the different typologies of structures identify the passive mitigation answer of the beach to the submersion.

2.2.3. Calculation of the "potential" vulnerability

The potential vulnerability (Vp) represents the vulnerability of the littoral when considering any defence structures (natural and/or anthropic) against marine ingression.
The variables used for the calculation of Vp are:
1) width of the emerged beach, 2) height of the emerged beach, 3) width of the submerged beach ('till the closure depth), 4) recent evolution of the shoreline, 5) historical evolution of the shoreline, 6) shoreface evolution, 7) subsidence, 8) mean diameter of the beach sediments and 9) pressure of use.

Vp is calculated through a multiple regression (Civita, 1994; Civita e De Maio, 1997) like:

$$V=v_1k_1+v_2k_2+v_3k_3+....+v_nk_n$$

V = index of vulnerability, v = codified value of the variable and k = ponderal weight assigned to the variable according to the importance of the variable itself to contribute to the system vulnerability.

The codified value of the variables is obtained by means of evaluating opportune classes of values, established in consideration of the characteristics of the examined littoral. Therefore a ponderal weight related to its importance for the mitigation of the risk is assigned to each variable. The weight is defined according to the characteristics and the particularity of the littoral.

2.2.4. Calculation of the "real" vulnerability

The real vulnerability Vr represents the vulnerability of the littoral, mitigated by the natural and artificial defences. The mitigation action of the defences is evaluated through an *Efficiency Index* (D_i) related to the anthropic defences and the natural dunes.
The efficiency of each defence structure is represented by:

$$D_i = d * \frac{Vp_{\max}}{e_{\max}}$$

d = original value of the class of the structure, Vp_{max} = theorical maximal potential vulnerability, e_{max} = maximal class of efficiency relative to the structure, Vp_{max}/e_{max} = coefficient of normalisation of the values related to the structures

A special index, the *Efficiency and Stability Index* (*IES*), is determined for the natural dunes according to the height of the crest, the rate between the dune height and the width of its marine side, the linear continuity, the conservation state and the vegetal cover.
The calculation of *IES* is given by:

$$IES = \frac{\sum V_i}{n}$$

V_i = variables related to the dunes; n = sum of the maximum values attributed to the variables (used to normalise the index in the range 0-1)

The total efficiency of the structures is: $IED = IES + D_i$
Vr may be therefore calculated as: $Vr = Vp - IED$

2.2.5. Calculation of the submersion risk

The analysis of the Risk (R) is evaluated according the following relation:

$$R = Vr \cdot E$$

Vr = real Vulnerability, E = economical value of the littoral

The Economical value (E) is an evaluation of the social, economical, natural value of the exposed zones or the cost in monetary terms of the direct and/or indirect impacts. Because the procedure for an economical evaluation is complex, a rapid and effective methodological approach is used to determine E, based on the coastal territory's land-use.

2.2.6. Storage modality of the parameters

The database is realised in order to be easily updated. The database is structured according to the parameters (variables) used for the definition of the risk. The structure of the GIS is realised in the ESRI® Arcgis environment for the management and analysis of the data and for the creation of the thematic cartography. The geographical definition of each stretch is defined through the Universal Transverse of Mercator projection system and the geocentric Datum WGS 84. The aerial images "Volo Italia" 1998/99 (IT2000) are used as topographical base.

2.3. Restitution modality of the territorial data: the thematic cartography

The representation of the results consists in a chart where the morphological and sedimentological parameters, the land use and the defence structures are represented with non-conventional symbols. A territorial informative level, resulting from the analysis of the impacts of the submersion scenarios at short, medium and long term, will provide (in phase C) an estimation of their incidence on the socio-economical pattern of the coastal zone. These scenarios, based on models of the extreme wave height on the coast, will be elaborated for each homogeneous stretch in order to "quantify" the coastal potential criticism for specific "morpho-types".
At long-term the sea level rise represents the climatic factor used for the evaluation of the submersion phenomenon. A "multi-scenario" approach will evaluate the potential incidence of more sea level rise scenarios on the coastal zone, considering the climatic (global) and geological (local or regional) causes of the phenomenon.

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3. Managing the Risk in the Coastal Zone

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3.1. Introduction

Flood risk is defined as the combination of the probability of a flood event, the potential adverse consequences to human health, the environment and economic activity associated with a flood event. For understanding the physical system of flooding, it is useful to consider the commonly adopted Source-Pathway-Receptor-Consequence (S-P-R-C) model. This is a conceptual tool for representing systems and processes that lead to a particular consequence. For a risk to arise, there must be a hazard that consists of a source or initiating event; a receptor (person or property); and a pathway that links the receptor to the source. For calculating the risk of flooding and for being able to develop reliable flood hazard maps, the following should be examined: (a) storm classification, (b) analysis of extreme events and estimation of return levels, (c) modelling of wave run-up and inundation, (d) Flood Hazard Maps. In the following sections these issues are described together with the methodology applied in coastal regions of East Macedonia and Thrace.

3.2. Storm classification

The impacts of storms on coastal areas induce a range of potential hazards for the natural as much as for the human environment. Phenomena such as beach and dune erosion, overwash, inundation, even infrastructure damages in developed coasts, affect systematically and dynamically the modulation of prevailing conditions in coastal areas. Therefore, storm classification is deemed to be essential in the framework of ICZM and of the aforementioned phenomena's scientific study, making easier the investigation of their impacts. The study of storms is carried on through statistical analysis of wind (wind speed and duration, frequency of occurrence), wave (wave height, period and direction) and water level. Various scales for classifying storms have been developed; although deriving from the same concept, their basic characteristics and assumptions (e.g. definition of storm events, classification criterion) often vary, dependent on the scope of each background study.

3.3. Analysis of extreme events and estimation of return levels

The fact that engineering works need to be designed for extreme conditions requires special attention to exceptional values. Block maxima and high thresholds are used, according to data availability, to extract design values for different structures. Extreme value methods are powerful statistical methods for drawing inference about the extremes of a process, using only data on relatively extreme values of the process. Extreme value methods are usually utilized for the purpose of extrapolation to levels more extreme than those which have been observed. The statistical methodology is motivated by a well established mathematical theory (Extreme Value Theory), which relies on the assumption that the limiting models suggested by the asymptotic theory continue to hold at finite but extreme levels. The estimate of extreme quantities is a critical subject in the analysis of risk of hydraulic structures. The analysis of extreme values using the Bayesian methodology is usually preferred, owing to the general lack of data and the easiness that it offers to include other sources of information in the analysis, via different prior distributions of parameters of the distribution function. Moreover, one of the main objectives of the analysis of the extreme values is also the estimate of the T-year return level u(T). This is fixed as the threshold u(T), for which the medium number of exceedances during a time length T is equal to unity.

3.4. Modelling of wave run-up and inundation

The confrontation of flooding risk is a priority for countries with long coastlines and highly developed coastal zones. Of course confrontation is the last stage in the procedure of understanding and quantifying the phenomena taking place in the marine environment, the sea-shore interface and the inner coastal zone. These phenomena are studied using various techniques; numerical forecasting models are of the foremost importance. In order to develop a complete an applicable methodology for forecasting coastal flooding, a structured approach to the selection of appropriate “tools” is needed, aiming to consider (i) a range of methods that may be appropriate for specific task, (ii) the specific physical characteristics, (iii) costs of developing and maintaining models and (iv) the overall function of the system. The underlying basis for the categorization system presented is the level of complexity of the model, which is considered to be dependent on data requirements, resolution, physical processes and characteristics of the underlying equations. According to the above, the categorization is based on a) the physical zone of each model’s application field (offshore, nearshore, shoreline response and flood inundation) and b) each model’s background theory (judgmental, empirical, 1^{st} / 2^{nd} / 3^{rd} generation). It is, however, critical to define each model’s restrictions and capabilities and afterwards decide about whether a homogenous or a heterogeneous model combination will serve the research objective.
A critical parameter when simulating coastal flooding is water level setup. Its importance lies on the fact that an accurate estimate of the mean water level (M.W.L.) elevation, could easily lead to the definition of the swash zone (the zone of wave action on the beach, which moves as water levels vary, extending from the limit of run-down to the limit of run-up). The extent of the swash zone is related to further shoreline response (overtopping, overflowing, breaching), given the beach profile characteristics. Therefore, the model selected to predict water level setup should have the capability of simulating wave propagation from offshore wave and wind data, as well as breaker and swash zone dynamics, while also taking into consideration cross-shore morphology alterations that affect the profile shape. SBEACH (Storm-induced Beach Change) is such a model, with wide operational applicability and well-confirmed results in various studies around the world. After its application for a number of representative cross-sections in the study area, a flood inundation model has to be applied in order to estimate the inner coastal zone response to extreme wave events, with the -previously estimated- water level setup constituting the seaward hydraulic boundary condition.

3.5 Flood Hazard Maps

There are different types of maps used in flood risk assessment.
(a) Flood plain maps indicate the geographical areas which could be covered by a flood according to one or several probabilities: floods with a very low probability or extreme events scenarios; floods with a medium probability (likely return period >= 100y); floods with a high probability.
(b) Flood hazard maps are detailed flood plain maps complemented with: type of flood, the flood extent; water depths or water level, flow velocity or the relevant water flow direction.

(c) Flood risk maps indicate potential adverse consequences associated with floods under several probabilities, expressed in terms of: the indicative number of inhabitants potentially affected; type of economic activity of the area potentially affected; installation which might cause accidental pollution in case of flooding.
Maps should include the basic information (title, location, North and scale -preferably scale pole-, responsible authority or institute with address, date of publication and disclaimer) and have consistent information (e.g., consistent extents for given event probability), although the content, format and dissemination may differ depending on the purpose and target audience. Explanations should always be given (directly onto the maps) for correct interpretation of maps (e.g. return period or probability, method of development, uncertainty, etc.), as appropriate for the target audience. Public maps should be simple and self-explanatory and include a legend, such that as little supporting or explanatory information as possible is required for correct interpretation. Organisational users (governments, local authorities, etc.) may require more detailed explanatory information to fully understand the development and limitations of the maps. Supporting information for organisational users should include: (a) GIS data available for download, emphasising the use of supporting information, (b) Meta-data information (e.g. quality, data sources, inventory of existing information, etc.)
The extent of potential flooding has to be presented as a surface covering the topography for a specified flood level /frequency. For reference, roads, railways, houses and permanent water bodies from which the floods originate may be included. Recently Google Earth has become a powerful tool to use as background layer for this kind of information. The more natural colour for this flood extent information is blue (dark for frequent floods, light for the areas covered during less frequent); an alternative colour is red, as the one representing danger.

3.6. Applications

In the present work, the risk of flooding is studied for the coast of East Macedonia and Thrace, between the River Nestos and the River Evros. Offshore wave (height, period and direction) and wind (speed and direction) data are used for open sea boundary conditions. Such data, as a result of hindcasting, are available for ten years (1995-2004), at ten locations along the coast, at approximately 50 m depth, with a separation distance of 10km, and are considered representative for the open sea boundary for both the wave and the wind climate.

4. A Method of Evaluation of Dangers and Reduction of Effects in the Coastal Zone. Recognition of Fractional Frames

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1. Introduction

In the Phase B IACM-FORTH is carrying on simulations for forecasting the extend of floods due to extreme weather phenomena. An approach based on simulation techniques for estimating and classifying the risk of flooding in time is favourable: it can forecast the time evolution of the phenomenon faster and more economically than in situ.

2. Description of the simulation model

The elevation of the sea level and the flood of coastal regions are owed in effect induced from the following phenomena:

1. meteorological-storm surge tides (storm surges) due to the effects of wind and baroclinic gradient in masses of the coastal basins;
2. astronomical Tides that are owed to the effect of the Moon's mass;
3. elevation of the mean sea level in the area of wave braking (set-up) which is due to the important loss of energy of waves because of braking.

For the estimation of the total sea's elevation level, the following methodology is proposed.

Application of a circulations numerical model in two horizontal dimensions (2 DH) in order to simulate the meteorological-storm surge tide.
One of the main natural factors which causes the sea circulation and fluctuations of the water level is the phenomenon of the meteorological (storm surge) tide which in combination with the astronomical tide is the main reason of producing changes in the level of coasts with extensive shelves. The general form of the mathematical model of circulation occurs from the Navier–Stokes equations under certain assumptions. The unknown magnitudes of movement and level changes in a marine basin are the velocity field components that in physical coordinates namely u(x,y,z,t), v(x,y,z,t), w(x,y,z,t), and the density ρ(x,y,z,t).

Estimation of the Astronomical Tide using field measurements (with tide recording buys).

Application of the wave model with extension in the coastal area and estimation of the set-up using analytic expressions.
We compute the elevation of the medium level of the sea in the area of wave braking (set–up) that is owed in the important loss of energy of the waves due to their braking. Taking into account the elevation (above the mean sea level) we forecast the flood of the coastal area.
A numerical model using the above calculated elevation based on the non-linear shallow water equations is used to predict the flood of coastal regions. This flood simulating model was developed and calibrated at FORTH-IACM (c.f A.I. Delis, M. Kazolea and N.A. Kambanis. "A Robust High Resolution Finite Volume Scheme for the Simulation of Long Waves over Complex Domains", to appear in International Journal for Numerical Methods in Fluids) and is using state of –the- art computational techniques which makes the code an efficient tool.

3. Choice of a pilot area

The beach of Georgioupolis has been selected for the implementation of the computational model. It is located in the north-western sector of the island of Crete, 39 km from the city of Chania and 11 km from the city of Rethimnon. The main reason of the choice of this region is the problem of flooding of the beach due to its structure and the powerful storms that affect occasionally the northern part of the island. The beach is flat and the floods cause many damages to the private properties and affect tourism, which is one of the biggest sources of income for the region.

5. Methodological Tools for Investigating the Risk Perception in the Coastal Zone

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5.1. Keywords

Coastal risk perception, public policies assessment, Integrated Coastal Zone Management (ICZM)

5.2. Phase B objectives

This phase of the program refers to the definition of the methodological tools regarding the field investigations. This relates primarily to the selection of the pilot sites, the design of the surveys by questionnaire, and the strategy of sampling. The field investigations result in preparing common surveys by questionnaire for sub-measure 3.1 (MEDPLAN) and sub-measure 3.2 (ICZM-MED) on the perceptions of coastal erosion, ICZM, and marine floods. This also makes it possible to compare the perceptions of coastal practitioners and users regarding coastal erosion and marine floods.
Two investigations are designed on two target groups:

- the “Stakeholders and coastal practitioners” intervening in the policies of beach management;
- the local “Users of the beaches” and tourists.

These two types of investigations correspond to two logics with a broad sample (around 300 investigations) and a short time of investigation (15 minutes) for the users, and a guide to carry out the interviews (approximately 2 hours and around 40 interviews).
These investigations aim at assessing the perception which the populations and the stakeholders have of the beaches and the risks of marine floods, and at assessing the public policies implemented to prevent these coastal hazards. One of our objectives is to assess if these public policies refer to the requirements of Integrated Coastal Zone Management (ICZM) in terms of dialogue between the stakeholders, institutional partnerships, transversality, information, etc.

5.3. Research protocol and choice of the pilot sites

5.3.1. Choice of the pilot sites

Three sites were selected:

- Valras-Plage with the districts of Orb Hérault and Orb Aude;
- the Sète – Marseillan-Plage lido;
- Palavas-les-Flots to which one added the beach of Villeneuve-lès-Maguelone to have a sample of natural beaches.

5.3.2. Layout of the field investigations

The analysis of the perception of marine floods and their related public policies requires field investigations. The “Stakeholders and coastal practitioners” survey is scheduled between March and June 2007, while the “Users of the beaches” survey is scheduled between April and August 2007 according to a sampling per site that crosses three criteria:

- changes in population frequenting the beaches for each site;
- seasonal users of the beaches and implied changes;
- the weekly distribution of the days (week days and weekend).

The surveys will be balanced according to the age and the types of profile of the population (family, group, couple, etc.). Approximately 100 investigations will be carried out for each site.
Within the “Stakeholders and coastal practitioners” surveys, three main categories of actors were identified:

- participants in the public policies managing coastal erosion and marine floods;
- stakeholders belonging to the steering and technical committees;

– stakeholders dealing with coastal management which are not directly concerned with coastal erosion and marine floods issues.

Moreover, the local and regional scales were assessed to select the stakeholders, whilst associating ten actors per site (local actors) and about fifteen global key actors concerned with the regional scale.

5.4. Survey motivations and questionnaires

5.4.1 The Stakeholder and coastal practitioner questionnaire

The questionnaire appears as a guide for conducting the interview. It makes it possible to gather:

– the institutional presentation of the interviewee;
– the analysis of the role and the stakes of the institution of the interviewee through the analysis of the policy cycle, the meetings of the various committees, the scales of management, the consultation and the communication towards local populations;
– the analysis of the representations of coastal erosion, marine floods, and policies managing the beaches as well as sustainable development and ICZM;
– the access and the level of information with collected information, the sources of information and the indicators of management;
– possible prospects for beach management.

5.4.2. The Beach user questionnaire

The questionnaire covers successively:

– the identification of the users with socioeconomic features;
– the type of residents by separating people as local residents from coastal municipalities, local residents from non-coastal municipalities / daily visitors, owners of second homes, and tourists;
– the representations associated with the coastal zone and the uses of the beaches, and goods and services associated with the beaches;
– the perception of coastal erosion processes;
– the public policies dealing with coastal erosion processes;
– the perception of the marine floods processes and required policies;
– the Willingness To Pay (WTP) as the daily maximum amount that people would be willing to pay to protect the beaches or the maximum surplus of additional fees which they would be willing to pay.

This part allows describing several issues. Firstly, the assessment of the range of perception by the population of marine floods, in particular in a context of sea-level rise. Is it a short-term or a long-term risk, and a realistic or an illusory risk? One assesses then the knowledge that the users of the beaches have of the consequences associated with sea-level rise, in terms of aggravation of the consequences of storms (floods on the houses in front line and floods related to the heavy rains), of disappearance of the beaches by covering of the sea, of immersion of the grounds at low altitude, of overflow of the lagoons and the impacts on the biodiversity, etc.

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6. Land use planning in the coastal zone. The case of Georgioupolis

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In Crete, research on land use methods in the frame of ICZM was centred on the Municipality of Georgioupolis, a coastal township on the north coast of the island which also has a large mountainous interior.
The main element of the transformations taking place in the Municipality is building and tourist development. Although building activity takes place in all the settlements of the Municipality, it is mostly concentrated in the coastal zone (length of coastline: 9 km). The overwhelming majority of tourist activity is also concentrated in the same area, obviously connected with the sea, and corresponds to the seasonal mass tourism model, active 6-8 months a year.
The building and land use planning of the Municipality is currently nearing completion. This is centred on the functional reorganisation of the relationships between the various Municipal Departments, the logical confrontation of pressures to expand the settlements, and the correct use of available natural resources for logical, sustainable development.
Particular emphasis is placed on the responses to pressures on the coastal zone where activities are concentrated and where ecosystems are particularly vulnerable.
The main feature of the coastal zone is an extended system of sand dunes, whose presence is due to the following:

a) the exposure of the coastline to the local prevailing north-westerly winds,
b) strong wave activity in the coastal zone, depositing and distributing sandy sediments from the land on the beach, and
c) the deposit (mass transport) of products of erosion brought down into the coastal zone by the local torrents (Delphinos, Sphakas, Mouselas, Petres), and especially the Almyros River, via their drainage basin.

As regards urban development, the coastal zone receives the drainage of urban waste from uncontrolled areas of solid waste deposits of various categories. It is also affected by rainwater from the urban areas (from houses, streets, hotels of various categories with a total capacity of 9,500 beds, restaurants, shops, filling stations, etc.), which brings down a large volume of materials, some of them toxic.
As regards the coastline, part of it has been built up, while the rest has been declared a no-building zone for 20 years.
The provisions of ICZM form part of the regulations of the relevant Ministry (the Ministry of the Environment, Planning and Public Works), currently subject to review.
As we can see from the above, the littoral is particularly vulnerable, while protection policies are based not only on the wider legislative framework, but also on the proposals of the project. They aim to control the expansion of human activities in the coastal zone, directing these activities towards the interior.
The connection of the interior to the coast is intended to control coastal dynamics.
Urban and land use planning in this case is exercised on a local level in an area corresponding to first-level local self-government. However, it forms part of a wider Region with a Regional land use plan.

The aim is to reorganise the territory following the principles of sustainable development. The development planning of the Municipality forms part of the above.
The main element of the strategic planning of the Region is the Regional Operational Programme implemented in the framework of Community Policies (Cohesion Policy, CSF).
Although the territorial dimension is taken into account in the specific approaches, so far it has only been determined in the form of towns, mountain areas, island areas and marginal areas.
The issue of the promotion of viable development, in the case of Georgioupolis, can form part of the general picture.
The area is the site of local-scale projects, mainly infrastructure projects, which aim to aid its internal organisation and improve residents' quality of life.
There are also projects of strategic importance for the whole Region, such as the North Road Axis of Crete. This road axis runs through the whole length of the area at a relatively small distance from the coast.
Local-scale interventions in the area aim to connect the coast and the interior, particularly as regards the reception of tourist activity, so that development can be more evenly distributed in space, limiting stresses on the coastal zone.

7. Strategic planning in a costal territory. The case of western Liguria

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7.1. General object and operations in the Phase B

The object of the research is to define innovative methods of spatial planning of the coastal zone. Innovation will consist of conjugating the integrated management of the sea-land interface with a planning process that is aimed to the sustainable development of the coastal region.
The research is carried on in a pilot stretch of coast (selected in the phase A and analyzed in the phase B) which has been chosen for the following peculiarities:

- the mixture of (an the conflict between) relevant resources (nature, landscape, archaeological remains, architectural heritage) and poor urban zones;
- the presence of fringe areas that can be exploited for a mere expansion of the urban zones or can be used for upgrading the quality of the environment (urban and natural);
- the necessity of stirring economic dynamism and the opportunity of encouraging new, sustainable forms of tourism;
- the intention of integrate a recent intervention of beach re-nourishment in a wider project of territory development.

The operations carried on in the phase B are:

1) the thematic mapping and the recording of the major elements that should be taken into account as a base for implementing the planning process;
2) the draft project of a costal trail;
3) a land survey aimed to collect the data necessary for laying out the master plan of a pilot area (the Nervia Estuary)

7.2. The thematic mapping of the coast and the recording of the heritage

In the phase A it has been completed an overall investigation concerning three main items: hazard, heritage and the planning system. In the phase B the collected data have been analyzed, ordered and

elaborated in order to make accessible the basic information for implementing the planning process (2 and 3).
The achieved results are:

- a series of three hazard maps and a final map of the integrated hazard;
- a file of inventory cards of the heritage, containing an evaluation of each recorded item;
- maps that synthesizes the contents of the land use plans, stressing the present level of protection of the environment and transformability of the land use.

All these results are original products of our research.

7.3. The project of the Costal Trail Balzi Rossi-Bordighera

A coastal trail of about 16 km could be obtained, connecting existing stretches. This trail, running form the French border (Balzi Rossi) to east border of the Commune of Bordighera (were the Ospedaletti-San Lorenzo 24 km long trail is now under construction) will link the pedestrian system of the seaside paths of the French Cote d'Azur with the Italian Riviera di Ponente one, so contributing to the definition of a transnational network.
The trail is not only a value in itself. Actually, it is the key for integrating a series of projects (someone existing, someone expected, someone new) aimed to protect the seashore, to preserve the natural areas and improve the quality of the landscape, to make the seashore accessible to the public, to use the relevant archaeological and historical resources of the region for encouraging tourism.
In the Phase B, a detailed analysis of the cost has been carried out to evaluate the feasibility of the trail and consider different hypothesis of route.

7.4. The Land Survey in the Nervia Estuary

In its final tract, the River Nervia forms a pond that is a small wildlife refuge in a context affected by dramatic and critical changes: the traditional rural activities (flower cultivations, once in open air, now mainly in glass houses) have been partially abandoned, leaving blight spots that are gradually enlarging; it is strong the pressure for new buildings, aimed to the immediate profit of the land proprietors, without consideration of the long term advantages for the individuals and for the community, that is facing a general economic crisis. On the western bank of the river there is a dismissed railway deposit that can be seen as an opportunity to improve the low urban quality of the nearby residential areas. North of the railway lies the archaeological site of a Roman city, Alba Intemelia. The area is divide among three Communes (Ventimiglia, Camporosso, Vallecrosia).
In order to promote new process of sustainable development and improve tourism, a Master Plan of the Nervia Estuary will be laid out; it is aimed to:

- preserve and enlarge the wildlife refuge;
- avoid the consumption and initiate the regeneration of the soils;
- concentrate the new building in the dismissed areas;
- increase the quantity and quality of services and facilities.

In the Phase B a detailed survey has been completed, leading to map accurately the land uses and to record the typologies, qualities and attitude to restoration of the existing buildings; the collected data will be the base for a Master Plan.
The Master Plan should represent, in this area, an innovative attempt of making local and regional administrations collaborate, in the perspective of improving ICZM; a peculiar finality of the Region is to consolidate the results obtained by a recent intervention of beach renourishment.

Table 2. Land use planning in the coastal zone and ways of managing the Coast

mode	**Level**	**context**	**matter**	**major goals**
ICZM	local/regional	sea-land interface	policies of protection and maintenance participation to decision actions on the littoral	to control the costal dynamics to involve in the choices stakeholders and inhabitants
Spatial urban and land planning	local	the administrated territory	land use overall land management a community development	to re-organize the use of the soil to govern the territory to foster development
Strategic planning	regional	a territorial system	sustainable development cooperation / integration	to produce visions of the desired future to promote integrated actions based on common visions
Strategic projects	local/regional	territorial networks strategic areas	land use transformation specific goals	to implement decisions to produce desirable settings

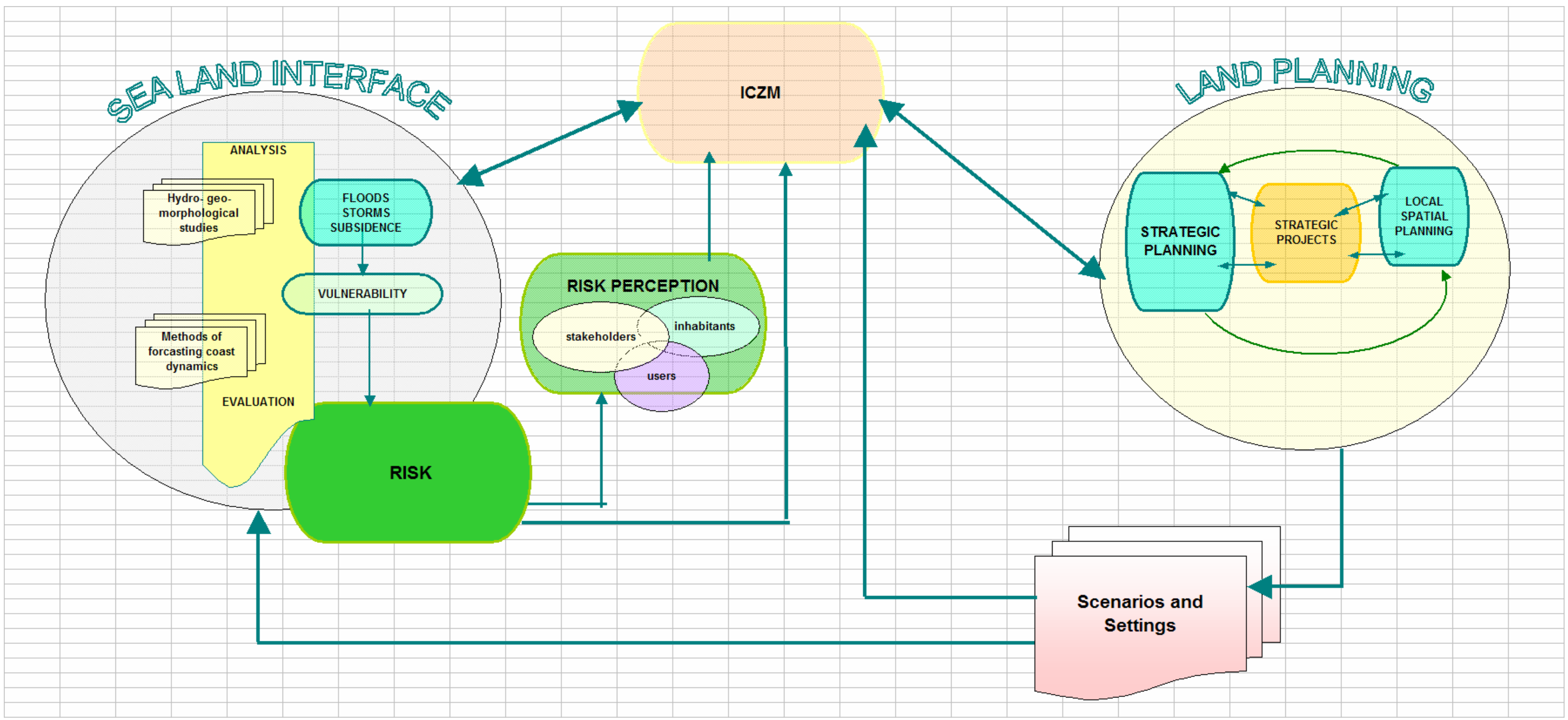

Table 1. Organization chart of the MEDPLAN sub-projetc

CONTRIBUTIONS OF THE PARTNERS

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