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Data Integration System for Eutrophication Assessment in Coastal Waters

InSea

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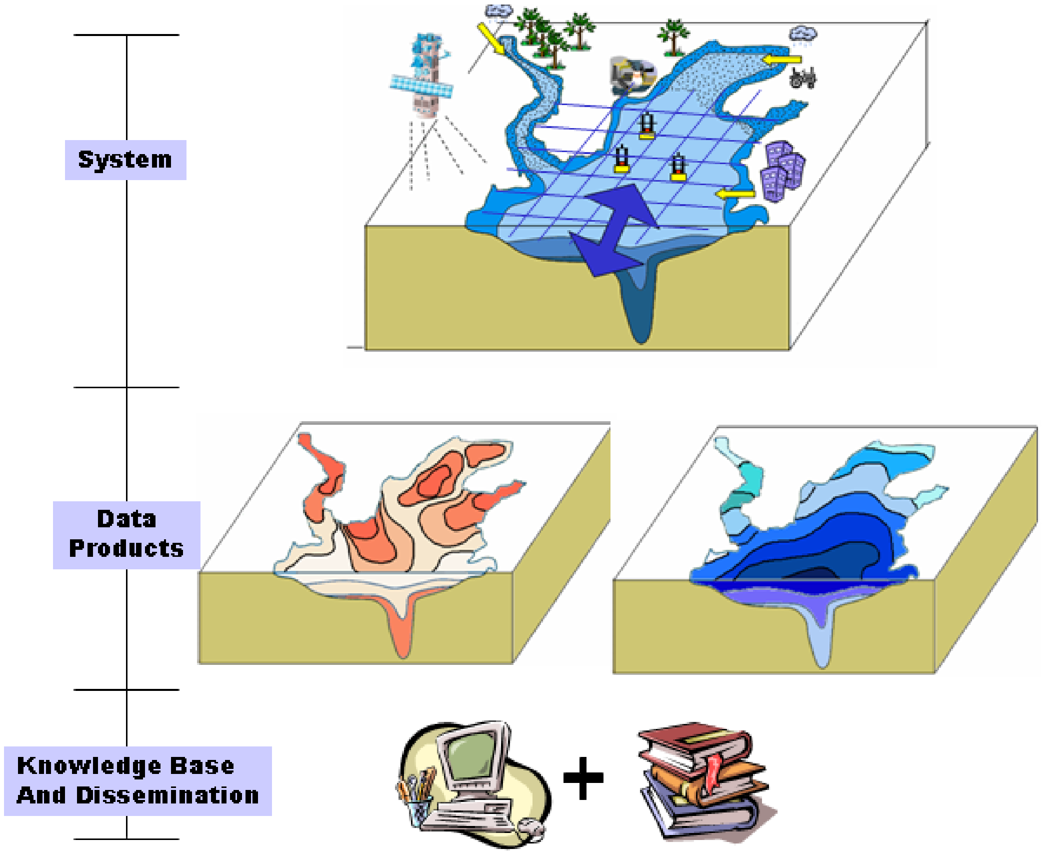
Proposal summary page

InSea will give to data users, in particular to local decision makers, valuable **information for assessing coastal eutrophication problems**. The data delivery system behind **Insea** will be supported by **state of the art numerical tools,** for simulating the complexity associated to these ecosystems, and the most recent information technology tools for supporting data delivery and storage. The success of the project is guaranteed by the high level of competence of the consortium, with proven expertise in all relevant areas of the project, the robustness and reliability of the numerical tools in use and the data rich approach combining **Earth Observation** and local **data** with the integrating power of **models**.



Strategic Objectives

The strategic objectives of **InSea**, which are in accordance with EuroGOOS and GMES purposes, are:

- Development of methodologies to downscale physics from large scale data systems to regional models in order to force ecological modelling systems on coastal areas
- Set-up and validate numerically robust ecological modelling systems for the areas under investigation in order to describe biogeochemical cycling of carbon and nutrients occurring under different hydrographic and trophic regimes
- Explore the system capabilities of a forecast mode to support coastal zone management issues
- To improve and develop new tools to link field measurements (from Earth Observation and acquired locally) to model results
- Demonstrate the potential of the combination of Earth Observation data, numerical modelling and in-situ data to solve eutrophication problems on coastal areas

Abstract

The EU recognizes that it is impossible to recommend a single European criterion to deal with eutrophication problems applicable to coastal areas. A number of scientific issues are addressed to develop efficient eutrophication criteria on coastal areas.

Coastal waters are transitional ecosystems buffered by variable landward-based freshwater input volumes and constituents, influences of oceanic provinces, and human disturbances, including nutrient enrichment, superimposed on these natural regimes. Even in a relatively narrow section of coastline, the ecosystem diversity and variability may be quite large.

Considering coastal systems complexity, associated with highly dynamic spatial (horizontally and vertically) and temporal changes, it becomes obvious that any type of monitoring, either remote sensing or local data acquisition, can only give a brief perspective of the problems in coastal waters and estuaries (eutrophication, sediment transport). Satellite imagery has an impressive capability of describing spatial distribution but, inevitably, short term temporal phenomena (in the range of hours) and vertical processes are impossible to track. On the other hand, local data measurements (with high costs) can show these short time trends but usually are unable to give a clear overview of spatial variation. With the proper modelling tools we are able to pick the information given by monitoring work and fill the information gaps, thus the combination of these components gives the best management tool to deal with such complex problems.

We aim to set-up and validate numerically robust ecological modelling systems for the areas under investigation in order to describe biogeochemical cycling of carbon and nutrients occurring under different hydrographic and trophic regimes, and to explore the system capabilities in a forecast mode to support coastal zone management issues.

One of the objectives of this project is the development of methodologies to downscale physics from large scale data systems to regional models in order to force ecological modelling systems on coastal areas and make use of the full potential given by the fast growing computer power and IT skills to deliver useful information to decision makers and other data users. By accomplishing such tasks, the consortium will be able demonstrate the potential of the combination of Earth Observation (EO) data, numerical modelling and in-situ data.

One of the most important issues of current eutrophication assessments is integrating information of different types (e.g. sampling data, numerical modelling results, stakeholders' preferences, common knowledge) to produce indexes representing the overall integrity of a particular ecosystem and to prioritize political options.

Major European (European Environmental Agency) and US Environmental Agencies (NOAA, EPA) are responsible for developing such indexes, to support the implementation of legislation and to answer specific environmental questions such as eutrophication, contamination and habitat vulnerability.

The data integration system developed under this project will sustain the implementation of spatially and temporally dynamical indexes and will be able to support a way of addressing different scale predictions, complex geometries and to efficiently incorporate different data sources to define boundary and surface conditions.

B.1. Scientific and technological objectives of the project and state of the art

B.1.1 Rationale

The consortium will develop a data integration system for management of coastal areas and dissemination of knowledge, able to:

- Derive information from large scale models, local models, Earth Observation data and local data acquisition
- Process data
- Delivery it to end users with focus on local water management authorities

B.1.2 Background

The guidelines followed by the project for assessing the eutrophication problem in coastal waters were designed having in mind the “Criteria for the Definition of Eutrophication in Marine/Coastal Waters”, proposed in the study carried out by ERM in 2000 on behalf of the European Commission. That study is divided in three main parts: (i) the scientific context of eutrophication, (ii) a trial to review, assess and compare criteria used in some EU Member States and (iii) some suggestions of complementary criteria to define eutrophication in coastal areas.

In the scientific context part, some relevant statements for the purpose of this project are:

- Eutrophication is not a “black and white” process (page 1);
- Eutrophication is a process not a state. Many upwelling areas have always been eutrophic and are not experiencing eutrophication (page 4);
- Eutrophication is a slow but universal phenomenon that started centuries ago (page 6);
- Quantification of the eutrophication rate requires the knowledge of baseline information and its current or predicted status, but baseline information is the exception rather then the rule (page 4);
- Short-term measurements of chlorophyll provide less certain evidence for eutrophication

In the conclusion of the scientific context, it is stated that:

- Much monitoring data has low statistical power to resolve the questions that were asked [about eutrophication], despite the sometimes enormous effort that was put into gathering it. Some aspects of marine eutrophication may be unanswerable, particularly with regard to baseline data;
- The elaboration of the precautionary principle in the late 80’s was an attempt to resolve this question. The fact that marine eutrophication remains contentious implies that this attempt was not entirely successful;
- The relevant question is not whether eutrophication has occurred in marine waters, but whether unacceptable eutrophication has occurred;
- Expectation of a universal ecological index that provides a simple biometric approach for evaluating eutrophication may be unrealistic;

When choosing criteria for assessing eutrophication, the relevant question is not “is the method perfect?”, but “is the method good enough for the purpose”. Techniques have to be judged in comparison with the strength and weakness of alternative methods rather then against a standard of perfection.

B.1.3 Strategy for assessing eutrophication process

Nowadays, there is awareness that low frequency point observations do not solve environmental and ecosystem variability at the appropriate spatiotemporal scales for present needs on eutrophication issues. According to GMES conclusions, "in-situ and Earth Observation (EO) data alone can rarely satisfy the user's purposes. On the other hand, the use of remote sensing resources can be extremely useful especially in places where there is a lack of local data.

A complete decision support process, including synoptic, analytic and predictive capabilities, is generally needed. It is thus necessary, for most end-uses, to exploit EO and in-situ data jointly with numerical models, data assimilation, and information presentation methods of varying sophistication". Still according to GMES, environmental services "must use those data sources that best meet user needs: In most cases this means that EO data, in-situ data and models must be used together to establish an integrated decision-support capability that is of practical use for policy and decision makers".

Taking into consideration coastal systems complexity associated with highly dynamic spatial (horizontally and vertically) and temporal changes, it becomes obvious that any type of monitoring, either remote sensing or local data acquisition, can only give a brief perspective of the problems in coastal waters and estuaries (eutrophication, sediment transport). Satellite imagery has an impressive capability of describing spatial distribution but, inevitably, short term temporal phenomena (in the range of hours) and vertical processes are impossible to track. On the other hand, local data measurements (with high costs) can show these short time trends but usually are unable to give a clear overview of spatial variation. With the proper modelling tools we are able to pick the information given by monitoring work and fill the information gaps, thus the combination of these components gives the best management tool to deal with such complex problems.

B.1.4 Project approach

Obviously this is not a new idea and it has been developed in several EU and local projects. Most projects are concerned with two distinct spatial scales. On a large scale level, existing forecasting systems in European waters provide real time and near real time products describing wind field, wave height spectra, sea surface temperature, salinity, floating sea ice, chlorophyll, tides, surface currents, and storm surges. There is a number of operational pollution monitoring systems measuring chemical variables in near real time, but not incorporated into real time models. Movements of oil slicks and algal blooms are also predicted on an emergency operational basis.

On a local scale, a large effort is being made on the development of coupled physical-ecological systems comprising state of the art numerical tools including 3D physical models coupled with ecological models on high resolution grids for computing transport and biological activity in the aquatic system. The anthropogenic influence is usually translated into inputs to the aquatic system (e.g. organic matter, nutrients and toxic substances) or in local changes such as dredging or coastal works.

The prediction of the spatial and temporal variability of the physical and biogeochemical characteristics of a marine ecosystem is a fully coupled coastal-open sea problem. It requires the solution of a fully three-dimensional wind and density driven general circulation problem, together with the appropriate description of ecological and biogeochemical processes. The three-dimensional modelling of marine ecosystems is lagging behind the modelling of marine physics, because it requires robust hydrodynamic models and adequate computing resources. Recently, the computing resources and numerical modelling systems have become mature enough to use them to address the ambitious task of reproducing, explaining and predicting the evolution of marine ecosystems and their response to the variability of physical forcing. The **InSea** project will contribute towards improved and innovative coupled physical-ecological numerical models capable of underpinning the development of a forecasting system.

B.1.5 The aim of the project

Presently the main effort is to bring these two scale approaches together (local and regional) and make use of the full potential given by the fast growing computer power and IT skills to deliver useful information to decision makers and other data users. This is precisely where this project is positioned. Large scale systems don't have (or need) the ability to predict local (temporal and spatial) phenomena, that usually have great impact from a socio economic point of view and have disproportional relevance to local decision makers. On the other hand small scale systems are able to track this type of event but frequently have a lack of information concerning their ocean boundary conditions. Thus a purpose of this project is the development of methodologies to downscale physics from large scale data systems to regional models in order to force ecological modelling systems on coastal areas. The aim of **InSea** is to set-up and validate numerically robust ecological modelling systems for the areas under investigation in order to describe biogeochemical cycling of carbon and nutrients occurring under different hydrographic and trophic regimes, and to explore the system capabilities of a forecast mode to support coastal zone management issues. By accomplishing such tasks the consortium will be able to demonstrate the potential of the combination of Earth Observation (EO) data, numerical modelling and in-situ data.

One of the most important issues of current eutrophication assessments is integrating information of different sources (e.g. sampling data, numerical modelling results, stakeholders preferences, common knowledge) to produce indexes representing the overall integrity of a particular ecosystem and to prioritize political options.

Major European (European Environmental Agency) and US Environmental Agencies (NOAA, EPA) are responsible for developing such indexes, to support the implementation of legislation and help to address specific environmental questions such as eutrophication, contamination and habitat vulnerability.

The data delivery system developed under this project will support the implementation of spatially and temporally dynamical indexes and will be able to support a way of addressing different scale predictions, complex geometries and to efficiently incorporate different data sources to define boundary and surface conditions.

B.1.5.1 Inovation related activities in InSea

Assimilation techniques

Particular emphasis will be placed on data assimilation techniques and on the parameterisation of the response of the ecological state variable to sub-grid-scale physical processes.

Data assimilation systems for meteorological models and OGCM's are well established. However, the use of data assimilation in marine ecosystem models is far less developed than it is in meteorological and ocean circulation models. Recently, assimilation techniques with such models have been successfully implemented (Carmillet *et al*., 2001, Hoteit *et al*., 2003; Triantafyllou *et al*., 2003).

Model results integration

The diversity of marine systems makes it unlikely that a single integrated model will evolve. However, rationalization of modules within tailored modelling systems is a common goal, together with standardisation of prescribed inputs such as bathymetry, tidal boundary conditions etc. Such enhanced rationalisation will enable the essential characteristics of various types of models to be elucidated, including the inherent limits to predictability. This approach stated on EUROGOOS is well recognized by **InSea** where instead of trying to develop an overall modelling strategy we try to take advantage of existing local model solutions and focus on harmonization of their results to fit a common data distribution system.

Modelling and management

The application of state-of-the-art process knowledge into a data processing system tool that addresses the information needs of coastal system managers is a challenging objective. Care shall be taken to ensure that the output of the model is relevant to the type of questions asked by managers, while at the same time the tool will have an educational aspect by showing potential interactions in the system dynamics. To ensure the close fit between needs and questions on one hand, and answers from the modelling tool on the other hand, a stakeholder reference group will be formed to help with the formulation and evaluation of example runs of the model.

Data Integration

One of the innovations in this project concerns is the use of spatial and temporal integration tools already developed by the consortium and designated as Integration Boxes. With this method, which performs post processing of the information computed by the models over coarse grids and small time steps, but which is also easily adapted to other data sources (e.g. remote sensing data), it is possible not only to know the average state variable value (e.g. salinity, temperature, phytoplankton, BOD, organic matter, toxic pollutant and others) in each area defined by the box (that integrates several computing grid cells), but also to compute the properties fluxes between boxes, which gives a great insight into the dynamical processes in the estuaries. The user can easily select both the time period and the boxes area for integration. With this method it is possible to determine and calibrate the mass fluxes between the subsystems and to reach for more accurate answers, from a quantitative point of view.

Indexes

The main objective in integrating information of different types (e.g. EO data, numerical modelling results, stakeholders' preferences, common knowledge etc) is to produce an index representing the overall integrity of a particular ecosystem and to prioritize political options. The complexity associated with coastal systems makes it impossible to define any kind of index without considering spatial and temporal variably. The data framework developed by the consortium will support the implementation of indexes variable on three levels: space, time and form. In the matter of space and time variation, results will be integrated in selected areas. In the matter of form, it means that users will have full access to reference information and formulation behind indexes, allowing them to generate new indexes based on the available data and on newly acquired data, or even to change the threshold values of the already delineated indexes.

Satellite based Data Acquisition System

Local data acquisition is an important component of the total information system developed in **InSea** to assist local water management agencies with their decision-making processes. The **InSea** project will be a 'technological laboratory' to develop key aspects of a 'data acquisition unit' (DAU) which, when coupled with appropriate sensors, will capture and communicate water status parameters. The objectives of this task are to analyze the data acquisition requirements of the **InSea** application, and explore the development of a cost-effective satellite-based data acquisition solution that could be adopted universally at any location across Europe. The idea is for the satellite solution to be used whether or not terrestrial communication alternatives such as GPRS exist, since it would offer greater ease of deployment and a consistent method of integrating local data with the **InSea** toolset.

B.1.6 Problems to address

B.1.6.1 Introduction

Ecosystem modelling has made great advances in the last decades during which it progressed from "naïve" mechanistic and process-oriented modelling to data-driven approaches and individual-based models. Processes describing primary production and nutrient recycling are nowadays sufficiently well known to build models based on a set of parameters short enough to be manageable, but large enough to be common to many coastal systems. Large projects that tried to model whole ecosystems have proven to be of limited use (also due to a lack of data) and the trend today appears to go towards more modest and perhaps more successful models of limited aspects of ecosystems (EuroGOOS, 2000). Although the main processes are already well described, each study site has its own characteristics and the specific weight of each process (physical and biological) differs between them, thus it is necessary to perform in-depth analyses in order to fully understand the dynamics associated with each ecosystem. The following are some of the aspects that will be considered:

B.1.6.2 Definition of the ecosystems state

To address the eutrophication problem, the development of an appropriate approach must take into account the existing significant variability of natural enrichment throughout the geographic and geological regions of Europe. Thus it is necessary in many cases to determine the natural ambient background nutrient condition for each study area so that the eutrophication caused by human development and abuse can be assessed. In the absence of comparable reference water bodies, the historical record of inherent and cultural enrichment may be particularly significant to developing reference conditions.

There are distinct signs and symptoms of eutrophication within the coastal environment (Schramm & Neinhuis, 1996; Bricker *et al.*, 1999). It is the purpose of this project to look at the evidence for signs and symptoms of eutrophication within the study areas, and the effects of these as impacts on the system. Within the read literature and historical data analyses we will establish the existence and frequency of events indicating eutrophication problems such as:

- Decreased light availability
- Algal dominance change
- Increased organic matter production
- Loss of submerged aquatic vegetation
- Nuisance/toxic algal blooms and algal mats
- Benthic community change
- Low dissolved oxygen

B.1.6.3 Primary production limitations

Ecological processes, such as primary production, only occur if the adequate conditions of light, nutrients and temperature are found and if the transport processes give enough time for the ecological processes to occur in a certain area where these conditions are achieved.

B.1.6.3.1 Light availability

The major light absorbing and scattering components in the water column include dissolved organic substances, dead and living plankton material, suspended inanimate particles, and water itself. These components differ in the way they absorb and scatter downward irradiance across the photosynthetic wave band. Their transport (horizontal and vertical) is determined by the physical model, and the overall effect will determine the light availability for photosynthesis, thus imposing a direct effect on the phytoplankton growth rate.

B.1.6.3.2 Nutrient availability

Nutrient availability is determined by transport and mixture processes (physical model) and also by the ecological processes acting both as sink (consumption by primary producers) and as source (mineralization of organic matter, respiration). Determination of:

- Limitation of the growth rate of phytoplankton populations currently in a waterbody
- Limitation of the potential rate of net primary production, allowing for possible shifts in the composition of phytoplankton species
- Limitation of net ecosystem production

The relative importance of each of these limitations depends upon the trophic state of the systems and will help to predict possible consequences of nutrient increase.

B.1.6.3.3 Temperature

Water temperature is a typical physical variable and represents the balance between transport and mixture of water at different temperatures and surface heat fluxes. Temperature regulates, within certain limits, the metabolic rates of organisms, and influences the distribution of many species.

B.1.6.4 Organic Matter Cycling

The import of organic matter, especially in estuaries and coastal waters, can lead to water quality problems (e.g., hypoxia). Organic matter input from sewage was historically a major source of organic carbon that drove aquatic systems toward dissolved oxygen (DO) deficiency through direct microbial heterotrophic activity. However, the input of nutrients, whether in organic form followed by recycling or inorganic form with direct nutrient uptake, is what stimulates potential phytoplankton biomass production, and this organic matter may contribute to symptoms of nutrient over-enrichment.

B.1.6.5 Discharge loads

The importance of freshwater inputs is obvious; it is a central feature in the definition of coastal systems, since it influences physical dynamics, is often well correlated with nutrient inputs, and has been implicated in regulating, either directly or indirectly, coastal processes ranging from primary production to benthic secondary production.

It is frequently difficult to distinguish the natural ecosystem variability associated with net primary production from that induced by anthropogenic stress, especially nutrient enrichment, which often is a consequence of variability in physical processes. Such indeterminacy is a condition that water quality managers must contend with, and argues for broad scientific input.

It is important to understand nutrient load and ecological response relationships because of the need to conduct load allocations (e.g., total maximum daily loads), and it may be necessary to perform some management triage when systems are poised along a gradient of risk and there are too many systems to treat in a timely fashion.

These ecosystems exhibit a notable degree of process asymmetry and lag in responses, which means that a stress at one location and time may show up as a response at another location and time. Additionally, different mechanisms may result in a similar response. This type of behaviour enhances the tendency to confound cause-and-effect relationships.

B.1.7 Socioeconomic assessment aspects

Eutrophication in coastal areas is an increasing concern for environmental management agencies, municipal governments and coastal residents. Within this work package we aim to understand the results and consequences of approaches for dealing with eutrophication that were previously implemented in each site, and to establish a clear purpose to the data products that will be delivered by the project. The forcing function that defines the necessity for these data products is the legal framework and the water managers responsible for their implementation. To each study site we have identified and established contact with entities with direct interests in water management, and in some of these cases the entities have made a commitment to support the project by allowing the use of their databases and by becoming end-users of the project's results.

B.1.7.1 Portugal

Error! Reference source not found., representing a rectangle of about 120 km on horizontal times 80 km on vertical, shows the region of Lisbon, Portugal. On the figure are indicated the Tagus Estuary with 300 km^2, the largest estuary in Western Europe, the Sado estuary further south with 100 km^2 and local streams and beaches. The Tagus estuary represents by far the main fresh water input of the area, is strongly influenced by the products of land and riverine runoff. This two input sources interact to create temporal and spatial complexity, known to be important in the stimulation of primary production supporting all higher trophic levels. The river flow plays an important role during winter and its influence diminishes largely during dry months. The estuary is subjected to strong anthropogenic pressure both of urban and industrial nature. Despite the high concentration of nutrients, the estuary do not show generalized eutrophication symptoms, which can be attributed to strong growth limitation by lack of light due to the high turbidity.

Costa do Estoril area is represented in the upper detail rectangle with all the beaches plus the three beaches westward of the rectangle. This area corresponds to the drainage area of streams westward of Lisbon. The catchments areas of those streams start at Sintra mountain (600 m high) which is a major local geological feature individualizing Costa do Estoril drainage area.

Costa do Estoril is a residential and tourist area, with 720 thousand people equivalent, being one of the most attractive areas in Lisbon surroundings, due to its sandy beaches and appealing landscape. In the fifties Costa do Estoril population was less then 200 thousand inhabitants, living in small agglomerations located mainly along the coastline, with independent sewer systems, including sometimes short submarine outfalls. In the sixties, these agglomerations experienced a rapid growth and new cities were born further inland, contaminating local streams and through them the coastal waters. Then water quality started to deteriorate and, in the eighties, most of Costa do Estoril beaches had incompliant bathing water.

In the seventies, it was decided to build an intercepting system for transporting whole sewage to Guia, the rocky coast between the beaches located in the detail rectangle in Figure 1 and “Cresmina – Guincho - Abano”, the 3 beaches located westwards. There, a treatment plant should be built and the effluent should be disposed in the ocean through a submarine outfall 2750 meters long, terminated by a diffuser with two 400 meter long branches.

The construction of this system was very much affected by the political and economical instability lived in Portugal during the late 70’s and early 80’s and the first phase was concluded only in 1994. A special office of the National Water Institute (INAG) conducted the works. In 1996 a company – SANEST – was created for completing and managing the system.

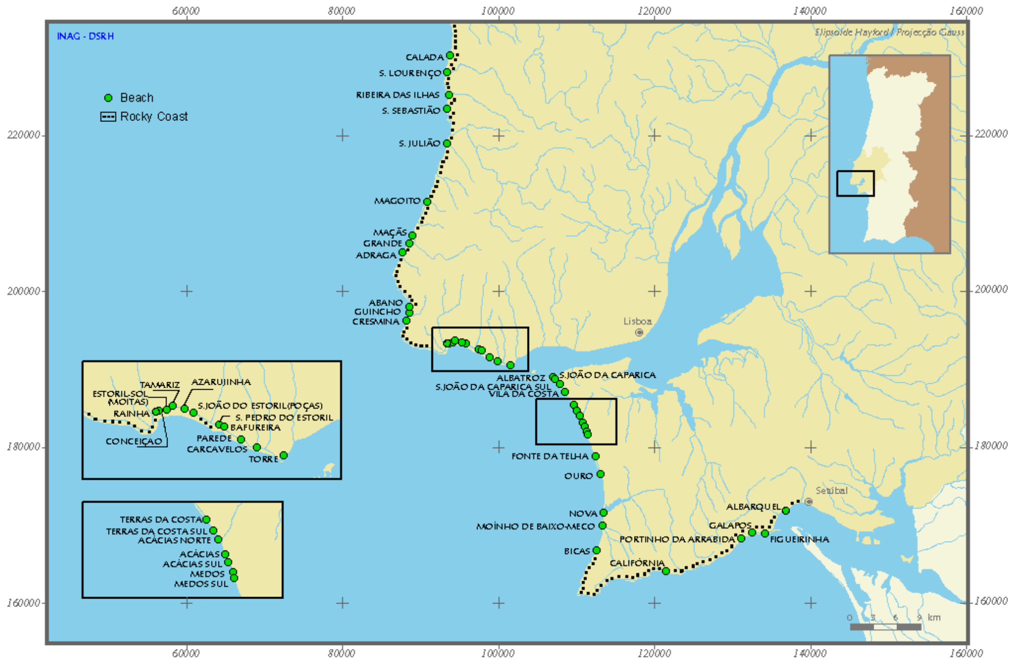


Figure 1: Map showing bathing areas, streams, the Tagus estuary and the Sado estuary (southward) in the region of Lisbon.

In the Portuguese case four major stakeholders have a clear interest in the outputs of this project, which is proven by their letter of support (see Annex): INAG, SIMTEJO and SANEST.

INAG

INAG is the Portuguese National Authority in charge of fresh and coastal waters management. In the framework of its activities, INAG is in charge of implementing the European Directives related to water and of promoting the technological developments required to control and improve water quality. Members of this consortium have been working in close relation with this entity, supporting the classification of coastal areas in Portugal (including the study area proposed in this project) with regard to eutrophication in the framework of the OSPAR Convention for the Protection of the Marine Environment, and also supporting the implementation of the Urban Waste Water Treatment Directive and the Nitrates Directive. Thus the outputs coming from **InSea** will be extremely relevant for the continuity of the work already underway as data and knowledge sources.

SIMTEJO

SIMTEJO is a large company responsible for the waste water management of part of the metropolitan area of Lisbon (about one million inhabitants). A current project financed by SIMTEJO is underway with members of this consortium to establish a monitoring system in the Tagus estuary and to quantify the influence of fresh water effluents to their interest area (see map below). This current project has deeply influenced the study area selected for **InSea**. Results from this project will be extremely useful in establishing the land boundary conditions of the **InSea** interest area and to quantify with more detail the influence of the Tagus estuary. On the other hand, results from **InSea** will be useful for SIMTEJO to quantify the buffering capacity of the Tagus estuary to organic and nutrient loads and consequently to predict the facilities (WWTP) and level of treatment needed to achieve adequate standards of waste water disposal to the Tejo ecosystem.

SANEST

SANEST is a large company responsible for the waste water management of part of the metropolitan area of Lisbon, more precisely Costa do Estoril (about 700 000 inhabitants). Among many questions SANEST needs to quantify is the influence on water quality of their outfall located precisely on the study area of **InSea** and to control water quality on the shores with intense recreational use located along Costa do Estoril. Since 1998 members of this consortium have participated in (and recently assumed coordination of) a monitoring programme also including modelling obliged by the EU for this area which is financially supported by SANEST.

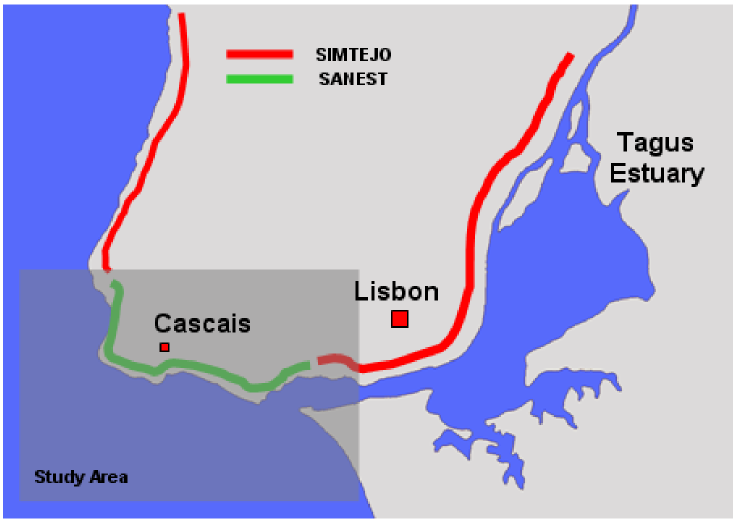


Figure 2: Map of the Portuguese study area showing the interest areas of SANEST and SIMTEJO, the waste water management companies of the metropolitan area of Lisbon

IDRHa

Among the tasks allocated to IDRHa, are the formulation of National Policies for irrigation, use of soil and management of the rural environment. These activities involve fresh water directly, but trough river discharges are related to coastal water properties. As a consequence a better understanding of the fate of materials carried by rivers is a great advantage for planning activities in catchments. The Portuguese study site is deeply influenced by the Tagus River which is surrounded by a large intensive agricultural area. Any decision taken among the estuary or costal area to control nutrient loads, will have a huge socioeconomic consequence to those areas, thus IDRHa have large interest in understanding these processes to evaluate any kind of decision.

B.1.7.2 France

The study area for France will be the Gulf of Fos a shallow coastal area located in the Gulf of Lion (Northwestern Mediterranean).This coastal area is a semi-enclosed bay covering 42 km² for a mean depth of 8 m. This atidal, wind driven system, is under the intermittent influence of the discharge of the

Rhône river. The northern and eastern coast part of the Gulf of Fos is bordered by chemical, fuel and steel-work plants. The eutrophication has important economic consequences for the region especially because of the culture of mussels in the Anse of Carteau in the western part of Gulf of Fos which requires a good level of quality of the water. The fisheries also depend of the water quality of the littoral zone which is a nursery for a number of species. The region of the Rhone delta is also characterized by a diversified fauna which depends directly on the quality of the environment controlled by the degree of eutrophication of the area.

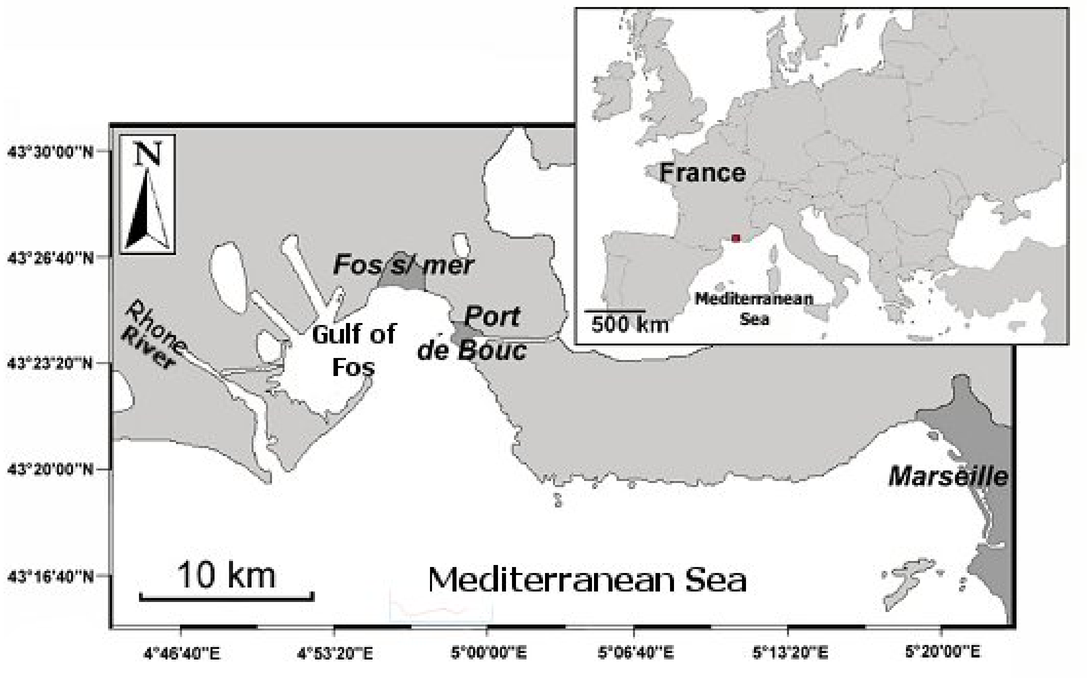


Figure 3: Representation of the Gulf of Fos

Agence de l'Eau

Agence de l'Eau is a State organization under the double control of Ministry for Ecology and Durable Development and Ministry for Finances. The Agence is involved in six fields related to restoration and maintenance of the aquatic environments, stock management of surface and underground waters, improvement of the quality of water for drinking water supply and control of pollution, industrial and toxic waste disposal. In September 2000, the directive "establishing a framework for the Community action in the field of water", known as water framework directive, was adopted by the Parliament and the European Council. Harmonizing the existing directives, the new text defines a general framework for the protection and the improvement of all the continental aquatic environments.

For instance, the directive took the French principle of a water management per basin, which represents the basin type structure of Agence de l'Eau. The Agence de l'Eau - Basin Rhone-Mediterranean Corsica (AE-RMC) contributes to improve water management and to fight against pollution, on the scale of the catchment's area of the Mediterranean. To study and follow in a systematic way and at basin scale the aquatic environments and the water resources, Agence de l'Eau set up networks of data acquisition programs, either directly, or in partnership with public organizations (the Higher Council of Fishing, BRGM, IFREMER...), services of the State (DIREN in particular) or local authorities. The networks in place cover the whole area of the basin today: subsoil waters (quantity and quality), rivers (quantity and quality), water levels (quality) and coastal waters (quality). Agence de l'Eau RMC is financing monitoring programmes in the **InSea** study area and has shown their interest in a partnership in the field of data acquisition.

B.1.7.3 Greece

Pagasitikos is a semi-enclosed gulf located in the western Aegean Sea north of Evia Island surrounded by the mountainous areas of Pilio, Halkodonio, Giouras and Orthys. The mean depth is 69m characterizing the system as shallow while the deepest area (108m) is found at the eastern part of the gulf where bigger gradients are observed.

The total area is 520km2 with a total volume of 36km3 connected with the Aegean Sea and north Evoikos through the narrow (5.5 km) and relatively deep (80m) Trikeri channel. Although the ribbon development in the coastal areas is not considered significant, at the north part of the gulf there is the city of Volos with a population of 120,000 and major industrial production. The development started during the 60's characterized by population explosion, industrialization and intensive agriculture affecting the littoral and sub-littoral systems, which received significant quantities of rural, industrial and agricultural effluents.

Although a sewage treatment plant for the domestic effluents was planed as early as 1964 it took 23 years to become operational. Another significant event was the draining of lake Karla in the early 60's via an aqua duct in the north part of Pagasitikos during when large quantities of enriched waters with nutrients were poured into the system. Although the lake is dried at present, winter rainwater washes the soil in the wider area of Karla, becoming enriched with fertilizers, pesticides and particulate material and a proportion is finally poured into Pagasitikos. nitrogen, phosphate and sulphur are used annually in the scattered farmlands along the coastline where intensive agriculture of cereals and cotton is practised. Although in the wider area there are no major rivers, it is believed that a significant proportion of these nutrients enter the system during winter through a network of small torrents.

Figure 4: Representation of the Gulf of Pagasitikos

Ministry of Environment Physical Planning and Public Works

The Ministry of Environment Physical Planning and Public Works (MEPPPW) and in particular the General Directorate for the Environment and Spatial Planning is mainly responsible for the development of an integrated approach to the planning and management of coastal areas and islands. The MEPPPW has initiated a process towards a more effective coastal management. The new initiative provides for a high level National Committee for the Management of Coastal Areas and Islands, assisted by a Secretariat and several Task Forces at the Ministry level with the participation of experts from research and academic institutions. The initiative foresees the elaboration of a strategy for the sustainable development of coastal areas and islands and the development of an Action Program for Coastal Areas and Islands.

The preparation of coastal policy includes:

- Definition of general and specific goals and objectives for sustainable development of coastal areas and islands.
- Delineation of the coastline and a critical zone along the national coasts to be designated as national heritage to be preserved as an area of protection for natural ecosystems and public open space.
- Identification of a broader zone for coastal management to be delineated for all coastal areas. In areas which face problems of pressure for development the purpose of management will be to specify the rules for the development of human activities ensuring the preservation of natural resources and ecosystems. In areas which face environmental degradation because of intensive development the purpose of management will be environmental upgrading enhancing natural resources, protecting the function of ecosystems and upgrading human activities. In areas relatively unharmed by human activities the purpose of management will be to ensure their protection as national reserves. For every type of coastal area desirable and permitted uses will be defined and adequate public access to the coast will be provided for.
- Preparation of a particular approval process for all significant projects to be located on the coast. This could be achieved by refining existing tools (EIA).

Water and sewage authority of the grater region of Volos

The water and sewage authority of the grater region of Volos allocates technical services that deal with:

- The study, manufacture, supervision and maintenance of the works regarding rain, sewage and impure water supplies.
- Operation of water supply pump stations and biological treatment installations.
- New supplies of water and new connections of sewerage waters.
- Chemical quality control of potable waters.
- Quality control of air pollution and swimming areas.
- Research for the protection of the Pagasitikos marine ecosystem.
- Manufacture and operation of small hydroelectric power stations.
- Supervision of manufacture of the low pressure Natural Gas network etc.

Future plans of the authority include the qualitative upgrade of the provided services as well as the optimization of effort towards a continuous protection of the environment in the wider area of Volos.

B.1.8 Technological improvements and current technological status

InSea will develop an integrated modelling environment where a number of applications will be set up to test the code, parameterizations and consistency of the system

Before going into further detail describing each of the objectives and the work needed to achieve them it is necessary to clarify two aspects:

- What is the state-of-the-art on each particular technological aspect and on the methodological approaches to deal with eutrophication problems on coastal areas?

- What is the starting point concerning the numerical models and other technological tools for each study site?

The answers to these two questions will determine the way the existing numerical and data components will be linked and consequently will give a detailed description of the activities needed to achieve each of the proposed objectives.

B.1.8.1 Physical modeling

State-of-the-art physical models must provide a way of addressing different scale predictions, complex geometries and to efficiently incorporate different data sources to define boundary conditions (land, open sea, surface). State-of-the-art physical models use a generic vertical mesh; in this way the model is independent of the vertical discretization. This allows the model to be applied to a large range of sites with different geometries, boundaries and scales. Models should allow the application of different turbulence schemes that should also be validated across a large range of application sites. According to the application site, these 3D models should be prepared to compute their major physical forcings such as density gradients (baroclinic flows), tide, wind, fresh water inputs and others.

B.1.8.2 Hydrodynamic modelling

Several break troughs have been achieved in the area of ocean and coastal modeling in the past decade in the follow subjects:

- Improvement and diversification of the open boundary conditions (Palma e Matano, 2000, Marchesiello et al., 2001);
- Generalization of the vertical discretization (Adcroft and Marshall, 1997, Martins et al., 2001, Pietrzak et al., 2002 and Mellor et al., 2002);
- Higher order advection schemes (Piterzak, 1997, Shchepetkin and McWilliams, 1997, Webb et al., 1998);
- Baroclinic pressure discretization (Kliem and Pietrzak, 1999, Shchepetkin and McWilliams, 2003);
- Two-way nesting (Oey and Chen, 1992, Perkins et al, 1997, Ginis et al., 1998).
- Non-hydrostatic pressure (Marshall et al., 1997)
- New vertical turbulence parameterizations (Canuto et al, 2001, Burchard and Karsten Bolding, 2001);
- Vertical mixing induced by waves (Burchard, 2001, Kantha and Clayson, 2004).

However several numerical models running operational do not have benefit of these developments. The HYCOM consortium is a multi-institutional effort funded by the National Ocean Partnership Program (NOPP), as part of the U. S. Global Ocean Data Assimilation Experiment (GODAE), to develop and evaluate a data-assimilative hybrid isopycnal-sigma-pressure (generalized) coordinate ocean model (called HYbrid Coordinate Ocean Model or HYCOM). This consortium strategy is to improve the operational model results using data assimilation but also improving the hydrodynamic model accuracy incorporating some of the developments enumerated earlier (Bleck, 2002).

B.1.8.3 Ecological modelling

The absolute minimum requirement for state-of-the-art ecological modelling is a description of how phytoplankton grows in response to light and nutrients. To understand and analyze “algae blooms”, the phytoplankton has to be separated into several distinct state variables with different parameterizations for nutrient limitation to cover the annual cycle and successions of different groups. For the simulation of “nutrient regeneration” it is necessary to differentiate between several particulate and dissolved organic compartments for the regeneration of the C, N, P, and Si matter cycles. It is necessary to simulate N:P nutrient ratios and compute explicitly the microbial loop for organic matter recycling. Oxygen demands have to be included. To study “trophic relations” the number of state variables has to be connected as a web. The “pelagic-benthic coupling” requires a pelagic and benthic subsystem with appropriate physical forcing at the benthic boundary layer scale.

State-of-the-art ecological models should be able to describe the evolution of the benthic system (sediment column) and determine its interaction with the pelagic system (water column). Both in the water column and in the sediment column, properties can be either dissolved or particulate. The evolution of dissolved properties depends greatly on the water fluxes, both in the water column and in the sediment interstitial water. Particulate properties evolution in the water column depends also on the water fluxes and on settling velocity. Once deposited in the bottom they can either stay there or be resuspended back to the water column. If they stay there for a determined period of time, they can become part of the sediment compartment by consolidation and become available for the biogeochemical processes occurring in the bottom layer. The products of these processes will change sediment composition but can also be exported to the water column.

B.1.8.4 Downscaling coastal processes

In the last decade several countries started implementing marine observing systems with forecast capabilities at the ocean scale (ex: FOAM – United Kingdom, MERCATOR - France, HYCOM and NLOM – USA) at the regional scale (ex: MFS – several Mediterranean countries, Topaz – Norway, GoMOOS – Coast of Maine, USA, Juan de Fuca Model - southwest British Columbia, Canada, Water Forecast System, Denmark coast, MUMM – Belgium Coast) and also at the local scale (ex: New York Harbor Observing and Prediction System, The Tagus Estuary Observing and Prediction System).

There is some literature where each system (or part of it) is described (ex: De Mey and Benkiran, 2002, Thacker et al., 2004). However there is little experience in using large scale operational models has boundary conditions for smaller scale applications. Large scale forecasts are becoming a realistic way (due to increase of solutions accuracy and speed in communications) of smaller scale operational system improve their open boundary conditions.

The future challenge is in improve not only the present systems but also improve the way the larger systems can be use to establish the open boundary conditions of the smaller scales applications.

The main obstacle to this is the different numerical nature of large scale models and smaller scale ones. The dominant processes depend of the scale that is being resolved. For example at the ocean scale the tide is usually ignore but at the coastal scale the tide can be the dominant forcing mechanism. Methodologies of adding the global tidal solutions (Provost et al., 1998) to the large scale forescast at the open boundaries of regional and local applications must be developed. Another way to solve this particular problem is to simulate explicitly the tide effect in the global forecast solutions.

B.1.8.5 Merging the water cycle numerical tools

The simulation of physical and biogeochemical processes in coastal areas in forecast mode needs forecasts no only for the open boundary but also for the surface and land boundaries. The usual way of imposing the surface boundary condition is to couple the marine operational system to an atmospheric operational system. At the global scale usually this boundary condition is imposed with atmospheric forecasts like the ones produce by ECMWF. The regional and local scale systems try to benefit from the higher resolution solution produce by the mesoscale operational meteorological systems already running for the areas of interest (ex: MeteoGalicia – Balseiro et al., 2003, SKIRON – Kallos et al, 1997). High resolution models can be very useful to describe more accurately the influence of the land sea gradients in the air sea interaction, for example, the effect of topography over coastal currents (Munchow, 2000).

The land boundary is also a very important issue manly from the biogeochemical point of view. However this boundary is also an important source of buoyancy that can condition greatly the flow in regions of fresh water influence (Simpson, 1997). Due to the increasing of environmental standards forced by EU all the member countries have large networks of automatic data acquisition stations that are able to give in real time the input of fresh water.

The future of water quality forecast in coastal areas will be the merging of run-off models with atmospheric models (Yarnal et al, 2000, Chen and Dudhia, 2001) and with marine modeling systems.

B.1.8.6 Data assimilation

Information about numerous physical processes can be provided by numerical models and observed data. Both can be considered as components in a framework to gather and to generate specific user information.

A considerable step ahead can be made by exploiting the complementary character of models and observations: the generic, dynamically continuous character of process knowledge embedded in models versus the specific, quantitative character of observed data. By means of data assimilation, model information and observed information can be integrated in an optimal way, taking into account the uncertainties or errors in the model and the observations,

- To validate and calibrate the models,
- To determine the best representations of parameter fields for use as initial conditions in forecast runs, etc.

One of the most widely used statistical assimilation schemes is the Extended Kalman Filter (EKF), which is an extension of the common Kalman filter to non-linear models. However, brute-force implementation of the EKF filter in realistic ocean models is difficult due to the extensive computer resources required. In particular, it is important to have a less expensive tool, which maintains the complexity of the EKF in terms of the capability to correct a multiplicity of correlated dynamical variables. To overcome this problem, different degraded forms of the EKF have been proposed. These forms basically reduce the dimension of the system through some kind of projection onto a low dimensional subspace (Dee 1990; Evensen 1992; Cane, Kaplan et al. 1995; Fukumori and Malanotte-Rizzoli 1995; Hoang, De Mey et al. 1997; Dee and Da Silva 1999). With the same view, the Singular Evolutive Extended Kalman (SEEK) filter has been developed (Pham, Verron et al. 1997). It essentially performs an approximation of the error covariance matrix by a singular low rank matrix, which leads to data assimilation corrections being made only in the dominant directions of error covariance.

The quality and the scarcity of data to be assimilated hamper the development of assimilation tools for the ecosystem. However, remote sensing data, in the form of satellite ocean colour and its derived data products, exists and is the only full coverage, continuously available data source suitable for this application. Therefore, this information is assumed to be sufficient for the studying areas and we will concentrate on those data sets. Furthermore, this is a necessary first step towards optimal estimation of biogeochemical fields (nowcasts or hindcasts) that is a prerequisite of any predictive system.

B.1.8.7 Satellite ocean colour data

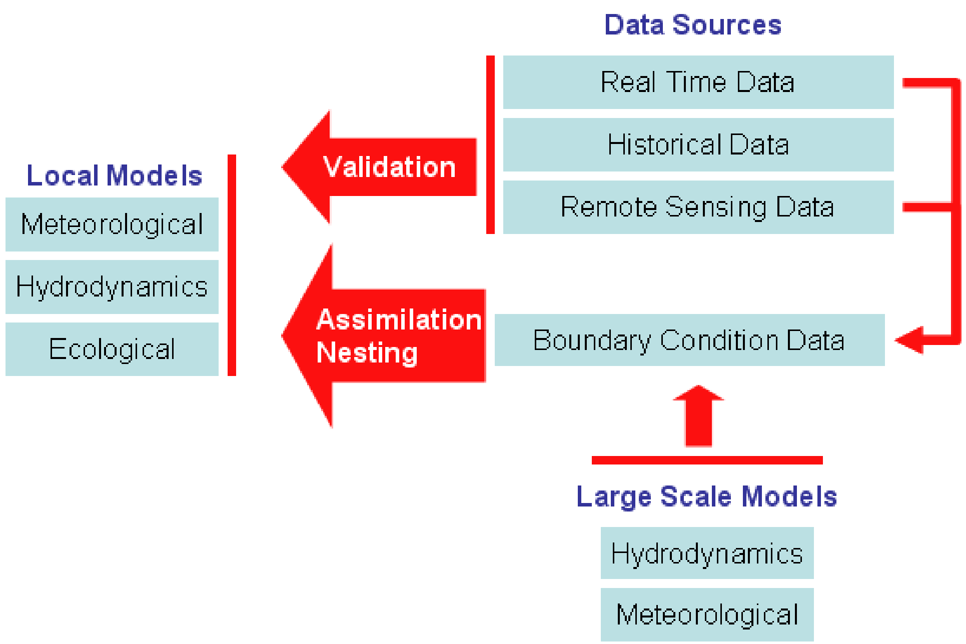
Since the launch of the Coastal Zone Colour Scanner on the Nimbus 7 satellite in 1978, satellite borne ocean colour sensors have become the standard tool for determining distributions of phytoplankton and other biogeochemical parameters in the ocean (IOCCG, 1999). This is because of the ability of remote sensing of sea colour, through the analysis of ocean leaving radiance, to yield information on water-quality parameters such as phytoplankton pigments (more precisely chlorophyll *a* and phaeophytin *a*), suspended sediment, and yellow substance (gelbstoff) in the euphotic layer (Tassan, 1994). It is also because satellite borne ocean colour sensors provide synoptic data with a moderate spatial (c1km or less) and a high temporal resolution (typically in the order of 1-3 days). Even though remote sensing of ocean colour affords us our only window into the synoptic state of coastal and pelagic ecosystems (Platt et al., 1995), it is limited to providing data on surface conditions. In an environmental prediction and ecosystem simulation tool for coastal management, as is proposed here, accurately relating this horizontal distribution data to what is happening vertically throughout the water column of a given area relies on comparison with the results of coupled physical-ecological numerical models or assimilation into these models. This assimilation of data into the best available models can represent a key use of remotely sensed data in helping to provide an accurate prediction system. As mentioned above, ocean colour data provides a good basis for such a scheme.

Currently there are 8 operational ocean colour sensors in space: the Chinese Ocean Colour and Temperature Sensor (COCTS); the MEdium Resolution Imaging Spectrometer (MERIS); the MODerate resolution Imaging Spectroradiometer - Aqua (MODIS-Aqua); MODIS-Terra; the Ocean Colour Imager (OCI); the Ocean Colour Monitor (OCM); the Ocean Scanning Multispectral Imager (OSMI), and the Sea viewing Wide Field of view Sensor (SeaWiFS). This project will make use of three of these. The SeaWiFS sensor has been collecting ocean colour data of the world's oceans, including Pagasitikos Gulf, since 1997. As part of its ongoing commitment to oceanography from space, the Hellenic Centre for Marine Research (HCMR) has access to all the archived, daily full resolution data for this sensor, parts of which will be used to provide a good time series of ocean colour data to test the assimilation schemes. The centre also operates a NASA authorised receiving station for SeaWiFS which can provide near real time data from the sensor. This will be used to test the system in pre-operational conditions with short turnaround times for the data assimilation and subsequent coastal environment predictions. Data from the more recently launched (2002) MODIS-Aqua and MERIS sensors will also be used. Analysis of the data from these latest generations of sensors provides more accurate ocean colour data and derived biochemical variables and inclusion of this data in the assimilation process will ensure that the proposed environmental prediction system is relevant to the future of ocean colour remote sensing. The expertise exists within HCMR to process this data, using NASA software, to a level ready for assimilation. The project will also contribute to the further automation of satellite ocean colour data processing at HCMR and will include: the investigation of the optimum temporal resolution for the data assimilation; associated temporal averaging schemes necessary because of limiting factors on daily ocean colour data, such as possible cloud cover over the area of interest; investigation into the improvement of existing methods of biochemical parameter derivation from raw ocean colour data.

B.1.9 InSea technological starting point

The diversity of marine systems makes it unlikely that a single integrated model will evolve. However, rationalization of modules within tailored modelling systems is a common goal, together with standardisation of prescribed inputs such as bathymetry, tidal boundary conditions etc. Such enhanced rationalisation will enable the essential characteristics of various types of models to be elucidated, including the inherent limits to predictability. This approach stated on EUROGOOS is well recognized by **InSea** where instead of trying to develop an overall modelling strategy we try to take advantage of existing local model solutions and focus on their results harmonization to fit a common data distribution system.

Generally speaking, to accomplish the project purposes we need to establish in each site the following structure:



The components presented in this scheme (Local Models, Data sources and Large Scale Models) are already developed and available in each study site. One of the purposes in **InSea** is to improve and develop new links between them.

B.1.9.1 Large Scale Models

The next table, adapted from MERSEA Strand-1 documentation, presents the modelling and assimilation systems available for the study areas in **InSea** that will deliver the necessary boundary conditions to the local models.

System	Targeted Area	Key Input	Key Output: Hindcast-Nowcast-Forecast
SYS 2: MERCATOR	North Atlantic, Azores, Mediterranean	Atmospheric forcing data. Remote sensing SLA, SST and ocean color, and Argo profiling floats.	Ocean currents, temperature, salinity, mixed layer depth.
SYS 3: FOAM	GCNRS-LOBal, North Atlantic, Mediterranean Sea	Atmospheric forcing data. Remote sensing SLA, SST and sea ice, and Argo profiling floats, VOS XBTs.	Ocean currents, temperature, salinity, mixed layer depth.
SYS 4: MFS	Mediterranean	Remote sensing SLA and SST, VOS XBTs, Buoy and Argo profiler data.	Ocean circulation forecasts at basin scale and selected coastal areas.
SYS 5: MI_POM/ NORWECOM/ POSEIDON/ BOOS/ POL3DB/ ERSEM/ POLCOMS	North Atlantic, Northern European shelf seas, Baltic, Greek Seas, Adriatic Sea, etc.	Atmospheric forcing data, tides, buoy data information, river run-off, satellite SST, SSI and wind, boundary conditions from SYS 1 to SYS 4.	Sea level, storm surges, T; S; currents, sea ice, drift (oil, objects), transports of pollution, dispersion.
SYS 6: National Monitoring Programmes (NMP) at regional and local scales	North Sea, Skagerrak and Kattegatt, Mediterranean, Aegean Sea, Baltic	Atmospheric forcing data, river run-off, boundary conditions from SYS 1 to SYS 4. Ferry-box data.	Ocean currents, temperature, salinity, mixed layer depth, data related to eutrophication (i.e. concentrations of chlorophyll, nitrate, phosphate, silicate, ammonia, diatoms, flagellates, detritus, oxygen, primary production, suspended matter), transport and distribution of fish larvae, organic pollution and nuclear waste.
SYS 7: WAM	North Atlantic and adjacent seas	Meteorological forcing, wave buoy information, satellite SAR, scatterometer and altimeter data.	Wind wave, swell, significant wave height, wave spectra, wave-period.

B.1.9.2 Local models

B.1.9.2.1 Costa do Estoril (Portugal)

Local Models	Model	Inputs	Outputs
Hydrodynamics and Transport	MOHID	Meteorological forcing, river run-off, tides.	Ocean currents, temperature, salinity, mixed layer depth.
Ecological	LIFE (ERSEM adapted)	Light, temperature, transport, properties loads.	Data related to eutrophication, i.e. concentrations of chlorophyll, nitrate, phosphate, silicate, ammonia, diatoms, flagellates, detritus, oxygen, primary production, suspended matter.
Meteorological	MM5	Atmospheric forcing data.	Heat fluxes, Surface temperature, Humidity, wind shear velocities

Hydrodynamics and Transport

MOHID, a 3D Hydrodynamic and cohesive sediment transport model, is already established for the Portuguese study site.

This model will provide a way of addressing different scale predictions, complex geometries and to efficiently incorporate different data sources to define boundary conditions (open sea, land, bottom, surface). It will include a 3D baroclinic hydrodynamic module for the water column. To this module it is possible to couple Eulerian and/or Lagrangian transport modules that are also 3D.

The hydrodynamic model solves the 3D incompressible primitive equations. Hydrostatic equilibrium is assumed as well as Boussinesq approximation. The model uses a finite volume approach. This method makes the solution independent of the mesh geometry, allowing the use of a generic vertical mesh. The model also solves a transport equation for salinity and temperature in order to compute the specific mass.

The Eulerian transport module used to transport these properties is based on the same finite volume approach of the hydrodynamic model and is independent of the property transported. The same transport module is invoked in the sediment transport, water quality and ecological modules to transport different conservative and non-conservative properties.

The water properties module coordinates the evolution of the state variables in the water column, using a eulerian approach. This coordination includes the transport due to the advective and the diffuse fluxes, water discharges from rivers or anthropogenic sources, exchanges with the bottom (sediment fluxes) and the surface (heat fluxes and oxygen fluxes), sedimentation of particulated matter and the internal sinks and sources (water quality). The Lagrangian module (particle tracking module) is used to simulate point source pollution and residence times. This methodology avoids the problem of numerical diffusion associated with the advective term, common in eulerian approaches. Another characteristic is the ability to keep track of the water masses trajectories.

This modelling system provides an answer to different scale predictions through its nesting capabilities. With this methodology it becomes possible to downscale the solution and also to force local models with large-scale processes. The nested modelling methodology can also be used to integrate in only one tool several local models that are forced with the same regional model, or by assimilation of data (local or remote sensing).

The MOHID model has been applied to several coastal and estuarine areas and it has showed its ability to simulate complex features of the flows. Along the Portuguese coast, different environments have been studied, including the main estuaries (Minho, Lima, Douro, Mondego, Tejo, Sado, Mira, Arade and Guadiana) and coastal lagoons (Ria de Aveiro and Ria Formosa) (Martins et al ,2000)

. The model has been also implemented in most Galician Rías: Ría de Vigo (Taboada et al, 1998, Montero, 1999, Montero et al 1999) Ría de Pontevedra (Taboada et al 2000 , Vilareal et al 2000, Péres-Villar 1998). Far from the Atlantic coast of the Iberian Peninsula, some European estuaries have been modelled - Western Scheldt , The Netherlands, Gironde, France, (Cancino and Neves, 1999) and Carlingford, Ireland (Leitão, 1996) - as well as some estuaries in Brasil (Santos SP and Fortaleza). Regarding to open sea, MOHID has been applied to the North-East Atlantic region where some processes including the Portuguese coastal current, (Coelho et al, 1994), the slope current along the European Atlantic shelf break, (Neves et al, 1998) and the generation of internal tides, and also to the Mediterranean Sea to simulate the seasonal cycle, (Taboada, 1999) or the circulation in the Alboran Sea, (Santos, 1995). More recently MOHID has been applied to the several Portuguese fresh water reservoirs Monte Novo, Roxo and Alqueva, (Braunschweig, 2001), in order to study flow and water quality.

Ecological

The Ecology model deals with primary and secondary production, nutrient and organic matter cycling, oxygen availability and pathogens decay. Primary producers consume nitrate, ammonia, phosphate and silica. Organic matter input from sewage was historically a major source of organic carbon that drove aquatic systems toward dissolved oxygen (DO) deficiency through direct microbial heterotrophic activity. However, the input of nutrients, whether in organic form followed by recycling or inorganic form with direct nutrient uptake, is what stimulates potential phytoplankton biomass production, and this organic matter may contribute to symptoms of nutrient over-enrichment.

The benthic subsystem will also be included, interacting with the water column through deposition and resuspension processes, accounting for deposited organic matter decay and pollutants from physical-chemical reactions of pollutants.

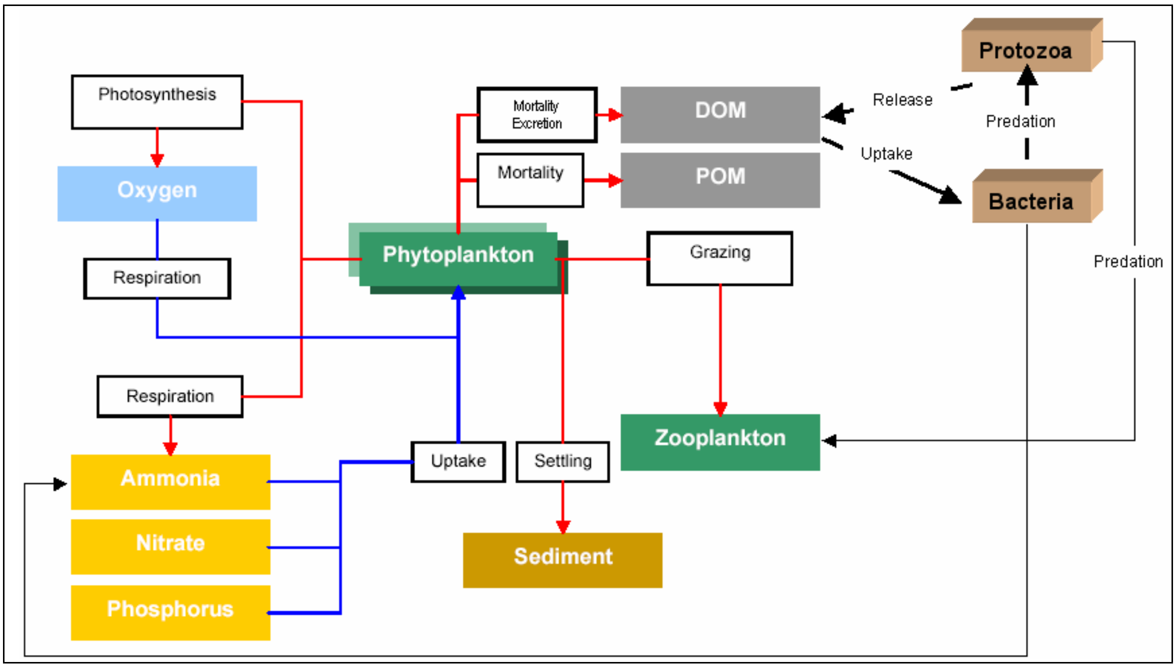


Figure 5: Ecosystem model scheme

Meteorological modelling

The research group MARETEC and the company Hidromod collaborate in very close way in the last 5 years with MeteoGalicia, a meteorological agency from the self-governing region of Galicia. This agency is responsible for weather forecasts for the Galicia region. Their forecasts are supported by two mesoscale meteorological models running operational for Iberia (MM5 and ARPS). One of the products that come out from this close collaboration was the implementation of MM5 in operational mode for the Portuguese coast. This system is being run operational in the Environmental department of IST (head quarts of MARETEC) since 2002. The MM5 allows a two-way nesting approach that was used to refine the solution in Lisbon area. The forecasts are published in the internet site (*http://meteo.ist.utl.pt*). The model runs with three levels of nesting with the follow spatial steps: 81 km (level 1), 27 km (level 2), 9 km (level 3).

B.1.9.2.2 Gulf of Fos (France)

Local Models	Model	Inputs	Outputs
Hydrodynamics and Transport	SYMPHONIE	Meteorological forcing, river run-off, tides	Ocean currents, temperature, salinity, mixed layer depth.
Ecological	CNRS-LOB	Light, temperature, transport, properties loads	data related to eutrophication, i.e. concentrations of particulate and dissolved carbon chlorophyll, nitrate, phosphate, silicate, ammonia, diatoms, flagellates, detritus, oxygen, primary production, suspended matter
Meteorological	ALADIN	Atmospheric forcing data	Heat fluxes, Surface temperature, Humidity, wind shear velocities

Hydrodynamics and Transport

The model is basically the three-dimensional primitive equation coastal ocean model, *symphonie,* described in http://www.aero.obs-mip.fr/activite_scientifique/oceano/ index2.htm. The model has been recently used to study the wind induced circulation in the Gulf of Lions, the intrusion of the Liguro Provençal current on the continental shelf and the Rhône river plume circulation. The three components of the current, free surface elevation, temperature and salinity are computed on a C staggered-grid. A stepped generalized topography following co-ordinate system is used. The turbulence closure is based on a prognostic equation for the turbulent kinetic energy and a diagnostic equation for the mixing and dissipation length scales. A leap frog scheme is used for the time stepping. We use a time splitting technique that permits to compute the vertical shear of the current and its depth-averaged component separately with appropriate time steps.

Sea surface momentum and heat fluxes are calculated with meteorogical models surface outputs (surface pressure, air temperature and relative humidity at 2m, wind velocity at 10m) and the sea surface temperature computed by the ocean model. At the open boundaries we use a radiation conditions scheme combined to restoring terms to the large-scale circulation, i.e. large scale thermo-haline currents and tides. The later is also included though the generating potential forcing. The model is also forced by the river discharges.

This model has been recently chosen to provide weekly regional predictions of the NW Mediterranean in the frame of the EC project, MFSTEP. This regional model is forced by the outputs of a general circulation of the Mediterranean sea.

The *Symphonie* model includes a suspended matter transport model making use of the physical variables of the ocean model and waves model outputs. The transport model includes an advection-diffusion module and a bottom boundary layer scheme representing the current-waves interaction in order calculate the bottom turbulence and related matter resuspension processes. This transport modulus is used to couple the biogeochemical equations developed by CNRS-LOB with the circulation model.

Ecological modelling

In the context of an eutrophication study of coastal ecosystems we propose to apply for the Gulf of Fos, an ecological model developed by CNRS-LOB in collaboration with colleagues from the French

Research Institute for the Development (IRD). This model will be coupled to a high resolution physical model adapted to Gulf of Fos already developed by UPS-LA.

CNRS-LOB has a long experience in biogeochemical modelling comprising hydrodynamic processes, from simple integration of water exchange rates in regions of restricted exchanges to fully coupled biogeochemical physical models for different systems in the Mediterranean Sea, the tropical lagoon of New Caledonia, European Fjords etc.. (Tett and Grenz 1994, Cloern et al., 1995, Pinazo et al. 1996, Bujan et al. 2000, Pinazo et al. 2001, Durrieu de Madron et al. 2003, Tett et al. 2003, Pinazo et al, 2004).

Initially this ecological model was developed in order to including an explicit description of the microbial loop including multiple plankton communities with different sizes. The model is based on multi-element recycling processes (nitrogen, phosphorus, carbon...) described by biogeochemical rates and states variables including variable stoichiometry of each element in the different compartments. Additional variables included bacterial production and dissolved organic matter and a better description of the recycling of organic matter. In the proposed work, a particular effort will be made to calibrate parameters of the model for the restricted area studied using representative field measurements and experiments. Benthic pelagic coupling will be included through sediment water exchanges of dissolved and particulate matter (diffusion driven fluxes of dissolved oxygen and nutrients, and resuspension/sedimentation of organic particles). Mineralization processes in the sediment will be modelled using classical diagenetic formulations including macrobenthos linked biodiffusion and bioadvection processes and reaction terms. The resulting model will be used to calculate phytoplankton biomass, bacterial production, dissolved organic matter concentrations and nutrient recycling in the restricted area of the Gulf of Fos. Spatial distributions of key physical and ecological variables taken from the 3D coupled model simulations will be compared with the relevant field measurements, to emphasize the role of the Rhône river inputs and the physical processes in determining the factors controlling eutrophication of Gulf of Fos ecosystem. Furthermore, a study of the remineralisation processes using simulations highlighted the role of the microbial loop in the study area.

B.1.9.2.3 Gulf of Pagasitikos (Greece)

Local Models	Model	Inputs	Outputs
Hydrodynamics and Transport	POM	Meteorological forcing, river run-off, tides	Ocean currents, temperature, salinity, mixed layer depth.
Ecological	ERSEM adapted	Light, temperature, transport, properties loads	data related to eutrophication, i.e. concentrations of particulate and dissolved carbon chlorophyll, nitrate, phosphate, silicate, ammonia, diatoms, flagellates, detritus, oxygen, primary production, suspended matter
Meteorological	Eta/SKIRON and RAMS	Atmospheric forcing data.	Heat fluxes, Surface temperature, Humidity, wind shear velocities

Hydrodynamics and Transport

The model is primitive equation, sigma coordinate and has a free surface and a split (external/internal) time step. It contains an embedded second moment turbulence closure sub-model, which gives the vertical eddy viscosity/diffusive parameters. The analogous horizontal parameters are calculated through the Smagorinsky formulation, i.e. interactivity with the model velocity field. The horizontal grid uses curvilinear orthogonal coordinates and an Arakawa C differencing scheme. The bottom following layers in a sigma coordinate system, allow the model to represent accurately regions of high topographic variability. Together with the free surface, which is important for high frequency forcing, this makes the model suitable for applications in coastal seas and continental margins. It has been successfully implemented in the Mediterranean basin, the Adriatic Sea, the Aegean Sea, and the Cretan Sea on a 5 km grid and Pagasitikos Gulf 900 m, as well as in the Thermaikos and Saronikos gulfs in higher resolution applications (1-2 km).

The application of the high-resolution hydrodynamic model in Pagasitikos will rely on the POSEIDON system, an operational oceanography system installed in the Greek Seas since 1999. The POSEIDON system is an integrated monitoring, forecasting and information system for the Aegean and Ionian Seas (Eastern Mediterranean). Its modelling components include:

- An atmospheric modelling system based on the Eta/SKIRON model that provides 72 hours forecasts for the Mediterranean Sea (20 km resolution) and the Aegean/Ionian Seas (10 km resolution).
- A hydrodynamic modelling system based on POM (Princeton Ocean Model) that provides circulation forecasts for the Eastern Mediterranean (10 km resolution) and the Aegean Sea (5 km resolution).
- A wave forecasting system based on the WAM model that provides sea state forecasts for the Mediterranean Sea (20 km resolution) and the Aegean Sea (5 km resolution).

The monitoring units (10 fixed buoys in the Aegean) of the system provide the necessary information for calibration and evaluation of the model's forecasting skill while data assimilation methods are currently in an evaluation phase. Additional information about the system can be found in Nittis et al. (2001), in the special issue of GAOS for the POSEIDON project (The GCNRS-LOBal Atmosphere Ocean System, Vol. 8, No. 2-3, 2002) and through the project's web page (www.poseidon.ncmr.gr). Concerning the reliability of the system, published results can be found in Nittis et. al. (2001), Soukissian et. al. (2002), Zervakis et. (2002).

Downscaling/Initialization of the hydrodynamic model

The model initialization problem in terms of downscaling a larger scale coarse model solution is of central importance for a short-range near real time forecast system. A proper initialization procedure produces balanced initial conditions that do not excite inertia-gravity oscillations in model integration and thus restricts model spin-up periods within the acceptable limits of the coastal scale. This is of great importance for the POSEIDON hydrodynamic model which due to the bathymetric steep slopes within the Aegean basin and its numerous coastal areas, is prone to produce high frequency oscillations when a coarser model solution is downscaled by simple or even sophisticated interpolation techniques onto its model grid. Moreover, the model has a free-surface which in contrast to the rigid-lid assumption cannot filter out fast moving waves with disastrous sometimes consequences for the limited time forecast itself.

Among different approaches to treat the initialization problem (damping time integration procedures, adjoint model) the POSEIDON model will make use of the 2D variational initialization method (VIFOP) developed and tested within MFSTEP EU Project which minimizes a cost function based on data constraints and dynamical penalties which involve the barotropic part of the tangent linear model. Such a technique designed to satisfy both statistical and dynamical constraints leads to a drastic reduction of numerically generated external gravity waves and produces a dynamically consistent model initialization field (Auclair et al., 2001a & 2001b).

An alternative initialization/downscaling strategy that will be tested within this project is based on the SEEK filter (Hoteit et al., 2002 & 2004) initialization methodology. SEEK is an extended Kalman filter and has been recently implemented into POM model by Korres et al. (2004) with very promising results. The idea behind this strategy is to use a limited number of 3D multivariate EOFs that describe the variability of the model's full state in order to project in an optimal way the coarse model solution onto the POSEIDON model. More precisely, the EOFs that will be used for the initialization problem, are the eigenmodes of the error covariance matrix of the model which can be estimated from a reference multi-year hindcast simulation.

Ecological modelling

A generic model that describes both the pelagic and benthic ecosystems and the coupling between them in terms of the significant biogeochemical processes affecting the flow of carbon, nitrogen, phosphorus and silicon. The ecology described is not site-specific and responds to the physiochemical environment within which it is placed. Having all significant ecological pathways in the simulation system, the models become capable to respond to the physical and chemical forcing in a way that is at least qualitatively correct under a wide range of conditions. It considers the ecosystem to be a series of interacting physical, chemical and biological processes that together exhibit coherent system behaviour. The dynamics of biological functional groups are described by population processes (growth, migration and mortality) and physiological (ingestion, respiration, excretion and egestion). The ecosystem is subdivided into three functional types: producers (phytoplankton), decomposers (pelagic and benthic bacteria) and consumers (zooplankton and zoobenthos). These broad functional classifications are then subdivided, by grouping biota according to their trophic level (subdivided according to size classes or feeding method) to create a foodweb. State variables have been chosen in order to keep the model relatively simple without omitting any component that exerts a significant influence upon the energy balance of the system. The chemical dynamics of nitrogen, phosphorus, silicate and oxygen are de-coupled from the biologically driven carbon dynamics. The combination of a foodweb with coupled nutrient dynamics allows the model to adjust to spatial and temporal variations in carbon and nutrient availability and reproduce the different types of ecosystem behaviour. The model has been successfully applied in a number of EU projects, in a wide variety of regimes from coastal eutrophic to oligotrophic, and on a variety of spatial scales.

Meteorological modelling

The SKIRON/Eta model will be used for dust deposition covering all experimental site of the project while RAMS will be used for very high resolution weather analysis and forecasts for the operational period.

RAMS

The Regional Atmospheric Modelling System (RAMS) is a highly versatile numerical code, developed by scientists at Colorado State University and Mission Research Inc/ASTeR Division. It is considered as one of the most advanced modelling systems available today. It is a merger of a non-hydrostatic cloud model and a hydrostatic mesoscale model. It has been developed in order to simulate atmospheric phenomena with resolution ranging from tens of kilometres to a few meters. It has several capabilities but the most important are the two-way interactive nesting of any number of grids, the incorporation of one of the most advanced cloud microphysical process algorithms, a surface parameterization scheme able to utilize information on land-use and soil texture at subgrid scale, an advanced radiative transfer scheme able to describe radiative processes at cloudy environment, a full soil temperature and moisture model and a hydrological model providing partitioning of rain water. It uses various level of complexity turbulence scheme. It has the capability to include any number of passive scalars. A general description of the model and its capacities is given in Pielke *et al.* (1992), Walko and Tremback, (1991), Nicholls *et al*., (1992). It is a very useful tool and can be used either for research or for operations. There are more than 1200 publications during the last twenty years and more than 500 installations worldwide.

SKIRON/Eta

The SKIRON/Eta modelling system with the dust cycle capabilities has been initially developed at the University of Athens at the framework of SKIRON and MEDUSE projects funded by the EU and the Greek government (Nickovic and Dobricic 1996; Kallos 1997; Kallos et al. 1997; Nickovic et al. 1997a, b; Kallos et al. 1998; Papadopoulos et al. 2002). Further development of the modelling system was undertaken at the framework of ADIOS project funded by the EU. The system is successfully used operationally in the University of Athens since 1997 (http://forecast.uoa.gr), and for simulations of historical dust-storm events (Nickovic et al. 2001; Tsidulko et al. 2002; Papadopoulos et al. 2002).

SKIRON/Eta atmospheric model

The SKIRON/Eta system is based on the Eta/NCEP model, which was originally developed at the University of Belgrade. The Eta model has been further developed at the National Center for Environmental Prediction (NCEP/NOAA) in Washington, USA since 1993. It is used as a fully operational weather forecasting model in United States, having in tests outperformed other NCEP models. The model has the unique capability to use either a "step-mountain" vertical coordinate (Mesinger 1984) or the customary pressure or sigma (or hybrid) coordinate.

SKIRON/Eta consists of various modules for pre and post processing together with a version of the Eta model appropriately coded in order to run on any parallel computer platform. SKIRON/Eta has several unique capabilities making it appropriate for regional/mesoscale simulations in regions with varying physiographic characteristics and for simulations of the dust cycle. This version of the Eta/NCEP model is considered as the most advanced version of the Eta model and is the most appropriate for the proposed work. Some of the features of this model are summarised in the following:

- The arithmetic solution of the set of equations is performed in a grid point model using a finite difference scheme.
- It has an option for hydrostatic/non-hydrostatic assumption (Janjic et al. 2001).
- The model variables are represented on an Arakawa E-grid system.
- It has the unique capability to use eta as vertical coordinate which is a generalisation of σ-coordinates for a better parameterization of step-like terrain (Mesinger, 1984).
- A special technique for protection from grid separation is used (Mesinger 1973; Janjic 1979; Vasiljeviz 1982; Cullen 1983, 1985)
- For horizontal advection the cascade process of non-linear energy toward smaller scales is under control (Janjic, 1984).
- Use of a split-explicit time differencing scheme (Mesinger, 1973, 1977; Janjic, 1979).
- Use of a 2.5 order closure scheme proposed by Mellor and Yamada for parameterization of the boundary layer (Vager and Zilitinkevitch, 1968; Mellor and Yamada 1974, 1982).
- Use of a 2nd order closure scheme proposed by Mellor and Yamada for parameterization of the surface layer (Mellor and Yamada 1974, 1982).
- Use of a viscous sub layer scheme (Janjic 1994).
- Parameterization of the surface processes using the advanced model for surface processes from Oregon State University (Mahrt and Pan 1984; Pan and Mahrt 1987). A data assimilation scheme for soil temperature and soil wetness has been recently developed.
- Use of 4th order diffusion scheme in the field boundaries with diffusion coefficients dependent on the deformation and turbulent kinetic energy.
- The convective parameterization is based on the modified Betts, Miller, Janjic (Betts, 1986; Betts and Miller, 1986). Alternatively it can use the Kain-Fritsch convective parameterization (Kain and Fritsch 1990).
- The use of GFDL radiation schemes with random interaction of clouds at various levels.
- Dust uptake, transport and deposition module (including removal processes).
- Mercury cycle module.
- A series of pre and post processing modules for better utilization of the available input data and the model results.
- Fully parallelized code to run efficiently on any parallel computer platform (SMD or Distributed Memory Systems).

SKIRON/Eta dust module

The dust cycle module is based on a number of schemes with unique characteristics that make SKIRON/Eta the most appropriate modelling system for dust simulations. Special care was taken to represent realistically all the phases of the dust cycle. The dust modules of the entire system incorporate the state of the art parameterizations of all the major phases of the desert dust life such as production, diffusion, advection and removal.

The Eta/NCEP model scheme for advection of a passive substance (Janjic 1997) is used for horizontal advection of dust concentration. The vertical advection of concentration is simulated using the scheme of Van Leer (1977) which avoids the production of negative values of positive quantities. A 2nd order diffusion scheme is used for lateral diffusion by utilizing the Smagorinsky-type horizontal diffusion coefficient modified by the presence of the model turbulent kinetic energy term (Janjic 1990).

The dust modules include the effects of the particle size distribution in order to simulate more accurately the size-dependent processes. Currently, there are four bins of dust particle size distribution available. Recent improvements and modifications of the transport part of the model have been made in order to have this module available as a separate plug-in to the entire system which can be easily switched on/off according to the needs and applications (Nickovic et al., 2001; Papadopoulos et al. 2002). Special care was given in the determination of the dust productivity areas since the aerosol production phase is critical for the simulation. In the pre-processing phase of the weather forecasting system, before the actual model execution begins, each grid point is specified if it will act as a desert dust source according to its corresponding soil and land cover. For this purpose, the high-resolution data sets of vegetation and soil and texture types that are utilized for the preparation of the input data for the atmospheric driving model are also used for the specification of dust sources and for the calculation of dust-related processes dependent on soil conditions. The vegetation data are available from USGS with a resolution of 30x30 arc sec, following the SsiB classification. For soil textural class the UNEP/FAO dataset (2x2 arc min) is used after its conversion from soil type to soil textural ZOBLER classes.

During the model run, the prognostic atmospheric and hydrological conditions are used in order to calculate the effective rates of the injected dust concentration based on the viscous/turbulent mixing, shear-free convection diffusion and soil moisture. The viscous sub layer scheme of the atmospheric model (Janjic 1994) is applied for the calculation of surface vertical flux of dust and the corresponding dust concentration. The method of Zilitinkevitch et al. (1998) is used for the calculation of vertical fluxes of dust in the grid-points with shear-free convection. Contrary to traditional approaches (e.g. Monin-Obukhov) this method allows upward vertical transport of dust even in the absence of surface wind shear, such as in cases of overheated desert surfaces.

The model parameterizes both dry and wet deposition. The dry part of particle deposition is parameterized according to the scheme of Giorgi (1986). This scheme includes processes of deposition by surface turbulent diffusion and Brownian diffusion, gravitational settlement, and interception and impaction on the surface roughness elements. The wet deposition is calculated using the model precipitation water.

Finally, the SKIRON/Eta system utilizes SST fields from NCEP with a resolution of 1 or 0.5 degrees, and meteorological fields from NCEP and ECMWF or other sources (e.g. COLA). In general it is an easily configurable modelling system and it can be used at almost any place on the earth.

B.1.9.3 Development of satellite based Data Acquisition System

A long term vision for the project outcomes is a set of generic tools and methodologies that can be applied across Europe (or even globally) to assist local water management agencies with their decision-making processes. Local data acquisition is an important component of the total information system and is necessary for calibration purposes and for setting the initial conditions of models that are used to perform forecasts. Part of the envisaged INSEA 'tool-set' is therefore a 'data acquisition unit' (DAU) which, when coupled with appropriate sensors, will capture and communicate water status parameters back to the local agencies.

A variety of platforms and communications methods can be applied to this requirement, depending on local conditions and available communications infrastructures. However, in keeping with the project goals of developing a generic toolset, it is compelling to consider also the idea of establishing a single standard DAU design that can operate identically in all geographical locations across Europe.

DAUs will typically be located on buoys floating in coastal or estuarine waters, and may also be at fixed sites along banks/shores of waterways. Many sites will be within the coverage area of terrestrial wireless communications systems (such as GSM/GPRS or 3G/UMTS). However, a large number of sites are expected to be outside terrestrial coverage, particularly in countries with less developed wireless communications infrastructure. Opportunities can also be envisaged in the future to export the INSEA technology to regions outside of Europe where GPRS or other terrestrial wireless communications systems are unavailable (e.g. parts of Africa, South America and Asia). The need for a secure communications capability independent of local infrastructure may also arise in the future for security reasons. For all of these scenarios, a satellite-based solution is applicable – it offers the real possibility of a universal DAU design that is totally independent of local communications infrastructures. However, a satellite-based system will only be universally adopted (i.e. even when terrestrial options are also available) if the cost of procurement and operation is low and competitive with the terrestrial alternatives.

The INSEA data acquisition requirements are of a relatively low 'bandwidth' (as discussed below). Hence the operational costs in terms of subscription costs and cost-per-bit are less important than higher bandwidth applications. ComSine analysis suggests that for the INSEA application the operational costs for a GSM/GPRS based solution could approach as little as €10 per DAU per month.

Even if a site were to use multiple DAUs, the operational cost for data communications will only represent a small fraction of the overall water management project's budget. The challenge for a satellite-based solution is not to match or beat the cost-per-bit of terrestrial methods (this is not likely to be possible), but to offer an overall operating cost that is comparable to GPRS and low enough not to become a significant fraction of a project's budget. A target figure for operational cost in the order of €30 per DAU per month should be acceptable – about €1 per day. Even though this may be higher than many GPRS service offerings, we believe the delta in price would be more than offset by the convenience and efficiency of using a common DAU design universally across all sites. In particular, the integration of locally acquired data with the INSEA tools should be much more consistent and effective with a single DAU type than would be the case if a number of disparate data collection systems were used.

B.1.9.3.1 Satellite Remote Monitoring / Telemetry

A variety of satellite-based remote monitoring systems are already in the marketplace. Some, such as Orbcomm and Argos, use a store-and-forward messaging approach. Others provide direct near-real-time (NRT) messaging via geostationary satellites, most notably those which use the Inmarsat D+ system. The majority of such systems are actually targeted more at tracking and telemetry applications such as tracking fleet vehicles or shipping containers. Although a DAU for the INSEA application could be based around an existing satellite tracking/telemetry system, none of the current offerings provides a close match to INSEA's requirements (see below), and the cost-per-bit is typically much higher than what is necessary to meet the operational cost target suggested above.

ComSine is currently developing its own satellite based tracking/telemetry system known as 'PicoTracker'. This platform has the potential to provide a very suitable basis for the required universal DAU. PicoTracker is designed to communicate via L-band geostationary satellite transponders such as those provided by Inmarsat, Thuraya, Express and others. It uses a proprietary air interface developed by ComSine to provide highly robust and efficient low-rate data communications, at a very low cost-per-bit. Depending on the terminal type used, a PicoTracker-derived DAU could cost less than €300 and operate autonomously for many months, even years, using battery or solar power. The PicoTracker terminal's data capacity matches well the projected requirements of the water management application envisaged by the INSEA consortium. The potential exists to get operating costs down below €30 per DAU per month, hence meeting the target cost figure suggested above.

B.1.9.3.2 InSea Communications Requirements

Each DAU will be typically required to monitor 10 to 15 variables, e.g., chlorophyll level, salinity, temperature, turbidity, oxygen content, etc. The location (e.g. via GPS/Galileo) of the DAU must also be monitored to ensure the unit has not moved away from its intended station.

In general, each variable could be sampled with a different temporal resolution, i.e., some variables could be logged more frequently than others, such as to minimise the amount of overall data to be stored and communicated. However, for the moment we assume each is sampled at the same frequency. The maximum frequency has been estimated at half-hourly, although more typically would be twice per day. If we design the DAU to sample 20 variables and each is stored as a 16-bit (2 byte) number, then the total data payload for each sampling instant is 40 bytes (320 bits). Including location and ID information, a payload size in the vicinity of 60 bytes appears appropriate. This is very close to the payload size of 64 bytes (512 bits) already planned for one of the bearers of the PicoTracker air interface.

In the short term, INSEA will focus on three specific sites in Portugal, France and Greece, respectively. However, the implementation of EU directives will mean that in the long term there could be hundreds of sites across Europe being closely monitored for water management purposes, and each site might wish to deploy anywhere from a few DAUs to tens of DAUs. Therefore a single communications system serving all these users may need to handle a DAU population of up to several thousand. As an example, let us assume there are 5000 DAUs deployed across Europe. If each were wishing to collect data every 30 minutes, this would mean the system must support 10,000 transactions every hour.

B.1.9.3.3 PicoTracker Capabilities

PicoTracker is a scalable system with the building block being 50 kHz allocations of return channel spectrum. A single 50 kHz allocation is designed to support ~18,000 64-byte transactions an hour – comfortable to handle the projected traffic level. By adding further 50 kHz allocations, the total traffic supportable could be scaled up to any future requirement.

The PicoTracker system supports two terminal types: (1) Transmit-Only and (2) Transmit/Receive. The advantage of the Transmit-Only type is simpler, smaller and less costly hardware, since no receiver is required. Battery life is also higher since there is no receiver processing to drain power. However, without a forward channel to receive, there can be no acknowledgment signals returned to the terminal to control re-transmissions in the event of errors in the data packets transmitted to the satellite, i.e. it is not possible to guarantee 100% data integrity. There is also no mechanism available to remotely control the operation of the terminal – operation must be set and controlled locally. For example, if a change is required to the data collection schedule, this will require a physical visit to the terminal for re-programming of schedule parameters.

These shortcomings are addressed with the Transmit/Receive terminal type. These terminals are capable of receiving a forward channel carrier, and this can serve a variety of purposes. It can convey acknowledgement signals to implement error control, allowing 100% data integrity to be guaranteed. It can also be used for remote terminal configuration and control, meaning a user's set of DAUs could be re-programmed without physically attending the terminal (this is carried out via a website). The forward channel can also provide a means of sending short text messages to a DAU, although this is less applicable to remote data acquisition applications.

For the water management application considered by INSEA, the choice of the particular PicoTracker terminal type is open. On the one hand the Transmit/Receive type offers 100% data integrity, which may be important for water management applications, since erroneous data could de-stabilise forecasting models. The Transmit/Receive type also offers the flexibility to remotely control and configure the DAU's operation. On the other hand, the cost of the Transmit-Only terminal is lower (<€300 compared with <€1000), operating costs are lower (since the user is not paying for the overheads of bi-directional 'hand-shaking'), and battery life is longer. However, for many water monitoring applications it may be possible to use solar power, which removes the battery life aspect from consideration.

Note that all PicoTracker terminals will include a GPS/Galileo receiver as standard, hence the location monitoring requirement would be satisfied by default. Initial prototypes would utilise a GPS receiver, but later designs would include a dual-mode receiver capable of processing both Galileo and GPS signals.

PicoTracker provides 'instant messaging' as opposed to a store-and-forward communications method. This means collected data is near-real-time (NRT) which is crucial for many data acquisition applications, including many water monitoring situations. Normally data will be returned according to a fixed schedule with a specified sampling frequency of the sensors. For terminals with a receive capability, there will also be the possibility of capturing NRT data on request, since a command can be issued on the forward channel (via a website interface) to request an immediate reading of the sensors. PicoTracker is also designed to support the sending of unscheduled return messages, e.g. a DAU could send an alert in the case of an unusual sensor reading or equipment malfunction.

Clearly because of the marine operating environment, DAUs will need to be robust, reliable and suitably water-proof. A PicoTracker-derived DAU could be built to a very compact form factor. The Transmit-Only terminals will be smaller than a mobile phone, while the Transmit/Receive terminals will be slightly larger. Both types can be readily ruggedised for this type of application.

In conclusion, we propose that a very suitable DAU for the water management applications considered by INSEA can be developed based around ComSine's PicoTracker concept, taking into account the specific operational requirements of this application. Two PicoTracker terminal types are supported; Transmit-Only and Transmit/Receive. Both types have their selling points and both may have a place in water management applications.

B.1.9.3.4 Operational Costs

The cost of establishing, operating and maintaining a remote monitoring data acquisition system will vary depending on the site location and the environmental conditions under which the DAUs must operate. The site location will determine whether a terrestrial or satellite-based solution is required, and if terrestrial is used, determine the data traffic costs (which will varying considerably according to the local terrestrial service provider's charge rates).

If we assume for the moment that equipment capital costs and maintenance costs are similar, regardless of the communications method used, then operating costs become the deciding influence.

For GPRS, charges across Europe over coming years can be expected to be in the following range:

- monthly subscription: €10 to €20
- data traffic charges: €2 to €5 per Mbyte

Even with multiple messages per day, and the considerable overheads associated with TCP/IP communications via GPRS, it is unlikely the total monthly traffic will exceed 1 Mbyte. Therefore a typical GPRS-based DAU might have an operational cost of ~€15 per month.

As an example of a satellite-based system, Inmarsat D+ services might cost around €0.10 per message, but it would take 8 messages to convey a 64-byte data packet. Hence each complete packet would cost ~€0.80 to transmit. With half-hourly transmissions, the daily cost would approach €40 per DAU – over €1000 per month per DAU.

This shows the significance of the PicoTracker development. PicoTracker aims to get the average price per data packet down below €0.02 – a factor of 40 reduction in cost-per-bit on this application when compared to Inmarsat D+, a leading contemporary satellite telemetry solution. In fact if the PicoTracker programme achieves its objectives, the price per message would actually be ~€0.01 and users would pay a monthly subscription charge in the order of €10, making a total monthly operational cost of ~€25 for a DAU sending messages every 30 minutes. The cost for a DAU sending just two messages a day would be ~€11, which is actually less than the expected cost of a GPRS solution.

B.1.9.4 Data-Management Activities

Considering that **InSea** will be dealing with large amounts of data associated to different sources and describing complex physical and biological processes, data-management activities represent one of the most relevant issues to achieve efficiency in he project. These data-management activities can be divided in:

a) Data Quality Control/Assessment

b) Harmonization and conversion of data to agreed meta-data formats

c) Development of Remote Data Access System

B.1.9.4.1 Data Quality Control/Assessment (DQC/DQA).

The success of (marine) environmental monitoring programs is directly related to the relevant and reliable data. Or a laboratory to produce consistently reliable data it must implement an appropriate program of quality assurance procedure. Analytical methods must be validated as fit for their purpose before use in the laboratory. The methods must be fully documented. Where possible, all reported data should be traceable to reliable and well-documented reference materials, preferable certified reference materials.

Therefore quality control and quality assurance of data and meta-data are essential to produce data catalogues of quality controlled meta-data and the aim is to produce validated quality assured mete-data records within the data catalogues. Through this end-users can get an impression about the quality of the actual data & information within partner's databases. In general all data source-holders (partners) are leading research institutes committed to strict quality control.

The data and information to be used within the project will be assessed on data quality, including description of the applied data quality procedures, taking into account existing DQC procedures, directives and guidelines, as:

- MAST: Guideline for better practise in data communication, MAST data Committee, march 1997.
- ICES oceanographic database codes and guidelines.
- IOC/GETADE document “Formatting Guidelines for Oceanographic Data Exchange” (Intergovernmental Oceanographic Commission, UNESCO).
- EU Water Framework Directive
- Other existing guidelines/directives within other international organizations, such as EEA, for different nature of environmental data.

There will be considered, among others: accuracy, precision, proficiency testing, quality control sample, quality manual, quality system, certified reference material, suitable equipment and standards and records of calibration.

The assessment will be carried out by the participating scientific partners and data source holders.

B.1.9.4.2 Data Quality Classification of partner’s/source holder’s data & information.

Taking into account the results of the DQC/DQA, a special meta-data field will be developed for partner’s and source holder’s data, informing the end-user about the quality of the data & information he or she is looking for; within the meta-data formats the following fields will be mandatory:

- Data Quality Procedure/Method applied
- Descriptive kind of “Data Quality Label”

B.1.9.4.3 Harmonization and conversion to agreed meta-data formats

From month 3 to 10 the project/data holding partners will make an inventory of the different nature of data & information within their possession, including the available format (database, hard copy, map), information about the data quality and data quality procedure/method applied.

Partner’s inventories will be discussed during the data-management workshop in month 10.

Following the production of the Meta-data Format Manual (as result of the data-management workshop), the partners/data source holders will commence compilation of the different nature data & information.

Based on the data formats have been agreed and specified at the data-management workshop and Meta-data Format Manual, next partners will begin producing meta-data records (files) using standardized forms and templates and other appropriate data submission and transmission tools developed and supplied by the data-management partner MARIS.

In case partner’s existing meta-data formats differ from the agreed standards, MARIS will assist in development of appropriate conversion software tools. The standardized templates and forms for meta-data submission will used by all data-holding partners. This will ensure tuning band conformability of the meta-data input and procedures. Technical Data Quality Assurance mechanisms developed by MARIS will be used to validate the submitted data & information. Data will be allocated a probationary status prior to final checking of submitted files by meta-data suppliers, who will remain responsible for accuracy of meta-data to their data holdings. MARIS will coordinate and oversee the assembly of quality controlled meta-data files and their implementation within the Remote Data Access System.

B.1.9.5 Development Remote Data Access System

B.1.9.5.1 State of the art

Water managers and policy makers want to be informed about the situation of marine ecosystems. For the execution of integrated regional marine environmental (coastal zone) management facilitating tools in information strategies are required. An effective tool is a so-called Marine Environmental Management Support System. Such a system requires qualitative controlled data; these are the source for decisions. With these data the state of the art of marine ecosystems in the past can be compared with predictions, as well as input data (geographical information, water quantity and water quality data) can be obtained for numerical models, among others using satellite data.

In general data are available in digital form, but not always in possession of the organisation which needs these data and information and most of time these data are not available in the required format. Moreover, 1) there is not always appropriate overview of the available data including of the source holders, and 2) these data are in general not (remote) accessible from a “central focus point”. A direct and uniform access to external regional data (bases), based on Telematics World Wide Web technologies, is of great importance.

Besides, environmental managers have to deal with different kind sand nature of data and datasets. These datasets must be combined with other data types and information sources. To upgrade the data-accessibility of the existing regional infrastructures, all this information should be embedded in a dynamic GIS-based Management Support System with a user-friendly interface, and made remotely accessible from a central focus point on the WWW. Such a Management Support System should provide the user an interactive working model, integration at various scales, viewing output in time and space and comparison of input and output data. To build and validate the application, “centralized” (remote) access through the WWW to meta-information should be possible.

B.1.9.5.2 General Objectives

“Development and establishment of a Remote Data Access System on the WWW for remote access to environmental, socio-economic, industrial and administrative data & information, based on a telematic solution (World Wide Web Technologies – Internet -), to improve the overview, availability and accessibility of these data, and to provide a innovative WWW-tool for effective exchange of information, accessibility of data & and information, and communication within European Research Infrastructures.

The aim is to develop a Remote Data Access System, providing uniform query facilities, to search on multiple environmental, socio-economic, industrial and administrative database catalogues, where these databases are geographically distributed over the research region, and being heterogeneous. I.e. each of the databases has its own query interface which may or may not be available from the World Wide Web. Moreover, it will provide remotely accessibility to the data & information within source holder’s databases.

An uniform query interface will make it possible for scientists, governmental decision makers, managers and administrators, industrial enterprises and the general public to search for data, based on the data type, geographical location and time together with other relevant parameters, as well as to retrieve the require data remotely. The Remote Access System will be developed to use the capabilities of the Internet (WWW Browser, HTTP Servers), and the existing architecture of the involved Data Holding Centers (partners). It is seen as very important that the data centers should not convert their data to a common format but rather continue to use their existing format.

B.1.9.5.3 Technological Innovations

* The Remote Data Access System, a Environmental Management Support System enabling access into each others data of organisations dealing with environmental ecological, ICZM data, socio-economic, industrial and administrative data, on an independent base and maintaining the control of their own data. This concept results in a large number of connected databases which are physically separated, but appear as one.

- Design of a Central Meta Database (CMD) as central element of the system, considering the guidelines of the Catalogue of Data Sources of the European Environment Agency. The CMD describes what information is available at what location and will be installed as a World Wide Web Server (WWW), supported by applications based on a Geographical Information System (GIS) for geographical interfacing.
- Automated procedures and telemetric solutions (by the Internet) to access remotely the actual distributed databases and to locate and bring out the required data.
- The distributed database model will be based upon CORBA-software architecture; the telematics/transport model upon Internet techniques.

B.1.9.6 Implementation of Remote Data Access System

The Remote Data Access System will consist of the following elements:

- Descriptive information, regarding elements of the project, manuals, reports and any other relevant document and documentation; the descriptive part also includes descriptions and manuals for data quality control procedures.
- Central Meta-database, divided in a number of meta-data catalogues for the different nature of environmental, socio-economic, industrial and administrative data & information.
- Remote Access Module, enabling remote access to actual data within partner's database.
- Application layer containing GIS-based interfaces for numerical and graphical search, retrieval, (graphical) presentation, data-import (central up-dating of the meta-databases and import of new data into the meta-databases) and export functionalities.
- Numerical models: downloadable executables

The (simplified) schematization of the Remote Data Access System is as described in Figure 6.

B.1.9.6.1 Technical System Overview to be developed:

The System allows a Scientific User to formulate a query using a standard Web Browser or an applet viewer. The user can select query parameters via the user interface. The user interface contains text fields and lists of values, which the user can use to formulate the uniform query. Furthermore the user is able to select an area of interest, from a map of the region.

The information needed to fill the user interface is fetched from the Guidance Catalogue Server, which holds information about the fields and field values which the different Local Query Servers is able to handle. When the user has finished the query formulation, he submits the uniform query to the Local Query Servers. The Local Query Servers will convert the uniform query to a local query using a local Mapping Catalogue.

The Mapping Catalogue describes how the uniform query fields can be converted to the locally used fields. The Local Query is then executed on the Local Scientific Database. The result fields of the Local Query must then be converted to uniform fields. This will be done by using the Mapping Catalogue.

The Local Query Server then returns the result to the user. In first instance the result contains a metadata description of the datasets which can be requested later.

The user can then browse through the metadata results from the different local query servers to identify the dataset(s) which he is interested in. These datasets can then be selected and fetched from the local query server, which holds the datasets.

B.1.9.6.2 Components Development Remote Data Access System

Component 1: Scientific and Technical function specifications

a) Drafting of the descriptive (scientific) functionalities of the system, based on the results of end-user and partner consultation as well as of the data-management workshop to be organized within the project in month 10, resulting in the scientific requirements for the Remote Data Access System.

b) Drafting of the technical functionalities, based on the descriptive functionalities.

The data-management workshop will involve all partners to discuss and agree meta-data formats for the different nature of data & information within partner's/data holdings databases.

During months 0-8 partners will hold extensive consultation exercises with potential end-users within their national and international networks to gather end-user input for the data-management workshop. They will present:

- Inventory about the different nature of data & information within their databases.
- Availability of meta-data and applied meta-data formats.
- Information about quality of data, data quality procedures/methods applied.

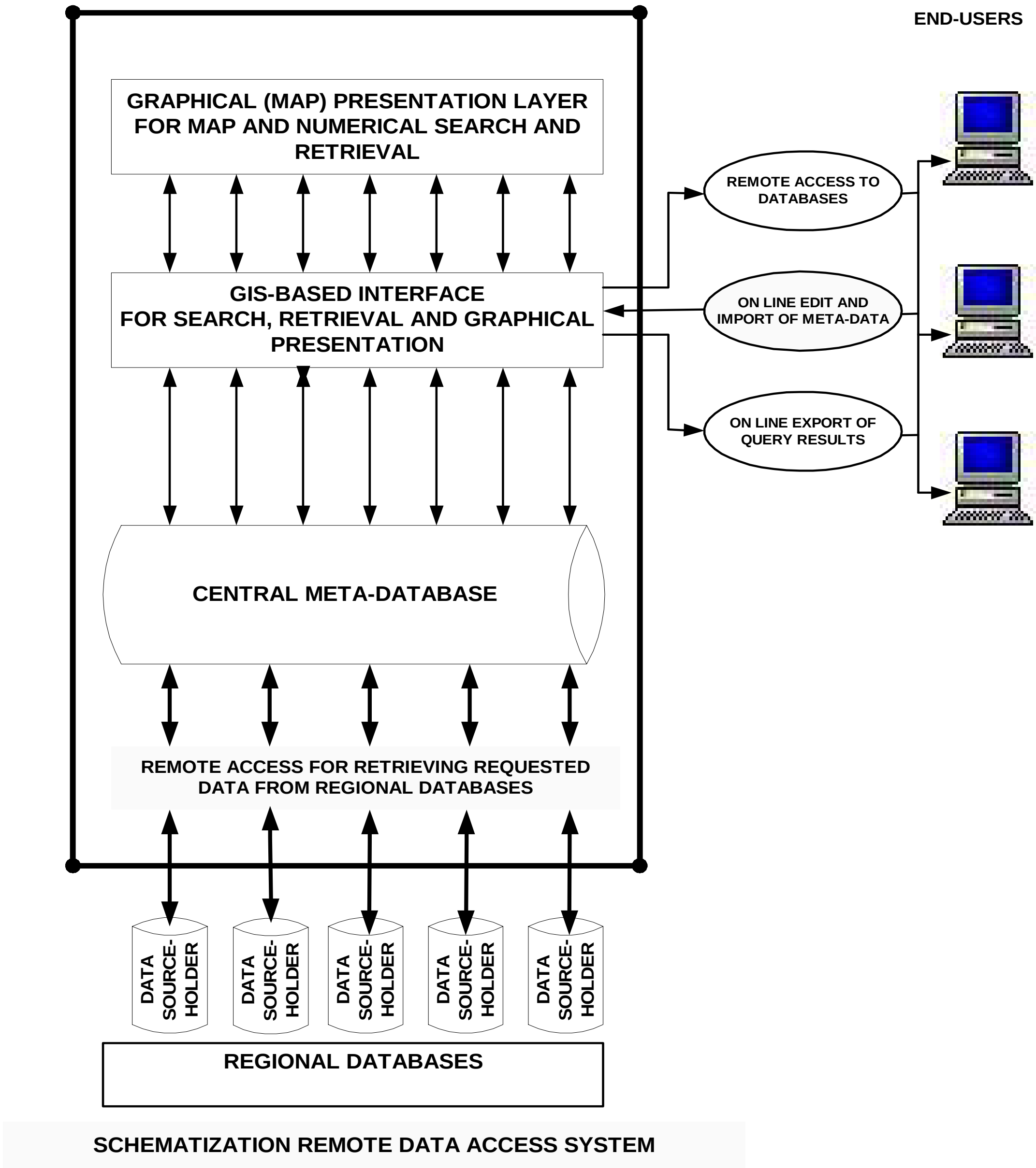


Figure 6: Remote Data Access System scheme

The aims of the workshop will be:

- To agree and define the required meta-data formats for the different nature of environmental, socio-economic, industrial and administrative data & information, including the meta-data characteristics (mandatory and optional meta-data fields).
- To discuss existing meta-data formats and agree required adjustments.
- To discuss and agree meta-data conversion and supply procedures.
- Scientific requirements for appropriate development of the Black Sea Remote Data Access System and its components.

This workshop will therefore be a key element in the standardization of national meta-data, and during this workshop feedback will be sought on the type of meta-data information that should be included in partner submissions and central meta-database of the Remote Data Access System. In addition, partners will provide an overview of their data holdings, which will form the basis of the meta-data submissions and remote accessible databases.

The meta-data schemes agreed will be harmonized with ISO meta-data standards, and the meta-data elements (fields) of these domain-specific schemes will be mapped to established meta-data element schemes.

Component 2: "Conceptual Design" Remote Data Access System

Based on the results of activity 1 (technical functionalities) the first draft of the so-called Conceptual Design of the Remote Data Access System will be developed. During project course, adjustments and changes might be drafted, resulting in a next version of the Conceptual Design.

Component 3: Descriptive Information

Besides the description of the project, this part also includes:

- Manuals, Reports and other documents developed within the framework of the project
- Descriptions and manuals on data quality control procedures/methods for the different nature of environmental, socio-economic, industrial and administrative data & information, as well as data quality assessment methods.
- Partners organizational information
- Any other relevant descriptive information

Component 4: Electronic Sounding Board

In an early stage of the project, an interactive Electronic Sounding Board on the Remote Data Access System will be developed, to be use for end-user consultation, communication channel, and feedback from anyone who is interested in the project and its products.

Component 5: Central Meta-database

For all environmental, ecological, socio-economic, industrial, satellite, model result and administrative data & information within partner's databases, uniform (standardized) so-called meta-data records will be developed, which will be stored in a Central Meta-Database on the Remote Data Access System. In case partner's data holding centre already has their own meta-databases, conversion software will be developed for the several partner's catalogue meta-data formats. The meta-data are related to quality controlled data and information.

The Central Meta Directory contains the information about the contents of the distributed servers at partner's data-holding centre, like which catalogues of data sources from a server and more detailed information about the catalogue, like what information is available at what location.

The Central Meta Directory will provide the end-users with forms to be able to query the Central Meta-Database (Central Guidance Catalogue Server) At least two top-level query forms will be provided for the end-user:

- Forms based queries (alpha-numerical search)
- Cartographic queries (map search)

The Central Meta-Database will be embedded in the Remote Data Access System interface that will be largely based upon a Geographical Information System for geographical interfacing. The Central Meta Directory will be installed as a World Wide Web server (Central Guidance Catalogue Server).

The information is stored in the Central Meta-Database is to limit network access and to have a central access point to the different distributed databases. The Central Meta-Database will contain a software program which makes it easy to add new servers if they comply with the Uniform Query Engine interface specification

Component 6: Remote Access Module

The Remote Access Module allows the end-user to formulate a query using a standard Web Browser or an applet viewer. The user can select query parameters (meta-data fields) via the user interface. The user interface contains text fields and lists of values, which the user can use to formulate the uniform query (so-called alpha numerical search). Furthermore the user is able to select an area of interest, from a map of the region (so-called map search).

The information needed to fill the user interface is fetched from the Central Guidance Catalogue Server, which holds information about the several meta-data catalogues and hereto related meta-data fields and meta-data field values, which the Local Query Servers at partner's data-holding centers is able to handle. When the user has finished the query formulation, he submits the uniform query to the Central Meta-Database (Central Guidance Catalogue Server).

The user can then browse through the meta-data results to identify the dataset(s) which he is interested in. These datasets can then be selected and if availability conditions are not provided, the end-user can negotiate on line or by e-mail with the data-holding centre(s) about the availability conditions of the required datasets.

If there is an agreement, the system manager will provide the end-user a user-ID and password for remote access to the required datasets. The end-user will submit next the uniform query result to the concerning Local Query Server, which will convert the uniform query to a local query using a Local Mapping Catalogue. The Local Mapping Catalogue describes how the uniform query fields (meta-data fields) can be converted to the locally used meta-data fields. The Local Query is then executed on the Local Database. The Local Query Server returns the results (required datasets) to the user.

The approach described above establishes the Central Guidance Catalogue Server (Central Meta-Database) as the main system component providing almost all interactions between the end-user and partner's data holding centre. It is possible that some countries do not have reliable Internet connections. Therefore, architecture with only one Central Guidance Catalogue Server seems to be slow and unreliable in this situation. A possible solution of this problem is to create copies of the Central Guidance Catalogue Server, so-called "mirrors", on each Local Query Server host. In this case the end-user may enter into the system from the nearest Central Guidance Catalogue Server. Moreover, if the client needs only data located on this Local Query Server it is not necessary at all to connect other Local Query Servers.

It should be noted that the need for creating Guidance Catalogue Server "mirrors" at Local Query Servers does not change anything in the end-user-Guidance Catalogue Server-Local Query Server interactions. The "mirroring-functionality" is an independent top level task.

Summarized, the Remote Data Access Module in general consists of the following parts:

End-User Software

The client software consists of a World Wide Web Browser like Netscape, Mosaic or Microsoft's Internet Explore. The user will use the standard WWW Browser to access the Central Meta Directory where he/she is presented with information about available environmental, socio-economic, industrial and administrative data-catalogues and their meta-data fields.

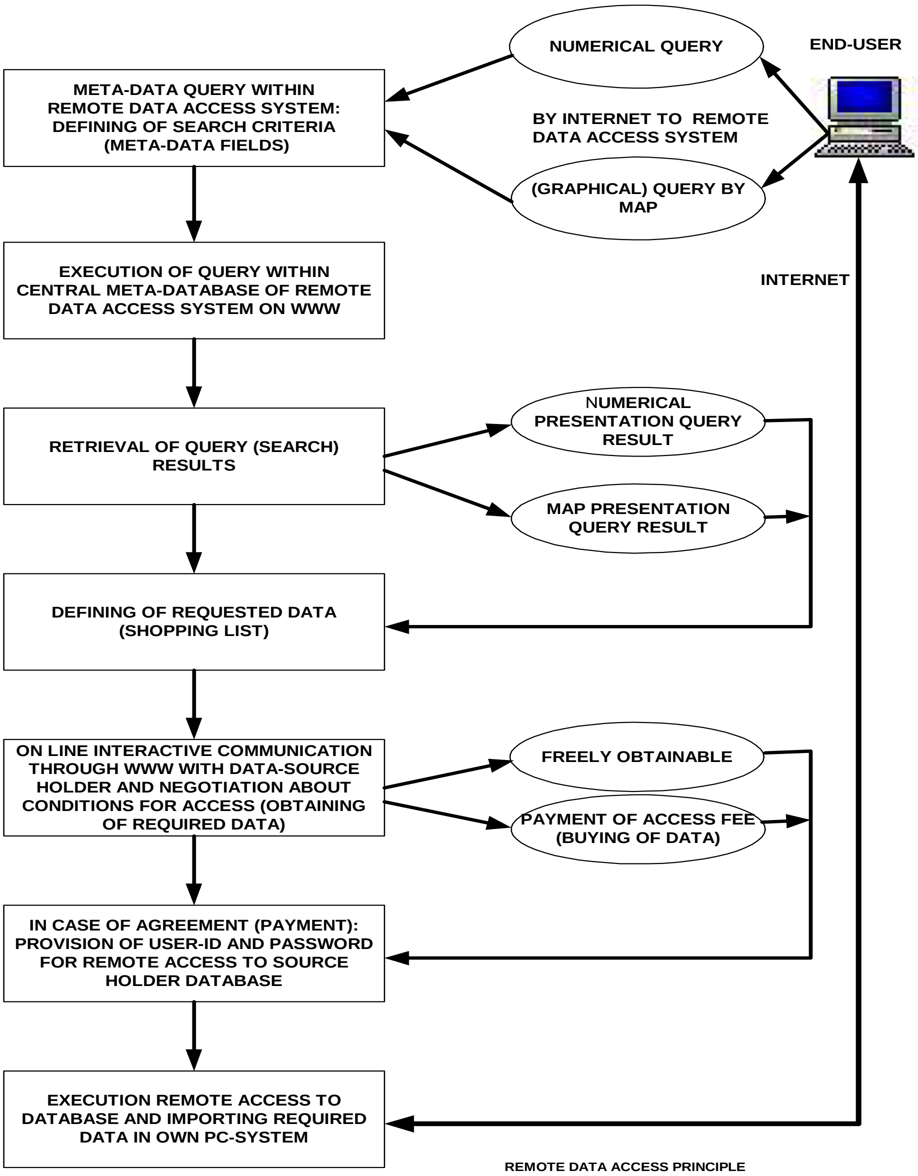
The end-user will be presented with a number of pages which will enable him to locate the data on one of the data-holding centers. When the required data have been identified, and after finding an agreement with the data-holding centre about the availability conditions, the end-user can fetch the data directly from the Local Query Server if the data are available via the network, or he/she can send a request to the data-holding centre for provision of the required data.

Distributed Server Software

The distributed server software will be located at the computer which holds the distributed meta-data catalogues i.e. at the different data-holding centers. The local catalogue will be accessed through a local query engine with a Uniform Query Interface. The Uniform Query Interface is used to hide the implementation layer of the different catalogue servers. Thus making the different heterogeneous catalogue servers appear as homogeneous servers that can be accessed through the same routines.

Local Query Server

The local query server receives uniform, by the end-user specified queries from the Central Meta Directory (Central Guidance Catalogue Server) via the WWW. The Local Query Server takes the uniform query and converts the catalogues and fields in the query to the local presentation of the catalogues and field names by using the mapping catalogue. After the query has been converted, the query is executed against the local catalogue(s). The result of the query, including the requested datasets, is passed through the result conversion layer, which is also using the mapping catalogue to convert the fields from the local presentations to the external presentation. This will ensure that results from two local query servers, which contain the same kind of data, will be represented in a uniform way with the same names and in the same units.



REMOTE DATA ACCESS PRINCIPLE

Activity 7: GIS Interfaces/Application Layer

GIS interfaces are required and need to be developed for numerical and graphical (map) search, retrieval, (graphical/map) presentation, data-import and export of retrieved data/information and hereto related map.The information demand will be focused on spatial information, available in various table formats and locations in various scenarios and interactively specified regions. It should be possible to view the output per grid cell and for the total region, to view it at various moments during the scenario and to view the differences between two scenarios.

The information demand of end-users that are implementing and validating applications is related to the requirement to integrate various geographical information sources as an input for the process model. It should be possible to view the various source data, to view the converted source data that feed the model and to compare the results. Another part of the application is aimed at the interactive presentation of data.

The application Layer will provide facilities for processing and presentation of environmental, \socio-economic, industrial and administrative data and information largely based upon a Geographical Information System (GIS) for geographical interfacing. This will among others efficiently support the production of thematic maps.

The GIS will have the following functionalities:

- Spatial presentation of all geographical elements defined in the database (visualization, spreadsheets, word processing, and overlays).
- Pre-processing of input data (spatial selection and combination and data integration, retrieval, conversion).
- Post processing.
- Production and download of thematic maps (and if available numerical models).
- Map-based access to metadata stored in the central meta-database.
- Access to the local (data-holding) databases after selection of required data.
- Map-based access to electronic information regarding the concerning inland waters (documents, reports, trends, photos, animations, etc).
- Spatial selection of data.
- Presentation of data regarding future scenarios (modelling results).
- Spatial analysis and statistics.

The application layer should be able to link raw information as well as derived products with various datasets and data layers, numerical models, etc. and will encompass the overlaying of various data types: raster, vector and numerical. In general the datasets can be subdivided as follows:

- Administrative country data (borders of countries, restricted economic zones, etc.)
- Topographic data (watersheds, rivers, seas, cities, etc.)
- Remote sensing data
- Environmental/ecological data
- ICZM data
- Socio-Economic data
- Industrial data
- Administrative data (laws, legislation, etc.)
- Satellite data
- (thematic) Maps
- Downloadable numerical models executables, model results

Activity 8: Testing of prototype Remote Data Access System

During the development phase of the Remote Data Access System components, thoroughly testing procedures will be carried out. At the end, the prototype of the final system will be tested out before it will be made operable through the Internet.

B.1.10 Final considerations

It is important to understand that **InSea** is not itself a “research project.” That is, its principal mission is not to conduct the research that will lead to a state of the art study of the workings of the study sites. Rather, **InSea** is more accurately thought of as a “utility”: the entity that will gather the best available knowledge, transmit/process/archive data, and maintain the infrastructure required to do this. The data and information produced will allow those who depend on the study areas for livelihood and well-being, and those whose business is marine research, to undertake their pursuits and enhance the understanding of coastal areas more efficiently and profitably than ever before. This does not mean that **InSea** won’t be involved in research, but this research will be sharply focused on observational techniques and technology, and on creating from the collected data the products most relevant to, and in the form most needed by, the ecosystems clientele.

B.2. Relevance to the objectives of the Aeronautics and Space Priority

The FP6 call for proposals FP6-2003-SPACE-1 for the GMES area under the application field of Ocean and Marine Applications, where **InSea** is placed, states that: to reach the envisaged pre-operational capabilities for environment and security, the work program foresees the integration and the pre-operational validation of existing research results obtained through previous initiatives of EC, ESA and national entities, planned research and technological development results, as they become available. **InSea** assumes this objective as one of its main aims, which is translated by the development of methodologies to downscale physics from large scale data systems to regional models. The main data and technological source will be the MERSEA project, described in detail in Section B3.6. Nevertheless existing national or international capabilities will be taken into account for synergies and to avoid duplication. The project will be user driven and will take into account user needs concerning information and services on eutrophication in coastal waters. These facts are clearly stated on the evaluation of potential customers for each study area and confirmed by the interaction already going on between consortium members and these potential customers, and by their leter of support to the project (See Anex). **InSea** takes into account EU policies, directives and standardization initiatives included in the project workplan explicitly as drivers for definition of data needs.

InSea will clearly demonstrate the potential of the combination of Earth Observation (EO) data, numerical modelling and in-situ data. The project's technological approach for dealing with eutrophication problems is inspired by GMES conclusions stating that "in-situ and EO data alone can rarely satisfy the user's purposes. On the other hand, the use of remote sensing resources can be extremely useful especially in places where there is a lack of local data.

A complete decision support process, including synoptic, analytic and predictive capabilities, is generally needed. It is thus necessary, for most end-uses, to exploit EO and in-situ data jointly with numerical models, data assimilation, and information presentation methods of varying sophistication". Furthermore according to GMES, environmental services "must use those data sources that best meet user needs: In most cases this means that EO data, in-situ data and models must be used together to establish an integrated decision-support capability that is of practical use for policy and decision makers".

The objective (and sub-objectives) of the project meet the EU orientations at other several levels.

B.2.1 Sustainable development

This project addresses several topics of the Plan of Implementation of the WORLD SUMMIT ON SUSTAINABLE DEVELOPMENT (WSSD).

This project is driven mostly by the "key societal issue" coastal ecosystems play in the development of the countries in the project. In all of these countries, coastal ecosystems are historically favoured for urban use due to natural resources abundance, to sea commerce, dilution and dispersion capability and recreational use.

All those uses of the coastal ecosystems are translated into economic value once more and more economic activities depend, on one hand, on the availability of natural resources, on the urban expansion possibilities, on the regenerating capabilities of the environment, and, on the other hand, on the availability of healthy ecosystems to preserve bio diversity in the long term (our legacy for future generations).

Ecologists and social scientists have only recently realized that in order to fulfil the requirements for sustainable development, human beings have to be explicitly incorporated as structural components of almost all ecosystems on earth. Indeed, the clear distinction between "natural" and "managed" ecosystems is slowly fading away, leaving us with the task of re-writing ecological theory in order to incorporate humans. New concepts and techniques are indeed necessary to understand these "eco-social systems".

In fact, to "reverse the current trend in natural resource degradation" (WSSD), all stakeholders in the ecosystem must be taken into account, integrated with the scientific knowledge of ecosystems, and generating an overall comprehension of the physical-ecological-social system. This is the way to “increase understanding of the sustainable use, protection and management of water resources to advance long-term sustainability of freshwater, coastal and marine environments” (WSSD).

B.2.2 Implementation of the EU environment policy

The policies with regard to key aspects of the proposal, namely eutrophication control and biodiversity protection, are increasingly determined at a supranational level. European regulations of nutrient loading to rivers and coastal waters may directly influence the productivity of these coastal waters for exploited stocks, and their potential for biodiversity protection. The European Water Framework Directive requires high biological quality in all estuarine waters. However more scientific input is needed for research into how this quality should be evaluated and achieved by management options. The common European market for food products, e.g. shellfish, is a reality which requires equal rules applying to all producers. It is therefore important that development of these policies can be based on a generic prediction tool, applicable to European coastal waters of quite different natures.

The project is also directly relevant to other European water-related directives, e.g. on nitrogen release into coastal waters and on the management of urban waste waters. As effects of eutrophication may differ between systems depending on their biological communities, the present project will be highly relevant to a rational management of the problem. Moreover, our approach of biodiversity in coastal systems in relation to both physical forcing and biological forcing is relevant to the prediction and understanding of eventual eutrophication effects on intensely monitored, but badly understood, biological indicators.

The work and outputs definition together with the strong commitment to establish synergies with local data managers will bring to **InSea** the ability to support the implementation of the following laws:

- Bathing Water Quality Directive (Council Directive 76/160/EEC concerning the quality of bathing water) and its proposed revision (COM(94)0036-94/00006SYN)
- Urban Waste Water Treatment Directive (Council Directive 91/271/EEC concerning urban waste water treatment) and the IPC Directive (98(C6)05 of 10/1/98
- Nitrates Directive (Council Directive 91/676/EEC concerning the protection of waters against pollution caused by Nitrates from agricultural sources)
- Water Framework Directive (COM/99/271, European Parliament and Council Directive establishing a framework for Community action in the field of water policy)

In addition to the Directives there are various Programmes and Communications in place which address coastal issues where **InSea** will also be a potential tool for their implementation:

- 6th Environmental Action Program which should help amongst others things the implementation of existing environmental legislation and the integration of environmental concerns into other policies
- Communication from the Commission to the Council and the European Parliament on Integrated Coastal Zone Management: A strategy for Europe

B.3. Potential impacts

B.3.1 Routes for the exploitation of the results

All data and tools developed under this project will be available for every partner and to interested stakeolders. Local environmental authorities and other major stakeholders (like Port authorities or local NGO's) will be involved in the process of defining priority subjects, index formulations.

Dissemination of results among the population, the scientific community, the public administration and the private companies will be done based on local needs of each site. Internet will be extensively used as the means to communicate with a wide range of people and institutions.

The knowledge base to be implemented, describing the studied processes and all gathered information regarding the project sites will be available. It is expected that 5 to 10 scientific papers will be written, as an outcome of the project.

B.3.2 Impact on competitiveness

Information society rests upon the large-scale diffusion and utilisation of new Information and Communications Technologies (ICT). ICT allows for unprecedented capabilities in data capture and information production, and in the processing, storing, and communicating of data and information. Since all economic activities involve these functions, the new technologies are used across the economy.

Information and communication technologies interact with the development and availability of human capital. Knowledge that can ensure that the human element is not subordinated to technological potentials is required in order to enhance creativity and sustainable development. With globalisation, and the availability of ICT resources to competitors, firms are being forced to innovate more rapidly and more efficiently. Access to advanced ICT infrastructures and skills is vital for the innovative capacity of firms and regions. New tools for innovation management are becoming competitive assets. Human capital that supports exchange and fusion of knowledge across professional and disciplinary boundaries is also a critical asset.

The knowledge-based economy involves changes in the production and use of knowledge. Organisations are confronted with an increase in the volume and variety of information, and of the knowledge with which to effectively use this information. More sorts of knowledge are required, as well as deeper knowledge. The growing complexity of knowledge means among other things that companies have to collaborate to access the knowledge required to enter new markets and to confront new challenges. This applies to innovations too, where collaborative R&D has become more important. Another result of the increased complexity of knowledge is that interdisciplinary, and the capacity to manage multidisciplinary teams and dialogues, are highly sought after capacities.

The management tool to be developed under this project results from the combination of several state-of the-arte technological areas, Modelling, Remote Sensing, Data Acquisition, Interface Development, and Database Management. The partners in this project recognize that they do not have the necessary competences and know-how to undertake innovation of this kind on their one. The result of this is that networking and collaboration is critical for the development of this project in the framework of developing knowledge-based successful business. In this context the possibility to gather a team with the different necessary skills will able to bring the SMEs investments to a more acceptable level, will create a unique opportunity for the technology transfer and will able to bring this technology to a competitive stage.

R&D is an investment that generates knowledge as well as prepares for the introduction and improvement of products and services. Europe's strategic aims need economic activities to be at the frontiers of knowledge and offering the highest value added cost effectively. High level research requests a constantly increasing "critical mass", and needs good connections with intermediaries that can relate it to commercialization. Additionally, new research management tools like the one we are aiming to build may also be important in increasing the productivity of research. A very important aspect of the project is the balanced integration of SME's and Universities into a Consortium with size and skills adequate to achieve the objectives of the project. Universities are nowadays responsible for most innovative R&D, but exploitation of their results is sometimes not a priority for them. On other hand, the costs associated with the integration of the tools used in this project are beyond the investment capacity of the individual SMEs involved in the project.

B.3.3 Impact on society

The project will aim at establishing cooperation with all stakeholders of the studied coastal zones in order to understand and manage those areas. Using an assessment framework based on Driving forces, Pressures, States, Impacts and Responses (DPSIR), enables a tight connection between all the actors in the coastal zone (stakeholders) and leads to specific answers to local problems with generic methodologies.

Direct driving forces in coastal zones are ports, industries, urban areas, tourism and fishing. As indirect driving forces, all activities in the inland water basin that deteriorate the fresh water resources, in terms of quantity and quality of the water, must be considered.

Pressures in the coastal zones are the outcomes of the driving forces like effluents (urban and industrial), over fishing, dredging, deforestation and bad water quality of inflowing rivers and aquifers.

States are assumed to be the physical and ecological conditions that absorb pressures. As physical conditions, it is understood the water body and the adjacent areas, like mangroves or salt marshes. Ecological conditions range from primary production, nutrient and organic matter cycling and oxygen availability to secondary production and benthic and pelagic macro fauna.

Impacts are the changes on the States driven by Pressures that may affect the ecosystem or the society that interacts with it. These impacts on coastal zones can be loss of economic activities (leading to unemployment or other socio economic consequences) or loss of environmental values (e.g., extinction of species).

Responses are the aim of such an analysis. Society (through its formal or informal representatives) must react to any of the preceding phases with specific actions and policies in order to achieve sustainable development with the least economic and environmental losses possible (or even with economic and environmental profit).

The analysis of diagnostics and development plans, for the sites that will be studied, will define the present situation of those coastal ecosystems, what stakeholders are involved in them and what their future development scenarios are.

For each of the three sites, there is a good understanding by the partners of what the problems are, who is responsible for them and what responses have been tried in the past. The new conceptual framework proposed aims at improving the understanding of each coastal zone by:

- Describing the physical characteristics of the system with appropriate modelling tools that describe water and sediment properties and fluxes;
- Describing the ecosystem with ecological models, including a link between models which usually work on different processes and on different time and spatial scales;
- Describing the interaction between local or remote human activities and the ecosystem in order to include them in the forcing functions of the ecosystem modelling;
- Evaluating impacts of different pressure scenarios on the ecosystem and quantifying their costs.

B.3.4 European added value

To understand the importance of carrying out the work at a European level it is useful to pay attention to some facts:

The EU water framework directive, which came into force at the end of 2000, will fundamentally change how water is monitored, assessed and managed in many European countries. Two of the key concepts it introduces to legislation are ‘ecological status’ and ‘water management at the river basin level’. Ecological status is an expression of the quality of the structure and functioning of aquatic ecosystems. Three groups of quality elements (biological, hydromorphological and physico-chemical) have been identified in the water framework directive as necessary to classify the ecological status of a particular water body.

The guidelines for such work are provided by the European Environmental Agency (EEA) which has the responsibility for delivering to decision-makers the information needed for making sound and effective policies, thus implementing the legal practices associated with the water framework directive.

The EEA is developing indicators, in a top-down approach, to answer specific policy questions. This approach is not always feasible as, in some cases, the appropriate datasets and dataflows are not available or developed at a European level, thus there is a real need for integrating new data sources that are able to fill the information gaps.

It is stated in several EEA documents, that to achieve the goals of effectiveness and efficiency of monitoring, scientific help is really indispensable. For instance, the efforts put into: (a) model development, (b) direct measurements, and (c) remote sensing may be combined and attuned to each other. By combining results of the three data sources, an optimal strategy may be developed using the specific strengths of each source. As a result, spatial and temporal coverage may improve, information may become more reliable and efforts put into generating the needed information may decrease.

The main conclusion is that the approach implemented in this project follows the requests of the EU by delivering quantified information that helps to explain how the quality of the water environment changes over time or varies spatially, and using tools such as remote sensing and models to develop optimal strategies to overcome the lack of information.

B.3.5 Relations with other national or international activities

We should distinguish three levels of activities from where we establish links to **InSea**:

- Global – which include large thematic networks such as ICES, GCNRS-LOBEC, EUROGOOS and ELOISE that should be considered as umbrellas for a number of research projects. The general link of these projects to **InSea** will be on the definition of gCNRS-LOBal strategies, access to the best available knowledge on the study subject and information gathered from the large data bases developed and maintained by such projects.
- Regional – mainly European funded research projects usually integrating different areas and interests. The main outputs from these projects with interest to **InSea** should be methodological approaches including downscaling techniques, assimilation schemes, remote sensing integration and state of the art use of Information Technologies. The focus is put on MERSEA –Strand 1 and MFSTEP.
- Local – projects funded by local and national entities which are responsible for the implementation of water related legislation, monitoring and control.

Next a more detailed description of the projects mentioned above is presented, focusing on the particular aspects that are more relevant to **InSea**.

B.3.5.1 Global projects

B.3.5.1.1 ICES

ICES (International Council for the Exploration of Sea) is an intergovernmental marine science organization which, since its foundation in 1902, coordinates and promotes marine research in the North Atlantic. The subject of the ICES is marine ecosystems and their relation to humanity.

The ICES mission calls for:

- Establishing effective arrangements to provide scientific advice;
- Informing interested parties and the public objectively and effectively about marine ecosystem issues;
- Coordinating and enhancing physical, chemical, biological, and interdisciplinary research;
- Fostering partnerships with other organisations that share a common interest;
- Developing and maintaining accessible marine databases.

ICES has consistently recognized the mutual interdependence of the living marine resources and their physical and chemical environment. Although the Council's original statutes have undergone occasional modification to adjust for changing conditions, challenges, and priorities, its main focus has continued to be on international cooperative studies. ICES is a leading forum for the promotion and coordination of research, and dissemination of research findings on the physical, chemical, and biological systems in the North Atlantic. ICES also provides advice on human impact on the North Atlantic environment, in particular fisheries effects in the Northeast Atlantic and the Baltic. In support of these activities, ICES facilitates data and information exchange through publications and meetings, in addition to functioning as a marine data centre for oceanographic, environmental and fisheries data. ICES works with experts from its 19 member countries and collaborates with more than 40 international organizations throughout the world, some of which hold scientific observer status.

B.3.5.1.2 GLOBEC

GLOBEC (GLOBal Ocean Ecosystem Dynamics) was initiated by SCOR and the IOC of UNESCO in 1991, in response to the recommendations of a joint workshop which identified a need to understand how gloal change will affect the abundance, diversity and productivity of marine populations comprising a major component of oceanic ecosystems. GLOBEC is focused on zooplankton – the assemblage of herbivorous grazers on the phytoplankton and the primary carnivores that prey on them.

The aim of GLOBEC is to advance our understanding of the structure and functioning of the global ocean ecosystem, its major subsystems, and its response to physical forcing so that a capability can be developed to forecast the responses of the marine ecosystem to global change.

GCNRS-LOBEC has four primary objectives:

- To better understand how multiscale physical environmental processes force large-scale changes in marine ecosystems
- To determine the relationships between structure and dynamics in a variety of oceanic systems which typify significant components of the global ocean ecosystem, with emphasis on trophodynamic pathways, their variability and the role of nutrition quality in the food web.
- To determine the impacts of global change on stock dynamics using coupled physical, biological and chemical models linked to appropriate observation systems and to develop the capability to predict future impacts.
- To determine how changing marine ecosystems will affect the global earth system by identifying and quantifying feedback mechanisms.

B.3.5.1.3 EUROGOOS

EuroGOOS (GCNRS-LOBal Ocean Observing System) is an Association of Agencies, founded in 1994, to further the goals of GOOS, and in particular the development of Operational Oceanography in the European Sea areas and adjacent oceans. Members of EuroGOOS co-operate to establish a concerted European approach to the following:

- Identifying European priorities for operational oceanography, promoting the development of the scientific, technology and computer systems for operational oceanography, and its implementation, assessing the economic and social benefits from operational oceanography
- Contributing to international planning and implementation of GOOS and promoting it at national, European and gCNRS-LOBal level

EuroGOOS activities are designed to collaborate with and maximise the benefits from existing activities in operational oceanography, promoting the integration of these activities within the framework of GOOS. Members of EuroGOOS collaborate and support the following groups of activities:

- Advancing European operational oceanography in GOOS
- Promoting development of European regional and local operational oceanography, taking into account the Modules of GOOS for the Coastal Zone, Health of the Ocean, Living Marine Resources, Climate, and Ocean Services.
- Promoting development of common European operational data procedures and services, including data quality control and data management for operational oceanography.

- Promoting research and pre-operational research which will solve problems relating to operational oceanography.
- Promoting pilot studies in GOOS operations, local, regional, or gCNRS-LOBal.
- Promoting development of common European operational oceanographic services and products of maximum value to European Governments and Agencies, furtherance of European industries and service companies, and the protection of the environment and health in the European coastal and shelf seas.

Many of the member agencies of EuroGOOS offer a large variety of operational oceanographic products, both for the national coasts of their countries and for larger sea areas. Products include nowcasts/forecasts, oceanographic databases, and bathymetric maps.

Members of the **InSea** consortium have been involved in EuroGOOS activities (meetings and workshops), thus they are well familiar with the type of products available to coastal data users that will certainly be useful to cover **InSea** data necessities on regional scale. The **InSea** consortium will assume responsibility to promote the dissemination of **InSea** results among the EuroGOOS association.

B.3.5.1.4 ELOISE

ELOISE (European Land-Ocean Interaction Studies) is an action (called “Thematic Network” or “Project Cluster”) where coastal zone research projects in the Commission are combined, with additional support, to focus on the important question of how the land-ocean interaction operates and on how this is influenced by human activities. It started under the Fourth RTD Framework Programme of the EU as an initiative of the ENVIRONMENT & CLIMATE and the MAST research Programmes, acting in concert with the Programme for International Co-operation (INCO) and the research programmes of the Member States; it is continued under the Fifth Framework Programme beyond the year 2000. Under ELOISE some projects (already finished) have special interest to **InSea** :

- OAERRE (http://www.lifesciences.napier.ac.uk/OAERRE/index.htm) –Oceanographic Applications to Eutrophication in Regions of Restricted Exchange, aiming to understand the physical, biogeochemical and biological processes, and their interactions, involved in eutrophication in coastal marine Regions of Restricted Exchange (RREs). This project started in 2000 with a duration of 3 years where one of the studied sites was the Gulf of Fos (a study site of **InSea**). Some results achieved under this project are very useful such as estimation of microplankton parameters (including ratio of microheterotrophs to total microplankton, photosynthetic efficiency, and the yield of chlorophyll from assimilated nutrient) for use in models, measurement of benthic nutrient and oxygen fluxes.
- DOMAINE (http://www.domaine.ku.dk/) – Dissolved organic matter (DOM) in coastal ecosystems: transport, dynamics and environmental impact. The overall aim of the project is to provide a better understanding of the terrestrial export of dissolved organic matter, its fate and impacts on coastal ecosystem functioning, i.e. the storage and cycling of carbon, nitrogen and phosphorus and the optical properties of DOM. This project also delivered information for an area under **InSea** interests (Gulf of Fos).
- EUROSSAM (http://ecobio.univ-rennes1.fr/eurossam/) – European Salt Marshes Modeling. The main objectives of this project were: (1) the improvement and testing of a range of ecological processes and hydrodynamic models to predict the likely responses of various salt marsh ecosystems to environmental changes such as potential impacts of predicted rise of sea level or human activities on the functioning of salt marshes and on the fluxes of various nutrients between the salt marshes and the marine coastal waters, (2) the calibration of the process models to specific conditions encountered in various European salt marshes, and (3) the linkage of the process models and the hydrodynamic model in order to develop a decision support system (DSS) tool. One of the study sites of this project was the Tejo estuary in the boundary of the Portuguese **InSea** study site. The Portuguese team of **InSea** had a participation on this project. Its results and conclusions led to increased knowledge of the system that will be incorporated under **InSea** to help in defining boundary conditions for the study system.

B.3.5.2 Regional projects

B.3.5.2.1 MERSEA

The MERSEA Strand-1 project (Marine EnviRonment and Security for the European Area) is directly related to the GMES Action Plan (initial period 2001-2003) on gCNRS-LOBal ocean monitoring and the marine theme. It builds on the current European capabilities for development, implementation and operational use of: marine modelling and data assimilation systems, spaceborne observations and in-situ observing networks and systems. The objective of **InSea** is similar to MERSEA but at different spatial scales and for some areas not covered in detail by the former project.

MERSEA Strand-1 is a research project supported by the European Commission under the Fifth Framework Programme and contributing to the implementation of the Key Action 3 "Sustainable Marine Ecosystem" within the Energy, Environment and Sustainable Development programme.

In MERSEA, four basin-scale near-real-time routine ocean monitoring systems were established acquiring remote sensing and in-situ data and assimilating them in state-of-the-art Ocean general circulation models to describe and forecast the state of the North Atlantic and adjacent European Shelf Seas, and the Mediterranean Sea. The results of these general circulation models are the input for smaller scale models. Nesting methodologies enable the passing of information highly variable in time and space to smaller spatial scale levels until the necessary detail is achieved. **InSea** is positioned to be the recipient of this information.

MERSEA project partners agreed on product standardisation and harmonisation such as: model outputs classification, convention and any format issues (e.g. dimensions, variables, samplings, attributes, organization, standard names, short and long names, units, etc), intercomparison framework, time series availability and product distribution. These are all relevant issues that **InSea** partners, especially the ones involved in the modeling area, are especially aware, so there will be a strong effort to learn from the experience of the MERSEA partners and incorporate all standards and related conclusions that were gathered on the MERSEA project.

On the subject of demonstration of different system applications from user perspectives, much was also accomplished within MERSEA concerning presentation of results and consequently data management that will also be taken into consideration upon the decisions within the current proposal. The fact that the partner responsible for data management in **InSea** was also a participant of MERSEA will help to accomplish this objective.

<u>Contacts to MERSEA were already established</u> in order to guarantee access and support to relevant information and knowledge gathered under MERSEA. Contacts were engage with MERSEA Project Office and with Dr. Kostas Nittis responsible for the HAB and eutrophication events module, who agree that the link between **InSea** and Mersea should come through downscaling and data harmonization. This is in fact the main conclusion of all application test cases (eutrophication, HAB, oil spills) that were carried out in regional - coastal areas during Mersea_s1 / Workpackage 5. It will be reflected in the final report of the project were all the recommendations will be summarized. Therefore, he strongly recommended downscaling from global (Mersea) to coastal (maybe using 2-3 fold nesting) in InSea project. He also considered that is not an easy task (especially for a pre-operational system) but it offers the right scientific framework/perspective and existing experience can be used.

B.3.5.2.2 MFSTEP

MFSTEP (Mediterranean Forecasting System Towards Environmental Predictions) aims at the further development of an operational forecasting system for the Mediterranean Sea based upon three main components:

- Near Real Time (NRT) Observing system;
- Numerical forecasting systems at basin scale and for regional areas;
- Forecast products dissemination/exploitation system.

The problems to be solved belong to three major categories:

- Technology developments, connected to the new instrumentation for NRT monitoring and the provision of NRT protocols for data dissemination and quality control procedures; Scientific development, connected to the understanding of the sampling scheme for different measuring platforms, the design and implementation of data assimilation schemes for different spatial scales, the ecosystem modeling validation/calibration experiments at the basin and the coastal areas scale, and the development of data assimilation techniques for biochemical data;

- Exploitation developments, consisting of software interfaces between forecast products and oil spill modelling, general contaminant dispersion models, emergency systems, search and rescue models, and fish stock observing systems. In addition, the study of forecast economic value and impact will be carried out.

B.3.5.3 Local projects

B.3.5.3.1 Portugal

INAG is the Portuguese National Authority in charge of fresh and coastal waters management. In the framework of its activities, INAG is in charge of implementing the European Directives related to water and of promoting the technological developments required to control and improve water quality. INAG is sponsoring a programme to establish the trophic level of the main Portuguese estuaries and adjacent coastal waters, which in the case of the Portuguese study site of **InSea** will constitute an interesting trade off opportunity for changing data and knowledge.

SIMTEJO and SANEST are two large companies responsible for the waste water management of the metropolitan area of Lisbon (about two million inhabitants), showing deep concern in quantifying system capability to assimilate the discharges of diffuse nutrient and organic matter loads and of waste water treatment plants under their control. These two companies are financing intense monitoring programs in the **InSea** study area and have shown their interest in the data products that will be made available by this project.

B.3.5.3.2 France

The national monitoring program of water quality of the marine environment is based primarily on three components:

- the microbiological network of control (REMI)
- the inspection network of the phytoplankton and the phycotoxines (REPHY)
- the national network of observation of the quality of the marine environment (RNO)

The REMI and the REPHY programs are managed by Ifremer. The RNO is financed by the Ministry for Ecology and Durable Development (MEDD). The data bank resulting from the monitoring process of the littoral area (called QUADRIGA) contains results on the major physical, chemical and biological parameters describing the environment. Basic parameters comprise temperature, salinity, nutrients (nitrate, nitrite, ammonia, and phosphate), chlorophyll a and pheopigments. The first data go back to 1974 for the RNO, 1987 for the REMI and the REPHY. They are updated permanently.
Finally, monitoring programs on physiology and pathology of shellfish are carried out for oysters (REMORA) and global pathology of molluscs (REPAMO).
Golfe de Fos hosting a mussel farming area is one of the controlled site visited regularly by RNO, REMI and REPHY. These data are available on request (www.ifremer.fr/envlit/surveillance/index.htm).

On a local scale, Marseilles Port Authority (PAM), the leading Mediterranean port, occupies roughly half of the shore line of gulf of Fos. So it is responsible at all times for the good ecological practice of its activities and respects the well-being of all. For this purpose, PAM undertakes monitoring in order to assess the impact of its activities on the environment and develop environmental concern with the occupants and with local authorities and associations (www.marseille-port.fr/anglais/visit/index.htm). PAM has shown main interest in the past for RDT projects performed for instance by CNRS-LOB and should be included as a major end-user for INSEA.

B.3.5.3.3 Greece

ESPEN**:** An Enhanced operational System for wave monitoring and Prediction with Applications in Hellenic Navigation. The objective of ESPEN project is the design, development and operation of an **E**nhanced operational **S**ystem for wave monitoring and **P**rediction giving special emphasis in applications to H**E**llenic **N**avigation (ESPEN system). The ESPEN system will be a multi-functional and multi-layered system, who's operation is expected to a) contribute substantially to resolve a major socioeconomic problem in Hellenic Shipping which concerns the constant and often pointless application of sailing suspension of car-passenger vessels due to bad weather conditions and b) cover, to a large degree, issues relating to the reliable knowledge of the prevailing sea-state and wave forecasting in the Hellenic Seas. The whole project is based on two scientific - technological pivotal points: i) The reliable and analytical (in space and time) short-term forecasting of the sea-state conditions, in relation to the (near real-time) knowledge of the prevailing sea conditions with the aid of “smart and handy” wave buoys and ii) knowledge of the dynamic behavior, safety and operability of ships in the forecasted sailing conditions.

B.3.6 Contributions to standards

Water quality assessment through monitoring cannot take into consideration all the frequencies responsible for spatio-temporal variability, being carried out monthly and most often only seasonally. Environmental managers and research community are aware that low frequency point observations do not describe environmental and ecosystem variability at the appropriate spatio-temporal scales for present needs. Nevertheless due to the lack of tools able to perform analysis considering system complexity, this simplistic approach is usually the only way for diagnosing problems and for establishing plans for their resolution.

These facts are stated in several documents that establish the legal and political framework for EU water management (e.g. The Water Framework Directive 2000/60/EC, OSPAR Convention) from which is also stated the emergence of requirements for an ecosystem approach to environmental management based on a profound knowledge of system behaviour. Thus, the use of predictive models to help the implementation and application of water policies is becoming very commonplace worldwide.

Considering the **Water Framework Directive 2000/60/EC**, adopted by the European Parliament and the Council of the European Union on 22 December 2000, referring to the need of ensuring comparability of monitoring systems between Member States. It is stated that the results of the systems operated by each Member State shall be expressed as ecological quality ratios for the purposes of classification of ecological status. These ratios shall represent the relationship between the values of the biological parameters observed for a given body of surface water and the values for these parameters in the reference conditions applicable to that body. This kind of approach derives its philosophy from the OSPAR convention where the concept of background conditions, or reference conditions, aims to represent the conditions existing before remarkable anthropogenic inputs. The main objective is to analyze the evolution trends of the system comparing it to recent measures. The definition of these reference conditions can be quite complicated due to the lack of historical information, or to the uncertainty of the system behaviour, especially in estuarine areas where spatial and temporal gradients are very intense. An incorrect definition of these reference conditions can have serious consequences on planning level with repercussion to social and economical level. Thus the implementation of the proposed data integration system in the study areas can represent a major advance for local administration to establish wise environmental decisions and a step forward in meeting what is becoming standard procedure in Europe on the definition of ecological quality ratios for the purposes of classification of ecological status.

B.4. The consortium and project resources

The **InSea** consortium represents a unique and highly-motivated team of academic, governmental and industrial (SME) scientists from 5 different countries of European Union (PT, UK, NL, FR, GR).

InSea will cover different disciplines such as hydrodynamics, water quality, atmospheric circulation, remote sensing, Web GIS, databases. Accordingly, the participants will require a wide range of skills expertise and tools and were selected to match these requirements.

InSea was also thought to assure an effective participation of the stakeholders. One of the main concerns of **InSea** is to achieve solutions that may in fact represent an added value to the actions for which the stakeholders are responsible, making use of the full potential given by the fast growing computer power and IT skills to deliver useful information to decision makers and other data users. Nowadays, despite the high investments that both governmental agencies and private companies are allocating to environmental monitoring actions, most of the times there are no effective capabilities to transform the data provided by in situ field data or remote sensing data in information useful to support the necessary management actions.

Thus **InSea** includes scientific groups capable to assure this fundamental stakeholder connection and needs analysis; to develop innovative knowledge management IT systems; to perform data analyses; and to perform process modelling studies.

A summary table identifies all the groups involved (*cf. Table 1*). Merging together Universities, Research institutes and SMEs the consortium has also the appropriate balance between knowledge generators and knowledge disseminators.

The **InSea** team has also an important EC-related experience with most of partners having had previous involvement in other framework programmes as well as expert-evaluators to the EC. *Table 3* and *Table 4* presents a summary of ongoing R&D projects where the InSea partners are involved.

Being one of the strategic objectives of **InSea** the development of methodologies to downscale physics from large scale data systems to regional models in order to force ecological modelling systems on coastal areas, the integration in the consortium of teams also involved in **MERSEA** and **MFSTEP** projects, will provide stronger links with the teams of these projects. This fact will be an additional guarantee of success in what concerns the integration of these regional projects results in **InSea** activities.

Table 1: General information on the participants. (= SMEs)*

N.	Acronym	Institute	Country	Key persons *(female and male)*	Role
1	IST	Instituto Superior Técnico	PT	Ramiro Neves (M) Pedro Pina (M) Sandra Mateus (F) Madalena Santos(F) Marcos Mateus (M) Rodrigo Fernandes (M)	CO,WL,P
2	HIDROMOD*	Hidromod, lda	PT	Adélio Silva (M) Paulo Leitão (M) José Leitão (M) Henrique Coelho (M)	WL, P
3	COMSINE*	ComSine Limited	UK	Ian Morrison (M) Alastair Burnett (M)	P
4	MARIS*	Marine Information Service B.V.	NL	Peter Davis (M) Bert Broeren (M)	P
5	UPS-LA	Université Paul Sabatier. Laboratoire d'Aérologie - Pole d'Océanographie Cotière.	FR	Patrick Marsaleix (M) Claude Estournel (F) Florent Lyard (M)	P
6	CNRS-LOB	Centre National Recherche Scientifique. Laboratoire d'Océanologie et de Biogéochimie.	FR	Christian Grenz (M) Christel Pinazo (F)	WL,P

7	NOVELTIS*	Noveltis	FR	Frédérique Ponchaut (F) Eric Jeansou (M) Pascal Prunet (M) Beatrice Berthelot (F) Gwénaele Jan (F)	P
8	HCMR	Hellenic Centre for Marine Research	GR	George Triantafyllou (M) George Petihakis (M) Gerasim Korres (M) Leonidas Perivoliotis (M) Anastasios Papadopoulos (M) Andy Banks (M) Anna Pollani (F) Kostas Nittis (M)	WL,P
9	NKUA	National and Kapodistrian University of Athens	GR	George Kallos (M) I. Pytharoulis (M) G. Galanis (M) P. Louka (M) P. Katsafados (M) E. Mavromatidis (M) F. Gofa (F) A. Voudouri (F) G. Emmanouel (M) M. Astitha (F) E. Katirtzoglou (F). J. Exidaridis (M)	P

CO=coordinator, WL=work package leader, P=participant

The following table gives an indication of the areas in which participants will have their major contributions.

Table 2: Areas in which participants have their major roles

Partner	Modelling	Data assimilation	Data Management	Remote Sensing	Communications	Integration & applications
IST	X	X				X
HIDROMOD*	X		X			X
COMSINE*					X	
MARIS*			X	X		
UPS-LA	X					X
CNRS -LOB	X	X				
NOVELTIS*			X			
HCMR	X	X		X		X
NKUA	X					

Table 3: Eu ongoing projects where partners are involved

Eu Projects	INSEA partner
5FP **EUROSTRATAFORM** European Margin Strata Formation	IST
5FP MaBenE – **Ma**naging **Be**nthic **E**cosystems in relation to physical forcing and environmental constraints	IST
6FP INCO **EcoManage**: Integrated Ecological Coastal Zone management System	IST, HIDROMOD
5FP-ESD **ICREW** – **I**mproving **C**oastal and **RE**creational **W**aters. Funded under the European Community's Interreg IIIB programme for the Atlantic Area	IST
Life Program - **ECORIVER** - Ecotoxicological Evaluation of Municipal and Industrial Waste Waters	IST
5FP **TempQsim**: Evaluation and improvement of water quality models for application to temporary waters in Southern European catchments	IST
5FP **EUROPHLUKES**: European Cetecean Photo-ID System	MARIS
5FP **EUROSEISMIC**: A central metadatabase for geophysical data derived from marine seismic surveys for the European Seas	MARIS
5FP **SEA-SEARCH**: gateway to Oceanographic and Marine Data & Information in Europe	MARIS
5FP **EMBARC**: European Maritime project for Baseline and Advanced Regional and Coastal traffic management and information services	MARIS
5FP **BIOFLOW**: Flume Facility Co-operation Network for Biological Benthic Boundary Layer Research	CNRS-CNRS-LOB
6FP **COBO**: Coastal Ocean Benthic Observatory	CNRS-CNRS-LOB
5FP **MFSTEP**: Mediterranean Forecasting System : Toward Environmental Processes	UPS-LA, NOVELTIS, HMCR, NKUA
5 FP **INTERPOL**: Impact of natural events and trawling on resuspension, dispersion and fate of Pollutants	UPS-LA
5FP **MERSEA_Strand1**: Marine EnviRonment and Security in the European Area – Strand1	HCMR
6FP **MERSEA_IP**: Marine EnviRonment and Security in the European Area	HCMR, UPS-LA
ESA GMES Service Elements **ROSES**: Real time ocean services for environment and security	HCMR
ESA **ENVIWAVE**: development and Application of Validated Geophysical Ocean Wave Products form ENVISAT ASAR and RA-2 Instruments	NKUA
MERCYMS: An Integrated Approach to Access the Mercury Cycling in the Mediterranean Basin	NKUA
AUTOHAZARD: Automated Fire and Flood Hazard Protection System	NKUA
ANEMOS: Development of a Next Generation Wind Resources Forecasting System for the Large Scale Integration on Onshore and Offshore Wind Farms	NKUA

Table 4: National ongoing projects where partners are involved

National Projects	INSEA partner
REALTIME: Integrated **Real Time** Modelling and Data Acquisition for Coastal Management	IST, HIDROMOD
ERIC - **E**ffects of **Ri**ver Flow **C**hanges on the Fish Communities of the Douro, Tejo and Guadiana Estuaries and Adjoining Coastal Areas (ERIC)	IST
MOBIDYCS - Integrating bioturbation and biodeposition processes in hydrodynamic and transport models for contaminated sediments	IST
TACIS: Technical Assistance Programme for Ukraine, Russia and Georgia within the framework of the Black Sea Environment Programme	MARIS
National Project Tourism Noord-Holland: Tourist and Recreation Information Service. This site gives you a wealth of tourist data & information about North-Holland, including Amsterdam, supplied by the Noord-Holland Tourist Board (VVV Noord-Holland)	MARIS
Programme National Environnement Côtier – Chantier Golfe du Lions	CNRS-LOB
Programme National Environnement Côtier – Chantier Nouvelle Calédonie	CNRS-LOB
ESPEN	NKUA, HCMR
ATHENS2004 OLYMPICS	NKUA

B.4.1 Finantial Resources

The overall budget over the 36 months program is as described in the following tables. Details of the effort (in persons/months) per partner, and per type of activities are given in the Project Effort Forms (see below) and in the Total Budget Forms. The technical risk management efforts are spread into all the technical Work Package and Tasks: they are counted as shared costs, since they involve risk sharing rules with the associated exploitation rewards.

Table 5: InSea overall budget (without management)

Start: Month 0	**Project Leader: IST**						**End:** Month 36
Budget	**Effort** (pers/month)	**Personnel** (keuros)	**Travel** (keuros)	**Consum.** (keuros)	**Equipment** (keuros)	**Overheads** (keuros)	**Total** (keuros)
	321	1,201,551	81,200	104,500	41,000	899,292	2,327,543

Table 6: Coordination and Management cost

	Overall project		**Coordination**			
	Total Effort (pers.months)	**Total Costs (keuros)**	**Effort (pers.months)**	**Costs (keuros)**	**% Total Effort**	**% Total Costs**
All partners	320	2,411,543	11	92,300	3.1	3.8
Coordinator	51	442,300	6	43,000	11.8	11.4

Table 7: Research and innovation efforts

WP	Research Partners	SME's	Total
1	14	1	15
2	134	44	181
3	51	17	68
4	3	25	28
Total	**202**	**87**	**289**

Table 8: Research and innovation efforts

WP	Research Partners	Industrial Partners	Total
5	11	10	21

B.4.1.1 Risk management

The project risks are concentrated:

- ✓ *Technical risks*: the technical issues are concentrated
- ✓ *Deadline risks*: it is compulsory to produce the project outputs on schedule, with a "one month" allowed shift;
- ✓ *Management risks*: the decision taking process must be tuned before the project starts in order to avoid inertia effects typical of large scale, multi organisation and multi disciplinary projects. This is why a common decision taking tool will be implemented.

STREP Project Effort Form 1

Full duration of the project

	IST	HIDROMOD	CONSINE	MARIS	UPS-LA	CNRS-LOB	NOVELTIS	HCMR	NKUA
Research/innovation activities									
WP1	4	1			3	2		5	
WP2	35	4	20		30	2	20	49	18
WP3		17				32		9	10
WP4	3	2		18			5		
Total research/innovation	42	24	20	18	33	36	25	63	28
Dissemination activities									
WP5	3	8		2	2	2		2	2
Total dissemination	3	8		2	2	2		2	2
Management activities									
WP6	6	5							
Total management	6	5							
TOTAL ACTIVITIES	51	37	20	20	35	38	25	65	30

B.4.2 Role of the partners in the project

INSEA partnership was thought to gather the necessary skills that will be necessary to guarantee the accomplishment of the project objectives. This will make necessary to join specialists from different areas such as modelling, physics, biology, data management and publication, local automatic data acquisition, Earth Observation interpretation and data transfer technologies (*e.g. communications*). Once the project is founded also on the capability to deliver products that are suitable to fulfil the needs of the end-users, a strong relation of local stakeholders was envisaged, in order to be possible to incorporate in the project results the real needs of the end-users.

Having these purposes in mind there were selected different sites and partners that, for one side may represent a wide variety of different problems and end-user needs (in order to guarantee that the project results will represent solutions for problems with a trans-national dimension) and, for another side, may bring inside the project team the necessary and sufficient skills to answer to the project objectives. The profile and the role of the different partners in the project are described in the following table.

IST

Short profile

Instituto Superior Técnico (IST), the Engineering School of Lisbon Technical University is the biggest Engineering School in Portugal. The mission of MARETEC is to carry out research and development in the fields of marine environment and marine technologies and disseminate the research results through publication. The research is sponsored by research agencies, industry and services and by the university itself. The permanent research staff is strongly involved in university educational programmes of IST at the graduate and post-graduate levels.

Priority is given to interdisciplinary projects involving water quality, ecology and sediment transport. MARETEC staff dedicated to these subjects occupies 17 people. Environmental modelling at MARETEC was initiated in the early 80's developing hydrodynamic models based on the shallow water equations and their application to coastal and ocean hydrodynamics. As computer capacity and knowledge increased, more generic and integrated models were developed and integrated into a modular system (MOHID) which is presently being used and improved in a private company (HIDROMOD), in the National Laboratory of Civil Engineering and in several Universities in Portugal and abroad.

MOHID is based on a "finite-volume" approach, which, together with an object-oriented strategy, allows the use of multiple vertical coordinates (sigma, Cartesian, Lagrangian) and the use of eulerian and lagrangian formulations for advection, still keeping the integration between physical and ecological processes.

Role on the Project:

IST will coordinate the project. It will also coordinate Workpackage 1, while being involved in 9 of the 24 tasks of the project. IST will be responsible for coordinating the WP1 with the purpose of focus on the problems addressed by the project and gather the available knowledge in each site. IST has a large experience on the application of modelling tools do support the implementation of European directives (Water Framework Directive, Nitrated Directive and other) and regional conventions (e.g. OSPAR), which will help lead the work to fulfil the knowledge need of the modelling teams as well the data needs of end-users and local stakeholders. IST will also be responsible for the development and implementation tasks relate to the Portuguese study site where it will apply the MOHID modelling system, together with HIDROMOD, and disseminate to local partners and stakeholders the results of **InSea** project.. The IST team is multidisciplinary and has proven on previous occasions to have the necessary skills to fulfil the project requirements.

Key persons involved in the project:

Prof. Ramiro Neves, is an Associate Professor at IST. He will be the scientific coordinator of the project. In the past, he has also coordinated the work of this team in several National and European research projects funded by MAST (JEEP 92, OMEX, EUROMODEL, OPCOM) and Environment (MATURE, EUROSAM). He has also large experience of results exploitation. His group is presently carrying modelling activities for 2 companies running wastewater systems and for the Portuguese water Authority, in the framework of the application of EU water related Directives.

These projects represent about 50% of the funding of his research group. He has oriented 9 Ph.D thesis and more than 15 MSc thesis on mathematical modelling of the Marine Environment. He teaches Fluid Mechanics, Physical Oceanography and Modelling of the Aquatic Environment. Recently Prof. Ramiro Neves was appointed by INAG (the Portuguese National Water Agency) to represent Portugal in the eutrophization modelling goup of OSPAR.

Pedro Pina has a degree in Environmental Engineering (1998- Technical University of Lisbon) and a master degree in Ecology, Management and Modelling the Marine Environment (2001- Technical University of Lisbon). He has a large experience regarding numerical simulation of biogeochemical processes in estuarine and coastal environments in the framework of several national and European research projects. He has focus is research in studying eutrophication processes and coupling remote sensing to numerical models. He gained large experience on the Insea Portuguese study area during a project for modelling and monitorization of the difuse pollution effects on the beaches in the Costa do Estoril. He also participated on a national research project with the National Water Institute (INAG), to a make an "Assessment of the trophic Level in Portuguese Estuaries", working in ecological and physical modelling in several Portuguese Estuaries.

Marcos Mateus graduated from the Marine Biology Department of the University of Algarve in 1997. He received his M.Sc. in Marine Sciences in 2000 from Instituto Superior Tecnico in Lisbon, and is presently finishing is PhD in Environmental Engineering in the same university. Meanwhile he has worked has a researcher at CIACOMAR (in Algarve) in physical oceanography and ecological modelling. In the last three years he has been working at MARETC research group (Lisbon), involved in many national and European projects. His work has focused in both the implementation and development of water quality and ecological models for estuarine and coastal systems. He currently holds a position of research scientist in MARETEC, as a member of MABENE project team, being responsible for the development of a biogeochemical model for the project study areas.

Madalena Santos graduated from the Physics Faculty of the University of Aveiro in 2001 and is currently finishing her M.Sc. in Ecology, Management and Modelling of the Marine Resources from the Lisbon Universities, Instituto Superior Técnico and Universidade Nova de Lisboa. During the last 3 years (2002-2004) she has been working at the Maretec research centre at the Instituto Superior Técnico de Lisboa as research associated. During this period she gained experience in computing resource management for operational applications, participating in Tagus Operational Model project. Currently she is involved in a project for the development of a Operational Model for the Portuguese Coast. She also participated on a national research project with the National Water Institute (INAG), to a make an "Assessment of the trophic Level in Portuguese Estuaries", where she worked in ecological modelling in several Portuguese Estuaries.

Rodrigo Fernandes graduated from the Technical Superior Institute of the Technical University of Lisbon in 2001 and has delivered his M. Sc. thesis in Marine Science in 2004 from the same University. Since 2001 he joined Marine and Environmental Technology Center (MARETEC) of Technical Superior Institute (in Technical University of Lisbon), where he worked as a research fellow. During these years he was mainly involved in projects about numerical modelling (especially in oil spills modelling), data management, and operational applications. He is highly involved in operational forecasts of Prestige oil spill, in processing and publishing marine automatic and non-automatic data. He is currently responsible for the operational model in the Tagus estuary developed by the MARETEC team.

Sandra Mateus graduated from the Marine Biology and Environment Sciences Faculty of the University of Algarve in 2001 and is currently finishing her M.Sc. in Ecology, Management and Modelling of the Marine Resources from the Lisbon Universities, Instituto Superior Técnico and Universidade Nova de Lisboa. For three years (1999-2001) she joined the Marine Biology group of Algarve University where she worked as an internship researcher. During these years she was involved in some European projects about Marine Biology and Water Quality, while she gained experience in field and lab work. She currently holds a position of junior researcher and master student in the Maretec research centre at the Instituto Superior Técnico de Lisboa, as a member of many European projects, working in the ecological modelling applications to potential eutrophicated environments as a forecast and management tools.

Four relevant Publications:

Braunschweig F., Martins, F., P. Leitão e R. Neves 2003 A methodology to estimate renewal time scales in estuaries: the Tagus Estuary case. Ocean Dynamics. Volume 53, Number 3; Pages: 137 – 145, September 2003.

Huthnance, J., H. S. Coelho, C. Griffiths, P. J. Knight, R. Pingree, A. Rees, B. Sinha, A. Vangriesheim, M. White and P. Chatwin, Physical structures, advection and mixing at Goban Spur. *Deep-Sea Research* 48*,* 2979-3021, 2001.

Coelho, H., R. Neves, M. White, P.C. Leitão and A. Santos (2002). A Model for Ocean Circulation on the Iberian Coast. Journal of Marine Systems, 32(1-3): 153-179.

Castro M., M. Gómez-Gesteira, R. Prego and R. Neves, Wind influence on water exchange between the ria of ferrol (NW, Spain) and the shelf. *Estuarine, Coastal and Shelf Research* Vol. 56, pp. 1055-1064 (2003).

HIDROMOD

Short profile

Hidromod, Modelação em Engenharia, Lda, (Hidromod) is a Portuguese technical consulting company which develops and applies technical software in engineering and scientific areas related to fluid mechanics: hydrodynamics, wave propagation, water quality, sediment transport, point source and diffuse pollution and ecology.

This scientific/technical expertise is based on ten years experience achieved in the application of models to real cases, in the framework of more than 200 engineering and scientific projects, and on the maintenance of a close cooperation with the Technical University of Lisbon (Instituto Superior Técnico).

The company maintains deep interest in several research areas and is / has been involved in different R&D projects both European (eg. OPCOM, INDIA and F-ECTS) and national funded (ECORUDI, MODELRIA, REALTIME). Besides those scientific projects, Hidromod is / has been also involved in major projects in Brasil, dealing with sediment transport, water quality and fieldwork programs, and several projects in Portugal dealing with wave propagation, water quality, sediment transport and effluent dispersion.

Hidromod has also an important experience concerning Tagus estuary and coastal zone and strong links with the local stakeholders. The involvement of Hidromod in other similar projects both in Portugal and Brazil will also constitute an added value in terms of the project results dissemination.

Role in the project:

In the framework of **INSEA** Hidromod, in cooperation with IST, will apply MOHID modelling system to the Lisbon test site. Hidromod will also responsible for the activities related with the data management and publication.

Hidromod will also be responsible for the project technical management activities as described in detail in the management description section.

Key persons involved in the project:

Dr. Adélio Silva has a degree on Civil Engineering (1984 - Technical University of Lisbon) and a Ph.D. in Mechanical Engineering (1992 - Technical University of Lisbon). He has a large experience regarding engineering consulting studies related with the application of mathematical models. He has also been the main responsible for the participation of Hidromod in different Research Projects (eg. OPCOM, INDIA, F-ECTS, ECORUDI, REALTIME, MODELRIA).

Dr. José Chambel Leitão has a degree in Civil Engineering (1987 - Technical University of Lisbon) and a Ph.D. in Mechanical Engineering (1992 - Technical University of Lisbon). Beyond his participation in several consulting projects in which HIDROMOD has been involved along the last 12 years, he has been the main responsible for important projects that are running in Brazil related with mathematical modelling, oil dispersion and risk assessment and field data programs.

Dr. Henrique Coelho has a Degree in Physical Oceanography (1993 - Classic University of Lisbon), a Master Degree in Ecology, Management and Modelling the Marine Environment (1996 - Technical University of Lisbon) a PhD in Environmental Sciences (2002 - Technical University of Lisbon). He has a large experience studying physical and ecological processes in coastal environments using numerical tools in the framework of research and engineering projects. He has participated in several European Projects (eg. SATOCEAN, OMEX I and II, EUROMODEL, EUROSTRATAFORM) as National projects.

Dr. Paulo Chambel Leitão has a degree in Civil Engineering (1993 - Technical University of Lisbon), a Master in Management, Ecology and Modelling the Marine Environment (1996 - Technical University of Lisbon) and a Ph.D in Environmental Engineering (2002 - Technical University of Lisbon). He has a large experience regarding numerical simulation of transport processes of momentum and mass in marine environments in the framework of research and engineering projects. He has participated in several European Projects (eg. OMEX, EUROSAM, OPCOM, F-ECTS, MABENE, EUROSTRATAFORM) as National projects.

Four relevant publications

Balseiro, C.F., P. Carracedo, B. Gómez, P.C. Leitão, P. Montero, L. Naranjo, E. Penabad and V. Pérez-Muñuzuri, “Tracking the ‘Prestige’ Oil Spill. An operational Experience in Simulation at MeteoGalicia”. *Weather*, Vol. 58, 2003.

Martins, F., R. Neves, e P. Leitão, 2002. Simulating water mixing in homogeneous estuaries: The SADO estuary case. Hydrobiologia 475/476:221-227.

Martins, F., Neves R., Leitão P. & Silva A.J.R., *3D modeling in the Sado estuary using a new generic coordinate approach*, Oceanologica Acta, Vol.24, Nº1 pp. S51-S62, 2001.

Villarreal M. R.. Montero, J.J. Taboada, R. Prego, P.C. Leitão and V. Pérez-Villar (2002). Hydrodynamic Model Study of the Ria de Pontevedra under Estuarine Conditions. *Estuarine and Coastal Shelf Science*. 54/1, 101-113 pp.

COMSINE

Short profile

ComSine Limited (ComSine) is a UK SME specialising in IT consultancy and software/hardware development for the telecommunications and geographic information industries. We have significant commercial and technical expertise in two increasingly synergistic domains: mobile communications (including satcoms) and spatial information systems (including GIS, location-based services and location-enabled applications).

ComSine mobile satcoms activities focus on air interface design and terminal development for next generation miniature mobile satellite terminals. Our Technical Director (Telecoms) has 20 years experience in the satcoms industry, leading numerous R&D projects for the likes of Inmarsat, Intelsat and Alcatel Espacio. In partnership with ESA, ComSine is currently developing an advanced miniature L-band satellite terminal for Inmarsat-4 services known as 'UPS-LAketSAT'. This unit operates as an accessory to a PDA or Smartphone and includes an integral GPS/Galileo receiver. Already the smallest terminal in its class, ComSine is continuing development to even smaller scales in creating the 'PicoTracker' terminal for remote monitoring/tracking/telemetry applications. PicoTracker will communicate via geostationary satellites and yet be sufficiently small and inexpensive to allow it to be used liberally in a distributed data collection system. It will provide "instant messaging" as opposed to store-and-forward messaging that has until now been the only possibility for terminals of such a small form factor. Instant real-time communications is considered highly desirable for many emerging GMES applications.

ComSine spatial information systems activities include the development of systems and services based on the use of OGC standards and web service architectures. Our Technical Director (Spatial Data Systems) previously worked for Hutchison 3G and designed their Map Portrayal service - used as part of their wireless LBS product line for rendering of maps at varying scales on varying screen sizes. Our Managing Director has 18 years experience of data management and processing of Earth observation data and we have just started three projects directly related to the application of web technologies for aiding spatial information access via the Internet. We also specialise in spatial data metadata standards (e.g. ISO 19115, Z39.50 (GEO), INFEO-CIP, etc.) and have been involved in work with the 'Committee of Earth Observation Satellites' (CEOS) since the early 1990s.

Role in the Project:

ComSine will perform Work Package 2.7 concerning local data acquisition. The InSea partners are interested in exploring the development of a satellite-based data acquisition system that could be deployed universally at any site across Europe, independent of local terrestrial communications infrastructure. ComSine will examine extensions/modifications to its 'PicoTracker' satellite telemetry system to satisfy the InSea water management requirements. This data acquisition solution is envisaged to form part of the complete InSea 'toolset' for end users. ComSine's tasks will include requirements capture, systems analysis and prototype design and implementation.

Key persons involved in the project:

Dr. Ian Morrison has a Bachelors degree in Electronic Engineering (1983 – South Australian Institute of Technology), a Masters degree in Electronic Engineering (1987 – South Australian Institute of Technology) and a PhD in Information Technology (1997 – University of South Australia). He has extensive experience in the fields of satellite communications and digital signal processing, in both academia and industry. His research has centred on modulation/coding algorithms and air interface design for satellite communications systems. He is currently Technical Director (Telecoms) of ComSine Ltd, which he co-founded in 2002. He is the architect of the 'PicoTracker' system, which is being proposed as the basis for a data acquisition solution for the InSea project.

Alastair Burnett has a Masters degree in Electrical and Electronic Engineering (2001 - University of Aberdeen). He has been the principal software engineer on ComSine's 'PocketSAT' project. ComSine intends to use the PocketSAT platform for key prototyping activities on the InSea project.

Four relevant publications

Morrison I.S. and Miller M.J., "The Implementation of Error Control Techniques in Digital Satellite Communications", Proc. I.E. Australian National Space Engineering Symposium, Canberra, Australia, 1984.

Morrison I.S., "ACE-QPSK: A New Method of Coding QPSK for the Nonlinear Transmitter", Proc. IEEE International Conference on Networks / International Conference on Information Engineering, Vol. 2, Singapore, September 1993.

Morrison I.S., Pietrobon S.S., Gray P. and Kasparian J.J, "A 155 Mbit/s FEC Codec for B-ISDN Over a 72 MHz Satellite Transponder", Journal of Electrical and Electronics Engineering, Australia - IE Aust. & IREE Aust., December 1993.

Morrison I.S., "Coding for Reduced Spectral Regrowth on Nonlinear Channels", PhD Dissertation, University of South Australia, 1996

MARIS

Short profile

Marine Information Service MARIS, (MARIS) is active as an independent company in 1) Marine Information services & Data brokerage, 2) Consultancy, development and implementation of Marine Data & Information management systems and services, 3) Project development and management and 4) Development and management of Internet sites and applications.

Information management systems are mostly developed in governmental projects and international bodies, such as the EC and UNEP, and for bilateral co-operation between the Netherlands and Eastern European countries. Data-Management Support and Data-Management Information & Support System Development within EU-Projects such as EUROCORE, EUMARSIN (www.eu-seased.net), EURONODIM (PC)- www.sea-search.net, ENGINE (www.gasandoil.com), MAGIS (PC)- www.sandandgravel.net, WADSIS (PC)- www.waddenseamaps.net), SEA-SEARCH (PC) and DECOM (PC) - (PC)=MARIS also project coordinator

Role in the Project:

As mentioned the Data-Management activities (WP4) will be executed by partner MARIS (Marine Information Service) from the Netherlands. MARIS is well experienced in all aspects of data-management, development of databases and meta-databases, as well as development of Management Information Systems and Decision Support Systems on the WWW, using GIS interfaces.

Key persons involved in the project:

M.Sc. P.G.J. Davis from MARIS, has extensive experience in coordination and management of a large number of national and international data-management projects with involvement of a large number of participants, including EU-projects such as: 4FP-INCO-MASS (12 partners), IST-INFO2000-MAGIS (12 partners), IST-INFO2000-WADSIS (12 partners), 5FP-COPERNICUS2-CASPSCIENCE NET (18 partners) and 5FP-EESD-Sea-Search (32 partners).

B. Broeren, System Analyst and Software Programmer MARIS. B. Broeren as System Analyst, will draw on his considerable experience as all round PC-system specialist for a number works at MARIS and his former employer System house RAET, including the design and programming of data-management and information systems for marine and land-based resources, in DOS as well Windows environment, data-retrieval, data-quality and data-presentation software. He is well experienced in development and application of Management Information Systems based on WWW technologies, and using GIS based WWW interfaces.

UPS-LA

Short profile

Pole d'Océanographie Cotière (UPS-LA) is a team of scientists involved in coastal ocean modelling studies. The main activities of UPS-LA are 3D modelling of coastal circulations, tidal prediction and data assimilation. The team is composed of 5 permanent researchers, 3 post-doc researchers and 5 thesis students.

Concerning the North Western Mediterranean region, UPS-LA is focussed on wind driven coastal circulations (upwelling, gravity waves and coastal jets), river plume dynamics, interactions of offshore circulations with shelf currents.

UPS-LA participates to several international (European and North American), national or regional projects. Most of them are the frame of cooperation of UPS-LA with the two others French partners of this STREP (Noveltis & CNRS-LOB). Among these projects, MFSTEP offers interesting links with our proposal. Indeed MFSTEP (part of MERSEA) is a European project focussed on operational oceanic predictions at basin, regional and coastal scales. UPS-LA provides weekly forcasts of the circulation of the Gulf of Lion. The Gulf of Fos, one of the 3 sites proposed, is a small bay enclosed in the Gulf of Lion and thus this STREP project is a perfect opportunity to extend the experience gained in downscaling methodologies, thanks to MFSTEP, to a high resolution modelling system of the Gulf of Fos connected to MFSTEP coastal model. UPS-LA is also involved in data assimilation work-packages of several EC projects (like MERSEA IP). UPS-LA has been cooperating for years with CNRS-LOB on ecological-physical modelling. UPS-LA and CNRS-LOB have recently worked together on a numerical model of the Gulf of Fos applied to modelfos2 campaign (ec project OAERRE).

Role in the Project

UPS -LA will be involved in 10 of the 24 tasks of the project. UPS -LA has a large experience on the application physical models to coastal waters and coupling with biogeochemical models which will help them following closely the implementation plan in each site. Together with CNRS-LOB, UPS -LA will also be responsible for the development and implementation tasks relate to the French study site and dissemination to local partners and stakeholders the results of **InSea** project.

Key persons involved in the project:

Patrick Marsaleix 1989-1990:training for ocean modelling in the team of Bryan Johns, Department of Meteorology, University of Reading (UK). 1993: PhD in coastal ocean circulations modelling. Université Paul Sabatier. Toulouse. France. Since 1993: research position at CNRS, works in the coastal oceanography team of Laboratoire d'Aérologie.Member of the POC (Pôle d'Océanographie Côtière) of «Observatoire Midi-Pyrénées».Activity: developpement of a sigma coordinate, free surface, ocean model (Symphonie) using finite differences technique. Studied areas: Golfe du Lion, Golfe de Fos (Northwestern Mediterranean),Bay of Biscay (Atlantic Ocean).

Claude Estournel Claude Estournel, born in 1958. Directrice de Recherche CNRS. Laboratoire d'Aérologie. Pole d'océanographie côtière. Toulouse. PhD in 1982 on the atmospheric boundary layer. 10 years of research on the study of radiative and turbulent processes in the atmospheric boundary layer. 10 years of research in coastal oceanography. About 25 scientific papers in peer-reviewed journals. Main interests : coastal modelling, ocean atmosphere interactions, sediment transport modelling.

Florent Lyard 1992: PhD in Fluid Dynamics. Université Joseph Fourier. Grenoble. France. Since 1997 : Research position at CNRS (Centre National Recherche Scientifique – France). Laboratory : LEGOS, 14 Avenue Edouard Belin, 31400 Toulouse, France Member of the POC (Pôle d'Océanographie Côtière) of «Observatoire Midi-Pyrénées». Research topics : Gravity waves and tides modelling based on finite and volume elements technics. Studied areas: Mediterranean sea, North Western Atlantic Ocean

Four relevant publications:

Estournel C., Durrieu de Madron X., Marsaleix P., Auclair F., Julliand C. and R. Vehil, 2003, Observation and modelisation of the winter coastal oceanic circulation in the Gulf of Lions under wind conditions influenced by the continental orography (FETCH experiment). Journal of Geophysical Research 108, C3, pages 7-1 to 7-18

Auclair F., Marsaleix P., and De Mey P., 2003, Space-time structure and dynamics of the forecast error in a coastal circulation model of the Gulf of Lions. Dynamics of Atmospheres and Oceans, 36, 309-346

Estournel C., Broche P., Marsaleix P., Devenon J.L., Auclair F. and Vehil R, 2001, The Rhone river plume in unsteady conditions: numerical and experimental results. Estuarine, Coastal and Shelf Science. 53, 25-38.

Pinazo C., Marsaleix P., Millet B., Estournel C., Kondrachoff V. and R. Véhil. 2001, Phytoplankton variability in summer in the northwestern Mediterranean: modelling of the wind and freshwater impacts. Journal of Coastal Research. 17, 1, 146-161.

CNRS-LOB

Short profile

Laboratoire d'Océanographie et de Biogéochimie (CNRS-LOB) is part of the Centre d'Océanologie de Marseille (COM) one of the largest Research Institutes in Oceanography in Southern France. As a component of the "Université de la Méditerranéen", COM participates in education/training through higher degrees (Licence, Maîtrise and DEA) in the field of Marine Sciences. Presently about 200 scientists carry out scientific research work concerning 3 topics from ocean flux studies (JOGS); through history of oceans and species from the evolutionary, paleoclimatic (GCNRS-LOBal Change) and biogeographical points of view; and finally to organic matter recycling studies in coastal areas.

CNRS-LOB is involved in several national projects as "Programme National en Environement Côtier (PNEC)", was involved in MAST-III in EU FP5 programs as well as in international programs (JGOFS-POMME; EUROSTRATAFORM, a joint EU-US program. Since the early 80, CNRS-LOB has contributed to coastal Ecology with studies in the estuarine system of the Golfe de Fos and Etang de Berre, which is largely influenced by continental freshwater inputs from the Rhône and Durance River respectively. These studies have provided a substantial amount of information in the fields of hydrodynamics, hydrobiology, pelagic and benthic processes. Specific expertise of CNRS-LOB participants relevant to the project is in the field of: dissolved and particulate fluxes at the sediment water interface; pelagic and benthic mineralisation process studies including bioturbation,; HPLC determination of algal pigments; resuspension and deposition processes (flume experiments) and numerical modelling of ecosystems and diagenetic processes.

Role in the Project

CNRS-LOB coordinate Work Package 3, while being involved in 8 of the 24 tasks of the project. CNRS-LOB will contribute on the coupling of the ecology routines into the hydrodynamic model applied to Golfe de Fos. Specifically, the adaptation will be based on previous work already tested in the frame of national and European projects. A benthic compartment will be added in order to describe the tight connection between water column and sediment in terms of particle and dissolved exchanges at this interface, based on a module already tested in EU PROVESS project (PROWQM). Data acquisition and management for model calibration and validation will be performed as developments of specific assimilation algorithms to be used in close collaboration with Noveltis and POC. Partner 6 will disseminate the results of **InSea** project to local partners and stakeholders already interested in close cooperation with the other members of **InSea**.

Key persons involved in the project:

Dr Christian Grenz, PhD graduated in 1989 while studying the process of biodeposition of bivalves and the related environmental impact in shellfish cultures. Between 1990 and 1992, he was involved in coastal ecosystem modelling with special attention to sediment-water exchanges performed at coastal meso-scales (Gulf of Lions) as littoral scales (Lagune de Nouméa, Gulf of Fos). In 1992, he was appointed Chargé de Recherche CNRS at CNRS-LOB and extended his work to pelagic-benthic coupling processes. He participated in French PNEC and EU PROVESS and OAERRE (parts of ELOISE) as work package leader and in UE BIOFLOW as PI. His present research is concerned with biogeochemical and hydrodynamic interactions at the sediment-water interface. This is performed in situ with benthic lander devices and through laboratory experiments by mean of the linear flumes he constructed (HERODE).

Dr. Christel Pinazo, graduated in oceanography in 1992 at the University de la Méditerranée in Marseille. During PhD research at the Oceanographic Center of Marseille (COM), she developed a 3D coupled physical-biogeochemical model to study the major phytoplankton dynamics at the mesoscale of the Gulf of Lions (northwestern Mediterranean).This work took part of the national National Program of Coastal Environment (PNEC – Chantier Golfe du Lion) and was partly based on data from the EU EROS2000-CYBELE campaign. In 1996 she became assistant-professor at the University de la Méditerranée. Her present research is concerned with modelling of the hydrodynamic impact on sediment and biological dynamics in coastal zones. This work takes part of the national PNEC and the EU OAERRE and BioFlow projects.

Four relevant publications

Bujan S, Grenz C, Fichez R, Douillet P. 2000. Evolution saisonnière du cycle biogéochimique dans le lagon sud-ouest de Nouvelle Calédonie. Application d'un modèle compartimental. C. R. Acad. Sci., Paris, 323 : 225-233.

Cloern J.E., C. Grenz and L. Vidergar Lucas, 1995. An empirical model of the phytoplankton Chlorophyll : carbon ratio -the conversion factor between productivity and growth rate. Limnol. Oceanogr. 40(7) : 1313-1321.

Pinazo C., Bujan S., Maurin A., Douillet P., Fichez R. and C. Grenz, 2004. Impact of wind and freshwater inputs on phytoplankton biomass in the coral reef lagoon of New Caledonia during the summer cyclonic period: a coupled 3D biogeochemical modelling approach. Sous presse Coral Reefs, 23 (2).

Pinazo C., P. Marsaleix, B. Millet, C. Estournel & R. Véhil, 1996. Spatial and temporal variability of phytoplankton biomass in upwelling areas of the northwestern Mediterranean : a coupled physical and biogeochemical approach. J. Mar. Syst., 7 : 161-191.

NOVELTIS

Short profile

The NOVELTIS Company devised and set up an organisation particularly apt to promote disciplinary interactions between its engineers, and favour the transfer from the world of Research to the world of industry and applications. Since its creation (december 1998), NOVELTIS has developed thematic engineer teams with expertise in the field of ocean sciences, atmospheric sciences, land surfaces and astrophysics.

NOVELTIS contributes to the definition, design and development of space systems and their applications in compliance with industrial development processes (quality standards, methodology, time allowance and cost control). NOVELTIS works for agencies and the European space industry in close conjunction with French and European research laboratories.

Since year 2000, NOVELTIS has partnership agreement with UPS-LA (Pôle d'Oceanographie Côtière, Toulouse) to use the 3D coastal ocean model SYMPHONIE and the 2D gravity waves model MOG2D. The aim of NOVELTIS is to develop tools to assist decision-making in environmental applications based on these scientific tools.

For instance, UPS-LA and NOVELTIS have developed a 3D high resolution model of the Gulf of Fos which is nested in the Gulf of Lion coastal model (www.aero.obs-mip.fr/activite_scientifique/oceano/Fos1.htm). First validations of the model were obtained through comparisons with in-situ data (Ulses et al., 2004 submitted to *Journal of Marine Systems*). Outputs were provided to CNRS-LOB for sedimentology studies. NOVELTIS is also involved in the MFSTEP project (Mediterranean Forecasting System – Toward Environmental Predictions, component of the MERSEA project) of the 5th PCRD (www.bo.ingv.it/mfstep). NOVELTIS is in charge of the documentation and diffusion of a 3D variational initialization method for regional and coastal models (VIFOP) developped by the UPS-LA. In addition, NOVELTIS and UPS-LA are in charge of producing 3-5 days ocean forecasting for the North western Mediterrranean sea and more particularly for the Gulf of Lion area during the MFSTEP operational phase (sept 2004-mars 2005). The ability of the regional model forced by the basin scale OGCM for real time forecasts will be evaluated during this operational phase.

In the frame of Topex-Poseidon and Jason missions, the NOVELTIS' ocean team has developed expertise on calibration and validation of the altimetric measurement but also on its improvement by better estimating the effects related to the propagation of the signal in the atmosphere. In this framework, NOVELTIS currently operates MOG2D for absolute calibration purposes.

In the context of the activities of the atmospheric group for the use of IASI data for meteorological applications, NOVELTIS developed and uses retrieval methods based on 1-dimensional variational assimilation techniques, and has an expertise of various assimilation methods used in operational context by Weather prediction systems. Hence, NOVELTIS supports research activities, through Ph D. thesis financing. At the moment, NOVELTIS is financing a PhD thesis dedicated to the development of an assimilation scheme in coastal or shelf models.

Role in the project

Noveltis, has a large experience on several areas concerning the current project: Modelling, remote sensing, data acquisition, GIS. Their role in InSea will be devoted to Earth Ôbservation (EO) in particular to data analysis and integration to numerical tools. Noveltis will be involved in 5 of the 24 tasks of the project On WP1 will be responsible for gathering the relevant historical EO data for the French site and on all tasks related to EO data. Noveltis will aso give scientific support to the Portuguese team in EO issues.

Key persons in the project

Frédérique Ponchaut is a graduate engineer of the Ecole Nationale de l'Aéronautique et de l'Espace in Toulouse. She holds a master degree in oceanography. She worked as research engineer during 2.5 years at the LEGOS in the C. Le Provost and Anny Cazenave team. She contributes to the ESA mission selection on Gravity Field and Steady-State Ocean Circulation (GOCE). She also participates to the World Ocean Circulation Experiment by providing a comprehensive analysis of the tidal signal in the WOCE Sea Level Data Set. Since October 1999, she joined NOVELTIS company in the ocean group where she mainly acts as project manager. She works in collaboration with the UPS-LAT on the three-dimensional coastal ocean circulation modeling. She also collaborated with the CNES to improve the ionospheric correction estimation to apply to the altimetric measurement

Eric Jeansou is a graduate engineer of the Ecole Nationale de l'Aéronautique et de l'Espace in Toulouse. He worked on the in-flight calibration/validation of TOPEX/POSEIDON and Jason-1 altimeter measurements. He designed data processing methods adapted to coastal data, permitting comparison between remote sensing observation with tide gauges measurements. He has a wide knowledge of the overall altimetric system and the various parameters impacting the quality of the altimetric data: propagation path delay, interaction with the sea-surface, altimeter and radiometer characteristics. He participated also to several projects related to altimetry: improvement of the ionospheric correction for Jason-1, preparation of future tracking methods for Jason-2.

Pascal Prunet holds a Ph.D. in physical and biogeochemical oceanography from Toulouse III university, concerning the assimilation of bio-geochemical and physical remote-sensed data (SST and Chla derived from ocean colour) in a surface ocean model of the carbon cycle coupling physical and bio-geochemical processes. He has a post-doctoral formation in atmospheric sciences, in the context of atmospheric parameter retrieval from satellite measurements. He has 5 years of experience in inversion of atmospheric parameters from ATOVS and IASI sounding instruments, and their assimilation in numerical forecast atmospheric models. In the context of the NOVELTIS atmospheric group activities, he mainly works as project manager on treatment and inversion of infrared satellite measurements for their use in atmospheric applications, with EUMETSAT, ESA and CNES.

Beatrice Berthelot obtained her PhD in 1991, in Physics and chemistry of environment at Institut National Polytechnique de Toulouse on the subject "Estimation of ocean primary production using ocean color data". She worked in bio-optics algorithms to estimate primary production and chlorophyll with satellite data (CZCS, Airborne PolDER). She is experimented in image processing in the Visible/ Near Infrared part of the solar spectrum, radiative transfer in the ocean and atmosphere. For three years now, she is working on the radiometric processing for Optical sensors.

Gwénaele Jan holds a Ph.D. in physical oceanography from Paris 6 university (Pierre et Marie Curie) in march 2001. Her thesis subject was concerned with the Impact of the atmospheric forcing on the sea surface layers dynamics, applied to the occidental Mediterranean Sea. Its main field of study is currently the numerical modeling of ocean dynamics. In the last 4 years, its research works have led to use and work on models of particles and floating objects trajectories in collaboration with Météo-France and the LODYC.

Four relevant publications

Lyard F., F. Ponchaut and C. Le Provost, Toward a better determination of the long period tides in the gCNRS-LOBal ocean from a high resolution hydrodynamic model and tidal gauge data assimilation, submitted to J. Geophys. Res.

Cazenave A., K. Dominh, F. Ponchaut, L. Soudarin, J.F. Cretaux and C. Le Provost, Sea level changes from Topex-Poseidon altimetry and tide gauges, and vertical crustal motions form DORIS, J. Geophys. Res., Vol. 26, N° 14, pp. 2077-2080, July 1999.

Prunet, P., J.-F. Minster, D. Ruiz-Pino, I. Dadou, 1996. Assimilation of surface data in a one-dimensional physical-biogeochemical model of the surface ocean. 1. Method and preliminary results, GCNRS-LOBal Biogeochemical Cycles, 10, pp. 111-138.

Prunet, P., J.-N. Thépaut, V. Cassé, J. Pailleux, A. Baverez and C. Cardinali, 2000. Strategies for the assimilation of new satellite measurements at Météo-France, Adv. Space Res., 25, 5, pp. 1073-1076

HCMR

Short profile

The Hellenic Centre for Marine Research (HCMR) is a governmental research organization operating under the auspices of the General Secretariat of Research and Technology (Ministry of Development). It has the mandate to promote basic research in all fields of aquatic environment and to deliver comprehensive scientific and technical support to the public. It was formed by the merging between the National Centre for Marine Research (NCMR) and the Institute of Marine Biology of Crete (IMBC) and it is now composed by the following five Institutes: Oceanography, Marine Biological Resources, Inland Waters (based in Anavyssos), Aquaculture, Marine Biology & Genetics (based in Crete). The scientific personnel numbers 200 researchers and 90 technicians while 55 people support its administration. HCMR operates the 62m R/V Aegaeo, the 23m R/V Filia and the manned submersible THETIS with a total crew of 34 persons as well as two aquariums in Crete and Rhode Islands.

Within the last 20 years the Institute of Oceanography has contributed to a large number of international research projects, carried out in several regions of the Mediterranean and the Black Seas, such as: POEM, METROMED, KEYCOP, PELAGOS, OTRANTO, CINCS, MATER, MEDATLAS, MARSAIS, DANUBES, INTERPOL, BIMS, EDIOS. In the same time it participates in large international initiatives such as GCNRS-LOBEC and GOOS and supports actively the efforts of IOC. Since 1996, NCMR is a member of EuroGOOS and contributes by (a) developing a national capacity in operational monitoring and forecasting through the POSEIDON project, and b) participating in various EU funded research projects for the development of a European capacity in Operational Oceanography [e.g. MFS-PP (1999-2001), MAMA (2002-2004), Ferry-Box (2002-2005), MERSEA-Strand1 (2003-2004) and MFSTEP (2003-2005)]. The POSEIDON system was implemented during 1997-2000 following a 14Meuro investment of EFTA and the Hellenic Ministry of Economy and since the beginning of 2000 it provides operationally information and forecasts for meteorological conditions, sea-state, currents, hydrological structure and water quality in the Eastern Mediterranean.

Role in the Project

HCMR will coordinate Workpackage 2, while being involved in 14 of the 24 tasks in the project. HCMR will be responsible for coordinating WP2 with the purpose of making the necessary developments to integrate efficiently the available data sources and numerical tools. HCMR has a large experience on the application numerical models to coastal areas and has developed plenty scientific work with emphases on assimilation techniques. HCMR will also be responsible for the development and implementation tasks relate to the Greek study site where it will apply the its water modelling system, together with NKUA supporting Atmospheric modelling, and disseminate to local partners and stakeholders the results of **InSea** project.. The HCMR team is multidisciplinary and has proven on previous occasions to have the necessary skills to fulfil the project requirements.

Key persons involved in the project

George N. Triantafyllou, Senior Scientist of the Institute of Oceanography HCMR. He has a Ph.D. (1990) in Oceanography from the Aristotle University of Thessaloniki, after his M.Sc. (1988) in Oceanography and his B.Sc. (1982) in Mathematics from the University of Athens. He has post-doctoral experience (1992-1994) from the University of Wisconsin-Milwaukee, Dept. of Geosciences, as a Research Associate (BCS-9207943, NSF), teaching Dynamic Meteorology courses to postgraduate and undergraduate students, and conducting research in Geophysical Fluid Dynamics and Non-linear Dynamics. Currently he is participating in the MFSTEP and COSTIMPACT projects conducting research in ecosystem modelling and data assimilation. His research interests include the development and application of numerical mathematical models and management tools, data analysis, data assimilation, nonlinear dynamics, nonlinear prediction, climate dynamics, ecosystem dynamics. He will be the scientist in charge for HCMRs contribution to the project.

George I. Petihakis, is a researcher of the Institute of Oceanography HCMR. He got an M.Sc. (1989) in Applied Fish Biology from the Polytechnic South West (Plymouth) after completed his B.Sc. (1988) in Ecology from the Royal Holloway and Bedford new College University of London and his Ph.D. «Hydrodynamic and Ecological Simulation of the Ecosystem of Pagasitikos» from the University of Thessaly. He is conducting research in Marine Dynamics and Ecosystem Modeling. Since 1995, joining HCMR, he is participating in national and EU research projects, mainly in the field of ecological modelling.

Kostas Nittis is a researcher of the Institute of Oceanography of HCMR and member of the scientific team of the “Poseidon” system, responsible for operational forecasting of ocean circulation. He has a BSc in Physics and a Ph.D in Physical Oceanography from the University of Athens. He has been involved in large number of national and EU research projects. Recently, he participated in the *MAST3/MATER* project, with contribution to the numerical modelling studies of the Eastern Mediterranean circulation, the *FP4/MFSPP* and *FP5/MFSTEP* projects, with contribution to the design and construction of the Mediterranean moored multi-sensor array *M3A* as well as the *FP5/MARSAIS* and *FP5/MERSEA* project with contribution in the coupling of oil-spill models with GSM and SAR extracted data of oil-spills. His main interests are in the field of dynamic oceanography, numerical modelling/forecasting and design of operational monitoring systems.

Andy Banks is a Post-Doctoral researcher for remote sensing at the Institute of Oceanography (HCMR). Previously at the Institute of Marine Biology of Crete (IMBC – now HCMR). His recent work includes: benthic habitat mapping using above water and underwater remote sensing and GIS techniques for the European project NATURA 2000; advanced underwater remote sensing, visualization, and filtering techniques for the European project AMASON; and sea-level monitoring using satellite altimetry and oceanographic modelling for the European project GAVDOS (scientific coordinator for HCMR). Dr. Banks is also a partner in an ongoing ESA ENVISAT project involved with assessing the surface radiation budget of Europe. He holds a PhD in Remote Sensing and Environmental Physics from the NERC Environmental Systems Science Centre (ESSC) at the University of Reading, a MSc in Remote Sensing from UCL and Imperial College, London University and a BSc (Honours) in Physical Geography from the University of Reading. For the fifth framework he was a member of the European Commission's Expert Evaluators Panel for Sustainable Marine Ecosystems, Energy, Environment and Sustainable Development Programme and has been a peer reviewer for an international remote sensing journal. His main research interests include coastal and oceanographic remote sensing, modelling and simulation of physical processes and remotely sensed data, GIS (theory and application), and advanced image processing and data visualisation techniques. He is a member of IEEE and IEEE Geoscience and Remote Sensing Society and the Remote Sensing and Photogrammetry Society.

Gerasimos Korres is an associate researcher of the Institute of Oceanography since January 2003. He has a B.Sc in Physics (1989), a M.Sc in Oceanography (1992) and Ph.D in Physical Oceanography (1996) from the University of Athens. He has been involved in a large number of EU research projects and in national projects as well. Recently, he participated in the *FP4/MFSPP* and *FP5/MFSTEP* projects, with contribution to forecasting of the Eastern Mediterranean general circulation and in the FP4/FERRYBOX project, with contribution to developing data assimilation methods for the POSEIDON forecast system. His main interests are in the field of hydrodynamic numerical modeling/forecasting, wave modelling, data assimilation in hydrodynamic/wave models and air-sea interaction processes.

Anastasios Papadopoulos received a B.Sc degree in Physics from the Aristotle University of Thessaloniki, a M.Sc and Ph.D in Meteorology from the University of Athens. His research interests and experience include: atmospheric modelling, operational meteorology and oceanography, evaluation of forecasting systems, numerical modelling of the desert dust cycle in the atmosphere, surface processes parameterisation, atmospheric stability and dispersion, severe storm theory and modelling. His present affiliation is at Hellenic Centre for Marine Research as a physicist-meteorologist and a member of the POSEIDON scientific team (since 1999). In the past (since 1993) he has worked at University of Athens as a member of the Atmospheric Modelling and Weather Forecasting Group.

Leonidas Perivoliotis graduated from the Physics Department of the University of Athens in 1987 and received his M.Sc. in Physical Oceanography in 1990 from the same University. For the next eight years (1990-1998) he joined the Physical Oceanography group of Athens University where he worked as a research associate. During these years he was involved in many European projects about numerical modelling, while he gained experience in computing resource management for operational applications. He currently holds a position of research scientist in the Hellenic Centre for Marine Research, as a member of POSEIDON project team, being responsible for the operational data post processing and numerical forecasting as well as the development of end user applications. He will contribute to the numerical modelling (downscaling) and the end-user applications of the IINSEA Project.

Anna I. Pollani, is currently working as systems analyst/programmer at the Institute of Oceanography, HCMR. She acquired professional experience working as programmer-analyst in different software companies for more than 15 years, and since 1997 she has active participation in several research projects of the Institute of Oceanography (FIGIS, THETIS, MFSPP, MFSTEP, COST-IMPACT) and other environmental impact studies of national projects, skilled in the area of developing and applying numerical models on the marine environment.

Four relevant publications

Hoteit, I., G. Triantafyllou, et al. (2003). "Towards a data assimilation system for the Cretan Sea ecosystem using a simplified Kalman filter." Journal of Marine Systems (in press).

Hoteit, I., G. Triantafyllou, et al. (2003). "A Singular Evolutive Extended Kalman filter to assimilate real in-situ data in a 1-D marine ecosystem model." Annales Geophysicae 21: 389-397.

Korres, G., A.Lascaratos, E. Hatziapostolou and P.Katsafados, 2002. "The Implementation of an Ocean Forecast System for the Aegean Sea."The GCNRS-LOBal Atmosphere and Ocean System, Vol. 8, No. 2-3, 191-218.

Korres, G. and A.Lascaratos, 2003. Analles Geophysicae, "An eddy resolving model of the Aegean and Levantine basins for the Mediterranean Forecasting System Pilot Project (MFSPP) : Implementation and climatological runs".MFSPP – Part I Special Issue, 21, 205-220.

NKUA

Short profile

The Atmospheric Modeling and Weather Forecasting Group (AM&WFG) is part of the Division of Applied Physics, School of Physics, University of Athens (NKUA). School of Phyisics has 132 faculty while the Division of Applied Physics has 30 (18 in Atmospheric Science). The AM&WFG has the Associate Professor of University of Athens G. Kallos as a leader, 5 Senior and Post Doctorate researchers and Research Associates, 2 MSc professionals in Atmospheric Physics and Chemistry, 1 computer expert, 3 PhD students and a number of MSc students working on various projects funded by external sources (EU, USA, Greece). The research activities of the group are related to model development and applications including weather forecasting, soil dust cycle modeling, air pollution, natural hazards, climatic variability, agricultural and wind energy applications and wave modeling. There is close cooperation between the AM&WFG group with the Oceanographic group in the field of atmospheric and oceanographic model coupling. Integrated modeling systems have been developed and used in several applications for research as well as operational purposes. These systems are the products of research projects funded by various sources. The most important of these modeling products are listed below:

NKUA is involved on the development and operations of the forecasting system that will be used for the Athens Olympics 2004. It has the commitment to provide updated versions of the SKIRON/Eta, RAMS and WAM models for weather, extreme event and wave forecasting to Hellenic National Meteorological Service (HNMS) and to operate the entire modeling system as backup during the events. SKIRON/Eta with dust capabilities will be in use too. In addition, NKUA is at the negotiations phase with the meteorological company METEOGNOSIS for providing high resolution weather and dust forecasts for commercial use. UOA has an agreement with George Mason University (GMU), USA for installing and operating the SKIRON/Eta system for transatlantic Saharan dust transport.

As it was mentioned previously, NKUA already provides services similar to the ones described in this proposal for the Municipality of Haifa (72-hour weather and dust concentrations for the city area) in order to issue warnings on air quality. In addition, UOA/AM&WFG will utilize the already operating web page for disseminating the project's products taking the advantage of being well known already to thousands of users from various countries (see http://forecastuoa.gr/usage).

Role in the Project

NKUA/AM&WFG will contribute with the software already developed at the framework of previous projects and an operating system running with the certain capabilities. Namely it will contribute on the further development of the SKIRON/Eta modeling system with the dust capabilities, the adaptation of RAMS model and the system integration, the operations and dissemination of the products. A tighter coupling between the models used for the system integration will be achieved by developing new and improved interfaces. It will contribute on the evaluation of the entire system. Based on the intermediate evaluation results the system will be fine tuned. The codes will be optimized through the implementation of parallel processing methodologies and algorithms. The entire system will be integrated in order to utilize open software and distributed memory architectures (linux clustering). On that way the operational costs of such computationally-intensive applications will be minimized and the porting to various end users will be easier.

Key persons involved in the project

Dr. George Kallos acts as Associate Professor at the University of Athens, School of Physics/Division of Applied Physics. He has also the position of Senior Research Associate at the SUNY/ASRC, Albany, NY. He leads the Atmospheric Modeling and Weather Forecasting Group. He has BSc from University of Athens/School of Mathematics (1975), MSc and Ph.D. in Geophysical Sciences/Atmospheric Sciences Division, Georgia Institute of Technology, School of Geophysical Sciences, U.S.A, (1985). He has 26 years of experience in atmospheric modeling working at the University of Athens, Georgia Institute of Technology, Colorado State University, SUNY/ASRC and National Center for Atmospheric Research (NCAR). Dr Kallos has 62 publications in scientific journals, 110 publications in conference proceedings, and 79 other publications in subjects related to atmospheric physics and chemistry. Most of them are related to atmospheric modeling. He has participated in 58 projects in 35 of them was coordinator. He serves at the Editorial Board of the scientific journals “GCNRS-LOBal Atmosphere-Ocean Systems – GAOS” and “Environmental Fluid Mechanics”. He will act as the project coordinator in this project.

Dr. I. Pytharoulis studied at the University of Thessaloniki/School of Mathematics (BSc), Reading University (MSc and PhD in Meteorology, 1999) and has 10 publications in synoptic and mesoscale weather phenomena. He joined AM&WFG in 1999.

Dr G. Galanis studied at the University of Athens (BSc, MSc and PhD, 1997). He has 12 publications in refereed journals in the topics of mathematics and meteorology as well as a number of conference presentations and various Technical Reports. He joined AM&WFG in 2000.

Dr. P. Louka studied at the University of Ioannina/School of Physics (BSc) and at the University of Reading (MSc and PhD in Meteorology, 1999). She has 10 publications in refereed scientific journals, 31 publications in conference proceedings and various Technical Reports, all related to atmospheric modeling and meteorological measurements and analysis in topics of the atmospheric boundary layer and street canyons. She has been acted as referee for papers submitted to Atmospheric Environment. She joined AM&WFG in 2002.

Dr P. Katsafados studied at University of Athens, School of Mathematics (BSc) and University of Athens (MSc, PhD 2003). He has 4 publications in atmospheric modeling, a number of conference presentations and Technical Reports He joined AM&WFG in 1996.

Dr E. Mavromatidis studied at University of Ioannina, School of Physics (BSc) and at University of Athens, (MSc, PhD 2003). He has 4 publications related to atmospheric dynamics and physics. He joined AM&WFG in 1997.

Ms F. Gofa studied at University of Patras (BSc), University of Reading and Desert Research Institute, USA, (MSc). She has 6 publications related to atmospheric physics. She joined AM&WFG in 1998.

Ms A. Voudouri studied at University of Athens, School of Physics (BSc) and University of Athens (MSc). She has publications in atmospheric modeling. She is currently working for her PhD. She joined AM&WFG in 1996.

Mr G. Emmanouel studied at University of Athens, School of Physics (BSc and MSc). He has 3 publications atmospheric modeling. He joined AM&WFG in 1999.

Ms M. Astitha studied at University of Athens, School of Physics (BSc and MSc). She has 3 publications related t atmospheric modeling. She is a PhD student. She joined AM&WFG in 2001.

Ms E. Katirtzoglou studied at University of Thessaloniki, School of Physics (BSc) and University of Reading (MSc 2002). She has two publications in atmospheric physics. She joined AM&WFG in 2003.

Mr J. Exidaridis studied at University of Patras, School of Mathematics (BSc) and University of Athens, School of Informatics (MSc, 2000). He joined the AM&WFG in 2001

Four relevant publications

Ranmar, D., V. Matveev, M.Peleg, M. Luria, U. Dayan, J. Kaplan, A. Gertler, G. Kallos and Y. Mahrer, 2001. Modeling ozone production and dispersion from transportation sources in East-Mediterrannean coastal regions: Numerical simulations, synoptic analyses and airborne measurements. J. Geophysical Research. (107, D0, 10.1029/2001JD000808.

Papadopoulos, A., P. Katsafados, and G. Kallos, 2001: Regional weather forecasting for marine application. GAOS Vol. 8, No 2-3, 219-237.

Pirrone, N. R. Ferrara, I. Hedgecock, G. Kallos, Y. Mamane, J. Munthe, J. Pacyna, I. Pytharoulis, F. Spovieri, A. Vodouri, I. Wangberg, 2003: Dynamic processes of Hg over the Mediterranean Region: Summary of results from the MAMCS project. Atmospheric Environment. 37, S21-S39, DOI: 10.1016/S1352-2310(03)00251-6.

Mavromatidis, E. and G. Kallos, 2003: An investigation of cold cloud formation with a 3-D model with explicit microphysics. J. Geophysical Res.. Vol. 108, DOI:10.1029/2002JD002711.

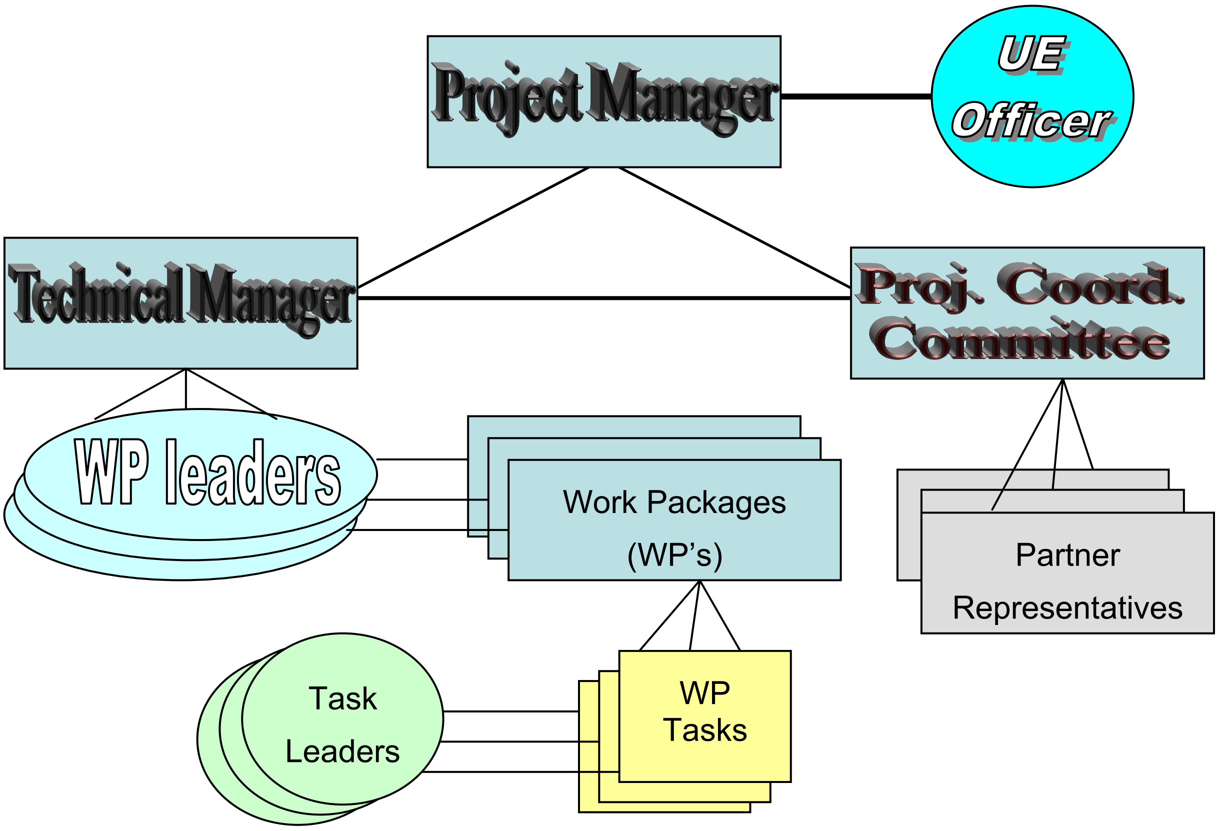
B.5. Project management

The basic purpose of project management is to ensure the proper level of co-ordination and co-operation amongst the project consortium members. Additionally, project management has the following responsibilities: project administration, project organization, management of the technical progress of the project, co-ordination with other EU funded projects and other interested parties. All of the consortium partners have had previous experience of working in EU consortia or working in large, complex, international projects.

Previous experiences have shown that Overall Project Management and Project Technical Management are different tasks and should be separated. The basic idea is to act at the project level in the same way that inside a company will act the President and the CEO. The first one is responsible for the project representation and definition of the strategic decisions while the second one is responsible for the respective implementation.

Supporting this structure there will be a Project Co-ordination Committee (PCC) which will assist the Project manager in handling all matters related to the coordination of the project and is the forum for discussion and management of any deviation from the proposed plans.

An overview of the most important parts of the project management structure is illustrated in Figure 1. The constraints of the above roles or groups are described in the following sections.



B.5.1 Project Manager

The Project Manager is the Partner Representative of the Prime Contractor (IST). Professor Ramiro Neves will assume this role and he will be the main responsible for this task. Professor Ramiro Neves a full professor at IST and, beyond his experience in the participation of several National and European research projects, he also has experience in the coordination of research projects.

The mandate of the Project Manager is to:

- represent the project in relations with the European Commission (EC).
- report to the EC and monitor overall performance of the project.

- promote project visibility and dissemination of project results in relevant international forums.
- promote acceptance of project results among relevant stakeholders.
- administer project resources and monitor project spending.

Specific tasks are:

- to convene and chair Project plenaries, Project co-ordination meetings.
- to receive tri-Monthly Control Reports from Project Technical Manager, review them and forward them to the Project Officer.
- to communicate with Partner Representatives with the view of co-ordinating the exploitation of the Project's results.
- to convene and participate in Project Review meetings, to ensure preparation of Technical Audit Documentation and to organise the team of delegates to the Technical Audit.
- to supervise the preparation of the Final Technical Deliverable.
- to supervise the preparation of documentation to support high level dissemination of Project results, and to ensure, in association with the Technical Manager, representation of the project in external events such as workshops on related topics.

B.5.2 Project Technical Manager

The Project Technical Manager will be from HIDROMOD and will provide assistance to the Project Manager. Dr. Adélio Silva will assume this role and he will be the main responsible for this task. Dr. Adélio Silva is a Civil Engineer, with a doctorate degree in Mechanical Engineer and, beyond his experience in participation in R&D projects, he also has an important experience in administration related with his management responsibilities in HIDROMOD. HIDROMOD will introduce in the project management its own Quality Management System (according to ISO 9001:2000) criteria.

The Project Technical Manager is the person responsible for overseeing the project technical work. The mandate of the Technical Manager is to ensure accomplishment of the technical objectives of the project, to progress supervision of the project's technical part and to promote, in association with the Project Manager, project's visibility in the international forum.

Specific tasks are:

- to co-ordinate technical activities of the project and to convene and lead technical meetings.
- to report to the Project Manager on the technical progress of the project and to co-ordinate the production of technical deliverables.
- to collect tri-Monthly Control Reports from Partners and forward Periodic Progress Reports to the Project Manager.
- to enforce compliance to the project's internal communication and editorial conventions and to maintain a Project document library.
- to attend the Technical Audit
- to ensure, in association with the Project Manager, the representation of the project in external events such as workshops on related topics and to co-operate in the preparation of at least one pamphlet to support high level dissemination of project results.

B.5.3 Project Co-ordination Committee (PCC)

A Project Co-ordination Committee (PCC) will assists the Project manager in handling all matters related to the coordination of the project and is the forum for discussion and management of any deviation from the proposed plans. The PCC consists of one delegate (Partner Representative) from each organisation participating in the project as a "full partner". Normally, Project Co-ordination Committee meetings will be called in association with Technical Meetings. Participation by full partners or their delegates is mandatory. The chairperson of the PCC is the Project Manager. The PCC shall meet as required, between two to four times per year.

It is intended that the PCC will reach decisions by consensus but where this is not possible, the vote of the Project Manager will prevail.

The work package leaders are responsible for the management of the scientific output and reports of the respective work packages. Any decision of any kind within each WP is made by general consensus but, in the case of lack of consensus, the opinion of the WP leader will prevail. The PCC aim is:

- To define and validate the expected outputs for the Project;
- To define exploitation targets by the partners and by outsiders for the knowledge gained during the consortium work;
- To terminate the consortium agreement in case of conflicts which make any one of the consortium project objectives unreachable;
- To decide about the entry of a new partner and the ensuing budget reshuffling;
- To contribute to the negotiations with the EU and relate with the EU on any contractual matters.
- To make sure that the expected outputs of the Project are coherent and can be met in due time (effectiveness), within preset funding constraints (efficacy);
- To choose technical or budget solutions which will resolve any conflict raised by any one in charge of the Work Packages of the project;
- To prepare and to manage a yearly convention in charge of disseminating the project outputs to end-users.

B.5.4 Planning, Monitoring and Reporting

The Project Technical Manager will use automated planning and reporting tools to collect information from Partner Representatives so that project information is always up to date, and can be reported in a timely and consistent manner. The use of a general management tool such as Microsoft Project will be prospected.

The Project Technical Manager is also responsible for preparing tri-monthly Control Reports (BCRs). The information contained in these BCRs will be generated by each Partner Representative and, after reviewing by the Project Manager, will be sent to the EU if requested. The BCRs will contain the following types of information: statement of all expenses incurred by the partner in each WP during that period, equipment purchased, progress report on Partner's activities, etc.

The Project Manager is responsible for organizing the preparation of the Periodic Progress Reports (PPRs), the Final Project Report and reviewing the Cost Statements that will be prepared by the Project Technical Manager. Partners are responsible for contributing to the completion of these reports. These reports will be submitted to the EU for the purpose of reviewing and evaluating the progress of work in the project. The reports will include or reference all deliverables for the reporting period.

B.5.5 Deliverables Handling, Confidentiality and IPR Handling

Public deliverables will be approved by the PCC before submission to the EU. The editor of each deliverable is responsible for ensuring that the appropriate procedure is followed and the deliverable is submitted to the EU and the project manager (for reference).

All results of the project will be made available to EU, except where they utilize background information and where imminent commercial exploitation/patents are foreseen. For these cases, the confidentiality of the deliverable will be changed appropriately. To facilitate the handling of intellectual property rights and ensure that they are not abused, the consortium agreement will make provision for an exploitation plan to be signed by the end of first year.

B.5.6 The risk management rules

The single decision criterion to adjust for project risk is to be effective**, viz.** "to meet the objectives of the RTD tasks, within the expected performance ranges, as proposed in the expected deliverable, and on time".

Clearly, the RTD costs, once the contract with the EU is signed, are of the responsibility of each partner:

- no cost overrun can be used as an argument to ask for a change in the task objectives or the timely delivery of the results;
- Objectives can only be changed in view of major unforeseen technical failures, or the departure of a partner.

These rules are described in the Memorandum of Understanding. The Consortium Agreement will define the "added value" which will define the shareholding property rights of each partner within the ECG.

B.5.6.1 Time versus cost of work appraisal

As described above, the main decision criterion will be **"to be effective":** timeliness for delivering the results within the expected performance will be the main decision rule. The consortium has budgeted the RTD costs to produce deliverables on schedule and in coherence with the main project objective.

B.5.6.2 The resource allocation

A first resource allocation is decided for a 12 months period at the beginning of each year. Every three months the coherence of the resource spent with the remaining resources will be made: adjustment will be proposed and accepted by the PCC to remain effective as a consortium.

B.5.6.3 The division of work to manage risks

The rule that has been used by the partners is to reach a Work Package size and timing where major new and unforeseen technical risks can be detected and taken care of in less than four months.

Each Work Package and elementary Task has its own leader within a given organisation: this leader reports to two persons:

- Within its own organisation, he/she responds to the PROJECT co-ordinating actor in charge of applying the consortium decision at whichever level it was taken;
- Within THE PROJECT, he/she responds to a technical expert in charge of a Work Package or a Task.

Consensus on the action plan is searched for every month. Conflict arbitration is implemented according to the rules set forth in the Memorandum of Understanding, the Strategic Steering Board being the last committee in charge of taking a final decision

B.5.6.4 The change control procedures

Any change must be implemented, once decided: the control procedure to make sure that this change is operational is made by a member of the coordination organisation who acts as a quality manager for the whole project.

It is this quality manager that will review on behalf of the coordinator the conformance of the deliverables with the contract. Non conformance will be communicated both to the Work Package and Task leader in order to implement corrective actions in due time.

B.5.7 Financial Issues

The coordination of the project will take the responsibility of obtaining from all the contractors Audit Certificates to certify the costs claimed in the financial reports, according to the rules of FP6. These Audit Certificates will be provided by each partner's own external auditor (or in the case of public body it may be provided by a competent public officer).

B.6. Implementation plan

B.6.1 Introduction

Gathering Data

The activities within **InSea** are split up into 6 work packages, which address different aspects of the approach outlined. Firstly, data gathering within each site will be done to find any missing links and information gaps relate to eutrophication processes and to establish their current ecological status, the main deliverable will be a meta database on the available knowledge. Local models, already established and Earth Observation data and local data will represent important sources of information. We will give special relevance to the data needs of local authorities and stake holders, since the beginning of the project in order to adapt the developed system.

Implementation

As a consequence of the conclusion of WP1 and considering the available data and numerical tools WP2 will develop the technological improvements and tools integration to improve methodologies to downscale physics from large scale data systems to regional models in order to force ecological modelling systems on coastal areas and also to set-up and validate numerically robust ecological modelling systems for the areas under investigation in order to describe biogeochemical cycling of carbon and nutrients occurring under different hydrographic and trophic regimes. Special attention will be given via assimilation to the integration of Earth Observation data.

Results

Thought WP2 will deal more with the technological aspects concerning the integration of the different numerical components and data sources, WP3 will deal with the interpretation and consistency of the results obtained by the fully integrated numerical system, Tasks concerning validation will be developed as well the production of different data products specific for the potential customers (local authorities, water management companies, governmental institutions).

Managing Data

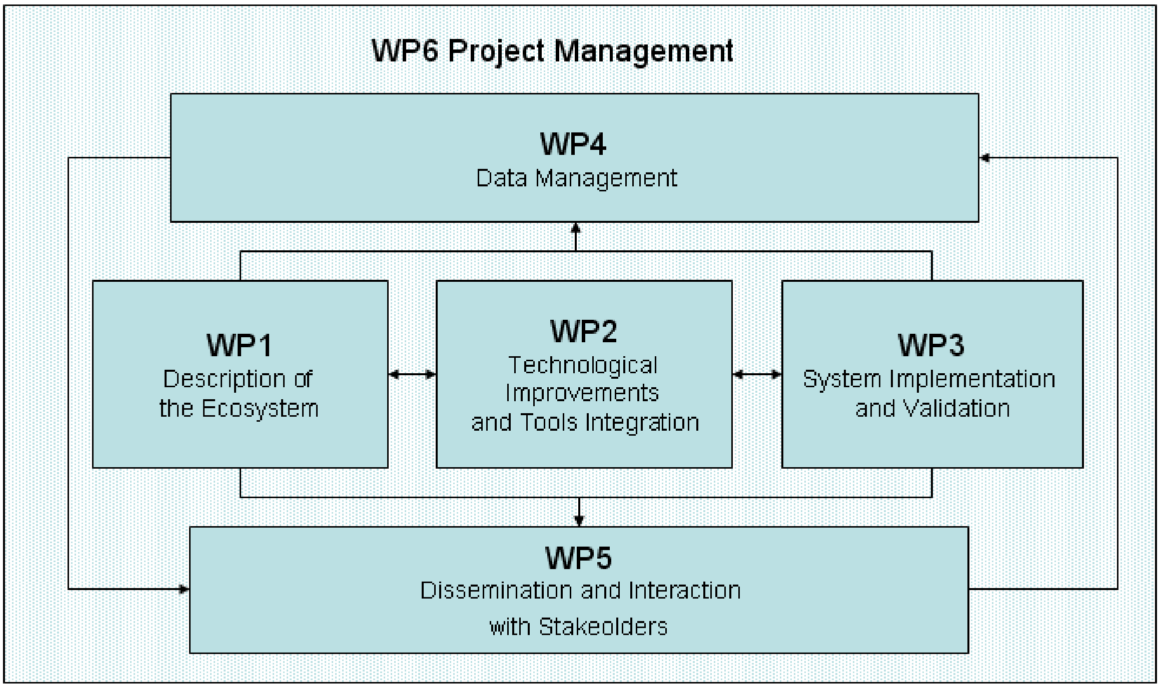
Considering that **InSea** will be dealing with large amounts of data associated to different sources and describing complex physical and biological processes, data-management activities represent one of the most relevant issues to achieve efficiency in he project. These data-management activities will be divided in: data quality control/assessment, harmonization and conversion of data to agreed meta-data formats and development of remote data access system.

Interaction

Finally, **InSea** will develop a strong effort to establish a close relation between stake holder and the project by acknowledging the data and legal needs of this entities and developing interfaces and information on the adequate format to fulfill their needs.

ID	Name	Main Objective
WP1	Description of the Ecosystem	Focus on the problems addressed by the project and gather the available knowledge in each site
WP2	Technological Improvements and Tools Integration	Make the necessary developments to integrate efficiently the available data sources and numerical tools
WP3	System Implementation and Validation	Implement and validate the full system in each study site
WP4	Data Management	Deal with data issues related to data harmonization, storage and consistency, and also with delivering information to data users
WP5	Interaction with Stakeholders and Dissemination	Addresses the dissemination and interaction with the stakeholders ensuring an effective transference of the knowledge developed in the framework of **InSea** to the civil society and the end-users.

WP6	Project Management	Ensure the coordination between the EC and the consortium partners and produce the expected deliverables to acceptable standards



Associated risks and contingency plan

Near-shore coastal waters naturally vary in the type, abundance and geographical coverage of biological communities at risk to nutrient over-enrichment, largely because of habitat differences. This variability is partially offset by salinity, which tends to "normalize" biotic community distributions. When ambient historical data are unavailable or are ineffective in characterizing resources lost through nutrient over-enrichment, it is often difficult to establish an accurate historical reference or determine the potential recovery from nutrient stress. Apparently, many coastal areas became moderately to highly enrich before effective monitoring programmes provided accurate descriptive information on biotic community distributions and abundance. When all else fails, professional judgment, which is available under the project's consortium, should be used to estimate reference conditions.

B.6.2 WP1 Description of the Ecosystem

WP Leader	**1**	**Starting date**		Month 1		**End Date**		Month 3	
Participant id	1	2	3	4	5	6	7	8	9
Person-months	4	1	-	-	3	2	-	5	-

Task 1.1 - Gather the available knowledge on each site to describe the main physical and biogeochemical processes involved.

Objectives: The purpose of this task is to find missing links and information gaps, that should be explored by the project and to establish the current ecological status in each site.

Scope of work: The gathered information should include: relevant publications with a focus on the main findings, available data (parameters, spatial and temporal definition) and records of known events concerning eutrophication processes such as decreased light availability, algal dominance change, increased organic matter production, loss of submerged aquatic vegetation, nuisance/toxic algal blooms and algal mats, benthic community change and low dissolved oxygen events.

Barriers to overcome: Access to existing data is not always allowed and in some cases data is simply not available. In the first case the teams must make an effort to reach the data owners and use reasonable means to obtain data, which usually is paid by EU or national governments i.e. by tax payers. In the second case, there is no solution, since **InSea** is not a data acquisition project, nevertheless this problem has a very low occurrence probability since the study sites were initially select based on the experience of the local teams, site available data bases and existing knowledge.

Partners: IST, UPS-LA, CNRS-LOB, HCMR

Description of work: The work comprises data gathering and intense bibliographic review. A metadata base for the description of the available data will be developed including: parameters, temporal and spatial coverage, qualitative level of confidence, method. All information will be gathered in a knowledge base accessible via WWW. This will surely be very useful beyond the project time frame and will be distributed among all interested.

Task 1.2 - Describe local strategies to deal with eutrophication processes and analyze their consequences.

Objectives: The objective of this task is to characterize for each study site, previous approaches for dealing with water quality problems. These approaches are usually related to control of effluent disposal (nutrients and organic mater)

Scope of work: These approaches, usually carried out by local authorities, are regularly accompanied by monitoring programs and evaluations boards that establish the efficiency of their implementation. Frequently more then achieving answers, these studies raise new questions and future work is proposed.

Barriers to overcome: Understand and establish assumptions on the effects of a certain policy implementation are no straightforward tasks. At the moment we have only partial knowledge on the implementation of such approaches on each place and its possible that there are cases where no valid conclusion is made.

Partners: IST, UPS-LA, CNRS-LOB, HCMR

Description of work: The work consist in analyzing in details the conclusions of these studies to understand the resilience of the system to any changes that were implemented, and obtain a clear view of what are scientific and technological needs of local authorities.

Task 1.3 - Analyze the legal framework in each site from a data requirement point of view in what concerns water management and eutrophication issues.

Objectives: The purpose of this task is to determine from the legislation applicable to each site what is needed in terms of data (parameter, temporal and spatial resolution) for the implementation of their legal framework, and specifically for computing environmental indexes.

Scope of work: One of the most important issues of current eutrophication assessments is integrating information to produce indexes representing the overall integrity of a particular ecosystem and to support the implementation of legislation. These indexes have different formulations. Usually the base data for computing such indexes is supported by local measures and hardly ever incorporate in a quantitative way the physical aspects of the aquatic systems such as residence time and average transport.

Barriers to overcome: There no barriers since indexes are already established and concerning eutrophication issues the data products derived from the project's numerical tools fully cover the data needs for implementing such indexes and supporting legislation.

Partners: HIDROMOD, CNRS-LOB, HCMR

Description of work: There are a number of developments on this matter on international level, some are more consistent then other. The quantification of the state of the environment is usually supported by index analysis. Major European (European Environmental Agency) and US Environmental Agencies (NOAA, EPA) are responsible for developing indexes, to answer specific environmental questions such as eutrophication, contamination and habitat vulnerability. These indexes have different formulations and the work associated to this task will consist on studding the legislation relevant to each site and contacting local authorities to define data specification on parameters, formats, spatial and temporal distribution for supporting legal requirements and index implementation. This will enable us to define the level 2 data products derived from the project.

B.6.2.1 Deliverables

- D1.1: Report characterizing each system
- D1.2: Report describing the objectives and main consequences and conclusions of approaches for dealing with eutrophication problems that were previously implemented in each study site.
- D1.3: Data Specification on parameters, formats, spatial and temporal distribution for supporting legal requirements namely indexes for describing environmental status. This information will be compile together with the previous one in a Join Report

B.6.2.2 Milestones

- M1.1: The test sites are characterized from the ecological point of view. Data requirements and legal status have been identified.

B.6.3 WP2 Technological Improvements and Tools Integration

WP Leader	8	Starting date		Month 4		End Date		Month 24	
Participant id	1	2	3	4	5	6	7	8	9
Person-months	35	4	20	-	30	2	20	49	18

WP2 is closely related to two main objectives of **InSea**:

- Development of methodologies to downscale physics from large scale data systems to regional models in order to force ecological modelling systems on coastal areas.
- To set-up and validate numerically robust ecological modelling systems for the areas under investigation in order to describe biogeochemical cycling of carbon and nutrients occurring under different hydrographic and trophic regimes.

This work package will develop an integrating modelling environment and set the standards for interfacing between the modules and data sources.

Task 2.1 - Implement and improve nesting techniques for ecosystem state variables to couple the Regional and Shelf Hydrodynamic Models.

Objectives: Implement and improve nesting techniques for ecosystem state variables to couple the Regional and Shelf Hydrodynamic Models

Scope of work: Nesting methodologies represent an efficient way of dealing with scale problems. With this methodology, it becomes possible to downscale the solution and also to force local models with large-scale processes. The nested modelling methodology can also be used to integrate in only one tool several local models that are forced with the same regional model. The work structure will build upon previous experience (from projects such as MFSPP and Mersea) where large scale models will give the boundary conditions to three-dimensional hydrodynamic models supporting local ecological models.

Barriers to overcome:

The large scale model solutions presently do not consider tide. In the Tagus application tide is one of the dominant forcing mechanisms. In this case methodologies of adding global tidal solutions to the large scale solutions in the open boundaries will be developed. One technical barrier is related with the access to the large model solutions. These models produce massive data, to maintain the forecast capabilities of the smaller scale systems will be necessary to develop efficient methodologies of download the large scale solutions for each site.

Partners: IST, UPS-LA, HCMR

Description of work: Work in Task 2.1 can be divided on the following actions:

- Action 2.1.1– Development and/or Implementation of software code for format integration to import data delivered by large scale models ;
- Action 2.1.2 – Testing nesting techniques between the large scale and local hydrodynamic properties (ex: flow relaxation scheme, radiation);
- Action 2.1.3 – Identification of sources for imposing the biogeochemical properties in the open boundary (ex: large scale forecasts, climatological data, remote sensing);
- Action 2.1.4 – Testing different schemes for imposing the biogeochemical variables in the open boundary;

Gulf of Pagasitikos (Greece)

Pagasitikos ecological model

The circulation model will be coupled with the ecological model with horizontal resolution of 900 m and vertical resolution of 25 layers/levels. The circulation model will be nested at the open boundary with the POSEIDON hydrodynamic model.

Model activities are the following:

- Model implementation
- Definition of initial condition from objective analysis of available datasets.
- Initial parameters setting based on published literature.
- Perpetual year simulations to calibrate the model.

Initial tests of the coupling with POSEIDON will involve only the nesting of physical state variables. Open boundary conditions for biogeochemical state variables will be defined by utilizing climatological values.

Downscaling from MERSEA to POSEIDON and nesting to Pagasitikos hydrodynamic model

Model initialization implementing downscaling methods (VIFOP or SEEK) from larger scale coarse model (MERSEA) to POSEIDON. Furthermore the nesting of physical state variables between the hydrodynamic models of POSEIDON and Pagasitikos will involve the free surface elevation, the zonal/meridional velocity components, temperature and salinity. This scheme has been extensively tested during MFSPP and MFSTEP EU projects under both climatological and high frequency atmospheric forcing (Korres and Lascaratos, 2003; Triantafyllou et al., 2003).

Gulf of Fos (France)

We propose to extend the downscaling strategy developed in the frame of the MFSTEP project to the present project, namely to develop a high resolution model (horizontal mesh 200m) of the Gulf of Fos forced with the outputs of the MFSTEP coastal model of the Gulf of Lions.

Model activities are the following:

- Model implementation
- Definition of initial condition from objective analysis of available datasets.
- Initial parameters setting based on published literature.
- Perpetual year simulations to calibrate the model.

Downscaling to Symphonie *model*

Initial tests of the coupling with MERSEA models will involve only the nesting of physical state variables. Open boundary conditions for biogeochemical state variables will be defined by utilizing climatological values. The hydrodynamic model Symphonie has been recently chosen to provide weekly regional predictions of the NW Mediterranean in the frame of the EC project, MFSTEP comprising large scale models also present in MERSEA. Following a specific downscaling strategy proposed by UPS-LA, our model is applied at a smaller scale to provide high resolution predictions of the continental shelf circulation of the Gulf of Lions.

Costa do Estoril (Portugal)

The circulation module coupled with the ecological module in the Mohid modeling system will be applied with variable horizontal resolution (200 to 1500 m) and different vertical discretization schemes will be tested.

Model activities are the following:

- Model implementation
- Definition of initial condition from objective analysis of available datasets.
- Initial parameters setting based on published literature.
- Perpetual year simulations to calibrate the model.

Initial tests of the coupling with MERSEA models will involve only the nesting of physical state variables. Open boundary conditions for biogeochemical state variables will be defined by utilizing climatological values.

Downscaling from MERSEA to MOHID model

Model initialization implementing downscaling methods from larger scale coarse model (MERSEA) to MOHID. Furthermore the nesting of physical state variables between MERSEA models and MOHID will involve the free surface elevation, the zonal/meridional velocity components, temperature and salinity.

Task 2.2 – Develop the ocean-atmosphere coupling with high resolution atmospheric forcing over regional and shelf areas.

Objectives: Develop the ocean-atmosphere coupling with high resolution atmospheric forcing over regional and shelf areas

Scope of work: The exchange of heat, moisture, momentum, and particles between the sea and the air is fundamental to an understanding of the ocean-atmosphere system, especially in the coastal zone. The coastal zone has a number of distinctive characteristics, including complex coastline and terrain variation, strong surface temperature gradient due to upwelling, and intense air-sea-land interaction. To better understand this complex and important climate system the members of the consortium have already developed coupled ocean-atmosphere modeling systems that are fed by high-resolution observations. This development is not finished and new solutions for improving the system continue to emerge.

Barriers to overcome:

The resolution of the mesoscale meteorological systems already running for the areas of interest is not enough to simulate some important features associated with atmospheric land-water gradients. In top of this some of these systems are already running in the limit of the available computational capability.

Partners: IST, UPS-LA, HCMR, NKUA

Description of work: Work in Task 2.2 can be divided on the following actions:

- Action 1 - Sensitive analysis to the meteorological model spatial discretization to identify the optimal discretization taking in consideration computational effort and accuracy of the dominant meteorological process at the study sites scale;
- Action 2 – Establish methodologies for imposing the atmospheric fluxes in coastal models.
- Action 3 – Simulations of typical scenarios highlighting the differences of imposing the atmospheric fluxes in one-way or two-way.

Task 2.3 – Coupling coastal processes with the available hydrological monitoring systems in the adjacent catchments.

Objectives: Coupling coastal processes with the available hydrological monitoring systems in the adjacent catchments

Scope of work: One crucial point in eutrophication assessment in coastal waters is the quantification of the land inputs of nutrients. The EU hydrological observing system is becoming more and more sophisticated. The access to near real time observations is now very easy due to the large networks of automatic data acquisition stations implemented by the EU countries water authorities. The forecast capabilities of nutrients and flow inputs base in run-off models are also improving. To implement a successful eutrophication assessment in coastal waters is necessary to develop methodologies that allow coastal models to be couple easily to the existing hydrological observing systems.

Barriers to overcome: No relevant barriers were identified.

Partners: IST, HIDROMOD, UPS-LA

Description of work: Work in Task 2.3 can be divided on the following actions:

- Action 1 – Development and/or Implementation of software code to import and format data delivered via internet in near real time measured by hydrological monitoring systems.
- Action 2 - Implement and test methodologies for the assimilation of hydrological data characterizing the main effluents to the coastal system.

Task 2.4 - Implementation and test of data assimilation techniques for biochemical variables

Objectives: Implementation and test of data assimilation techniques for biochemical variables

Scope of work: In order to improve model reliability, i.e., its capability of reproducing interactions and flows between its major compartments, a model can be adjusted to fit the observations, and the constrained model can then be used for making assessments. This adjustment is generally called Data Assimilation. Different Data Assimilation techniques will be implemented and used to improve numerical models established in each site and their forecasts. These numerical techniques, allow one to use the available experimental information for estimating the parameters of the model and/or constraining the model output.

Barriers to overcome:

The quality and the scarcity of data to be assimilated will be the main obstacles in the implementation of data assimilation tools in the three ecosystems. In this project remote sensing data (SST, colour, altimetry) will be used to minimize this obstacle.

Partners: IST, UPS-LA, HCMR

Description of work:

Action 1 - Implementation of data assimilation schemes

The general objective is to implement and evaluate assimilation techniques within the ecosystem models. The implementation will involve the development of software interfaces for the ecological model and the computation of the relevant empirical orthogonal functions (EOF).

The French and Portuguese teams will decide what scheme to use with the collaboration of the Greek which have already chosen their data assimilation scheme, SEEK. SEEK uses a method of order reduction. The error covariance matrix is then represented by a limited number of three-dimensional multivariate EOF's as an approximation of the system covariance matrix.

Action 2 - Twin Experiments

Twin experiments will be performed to examine the properties of the data assimilation scheme using model results rather than real data. Reference experiments will be performed and their results, noted as reference fields, will be compared with the field produced by the assimilation experiments. The assimilation experiments will be performed using "synthetic observations" from the reference experiments and a simulation run with different initial conditions. The synthetic observations will be selected to mimic the real observations; i.e. ocean color, chlorophyll, nutrients. In addition ocean color observations will be investigated with twin experiments, where the predictions of the ecosystem model will be corrected using pseudo-measurements of surface phytoplankton as a substitute for chlorophyll concentrations measured from the space.

Action 3 - Hindcast Experiments with Data Assimilation

Hindcast experiments will be performed utilizing the ocean color data of previous years processed for the study areas. The objective of this action is to demonstrate the capability of the data assimilation scheme to assimilate **ocean color data** into the ecosystem model.

Action 4 - Assessment of Assimilation Schemes

The performance of the data assimilation scheme will be evaluated with emphasis on the implementation and improvement of simulations. In addition sensitivity experiments will be performed using **ocean colour data** to identify the capability of the assimilation schemes to improve the simulation results of the ecosystem models with emphasis on the deeper euphotic layers.

Task 2.5– Improve the quality of coastal altimeter data

Objectives: To provide high-quality database of coastal altimetric measurements

Scope of the work: The work proposed here deals only with altimeter data. The reason is that altimetric data can be used directly in assimilation schemes, which is not the case of other types of observations, and present-day techniques are mature enough to make certain the objective will be reached. The issue of using data such as Ocean Color and Sea Surface Temperature in coastal zones is addressed in the separate workpackage 2.6.

Partners: NOVELTIS, UPS-LA

Barriers to overcome: The quality of remote sensing data must be improved in coastal areas before they can be profitably used in assimilation schemes

Description of work: Space observations in coastal regions should be considered distinctively. Though processing algorithms and data validation criteria are well established for observations remote from the coasts, one must take into account the interference of land in the measurements performed by spaceborne instruments close to the coast.

In the case of altimetric measurements, new **validation criteria** must be designed, techniques to **correct measurements from land contamination** must be developped, and eventually **improved geophysical corrections** must be applied to the altimetric data.

Validation (or editing) criteria are proposed with the standard altimetric products to help the user to screen data. Those criteria are based on assumptions true for the full ocean, but may appear inadequate in coastal regions and can be too severe or, on the contrary, too loose. This may lead to reject good data, or keep bad data. Hence, new validation criteria must be adapted to coastal applications.

A major land contribution is the contamination of radiometer measurements, which affects the wet troposphere delay correction, creating distortions in the data incompatible with their use for assimilation in models. We shall address this issue by applying a decontamination technique already successfully applied by NOVELTIS to remove the contribution from clouds to IR sounders measurements like those provided by IASI.

Among the geophysical corrections, the application of enhanced coastal-specific tide corrections is necessary because of the lack of precision of the gCNRS-LOBal tide models used in standard altimetric data. The substitution of the high-frequency signal produced by meteorological forcing (wind and pressure variations) to the raw invert barometer law is mandatory to take into account the propagation of quick and significant gravity waves in shelf regions. Those last two parameters shall be provided by the tide and gravity-wave MOG2D model.

Finally, from the enhanced sea topography obtained from the previous work, reliable coastal mean-sea surfaces will be constructed and used to compute the sea surface height anomalies ingested in assimilation schemes. Data inputs will altimetric products (along-track sea surface topography): Geophysical Data Records available for the TOPEX/POSEIDON and Jason-1 mission.

Task 2.6 – Specify the assimilation of remote sensing data of sea surface temperature (SST) and ocean color for coastal zone

Objectives: Definition and specification of methods and tools for the SST and ocean colour remote sensed data assimilation in the coupled model, for the coastal zone. Preliminary analysis of the potential gain for coupled physical-biogeochemical model.

Scope of the work: The use of remote sensed data containing information on sea surface temperature and ocean colour in assimilation scheme for the constraint of coupled coastal zone models requires specific preparatory work. This work deals mainly with the definition and specification of adapted data processing, and with the specification of appropriate observation operators.

It is proposed to identify specific approaches and problems for the use of SST and ocean colour remote sensed data in coastal zone, and to specify the data processing algorithms and the observation operators suitable for their assimilation into the coupled model. This work will be based on the analysis of existing SST products from, eg., AATSR (1 km resolution, about 1-week sampling, on

ENVISAT platform with MERIS), or from other sensors such as MODIS (1 km resolution, half-day sampling), MSG (3 km resolution, 1-hour sampling), AVHRR (1 km resolution, half-day sampling), and of existing chla and derived products from MERIS (300 m resolution, 2-day sampling, on ENVISAT platform with AATSR).

Partners: NOVELTIS, CNRS-LOB, HCMR

Barriers to overcome: Specific methodologies, data processing and observation operators have to be specified for the efficient use of remote sensed SST and ocean colour for the costal zone coupled model.

Description of the work: Approaches and suitable methodologies will be defined for the efficient assimilation of the physical and biogeochemical information provided by remote-sensed data of sea surface temperature and ocean colour, in the coupled physical-biogeochemical model. Consistent approaches will be proposed both on a short-term basis, by taking into account the state of the art of the existing model elements, and on a mid-term basis, by defining the required improvement for a full exploitation of the dynamical and biological surface information.

The available data and products will be identified. Their characteristics in terms of accuracy, spatial and temporal sampling, complementarity of the information from different sensors, will be identified. Preliminary analyses will be performed to assess the impact of such data for the coastal coupled modelling, and to identify the required data processing and specific products to overcome specific shortcoming linked to coastal area. The expertise available from altimeter data processing will be exploited (See Task 2-X).

Specification for the data processing and the observation operators for the use of these data for assimilation in the coupled model will be written.

Task 2.7 – Development of a SatCom data acquisition system for coastal waters

Objectives: To analyse the data acquisition requirements of the InSea application, and explore the development of a satellite-based data acquisition solution that could be deployed universally at any monitoring site across Europe.

Scope of work: The **InSea** consortium is looking to ComSine to address the data acquisition aspects of the project, ranging from requirements capture, to systems analysis, to prototype design and implementation. The partners are in agreement that, from a commercial point of view, it is most interesting to be able to deliver a complete package for end users that includes an integrated data acquisition solution, such as could be derived from ComSine's PicoTracker platform. However, it is recognised that the PicoTracker system is not yet at an operational stage, and thus the **InSea** project will be an excellent 'technological laboratory' within which to develop key aspects of the system and test certain elements in advance of full system deployment.

Barriers to overcome: To be adopted universally (even when terrestrial communications alternatives such as GPRS exist), the satellite-based solution must be cost-competitive and offer clear advantages in terms of ease of deployment, and improved and more consistent integration of locally acquired data with the INSEA tools.

Partners: COMSINE

Description of work: Work in Task 2.7 can be divided on the following actions:

Requirements Analysis: a detailed assessment of data collection and communication requirements for the **InSea** water management application. This will involve close co-operation with other project partners to capture and rationalise the data acquisition requirements they identify, and then generalisation of the findings to create a single common set of requirements to drive subsequent design activities.

Survey of Existing Solutions: a survey of existing terrestrial and satellite-based remote monitoring systems and services, with a comparison of the relative merits of each. This will reveal what is lacking with existing solutions, and point to where ComSine's own PicoTracker design has advantages – or how PicoTracker would need to be modified/extended to meet the **InSea** application requirements.

Architectural Design: the top-level systems design for a universal satellite-based data acquisition solution, based around ComSine's PicoTracker concept.

Air Interface Refinements: analysis to determine the specific additions/refinements needed to the basic PicoTracker air interface to meet the **InSea** requirements.

Proof-of-Concept System: the prototyping of key aspects of the proposed data acquisition system design using an existing hardware platform (ComSine's 'UPS-LAketSAT' platform), such as the return link signal processing. This system would allow a demonstration showing typical sensor data being transmitted wirelessly from a mobile terminal back to an emulated satellite ground station, where it is demodulated and displayed. The GPS co-ordinates of the platform would be included within each message.

B.6.3.1 Deliverables

- D2.1: Report describing the methodologies used to nest the local hydrodynamic solution with the large scale ones
- D2.2: Report describing the methodologies used to impose the biogeochemical open boundary condition
- D2.3: Report describing the best way of coupling local operational systems with large scale ones based in the project experience
- D2.4: Coastal sea surface topography database
- D2.5: Specification document for remote sensed Ocean colour and SST data processing in coastal zone.
- D2.6: Specification document for remote sensed Ocean colour and SST observation operators for their assimilation in the coupled model
- D2.7: Technical note for the analysis of the potential gain of remote sensed SST and ocean colour data assimilation in the coupled physical-biogeochemical model
- D2.8: Report with the characterization of the available data sources that can be use for data assimilation in each site
- D2.9: Report describing the outcomes of the data acquisition analysis and design tasks
- D2.10: Demonstration of wireless data messaging using a proof-of-concept implementation based on the 'PocketSAT' prototype satellite user terminal platform and a test receiver

B.6.3.2 Milestones

- M2.1: Establish protocols with the institutions responsible for the large scale modelling systems to make an official confirmation of their already approved agreement (during proposal preparation) for data access along the **InSea** project period.
- M2.2: The development of methods to improve coastal altimeter data is completed
- M2.3: Establish and rationalise local data acquisition requirements
- M2.4: Complete top-level design of satellite-based data acquisition system; terminal unit and air interface
- M2.5: Complete implementation of proof-of-concept system and conduct demonstrations
- M2.6: Accomplish results from ocean-atmosphere coupling
- M2.7: Characterization of the hydrological observing system implemented in the identified catchments
- M2.8: The EO data requirements were defined
- M2.9: The data assimilation techniques were incorporated in the modelling systems

B.6.4 WP3 System Implementation and Validation

WP Leader	6	Starting date		Month 7		End Date		Month 32	
Participant id	1	2	3	4	5	6	7	8	9
Person-months	-	17	-	-	-	32	-	9	10

Task 3.1- Test the numerical system generic structure by simulating the ecosystem dynamics

Objectives: Test the numerical system generic structure by simulating the ecosystem dynamics.

Scope of work: Within the framework of the project physical and biological variables will be available to users supporting a representation of the underlying processes driving many of the coastal management issues surveyed; The goal is to generate data products that address multiple objectives, contribute to solving specific problems, and provide a basic set of important contextual data for a broad array of regional issues and problems. To achieve the overall objectives of the project and considering the large amount of data that will be available there are 2 levels of consistency that should be considered: the first level is already addressed on WP4.1: Data Quality Control/Assessment (DQC/DQA) and refers to the more technical aspect of data transfer and to the levels of confidence on each data source. The second level analysis, which is the purpose of this task, more complex and deals with the necessity of looking to the processes involved from different perspectives given by the different data sources and models, checking if they all tell the same story and learning from the differences.

Barriers to overcome: If the objective was to implement from scratch the numerical systems in each study site, the risk of failure would be tremendous, under the project time frame, but since our technological starting point is well advance, thus the existing local modeling systems are already able to describe partially the ecosystem and the interface developments needed to link all components are scientifically accessible to all partners the barriers to overcome are very small.

Partners: HIDROMOD, CNRS-LOB, HCMR, NKUA

Description of work: Teams will analyze of the biological and physical consistency of the results and evaluate the meaningfulness of the results and consequently decide if any modifications or new implementations to the numerical system are needed. If so the teams will make the necessary modification and new implementation to the numerical system in order improve the obtained results.

Task 3.2 - Calibrate the coupled models under the numerical system by means of numerical simulations carried out under climatological forcing.

Objectives: Calibrate and assess the quality of model results by comparing them with the available data sources

Scope of Work: Calibration is the process by which the model is adjusted to reproduce the characteristics of the study area for a given set of conditions. The model output is compared against observed measurements and model parameters and coefficients are adjusted to improve agreement. Calibration data for hydrodynamic models consist of water levels, current speeds and directions, and salinity measurements. To achieve calibration of the tidal cycle the model is often compared to tidal heights or flows that have been harmonically analysed to remove the wind effect from observations. Other important considerations for hydrodynamic model calibration are: location and number of data points to give good coverage of the model area, particularly at specific points of interest (e.g. outfalls, end-receptors); accuracy of calibration data, including boundary conditions, initial conditions and meteorological conditions; distribution of data with respect to model dimensionality - vertical and lateral variability fully described, if appropriate; required level of agreement between model output and observations from field surveys, sampling etc., i.e. is the model fit for purpose?

Typically, the model resolution, the bathymetry and sea bed roughness coefficient are adjusted to improve agreement to the desired level. Good agreement between predicted and observed salinities and dye-tracking results is necessary to demonstrate that the model accurately reproduces the dispersive characteristics of the study area. This is essential to achieve accurate water quality simulations. Calibration data for water quality models consists of concentrations of the variables of interest at points throughout the model area over the period of interest. Seasonal variations may be important for some parameters such as nutrients and chlorophyll. The considerations listed above for hydrodynamic calibration are important for water quality calibration. In addition it is important that all inputs to the model area from e.g. outfalls or rivers are accurately specified. The reaction rates and coefficients in equations describing chemical kinetics in the water column are adjusted to improve agreement between water quality predictions and observations to the desired level. In general, the level of is less for water quality than for hydrodynamics because of greater environmental variability of water quality parameters.

Barriers to overcome: Model calibration is always a demanding task. The barriers to overcome in this task are correlated to barriers on previous tasks and concerns scarcity of calibration data and the reliability of the models. Nevertheless we have strong facts in our favour, such as the fact that although, not in fully integrated way, all models are already applied to the study sites and calibration to a relevant level were already accomplished.

Partners: HIDROMOD, CNRS-LOB, HCMR, NKUA

Description of work: Calibration of the models, including parameterization tuning using different methodologies and assess the quality of model results by comparing them against an ocean color and a buoy reference data set.

Simulations of the seasonal variability of the study sites will be carried out utilizing perpetual year (monthly varying) surface and external inputs forcing functions. The main aim of this effort is the refinement and parameter calibration allowing for a correct simulation of the study sites ecosystem dynamics and phenomenology.

Task 3.3 - Data products

Objectives: produce level 1 and 2 data products Level 1 products include maps and time series of the vailable state variables. Level 2 products derive from the time and spatial integration of Level 1 products and are presented in the form of maps or time series representing trends, averages and ecological indexes.

Scope of work: Decision makers have the strong necessity of looking to summarized information both in time and space but on the other hand the complexity associated to coastal processes doesn't allow it. The main objective of this task is to establish the bridge between the necessity of simplification and the responsibility of considering the relevant processes and to deliver derived summarized data products (averages and trends) that combine the different data sources available and are consistence with the knowledge available to the study site.

Partners: HIDROMOD, CNRS-LOB, HCMR, NKUA

Description of work: The production of level 1 data products is straightforward and a direct consequence of the implementation of the numerical system. For level 2 products we will be using the integration boxes methodology, that performs post processing of the information computed by the models over coarse grids and small time steps, but which is also easily adapted to other data sources (e.g. Earth Observation data), it is possible not only to know the average state variable value (e.g. salinity, temperature, phytoplankton, BOD, organic matter, nutrients, others) in each area defined by the box (that integrates several grid cells), as well as to compute the properties fluxes between boxes, which gives a great insight into the dynamical processes in the estuaries. The user can easily select both the time period and the boxes area for integration. With this method it is possible to determine and calibrate the mass fluxes between the subsystems and to reach for more accurate answers, from a quantitative point of view. Above all, this method allows synthesizing information to fit stake holders needs without neglecting relevant data. Indexes will represent quantified information helping to explain how the quality of the environment changes over time or varies spatially. Their formulation will be flexible and determined by stakeholder preferences, local legislation, or defined under EU legislation.

B.6.4.1 Deliverables

- D3.1: Level 1 maps and time series
- D3.2: Level 2 maps and time series

B.6.4.2 Milestones

- M3.1: Finish testing the numerical system generic structure
- M3.2: Finish calibrating the coupled models

B.6.5 WP4 Data Management

WP Leader	3	Starting date		Month 1		End Date		Month 30	
Participant id	1	2	3	4	5	6	7	8	9
Person-months	3	2	-	18	-	-	5	-	-

Objectives: The main objectives of this work package are:

- To support all partners and data holdings data-management activities.
- To develop and establish a Remote Data Access System on the WWW for remote access to environmental, ecological, socio-economic, satellite, ICZM, industrial and administrative data & information, based on a telematic solution (World Wide Web Technologies – Internet -), to improve the overview, availability and accessibility of these data, and to provide a innovative WWW-tool for effective exchange of information, accessibility of data & and information, and communication within European Research Infrastructures.

Task 4.1: Data Quality Control/Assessment (DQC/DQA).

Scope of work: Execution of DQC/DOA on partners and data holdings data. The data and information to be used within the project will be assessed on data quality, including description of the applied data quality procedures, taking into account existing DQC procedures, directives and guidelines. Taking into account the results of the DQC/DQA, a special meta-data field will be developed for partner's and source holder's data, informing the end-user about the quality of the data & information he or she is looking for; within the meta-data formats the following fields will be mandatory: Data Quality Procedure/Method applied and Descriptive kind of "Data Quality Label".

Partners: MARIS

Task 4.2: Harmonization and conversion to agreed meta-data formats

Scope of work: From month 3 to 10 the project/data holding partners will make an inventory of the different nature of data & information within their possession, including the available format (database, hard copy, map), information about the data quality and data quality procedure/method applied. Partner's inventories will be discussed during the data-management workshop in month 10.

Following the production of the Meta-data Format Manual (as result of the data-management workshop), the partners/data source holders will commence compilation of the different nature data & information. Based on the data formats have been agreed and specified at the data-management workshop and Meta-data Format Manual, next partners will begin producing meta-data records (files) using standardized forms and templates and other appropriate data submission and transmission tools developed and supplied by the data-management partner MARIS.

In accordance with this objective the project will whenever its possible implement standards in accordance with OpenMI IT approach which are under development in the HarmonIT project.

Partners: HIDROMOD, MARIS, NOVELTIS

Task 4.3: Development Remote Data Access System

The develop a Remote Data Access System, providing uniform query facilities, to search on multiple environmental, socio-economic, industrial and administrative database catalogues, where these databases are geographically distributed over the research region, and being heterogeneous. Each of the databases has its own query interface which may or may not be available from the World Wide Web. To provide remotely accessibility to the data & information within source holder's databases.

The following components can be distinguished:

Action 1 - Scientific and Technical function specifications

- Drafting of the descriptive (scientific) functionalities of the system, based on the results of end-user and partner consultation as well as of the data-management workshop to be organized within the project in month 10, resulting in the scientific requirements for the Remote Data Access System.
- Drafting of the technical functionalities, based on the descriptive functionalities.

Action 2: "Conceptual Design" Remote Data Access System

Based on the results of activity 1 (technical functionalities) the first draft of the so-called Conceptual Design of the Remote Data Access System will be developed.

Action 3: Descriptive Information

Description of the project, including manuals, reports and other documents developed within the framework of the project.

Action 4: Electronic Sounding Board

To be used for end-user consultation, communication channel, and feedback from anyone who is interested in the project and its products.

Action 5: Central Meta-database

The Central Meta Directory contains the information about the contents of the distributed servers at partner's data-holding centre, like which catalogues of data sources from a server and more detailed information about the catalogue, like what information is available at what location.

The Central Meta Directory will provide the end-users with forms to be able to query the Central Meta-Database (Central Guidance Catalogue Server): Forms based queries (alpha-numerical search) and Cartographic queries (map search).

Action 6: Remote Access Module

The Remote Access Module allows the end-user to formulate a query using a standard Web Browser or an applet viewer. The user can select query parameters (meta-data fields) via the user interface. The user interface contains text fields and lists of values, which the user can use to formulate the uniform query (so-called alpha numerical search).

The Remote Data Access Module in general consists of end-user software,, distributed server software and local query server software.

Partners: MARIS

Task 4.4: GIS Interfaces/Application Layer

Scope of work: GIS interfaces are required and need to be developed for numerical and graphical (map) search, retrieval, (graphical/map) presentation, data-import and export of retrieved data/information and hereto related map.

The application Layer will provide facilities for processing and presentation of environmental, \socio-economic, industrial and administrative data and information largely based upon a Geographical Information System (GIS) for geographical interfacing. This will among others efficiently support the production of thematic maps.

Partners: IST, HIDROMOD, MARIS, NOVELTIS

Task 4.5: Testing of prototype Remote Data Access System

Scope of work: During the development phase of the Remote Data Access System components, thoroughly testing procedures will be carried out. At the end, the prototype of the final system will be tested out before it will be made operable through the Internet.

Partners: MARIS

B.6.5.1 Deliverables

- D4.1: Report on Data-Management Workshop, including scientific functionalities Remote Data Access System
- D4.2: Meta-Data Handbook
- D4.3: Conceptual Design Remote Data Access System
- D4.4: Funcional Web/Gis Interface

B.6.5.2 Milestones

- M4.1: Operable prototype of Remote Data Access System
- M4.2: The WEB/GIS system design project is finished
- M4.3: The WEB/GIS system is implemented

B.6.6 WP5 Interaction with Stakeholders and Dissemination

WP Leader	**2**	**Starting date**		Month 1		**End Date**		Month 36	
Participant id	1	2	3	4	5	6	7	8	9
Person-months	3	8	-	2	2	2	-	2	2

Objective: WP5 addresses the dissemination and interaction with the stakeholders ensuring an effective transference of the knowledge developed in the framework of **InSea** to the civil society and the end-users.

Having these purposes in mind as a fundamental target of the project, **InSea** aims the development of a set of integrated tools that it will serve as input for management decisions that can also take into account social and economic aspects of the management problems in coastal areas.

In order to ensure that the monitoring programmes, campaigns and simulated scenarios are relevant to the management of the study systems, and in order to facilitate transfer of the final product to the end-users, the latter will be involved in the process of setting up, running and analysing a management-oriented applications.

At the end of the project a demonstration tool will be implemented at least in one of the selected sites of the project in order to put in evidence in a more effective way the real potentialities of the technologies developed in the framework of **InSea**.

Task 5.1: Implementation of the Project Web page

Scope of work: Within the project, dissemination of information will be mainly over the internet, and there will also be a project web site with several access criteria. This will be a suitable format for dissemination to end-users and stakeholders who are interested in the ongoing progress of the project. This will precede fuller dissemination at a later stage by other means. Popular email discussion lists used by the scientific research community will receive short reports on the objectives and results of the project, and will be informed of the availability of project deliverables.

In the framework foreseen in this work package it is aimed the development of a comprehensive, internet based, dissemination and dialogue among project partners and, more important, between the project and external stakeholders and visitors trough the implementation and maintenance of a "demand driven" Web forum.

As database and GIS technologies used in the project (e.g MapServer) will be accessible over Internet, in the final part of the project (over the last year) access will be granted to stakeholders and the general public. Also the publication of the results of the studied scenarios will make clear what the project was about and what were its outcomes.

The internet site, and the knowledge base that it will include, will use English, Portuguese and Spanish in order to broaden the access to the information.

This Internet site will also be a favourable way to engage junior technicians (engineers, biologists, sociologists) from institutional stakeholders (environmental agencies, industrial and port activities, NGO's) in the continued development of the knowledge base during the project, which should remain after the end of the project. This engagement will assure knowledge transfer from the scientific environment to the society. The production of basic to intermediate level information on the PHES-system, based on the knowledge acquired during the project, will be the best way to reach all levels of society, establishing synergies with education at all levels. Gender specific information will be produced, taking into consideration the different way man and woman locally interact with the ecosystem

Partners: HIDROMOD, MARIS

Task 5.2: One day workshops with relevant stakeholders of the three project test sites.

Scope of work: One day workshops with relevant stakeholders for Costa do Estoril, Gulf of Fos and Gulf of Pagasitikos will be promoted. These workshops will have as objectives a general presentation of the project, discussion of usefulness of such systems for supporting monitoring programmes and warning systems, presentation of the system results and its potential application. These workshops will take place, at least, during the first year of the project and at the end of the project. The first workshop has as main objective explain the stakeholders the project objectives and collect their main concerns and the kind of answers that they would like to get as result of the project. The final workshop will have as main objectives the presentation of knowledge base produced by the project and to promote an effective use of this knowledge by the end users.

Partners: IST, HIDROMOD, CNRS-LOB, UPS-LA, HCMR, NKUA

Task 5.3: General dissemination activities

Scope of work: The availability of effective integrated ecological coastal zone management systems is a major international issue with profound socio-economic implications. The related research outcomes of the project will be of significant interest to both scientific and water resources management communities. It is important that project results are disseminated in such a way as to ensure that they can be exploited effectively so as to improve water management in affected areas.

Research undertaken by the project teams will be of interest to scientists working in water quality and related fields. These form the first target group. However, it is important that water resources managers take on board the practical implications of the findings of the project. These end-users and stakeholders form the second major target community. The project dissemination strategy will ensure that both the scientific and user communities are kept well-informed of findings, with a view to ensuring that these can readily be implemented with social and economic benefits.

Apart from improved scientific understanding within the research and end-user communities, three major products of the research programme can be identified: the Web-GIS database, the ecological indexes and the improved models. These project products will be made available to the end-user and stakeholder communities as appropriate.

The deliverables of the project will have direct application for European consultancies and research centres in the gCNRS-LOBal environmental market. In particular, the models benchmarked provide opportunities for training, and their use could also generate an immediate market opportunity.

Most importantly, the outcomes of the project will lead to improved allocation of public and private funding for water resources and land use development. Better understanding of the effects of land use change and their quantification using improved models will provide a new degree of refinement in the strategic planning of costly water infrastructure investments, and play a key role in water resources supply and demand management.

Research findings of interest to the scientific target community will be published in peer-reviewed international scientific journals and presented at scientific conferences.

Open workshops

Dissemination to the end-user and stakeholder target communities will be through publications arising from the work programme and meetings with local representatives. These will address the relevance of the wider findings of the project at a local scale, by addressing specific local issues. End-user participants are then well placed to disseminate within the institutions and professional bodies to which they belong. The organisers of the meetings will pay particular attention to coordinating the transfer of research results in a suitable format for dissemination within the internal networks of these institutions. The participants will be encouraged to identify means of involving their peers within ministries, government agencies and professional communities.

Printed material

The production of printed material for the levels of society that doesn't have access to Internet should be a straightforward task for the stakeholders once the Internet site is set up.

Research findings of interest to the scientific target community will be published in peer-reviewed international scientific journals and presented at scientific conferences.

Partners: IST, HIDROMOD, CNRS-LOB, UPS-LA, HCMR, NKUA

Task 5.4: Implementation of a demonstration tool

Scope of work: Although the project objectives are not related with the development of a specific tool but with the development of methodologies and technologies capable to take advantage of existing knowledge by means of integration and downscaling, the implementation of a demonstration tool capable to better transmit the end-users the real potentialities of the project results, would result on a major added-value in terms of the project results dissemination.

With this purpose in mind, at the end of the project a demonstration tool capable to show the potentialities of the technologies developed in the framework of **InSea** will be implemented for one of the test sites.

Partners: IST, HIDROMOD

B.6.6.1 Deliverables

- D5.1: Web page and internet discussion forum
- D5.2: Report with the minutes of the first stakeholders workshop
- D5.3: Report with the minutes of the second stakeholders workshop
- D5.4: Printed material for project promotion
- D5.5: Demonstration tool

B.6.6.2 Milestones

- M5.1: Input from stakeholders to the remote data system for the three sites
- M5.2: Input from stakeholders to design relevant scenarios for the three sites
- M5.3: Results and their relevance for decision making discussed with the stakeholders

B.6.7 WP6 Project Management

WP Leader	1	Starting date		Month 1		End Date		Month 36	
Participant id	1	2	3	4	5	6	7	8	9
Person-months	6	5	-	-	-	-	-	-	-

Objective:

The declared goal of Project Management described below is to lead the **InSea** project to technical, scientific, organisational and economic success. The project management encompasses:

- Overall project coordination;
- Supervision of the various project activities;
- Relationship with the EU and other European projects;

Active support will be given and formal controls will be applied in order to assure efficient feedback loops and a close interaction among the different partners. Tasks, responsibilities and work distribution are dearly defined to avoid excessive interaction on the one hand and to ensure all necessary communications between the partners on the other.

Scope of work:

The core partnership on **InSea** is composed of 9 companies, universities and research organisations. They have a long-term strategic interest in the field and have contributed significantly to this area in previous projects. In view the size and scope of the project, the management structure has been organized by assigning clear responsibilities to these partners in specific research and development areas. For participation in the respective specialized R&D work within **InSea** all partners have been carefully selected. Among others, main criteria were excellence in the field, reliability, experience and commitment. Research and development is planned to be carried out in three areas (Work packages 2, 3 and 4) and corresponding tasks.

InSea will need an appropriate general Management Structure and a strong operational management to ensure the smooth running of the project.

The Management Structure will ensure the scientific management by a Project Coordination Committee composed by a representative of each the project partners. This committee will guarantee overall and interdisciplinary management, coordinate Work packages activities and monitor scientific progress and achievement of project objectives. Management resources are distributed according to the functions previous described.

Common transversal areas are devoted to User and Case Study requirements starting at the beginning of the project.

Each Work package has a team leader who is responsible for the coordination of the effort within this Work package and providing the respective deliverables. The Work package leaders will meet with the partners producing work for the respective Work package will meet as often as necessary to guarantee the accomplishment of the WP milestones.

For more information on Management Structure see Section B.5.

Task 6.1 Administrative & Technical Management

- The Management of the **InSea** project in accordance with the project management procedures already described.
- Organisation and run of the internal events as: regular management and technical meetings, audit preparation meetings, and audits.
- Close monitoring of the project milestones, ongoing tasks and resource consumption, by means of computer-based project management facilities and internal three-monthly progress

and resource consumption reports. Six- monthly Periodic Progress Reports will be the main deliverables

- Preparation of the Project Management Guide.
- Preparation of the infrastructure for the compilation and delivery of internal or public documents, exchange of messages (e-mail reflectors, document formats, converters, etc.).
- Preparation and maintenance of the internal Electronic Project Library with support for online document retrieval i.e. file transfer, web based, etc.
- Interface with the EU for every issue that concerns the project; convey the information to the partners for issues regarding payments, timely delivery of project documents, etc.
- Development and maintenance of the web presence of the project. This activity will significantly aid the dissemination procedures of the project and will be the core of the project internal communications.
- Participation and contribution to the following external events: industry meetings, exhibitions, workshops and conferences.

Partners: IST, HIDROMOD

B.6.7.1 Deliverables

- D6.1: Project Management Guidelines
- D6.2: Project Detailed Workplan + Quality Plan
- D6.3: Leaflet with a Project Presentation
- D6.4: Web page of the project
- D6.5: Periodic Progress and Management Reports
- D6.6: Periodic Management Reports & Cost statements
- D6.7: Final Progress Report

B.6.7.2 Milestones

- M6.1: Project Coordination Committee Meetings

B.7. Other issues

B.7.1 Ethical and gender issues

The following table summarises the ethical aspects of the **INSEA** project:

Does the project raise sensitive ethical questions related to….	**Yes**	**No**
Human beings?		**X**
Human biological samples?		**X**
Personal data (whether identified by name or not)?		**X**
Genetic information?		**X**
Animals?		**X**

The project does not involve:

- ✓ Research activity aimed at human cloning for reproductive purposes;
- ✓ Research activity intended to modify the genetic heritage of human beings which could make such changes heritable;
- ✓ Research activity intended to create human embryos study for the purpose of research or for the purpose of stem cell procurement, including means of somatic cell nuclear transfer;
- ✓ Research involving the use of human embryos or embryonic stem cells with the exception of banked or isolated human embryonic stem cells in culture.

In what concerns the gender issue, the project manager will propose the adoption of specific measures at the kick off meeting of the project. These measures are designed to serve as a binding document, approved and signed by all project partners. The project partners will also decide the framework in which this will be done. The progress of the respective implementation will be a standing item at the meetings of the PCC and will be closely monitored by the Project Manager.

In accordance with the commitment described above the consortium will actively seek to recruit female researchers at all levels to the project and each participating organisation makes a commitment to set up **a mentoring scheme** that links young female researchers in the project with role models outside the project to gain advice on long term career planning.

In addition the **project web page** will have **a section dedicated to the promotion of gender** equality within the project, including links to networks of women scientists, information on events and links to relevant legal documents and contact points for advice.

Gender issues

The PCC of **INSEA** takes the promotion of gender equality extremely seriously, in particular since female researchers are underrepresented in the field of information and communication technology.

There will be seek actions for the promotion of gender equality within the project are in line with the EU's action *plan 'Women and science – Mobilising women to enrich European Research'*, and aim, in the long term, to attract more female students to the engineering sciences and to increase in the number of female researchers working in this subject area.

The project therefore presents an excellent opportunity to promote gender equality and to encourage young women scientists to embark on research careers. The consortium has an obligation to ensure that the project benefits equally from the potential of young men and women and in return to provide support that facilitates the development of successful and sustained research careers for both sexes. The consortium also has the responsibility to disseminate the research findings to a broader audience in order to promote the subject, to raise awareness of its diversity and potential benefit for society at large and thus to contribute to an increased enrolment of young women.

All partners will be invited to review the plans for the integration of the gender dimension into the **InSea** project, to make further suggestions or to raise concerns regarding individual measures.

Workpackage list (full duration of project)

Work-package No[1]	Workpackage title	Lead contractor No[2]	Person-months[3]	Start month[4]	End month[5]	Deliverable No[6]
1	Description of the Ecosystem	1	15	1	3	D1.1-D1.3
2	Technological Improvements and Tools Integration	8	181	4	24	D2.1-D2.10
3	System Implementation and Validation	6	68	7	32	D3.1-D3.2
4	Data Management	3	28	1	30	D4.1-D4.4
5	Interaction with Stakeholders and Dissemination	2	21	1	36	D5.1-D5.5
6	Project Management	1	11	1	36	D6.1-D6.7
	TOTAL		**321**			

[1] Workpackage number: WP 1 – WP n.
[2] Number of the contractor leading the work in this workpackage.
[3] The total number of person-months allocated to each workpackage.
[4] Relative start date for the work in the specific workpackages, month 0 marking the start of the project, and all other start dates being relative to this start date.
[5] Relative end date, month 0 marking the start of the project, and all ends dates being relative to this start date.
[6] Deliverable number: Number for the deliverable(s)/result(s) mentioned in the workpackage: D1 - Dn.

Deliverables list (full duration of project)

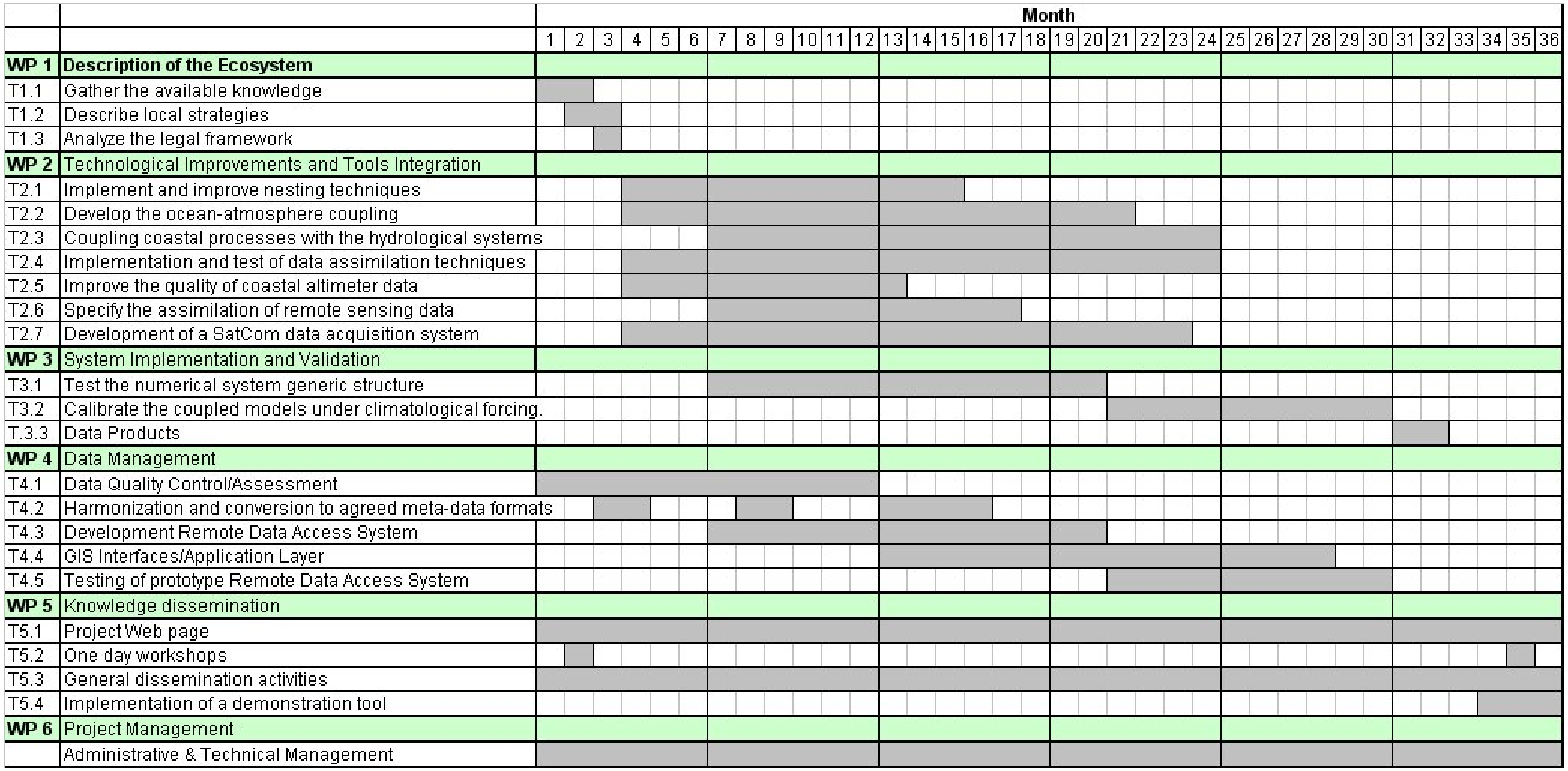
Deliverable No[7]	Deliverable title	Delivery date[8]	Nature[9]	Dissemination level[10]
D1.1	Report characterizing each system.	Month 2	**R**	**PU**
D1.2	Report describing the objectives and main consequences and conclusions of approaches for dealing with eutrophication problems that were previously implemented in each study site.	Month 3	**R**	**PU**
D1.3	Data Specification on parameters, formats, spatial and temporal distribution for supporting legal requirements namely indexes for describing environmental status. This information will be compiled together with the previous one in a Join Report.	Month 3	**R**	**PU**
D2.1	Report describing the methodologies used to nest the local hydrodynamic solution with the large scale ones	Month 15	**R**	**PU**
D2.2	Report describing the methodologies used to impose the biogeochemical open boundary condition	Month 24	**R**	**PU**
D2.3	Report describing the best way of coupling local operational systems with large scale ones based in the project experience	Month 18	**R**	**PU**
D2.4	Coastal sea surface topography database	Month 13	**O**	**PR**
D2.5	Specification document for remote sensed Ocean colour and SST data processing in coastal zone.	Month 8		**PU**
D2.6	Specification document for remote sensed Ocean colour and SST observation operators for their assimilation in the coupled model	Month 10	**R**	**PU**
D2.7	Technical note for the analysis of the potential gain of remote sensed SST and ocean colour data assimilation in the coupled physical-biogeochemical model	Month 17	**R**	**PU**

[7] Deliverable numbers in order of delivery dates: D1 – Dn
[8] Month in which the deliverables will be available. Month 1 marking the start of the project, and all delivery dates being relative to this start date.
[9] Please indicate the nature of the deliverable using one of the following codes:
- **R** = Report
- **P** = Prototype
- **D** = Demonstrator
- **O** = Other

[10] Please indicate the dissemination level using one of the following codes:
- **PU** = Public
- **PP** = Restricted to other programme participants (including the Commission Services).
- **RE** = Restricted to a group specified by the consortium (including the Commission Services).
- **CO** = Confidential, only for members of the consortium (including the Commission Services).

D2.8	Report with the characterization of the available data sources that can be use for data assimilation in each site;	Month 4	**R**	**PU**
D2.9	Report describing the outcomes of the data acquisition analysis and design tasks	Month 18	**R**	**PU**
D2.10	Demonstration of wireless data messaging using a proof-of-concept implementation based on the 'PocketSAT' prototype satellite user terminal platform and a test receiver	Month 23	**D**	**PU**
D3.1	Level 1 maps and time series	Month 33	**R**	**PU**
D3.2	Level 2 maps and time series	Month 33	**R**	**PU**
D4.1	Report on Data-Management Workshop, including scientific functionalities Remote Data Access System	Month 12	**R**	**PU**
D4.2	Meta-Data Handbook	Month 16	**R**	**PU**
D4.3	Conceptual Design Remote Data Access System	Month 20	**O**	**PU**
D4.4	Functional Web/Gis Interface	Month 28	**P**	**PU**
D5.1	Web page and internet discussion forum	Month 6	**P**	**PU**
D5.2	Report with the minutes of the first stakeholders workshop	Month 3	**R**	**PU**
D5.3	Report with the minutes of the second stakeholders workshop	Month 36	**R**	**PU**
D5.4	Printed material for project promotion	Month 13	**O**	**PU**
D5.5	Demonstration tool	Month 36	**P**	**PU**
D6.1	Project Management Guidelines	Month 3	**R**	**PU**
D6.2	Project Detailed Workplan + Quality Plan	Month 6	**R**	**PU**
D6.3	Leaflet with a Project Presentation	Month 2	**R**	**PU**
D6.4	Web page of the project	Month 3	**P**	**PU**
D6.5	Periodic Progress and Management Reports	Months 3, 9, 15, 21, 27, 33	**R**	**PU**
D6.6	Periodic Management Reports & Cost statements	Months 6, 12, 18, 24, 30, 36	**R**	**PU**
D6.7	Final Progress Report	Month 36	**R**	**PU**

InSea Planning Chart



Insea Delivers planning

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Insea Milestones planning

	Month																																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
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M5.3																																X				
WP 6																																				
M6.1	X					X						X						X						X						X						X

InSea task dependencies

The following images show the task dependencies between work packages. Arrows show the information path and each picture represents information flow from one work package to the others, consequently WP 5, which is a receiver of information doesn't have a specific picture. Work package 6 – Project management is not represented since it will interact with all Work packages in the some manner.

WP1 - Description of the Ecosystem

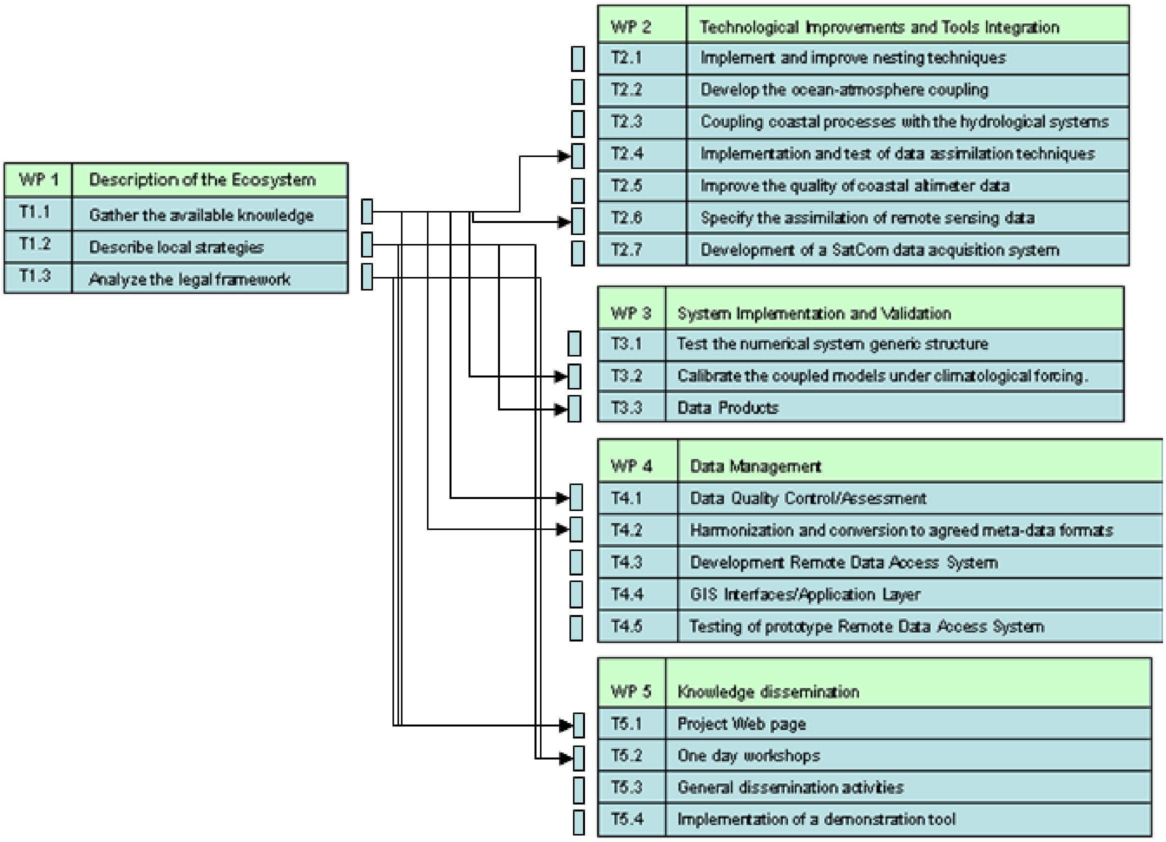

Figure 7 – WP1 information flow to other WPs

WP2 - Technological Improvements and Tools Integration

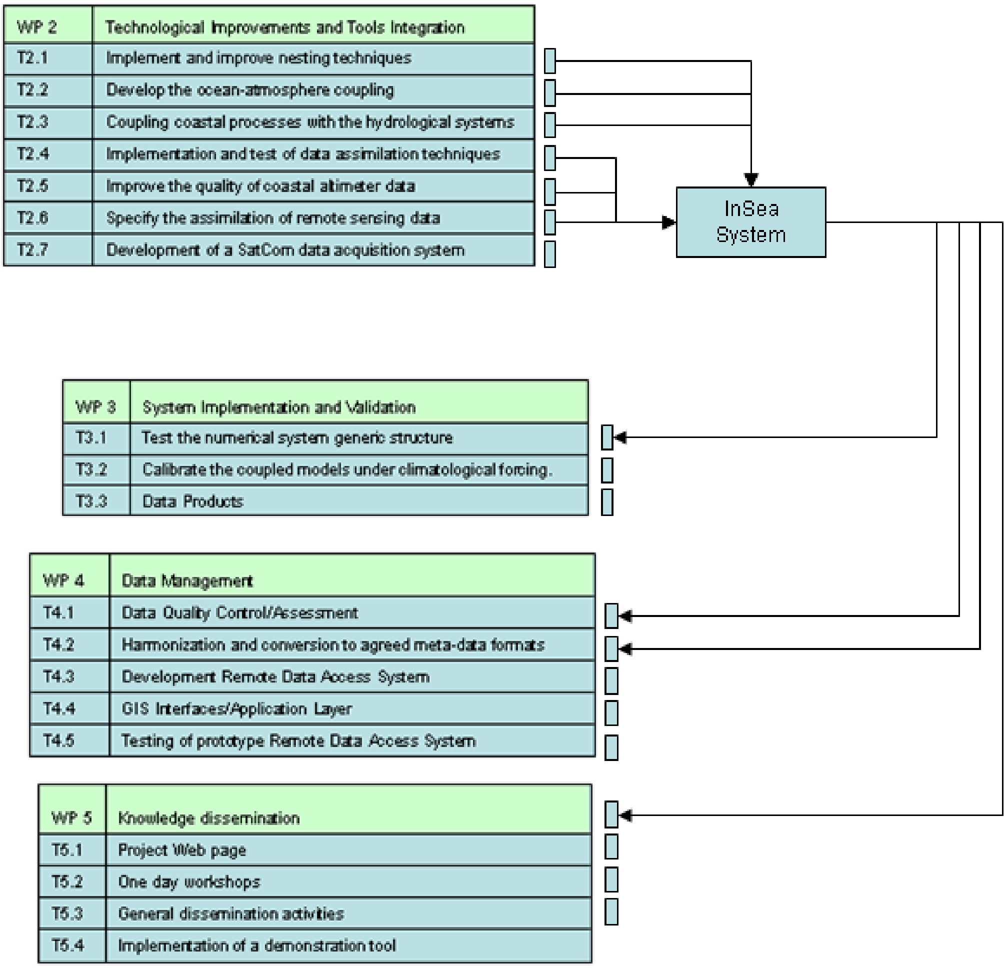

Figure 8 – WP2 information flow to other WPs

WP3 - System Implementation and Validation

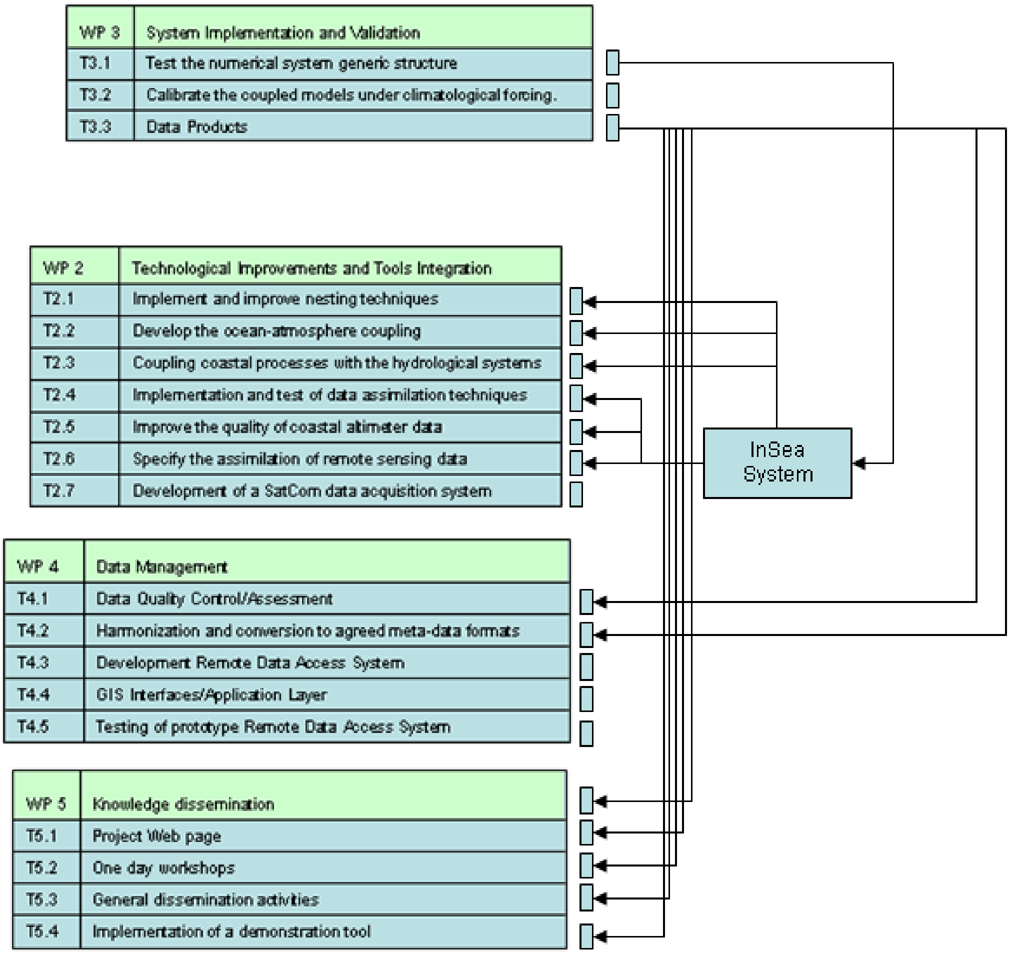

Figure 9 – WP3 information flow to other WPs

WP4 - Data Management

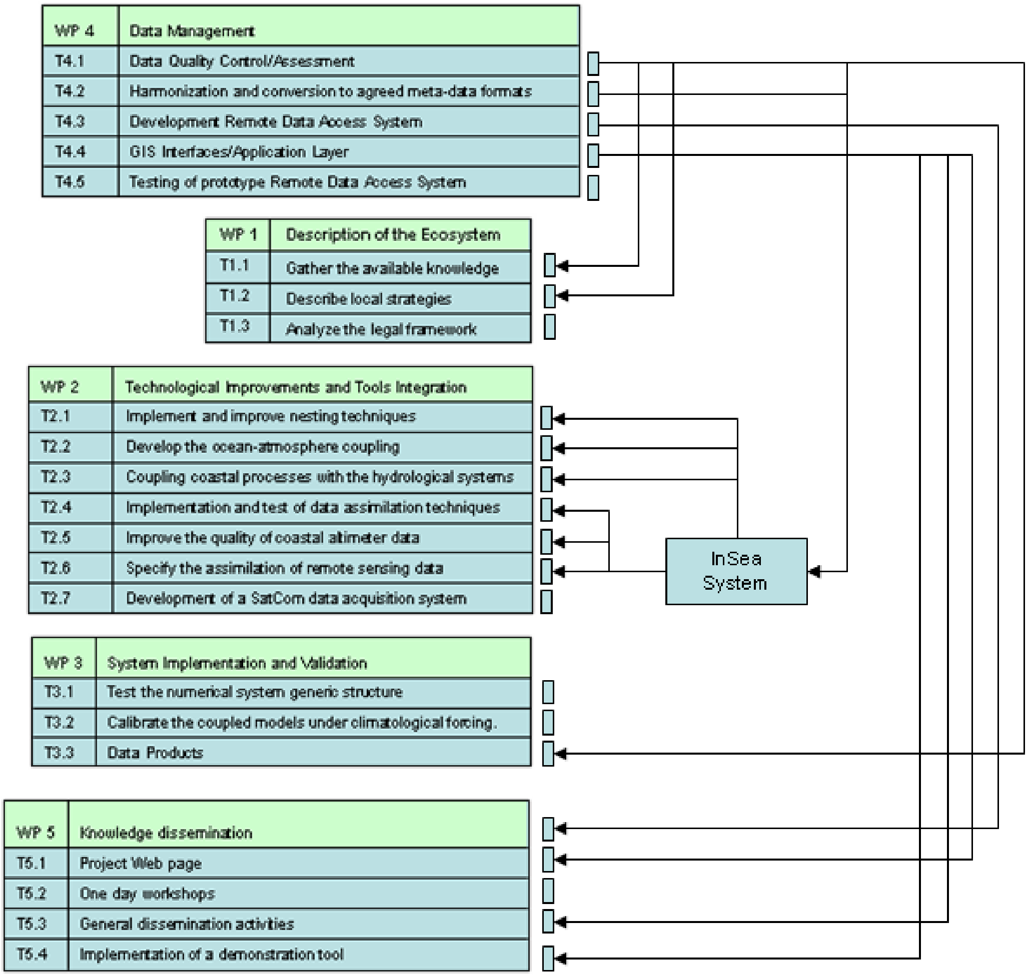

Figure 10 – WP4 information flow to other WPs

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