SIXTH FRAMEWORK PROGRAMME
PRIORITY [#]
[PRIORITY TITLE]

Contract for:

SPECIFIC TARGETED RESEARCH OR INNOVATION PROJECT

Annex I - "Description of Work"

Project acronym: ECOManage
Project full title: Integrated Ecological Coastal Zone Management System
Proposal/Contract no.:
Related to other Contract no.: *(to be completed by Commission)*

Date of preparation of Annex I: 15-2-2004

Operative commencement date of contract: *(to be completed by Commission)*

1 - Project summary

Ecologists and social scientists are presently merging their skills for developing integrated tools to help decision makers in the difficult task of integrated coastal zone management.

EcoManage project aims to push the capacity of assisting managers to join horizontally knowledge from ecological and socio-economic disciplines. The three key aspects of EcoManage are (1) the consideration that a coastal zone depends on local pressures, but also on pressures originated in the drainage basin, transported mostly by rivers and by groundwater, (2) that socio-economic activities are the driving forces of those pressures and that their impacts on the ecosystem have feedback on socio-economics and (3) the impacts depend on physical characteristics of the ecosystem that together with the loads determine its ecological state.

Three coastal zones showing conflicting interests between urban, industrial and agricultural pressures and environmental maintenance have been selected for developing the system. The selected areas are: Aisén Fjiord in Chile, Bahía Blanca estuary in Argentina and Santos estuary in Brazil.

Relationships between the origins and consequences of environmental problems will be described using a Driving forces, Pressures, States, Impacts and Responses (DPSIR) framework and indexes will be used to assess links between DPSIR elements.

Participatory methods will be applied for interaction with stakeholders in order to establishing study scenarios and indexes for social-economic and ecosystem analyses and to measure environmental impacts of management decisions. Field data and modelling results will be included into a Spatial Decision Support System (SDSS) for simplifying the assessment of the impact of management scenarios and evaluate their performance. The project will raise the opportunity to improve normative rules for the functioning of the systems, and in this way to improve environmental management for the estuaries towards sustainable development.

2 - Project objective(s)

During the last decades, strong developments have been done on environmental knowledge, legislation and public awareness. Research tools experienced important developments and nowadays mathematical models, local data acquisition systems and remote sensing are tools used routinely by the scientific community. Data acquired in the framework of research projects and monitoring programs is feeding environmental data banks and environmental impact assessments became part of the plan of any building project and public participates actively in their evaluation. Existing knowledge and tools have been built mostly on a vertical perspective inside each discipline using their own spatial and temporal scales. The use of this knowledge for further scientific progress and for improving environmental management requires the introduction of more horizontality both disciplinary and geographical.

EcoManage aims to develop tools for building horizontality in coastal ecosystems approach in order to improve their study and management at local scale. Physical and ecological models for estuaries will be coupled to models of the drainage basin in order to understand how anthropogenic pressures in the basin will affect coastal ecosystems and how resilience brought by ground water and by the ocean will modulate evolution rates.

Tools will be developed to be generic and to be useful for managers. To be useful for managers, tools must have predictive skills and must include the main features of a Decision Support System. The tool has predictive skills if parameters are generic and do not change from one scenario to another. This is also a requirement of generic tools and can be achieved simulating processes as explicitly as possible.

Having the aims and constrains of the project in mind, EcoManage specific objectives are:

1. Developing a generic integrated model that will allow to represent the three very different estuarine systems at a resolution that is useful to managers, while being sufficiently generic to allow the development of applications elsewhere;
2. Adapting and validating the three applications with local data;
3. Combine information in a Spatial Decision Support System (SDSS);
4. Train stakeholders in their use;
5. Jointly explore scenarios that are useful for coastal planning purposes under the socio-economic and institutional conditions in Argentina, Brazil and Chile.

An estuary (Santos, Brazil), a bay (Bahia Blanca, Argentina) and a fjord (Aisén, Chile) have been chosen in order to test the tool in systems with contrasting climates, pressures and geomorphologies.

The first objective is the critical path for achieving the others. An integrated modelling system including the coastal ecosystems under study, the coastal ocean, the catchment's area and the aquifer will be developed by the consortium, based on previous modelling work and mostly on existing data.

The system will be configured to be able to evaluate the development scenarios designed according to present and planned socio-economic conditions. Development scenarios will be assessed by the team and plausible ones will be used to modify environmental pressures and the modelling tool will quantify the environmental evolution of the ecosystem. Indexes will be used to quantify the pressures, the present and expected state of the environment and the performance of the management decisions, following the DPSIR and PHES approaches.

Examples of questions that can be answered at the end of the project are: (i) What factors are controlling eutrophication (ii) What level of treatment is needed for urban wastewater and where and how should it be discharged? (iii) How will dredging works affect dynamics of important species? (iv) What areas of mangrove should be restored first, considering its importance for the ecosystem? (v) What fish farming areas can be used and how will they interact with the ecosystem?

(vi) How will toxic pollution affect macro fauna growth? (vii) What is the origin of harmful algal bloom's? (viii) How will the recreational use be affected by local changes?

The activities within EcoManage are split up into 5 work packages, addressing different aspects of the outlined approach. Firstly, data will be gathered within each site to establish a database on the available knowledge. Local models, already established and remote sensing data will also represent important sources of information. Secondly, the physical ecological and social system (PHES-System) will be established for each site supported by the available data and models. Modelling results will be analysed and compared with the available data, and complementary data will be collected where and when necessary. Thirdly, indexes for defining system pressure, state and management performance will be implemented based on data and modelling results. Finally all available information will be processed on a spatial decision support system (SDSS) for helping stakeholders on environmental management. A knowledge base will also be implemented for supporting the SDSS use. These are the main tasks of the project that will serve as base for establishing work packages, products and milestones of the project. The schedule for each of these is established next on point **7.2 Workplanning and Time.**

3 - Participant list

List of Participants

Partic. Role*	**Partic. no.**	**Participant name**	**Participant short name**	**Country**	**Date enter project****	**Date exit project****
CO	1	Instituto Superior Técnico	IST	Portugal	Month 1	Month 36
CR	2	HIDROMOD, Modelação em Engenharia, Lda.	HIDROMOD	Portugal	Month 1	Month 36
CR	3	Noctiluca Marien-wetenschappelijk adviesbureau	Noctiluca	Netherlands	Month 1	Month 36
CR	4	Laboratório Nacional de Engenharia Civil	LNEC	Portugal	Month 1	Month 36
CR	5	UNIVERSITY OF TRIESTE	UNITS	Italy	Month 1	Month 36
CR	6	Instituto Oceanográfico da Universidade de São Paulo	IOUSP	Brasil	Month 1	Month 36
CR	7	INSTITUTO SUPERIOR DE EDUCAÇÃO SANTA CECÍLIA UNIVERSIDADE SANTA CECÍLIA	UNISANTA	Brasil	Month 1	Month 36
CR	8	Instituto Argentino de Oceanografía	IADO	Argentina	Month 1	Month 36
CR	9	Universidad de Chile	UCHILE	Chile	Month 1	Month 36
CR	10	Centro de Ecología Aplicada Ltda.	CEA	Chile	Month 1	Month 36

*CO = Coordinator
CR = Contractor

** Normally insert “month 1 (start of project)” and “month n (end of project)”
These columns are needed for possible later contract revisions caused by joining/leaving participants

4 - Relevance to the objectives of the specific programme and/or thematic priority

4.1 Introduction

This project addresses INCO-A.2 – "Rational use of natural resources" and specifically targets INCO-2002-A.2.2-Reconciling multiple demands on coastal zones. It also 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" (INCO-A) coastal ecosystems play in the development of the countries in the project (Portugal, Netherlands, Italy, Brazil, Argentina and Chile). In all of these countries, coastal ecosystems, and estuaries in particular, are historically favoured for urban use due to natural resources abundance, to sea commerce and to territory protection against sea attacks. The first two motivations are still valid these days, with tourism uses also gaining a major importance.

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 are presently merging their skills to help decision-makers in the difficult task of integrated coastal zone management. Credible scientific knowledge must explicitly incorporate human beings, and their complex socio-economic system, as a structural component of the whole ecosystem. This is the path to obtain criteria to choose between different development strategies. New concepts and techniques are indeed necessary to understand these "eco-social systems". The emerging transdisciplinary field which addresses this is Ecological Economics.

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 generate an overall comprehension of the physical-ecological-social system (PHES-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).

The "conceptual framework" proposed in this project, will test these concepts in three different PHES-systems, with different characteristics but all with the same problems of defining what the correct way to use the natural resources is.

4.2 Description of components and state of the art issues

4.2.1 Integrated modelling

Integrated modelling is usually used for designating interdisciplinary modelling. In that context it generally refers to a model that simulates physics and biogeochemical processes in a coastal system, using the same spatial grid. In this proposal this concept is widen to consider several physical systems exchanging information through common interfaces and where simulated processes can be different (estuary, coastal area and a river).

Until the middle eighties ecological models were "box models" where boxes were organized on a 1D grid with a few tenths of nodes. In case of estuaries the residual water flow between boxes was the river discharge and tide was simulated computing a diffusion coefficient based on the distribution of a known tracer (usually salinity). In the case of 1D vertical models, no advection was computed explicitly and vertical diffusion was computed using a turbulence model. Longitudinal box models used to consider a time step of 1 day, while vertical models used to consider a time step of minutes to seconds, according to the instantaneous diffusivity and vertical discretisation.

Some of the most well known ecological models have been developed, based on box approach, which have been coupled to circulation models during the nineties. Many groups have done applications of these models to the North Sea, the Mediterranean Sea and Baltic Sea. Coupling of ecological and physical models, merging both codes (often FORTRAN 77) in one unique code, has proven that the use of the same grid is the best method for including in the ecological model the details of the physical forcing (e.g. upwelling and time variability of the thermocline). Merging of the codes is however a limitation for scientific development of modelling, because it reduces the freedom of modellers to test and modify the code.

In this project a modular approach using Object Oriented (OO) programming will be used. OO programming based on FORTRAN 95 has been tested during the last five years by some members of this consortium and proved to be flexible enough for maintaining the freedom of individual modellers and the benefits of direct coupling, still avoiding doubling programming efforts.

4.2.2 Physical circulation models

State of the art physical circulation models must provide a way of answering to different scale predictions, complex geometries and to efficiently incorporate different data sources to define boundary conditions (land, open sea, surface).

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, or by assimilation of data (local or remote sensing). Vertical grid resolution is also an issue. 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 to 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.

4.2.3 Ecological models

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.

4.2.4 Catchments models

Watershed models face a challenging task: they must accurately describe the land phase of the hydrologic cycle. This includes modelling surface runoff, ground water flow, plant uptake, vadoze zone flow, and others. The number of uncertainty parameters associated with this task can make physical based models seem quite inadequate. However, over the last few years several tools that face this problem have been developed. There are models solving the full Richards equation for vadoze zone flow coupled with a three-dimensional groundwater model and a diffuse wave approach for runoff flow. Others use the Green & Ampt method for water infiltration or SCS curve number protocol. Plant growth models are also a common place nowadays, usually related to the head units theory for growth. Evapotranspiration theory and models are also easily available. Nutrient cycling models simulate carbon and nitrogen transformation in unsaturated soil according to agricultural practices.

4.2.5 Remote sensing application

Satellites offer the only way of systematically observing large areas of land and ocean over long periods of time and with the ability to scale down processes. Most of the parameters, which can already be measured from space, are among those identified as of high priority for this project. Recently new ocean colour sensors have been launched which are likely to expand the user community significantly. The scientific community has, after initial scepticism, become convinced of the value of such data and they are used extensively in studying land and coastal processes over a wide range of time and space scales, its interaction with biology, and the response to changes in atmospheric forcing.

4.2.6 Decision support system and indexes

There are a number of developments on this matter on international level, some are more consistent then others. The decision "philosophy" behind the project will be established from a DPSIR assessment framework. **D**riving forces (or human activities) lead to **P**ressures (emissions of nutrients and hazardous substances) on the environment. As a result, changes in the **S**tate of the environment may lead to **I**mpacts on ecosystems and human health and societal **R**esponses must be defined to reduce the adverse effects.

The quantification of the **S**tate 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. 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.

It is important to create a shared vision among stakeholders about the possible future outcomes of the system and which are more and which are less desirable. Scenario creation, coupled with models, provides the ideal tool for this. According to Alcamo *et al*., (2003, p. 22), "Scenarios are plausible alternative futures, each an example of what might happen under particular assumptions. They can be used as a systematic method for thinking creatively about complex uncertain futures. In this way, they help us understand the upcoming choices that need to be made and highlight developments in the present."

4.3 Site Description

4.3.1 Site 1- Santos Estuary

The Santos Estuary, in Brazil, is a highly changed ecosystem, after 500 years of urban, industrial and port use (it's the biggest port in Latin America). It has extensive areas of mangrove, partially degraded. Nevertheless, there are still some well preserved areas and the region is an important tourism area for the population of São Paulo. It is located at latitude of about 24º S. Santos is a major port and tourism area, located downstream from Sao Paulo (a city of 15 million people) and Cubatao, major industrial area. The Santos Estuary used to receive raw sewage from Sao Paulo and industrial and hydroelectric powerplant discharges from Cubatão. High levels of oxygen-demanding substances, phenols, metals (e. g., copper and zinc), and pesticides have been detected in the water, and metals and pesticides have been found in sediments.

A lot of research has been done in the past in this estuarine area, some of it by teams participating in this project, but all dealing with partial aspects of the ecosystem. An integrated approach is much needed to support local definition of sustainable development strategies, based on the data already available. Some decisions concerning port development and restoration of mangrove areas have to be taken by local stakeholders of the system. Stakeholders have shown their interest towards the project including local government, university and educational system, industrial and harbour consortiums and NGOs (environmental protection).

4.3.2 Site 2 - Bahia Blanca Estuary

The Bahia Blanca Estuary is a mesotidal coastal plain estuary in the southwest of Buenos Aires Province, Argentina. It is a less modified coastal system than the previous one. It is located in a temperate zone at about 39ºS. The estuary is characterized by the presence of various channels, fine sand and silt-clay sediments and low depth. Tidal oscillations of 4 m and predominant northwesterly winds create strong tidal currents, which facilitate water mixture, leading to a uniform vertical distribution of the main oceanographic parameters. At the northern boundaries of estuary various ports, towns (with a populations exceeding 350,000 inhabitants) and industries are located and several streams discharge within the area. Oil refineries and terminals, petrochemical industries, meat factories, leather plants, fish factories, textile plants, wool washing plants, silos and cereal mills discharge their effluents into the estuary with or without treatment. Moreover, this area is extensively used by fishing boats, oil tankers and cargo vessel and therefore requires regular dredging.

Recently a natural reserve was created due to problems like: introduction of exotic species, illegal fishing and hunting, oil spils and wastewater dumps. The stress that these actions introduce in the ecosystem need, once again, to be evaluated with an interdisciplinary and integrated view: the PHES-system. Also in this area, a lot of partial studies have been done in the past, some of them by partners of this project. Different organizations of Bahía Blanca community were invited as stakeholders to take part of the implementation of ECOManage; local government, university and educational system, research canters, industrial and harbour consortiums, NGOs, and general public are interested to be active participants.

4.3.3 Site 3- Fjord Aisén

Finally, the third application site is Aisén fjord in Chile. This fjord is located in one of the largest estuarine areas of the world: the Chilean austral fjords, at a latitude of 45ºS. A century ago this was a region only for brave colonizers. Since then it has been used for different productive purposes such as salmon farming, mariculture, mollusc harvesting and (rather recently) industrial development. This fjord support a large salmon farming industry, it receives the liquid residues of Puerto Aisén (a town of 37000 people, located close to its head). Its also home of a large seaport (Puerto Chacabuco), and it has harmful algal bloom's problems. Recently, a multinational company requested the Chilean government authorization to install a large industrial complex near the fjord (an aluminium processing plant), further requesting permission to evacuate its industrial residues in the fjord's water, which has been generating a large discussion in the community. Although both the central and regional Chilean governments state that one of the main characteristics of its environmental policy is wide citizen's participation, there is no stakeholder's agreed model for this ecosystem.

Stakeholders involvement will start at the onset of the project. The local government has agreed to host the preliminary workshop where the project will be launched. All stakeholders will be invited to this workshop. We anticipate generating the Fiordo Aisén PHES-SYSTEM from this workshop.

NGO's such as Greenpeace and local environmental protection organizations have been committed with aluminium issue and should also be interested in the project outcome.

4.3.4 Site dependence

Within the general phes-system analysis, the higher trophic levels of the ecosystem and the socio-economic interactions with the ecosystem will be site dependent. The reason for this is that the final use of the conceptual framework will be dependent on local questions. While in two of the sites port development questions like dredging or oil spills may be important, in the other it's more questions connected to industrial waste or salmon farming. This will lead to different approaches once the bio-ecological components are only those necessary to answer the question that generates the phes-system. Yet, the physical and low trophic parts of the phes-system are treated equally and with the same tools in all three sites.

4.4 Local and global relevance

The result of the project will be mostly the ability to understand coastal/aquatic ecosystems, which support local populations and local economy, and its future evolution depending on the use that is made of it. The sites that will be studied are presently subject of conflicts between different stakeholders. It even surpasses local stakeholders as World Trade Organization (WTO) recognizes that local sustainable development is important for the open trade negotiations between nations, which are very important for developing countries (see Nordström and Vaughan, WTO Secretariat: "Trade and Environment", 1999). Therefore, local management policies of the ecosystems may even be called upon in world trade negotiations. This point underlines the importance of the project in the context of the dialogue between Europe and Latin America.

June 2002 WTO committee meetings extract that follows shows how these matters appear in the negotiations: "Many Members reiterated the need to safeguard existing market access against unjustified environment-related market access barriers. Indonesia, Cuba, Djibouti, Pakistan and Venezuela stressed that developing countries required ample time to respond to environmental requirements in export markets and longer compliance periods. The EC noted the development of partnerships in the context of the World Summit on Sustainable Development for sustainable trade centres to help inform developing countries of environmental requirements in export markets."

5 - Potential Impact

5.1 What problems will be addressed and how they will help society

The project aims 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, whose 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 are the problems, who are responsible for them and what responses have been tried in the past. The new conceptual framework proposed (which integrates the experience of the analytical approach of the Millennium Ecosystem Assessment; see Alcamo *et al*., 2003, p. 149) aims at improving the understanding of each coastal zone.

Outcomes of the project will be of significant interest to both scientific and water resources management communities, improving allocation of public and private funding for water resources and improvement of land use. Better understanding and forecasting of the effects of land use options, 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. A better understanding of the processes is a major requirement for scientific progress. The inclusion of this knowledge into models will simplify the multidisciplinary studies, allowing one discipline to use results of other disciplines without having to go into all the details. Biologists can access physical results using a model where physics has been previously validated in collaboration with physicists.

The products of this Project will not replace stakeholders own analyses of development scenarios. Instead, this Project’s outcomes will help refine environmental and socio-economic Impacts and improve the Responses. On the same way, the work of one discipline will always be more efficient if work is carried out with other disciplines, however, their productivity will be improved by using integrated models.

5.2 Importance of carrying out the work at a European level

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 European Environment Agency's (EEA) core task is to provide decision-makers with 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.
- 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.
- Development of scenarios is a major thrust of EEA efforts. The EEA has a group wholly dedicated to this task (this group is also involved with the Scenarios Working Group of the Millennium Ecosystem Assessment).

The main conclusion is that the approach implemented in this project is the same that is requested on EU level for the future, including water management at the river basin level, use of indexes (or indicators) as quantified information that help to explain how the quality of the 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. Although the project does not concern European estuaries, the knowledge gained by the European partners and the robustness given to the developed tools by the extreme application conditions, will surely be relevant for future work development in Europe.

5.3 Innovation related activities

The project presents some valuable innovation aspects.

- In none of the study sites, and as far as we know, in none of the coastal areas of the participating South American countries, a similar PHES system and SDSS have been applied.
- The differences among sites are obvious. The same kind of experience, where a SDSS supported by complex numerical models, including connections between the contribution basin and estuarine area, have been implemented such as in this proposal, is very rare.
- The application of such methodology in different countries and areas, allows, apart from testing the tools robustness, to adapt it to the sensibility of stakeholders and local users. The project will only be successful if it becomes really useful. Thus, the bond to the end user is crucial.

- Usually the base data for computing water environmental indexes is supported by local water quality measures and hardly ever incorporates in a quantitative way the physical aspects. With available tools in this project it will be possible to account for the physical aspects of the aquatic systems, such as residence time and average transport, and incorporate them in the index formulation.
- The modelling framework developed by the consortium will support the implementation of environmental indexes variable on 3 levels: space, time and formulation.
- Post-processing methodologies will be applied over modelling results. These will be supported by the use of spatial and temporal integration tools already developed by the consortium.
- The SDSS will necessarily be highly versatile on input data, combining many utilities in the same system to allow an easy coupling of information.

5.4 Exploitation and dissemination plans

All data and tools developed under this project will be available for partners and stakeholders. Scientific achievements will also be published on open literature in order to be known and used by people not directly involved in the project. Results can be exploited by stakeholders and by the research team through subsequent studies funded by stakeholders for the project sites or scientifically as the bases for subsequent research projects.

Dissemination will use the following methods:

Stakeholders will be invited to attend the workshops in order to present the project objectives, its actual state of development and to get their feedback in terms of objectives (in the starting phase) and of critical evaluation of the results.

Papers will be presented in specialised conferences describing results and scientific achievements. Between 5 and 10 papers are expected to be presented during the project and a similar amount is expected to be presented after project conclusion, including papers in journals. Preference will be given to international meetings for visibility and to meetings occurring close to partner's quarters for cost/objective optimisation.

An internet website will be organised describing the project and for dissemination most important achievements including data and technical reports. The web site will be installed by the coordinator during the first 3 months of the project and will be updated continuously.

Training will be used both for dissemination and exploitation. A training course will be organised per studied site and stakeholders will have the possibility of registering up to 2 trainees in a total of 10. This course will include the modelling tools and the use of the SDSS and of the web data base built during the project.

5.5 What account is taken of other national or international research activities

Most restoration projects have emphasized structure rather than function, although both are of doubtless importance to sustainable use of the planet. Nevertheless, emphasizing the restoration of ecological services may enhance support for ecological restoration.

Several research activities similar to the proposed under this project were identified. Four relevant examples are mentioned below. The first two have objectives that are similar to the objectives of the current proposal and consist in providing tools for planning and managing coastal ecosystems integrating ecological and socioeconomic information to describe the physical environment, biological communities, human dimensions, and management issues in coastal regions. The following two occur have a broader scope, but their approach and methods establish a framework for this project, particularly with respect to socioeconomic aspects.

Example1: **NOAA** (http://www.csc.noaa.gov/lcr/text/swamp.html). The Landscape Characterization and Restoration (LCR) Program. Spatial Wetland Assessment for Management and Planning

LCR has developed a conceptual GIS-based model to help managers prioritize wetland habitats within a watershed. Called the Spatial Wetland Assessment for Management & Planning (SWAMP), this model consists of two modules, tidal and riverine, that examine a wetland's contribution to water quality, hydrology and habitat. The model considers site-specific characteristics obtained from soil and vegetation data, as well as landscape characteristics obtained from GIS analyses. SWAMP uses ArcView® Spatial Analyst® with an interface that walks the user through alternatives for prioritizing wetland habitat. SWAMP was developed for the Ashepoo-Combahee-Edisto River Basin of South Carolina but the approach should be transferable to other geographies provided care is taken to include knowledge of local wetland ecology.

Example2: Chesapeake Bay Project (http://www.chesapeakebay.net/)
The Chesapeake Bay Program is the regional partnership that's been directing and conducting the restoration of the Chesapeake Bay. Bay monitoring collects comprehensive data for a current description of the Bay, comprising over 165 stations. Nineteen physical, chemical and biological characteristics are monitored 20 times a year in the mainstream and many tributaries. Models are one of the main tools crucial to the Bay Program goals of reducing nutrients and sediments delivered to the Bay. The Chesapeake Bay project comprises a watershed model for estimating effluent loads derived from the watersheds, an estuarine model for computing water quality processes on the estuary and an airshed model for tracking atmospheric nitrogen deposition. The Chesapeake Bay Project also supports other projects such as projects that teach or promote sustainable practices for how to live, work, and play in the Bay watershed. Projects often involve 1) training of individuals, organizations, local governments, and businesses on watershed protection techniques, 2) involvement of citizen volunteers in the planning and implementation of local activities, and 3) a strong partnership component.
Example 3: Millennium Ecosystem Assessment (http://www.millenniumassessment.org)
The Millennium Ecosystem Assessment (MA) is an international assessment designed to meet the needs of decision makers for scientific information, concerning the consequences of ecosystem change for human well being, and options for responding to those changes. The MA was launched by UN Secretary-General Kofi Annan, and was designed to meet some of the assessment needs of the Convention on Biological Diversity, Convention to Combat Desertification, and the Ramsar Convention on Wetlands. Work in the MA is divided in four working groups: Conditions and Trends, Scenarios, Responses and Subglobal. The MA is a multi-scale assessment, comprising interconnected assessments at the global, sub-global and local levels. There are about 15 approved sub-global and local assessments, such as Sweden, South Africa, Chile and China.
Example 4: Subglobal Assessment of Portugal for the MA (http://www.ecossistemas.org)
Portugal joined the group of sub-global assessments of the MA in May 2003, in an initiative led by the Centro de Biologia Ambiental of the University of Lisbon. The Portuguese Millennium Assessment (ptMA) is analyzing the condition of ecosystem services in Portugal, recent trends in those services and scenarios based on economic and social drivers for the next 50 years. The ptMA is assessing both extractive services such as fiber production and agricultural production, as well as non-extractive services such as biodiversity and recreation. The final result of the Portuguese Assessment will be a report with a series of papers that will be published as a book. Each paper will present the evaluation of an ecosystem service at the national level, or a set of ecosystem services at the regional or local level. In the spirit of the MA, the Portuguese Assessment will try to compile data already available, and only when no data are available will new research be done.

5.6 Contributions to standards

Water quality assessment through monitoring cannot take into consideration all the frequencies responsible for spatio-temporal variability, being carried on 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 the 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. Similar concerns are also present in the US Clean Water Act. Thus, the use of predictive models to help the implementation and application of water policies is becoming very usual worldwide.
As already mentioned, the Environmental European Agency (EEA) declares specifically that to achieve the goals of effectiveness and efficiency of monitoring, scientific help on the combination of modelling, local measurements and remote sensing is needed. Considering the complexity of estuarine systems, characterized by highly dynamically 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, habitat vulnerability and others). 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 combinations of those components gives the perfect managing tools do deal with such complex problems.
The implementation of the proposed modelling system in the study areas can represent a major advance for local administration to establish wise environmental decisions and step forward in meeting what is becoming standard procedure in most developed countries.

5.7 Contribution to policy developments

Problems with sustainable development in coastal areas are addressed in this project. These problems are quite common all over the world and three specific problems were detected in three countries of Latin America. These problems have national and international dimensions tightly connected. The Port of Santos and the Port of Bahia Blanca act as important export gates for Brazil and Argentina’s goods. With increasing exports these ports are seeing high growth rates in their annual movement of goods, while investments are being planned to expand port and industrial activities.
Fiordo Aisén already hosts important salmon production (Chile is the world's second largest salmon exporter after Norway) and a big aluminium reduction plant nearby is being proposed by the Canadian company Noranda Inc.
The environmental costs of these projects will have to be evaluated and presented to other countries in order to prove the use of sustainable development policies. As EU is one of the important partners of the South America countries, cooperation in environmental studies is of strategic importance for both.

5.8 Risk assessment and related communication strategy

Risk analysis will be object of Steering Committee attention. A table of risks will be built and continuously updated. The table will have the following columns: (1) Risk description, (2) Control mechanisms, (3) Actions required/being taken, (4) Magnitude of the consequences (5) Probability (6) Severity for the project and (6) Risk “Owner”. Severity is computed as the product of the magnitude times the probability. The risk owner is the person/team that will suffer the consequences.

We can anticipate risks the following types of risks:

- Technological risks, (1) due to failure of the equipment due to weather conditions, vandalism, technological problems, etc. (2) due bad model results as a consequence of conceptual or algorithmic errors in the model or to bad data supplied to the model,
- Administrative risks, due to wrong expenditure of delays on financial reporting,
- Exchange risks due to international economic conjuncture,
- Policy risks due to unsuccessful relation with policy makers, stakeholders or owners of socio-economic data.

Anticipating the effective risks, the control mechanisms and the actions any effect for project development will be minimized.

For society/citizens outside of the project there are no risks anticipated and for researchers involved in the field program the risks are those common to any person carrying work in the marine environment and are minimized respecting the standard safety rules.

6 - Project management and exploitation/dissemination plans

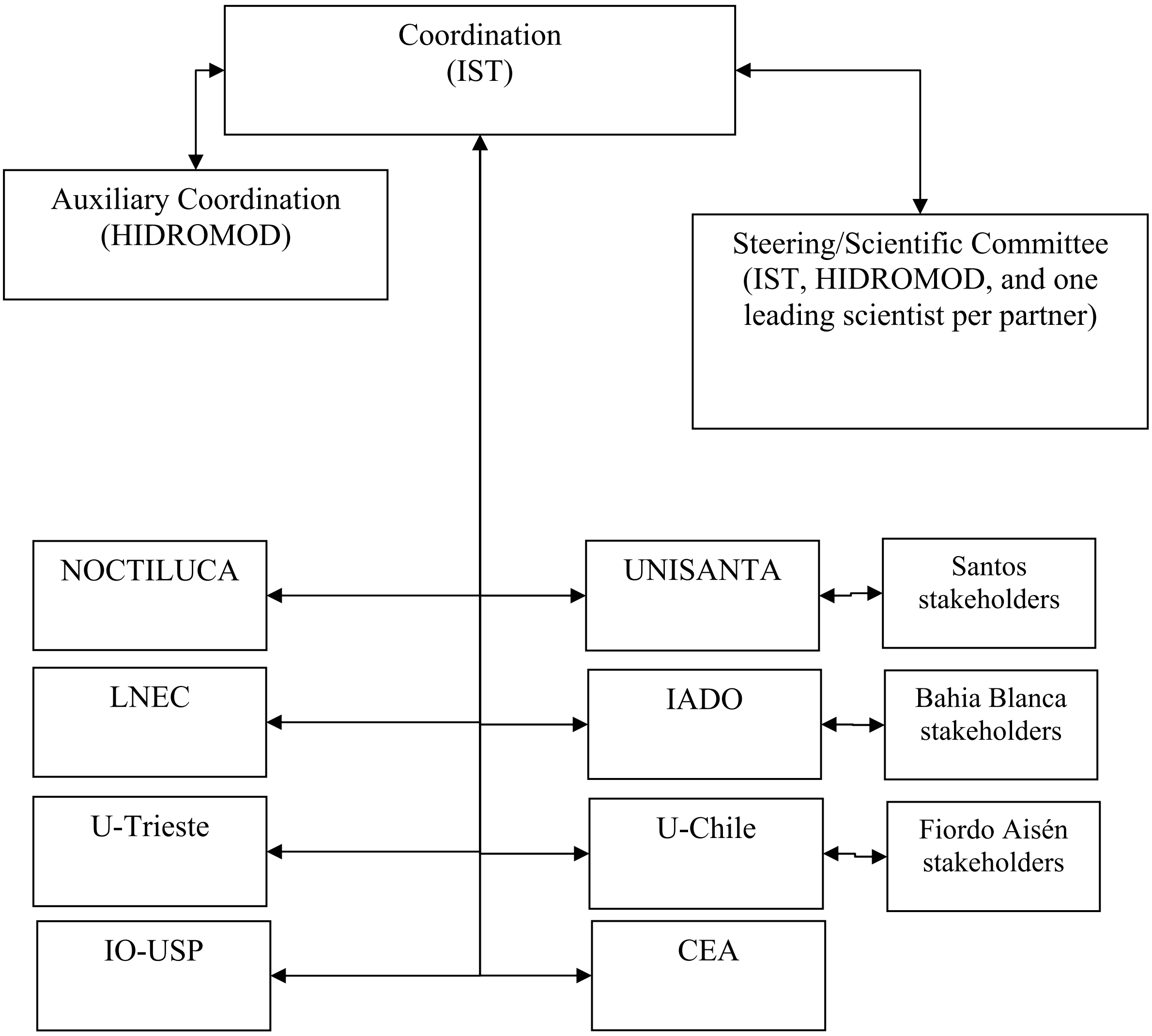
6.1 Project management

6.1.1 Introduction

The EcoManage project is about giving answers to several sustainable development problems in coastal environments based on the scientific expertise for assessing the physical-ecological-social systems (PHES-systems) and guided by the stakeholders and policy makers for designing a DPSIR (Driving, Pressure, State, Impact and Response) approach.
The consortium involves 10 teams from 6 countries and 3 study areas and require (1) a clear management structure, (2) clear management actions and (3) clear identification of development indicators.

6.1.2 Project management structure

The management structure will be based in two institutions that work very closely and have complimentary teams: IST and HIDROMOD. There will be a coordinator from IST and a deputy coordinator with technical and management experience in this kind of projects from HIDROMOD.
There will also be a site coordination level. This local coordination will ensure that all that is done in each site will have a local support and the best possible logistic. The main tasks of this coordination will be to ensure that local stakeholders are involved on the project, that workshops are well organized and that the measuring campaigns will run as well as possible.



The role of the coordination is to ensure that each phase of the project follows the schedule agreed by the consortium. It will monitor the progress against time and budget allocations and ensure that the project fulfils the objectives, milestones and deliverables.
The project coordination,

1. Is responsible for communication flow within the consortium and within the work packages. He functions as the interface between the consortium and the EC offices.
2. Ensures that each work package operates efficiently and that no overlap or delay rises between the work packages.
3. Is responsible for the administrative management of the project and the distribution to the partners of the funds obtained from the EU for the project.
4. Is in charge of the organization of the project meetings during the life of the project.

The project will be coordinated by IST where Professor Ramiro Neves will be the prime responsible, assisted by Dr. José Chambel Leitão from HIDROMOD.
Coordinator - Ramiro Neves (IST) is the main responsible of this management team. He is 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.
Deputy coordinator - José Chambel Leitão (HIDROMOD) is a Civil Engineer, with a doctorate degree in Mechanical Engineer, and has done modelling work since 1988. Beyond his experience in projects in Latin America, where he has done modelling work and provided consultancy on modelling estuaries and coastal zones, 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.
Additionally, in IST and in HIDROMOD, there will be an assistant of the coordination who will be involved in the technical and in the management part of the project. This will ensure some redundancy in the communications, thus reducing the probability of failure in management activities.

6.1.3 WP-Leader and Steering Scientific Committee (SC)

WP–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. WP1 will be coordinated by J. Chambel Leitão (HIDROMOD), WP2 by R. Neves (IST), WP3 by E. Sousa (IOUSP), WP4 by V. Marin (U. Chile) and WP5 by E. Feoli (U. Trieste).
The SC assists the project coordinator 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. It is intended that the SC will reach decisions by consensus but where this is not possible, the vote of the project coordinator will prevail. The SC is composed by WP leaders and by the leaders of the other teams: J. Baretta (NOCTILUCA), JP Lobo-Ferreira (LNEC), J. Marcovecchio (IADO), A. Figueiredo (UNISANTA) and M. Contreras (CEA).
SC meetings will be organized as described in 6.1.5 .

6.1.4 Local coordination

Local coordination in each of the sites of the project will be done by a local partner. UNISANTA will coordinate the works in Santos, IADO will coordinate the works in Bahia Blanca and Univ. do Chile will coordinate the works in Fiordo Aisén. This local coordination implies the responsibility for field campaigns, workshops or other meetings organization and contacts with stakeholders. The local coordinator will work in collaboration with WP leaders, the SC (to which he belongs) and the coordinator.

6.1.5 Meetings & workshops

Meetings and workshops in this kind of project are extremely important. In these reunions, exchange of scientific experiences is achieved and motivation of young scientists and stakeholders is enhanced. At least every 6 months there will be a meeting with specific purposes, which will be collated to administrative meetings.

Annual plenary meetings will take place with the objective of evaluating the overall status of the project. A deliverable of these meetings will be a report with the main achievements so far and with recommendations for the remainder of the project.

Technical workshops (coincident or not with the annual meetings) will be held in each of the three sites of the project with the purpose of actively involving local stakeholders in the project and to discuss each site's particularities with all the partners. Workshops will take place as soon as possible, after the project starting. They will also serve as a dissemination tool of the results and expectations of the project (*see workplan for details*)

For each meeting, a schedule, previously approved by the SC committee, will be distributed to all partners 2 months before the event. Technical meetings on partial subjects of the project may also be scheduled by the SC committee or by the project coordination.

The SC committee will meet with a regular interval of 12 months, or additionally whenever there is a need to do so. These meetings are scheduled by the coordinator of the project.

6.1.6 Coordination of the contractual obligations of the project partners

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's INCO. 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).

Another management task will be to obtain any financial security such as bank guarantees when requested by the Commission.

Overall legal, contractual, ethical, financial and administrative management will be also guaranteed by the coordination of the project.

6.1.7 Coordination of knowledge management and other innovation-related activities

In order to guarantee that the different targets of the project are accomplishment in due time by all the partners involved, deliverables describing the results of the different tasks have been programmed. The coordination of the project will guarantee that these documents will be produced by the responsible partners in the previewed schedule and verify if all the objectives have been accomplished.

A *Consortium Agreement* will be signed among partners to establish the rules for exchanging data, software and other resources within the project. It will also regulate the authorship for joint publications.

6.1.8 Quality Assurance and deviation control

One important management task is quality assurance. This is particularly important for the field activities. Quality assessment boards (QA-boards) will be established to facilitate this.

Their members will prepare, in close collaboration with the consortium, the protocols defining the standards for field measurements. Email communication in each workpackage group will ensure rapid detection of difficulties, so that activities can be adjusted to minimise deviation from the planned targets.

All significant deviations will be reported to the coordinator. In the event of problems the SC will define alternative strategies to achieve the overall target. The SC overall strategy will be aimed at avoiding or reducing to a minimum the probability of giving erroneous information or advice to stakeholders.

The coordination will also make use of the quality criteria rules defined according ISO9001:2000 from which it has experience due to the implementation of the certification process that took place in HIDROMOD.

6.2 Plan for using and disseminating knowledge

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 GIS database, the SDSS, the environmental indexes and the improved models. These 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 global environmental market. In particular, the models benchmarked provide opportunities for training, and their use could also generate an immediate market opportunity.

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

Consortium partners accept and authorize that the Commission disseminates relevant project information, including summaries and public project results, names and contact details of consortium partners through the visual, oral and electronic media.

6.3 Raising public participation and awareness

6.3.1 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.

6.3.2 Internet

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.

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 and the SDSS 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.

The website will be hosted by the coordinator and will have links to local partners. After the end of the project the site will be maintained by the coordinator for at least five years. Stakeholders and local agencies in charge of managing data will be alert for the interest of downloading the products of the project (especially data) by the end of the project. Maintenance of the models and of the SDSS will be done automatically by partners because they are products that are continuously improved by the users community.

6.3.3 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.

7 - Workplan– for whole duration of the project

7.1 Introduction - general description and milestones

Data | **Modelling** | **Indexes** | **SDSS**

The activities within ECOMANAGE are split up into 5 work packages, which address different aspects of the approach outlined (*cf. Figure 1*). Firstly, data gathering within each site will be done to establish a database on the available knowledge. Local models, already established and remote sensing data will also represent important sources of information. Secondly, the physical ecological and social system (PHES-System) will be established for each site supported by the available data. It will include estuarine models (physical and ecological coupled models) and watershed models (surface and ground water). Modelling results will be analysed and compared with the available data, and complementary data will be collected were and when necessary. Thirdly, indexes for defining system state will be implemented based on the available data and modelling results. Finally all available information will be processed on a spatial decision support system (SDSS) for helping stakeholders on environmental management. A knowledge base will also be implemented for supporting the SDSS use.

WP1 Data Management

The first work package deals with acquisition, interpretation and validation of data. Data sources will be historical measured data and remote sensing data. All three sites are already covered by local models (hydrodynamic and sediment transport mainly) that will provide relevant information for incorporating into the PHES-System (bathymetry, tide, input flows, sediments, and other)

Some components for SDSS will be developed since the beginning of the project, such as a web database that will allow access to project partners and selected users. Socio-economic data will be gathered in order to define Driving forces and corresponding environmental pressures.

WP2 PHES - System

The second work package deals with the implementation of the different modelling tolls that integrate the PHES-System in each one of the study areas. These modelling tools have been considerably tested, thus it’s predictable that its implementation will be straightforward. Nevertheless minor setbacks are common due to ecosystems specificities. For that reason the project foresees some time for tuning model parameters and eventually to develop any matching processes. The models will be validated using existing data and will then be used to forecast impacts of management scenarios, producing data for evaluating performance indexes.

WP3 Data Campaigns

The third work package deals with the collection of data to complement any information gaps detected on historical data or to study specific processes that were not covered. This task will not be in any manner exhaustive. Water quality and qualitative and quantitative aspects on groundwater resources will be measured.

WP4

The fourth work package deals with the integration of information

SDSS

from different sorts of types (e.g. sampling data, numerical modelling results, stakeholders preferences, common knowledge) to produce an index representing the overall integrity of each particular ecosystem and to prioritise political options. Indicators 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. The framework to carry out this task will be a SDSS that should be suitable for handling extensive and diverse information and be intelligible to the ecologist and the decision-maker. The SDSS user will have access to index maps, their formulation and to all kinds of compiled information available: numerical model results, measures, and historic data. The SDSS user will also be allowed to change index thresholds or their formulation, and to perform specific scenario simulations.

WP5 Knowledge Dissemination

A knowledge base will be implemented for supporting the use of the SDSS. In this knowledge base, the studied processes will be described, and all gathered information regarding the project sites will be available. The main function of this knowledge base is to help SDSS users to take full advantage of this tool. Up to 2 stakeholders trainees will be to follow closely project developments and to interact directly with the consortium in order to get the full perception of the detail concerning the modelling tools and the use of the SDSS.
A web site will be implemented since the beginning of the project allowing anyone interested to monitor all project developments. Several meetings with specific and general public are programmed.

Tasks associated to each work package

WP 1 - Data Management
- T1.1 - Data from previous models
- T1.2 - Historic data gathering
- T1.3 - Land use and land cover description
- T1.4 - Analysis of vegetation data
- T1.5 - Socio-economic data
- T1.6 - Data verification & organization

WP 2 - Implementation, improvement & validation of PHES-system
- T2.1 - Hydrodynamics & sediment transport
- T2.2 - Groundwater
- T2.3 - Ecology
- T2.4 - Drainage basin
- T2.5 - Human-Ecosystem interaction

WP 3 - Data Campaigns
- T3.1 - Santos (Brazil)
- T3.2 - Bahia Blanca (Argentina)
- T3.3 - Fiordo Aisén (Chile)

WP 4 - Coastal Zone Management
- T4.1 - Interaction with stakeholders
- T4.2 - Integration & harmonization of information
- T4.3 - Definition of index assessment strategy
- T4.4 - Scenarios in Santos
- T4.5 - Scenarios in Bahia Blanca
- T4.6 - Scenarios in Fiordo Aisén

T4.7 - Integration of decision support systems in GIS

WP 5 - Knowledge dissemination

T5.1 - Line training courses

T5.2 - Meetings with case studies

T5.3 - Knowledge base dissemination

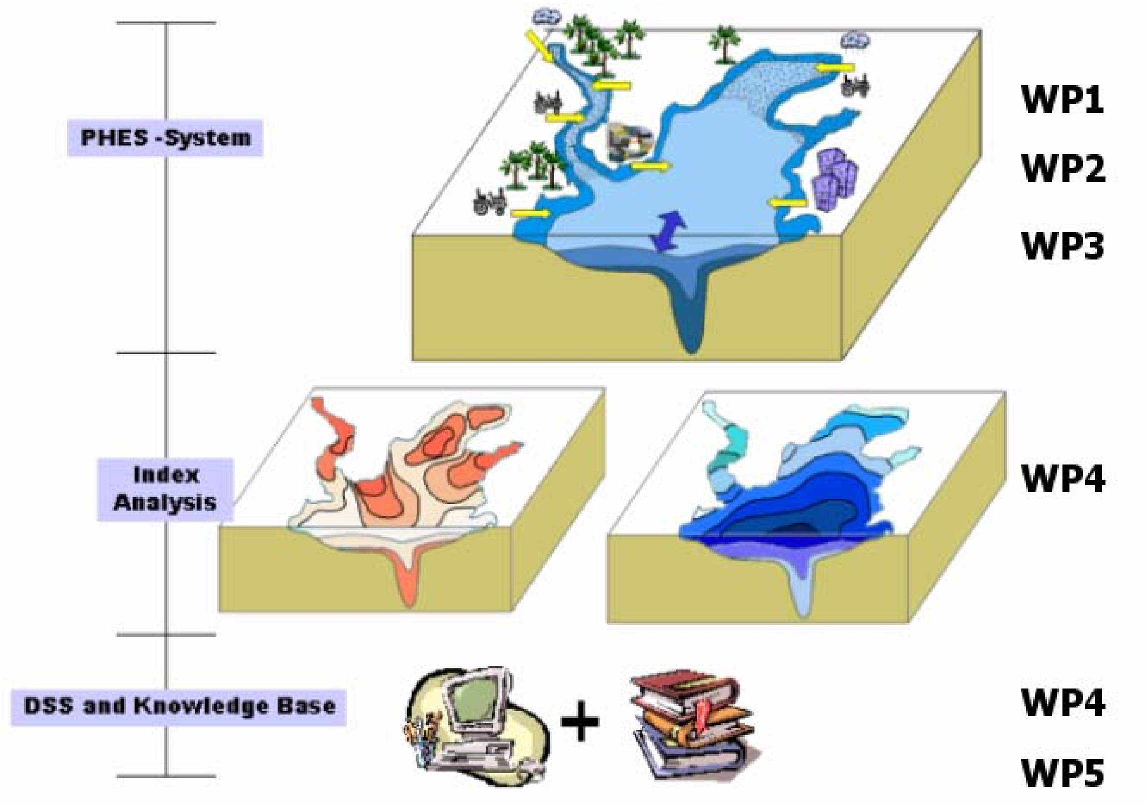


Figure 1: Graphical presentation of the project's components

7.2 Research, technological development and innovation activities

The development of the EcoManage project will bring the possibility to get a scientific and rational tool to multilaterally discuss water management topics, and together obtain a possible solution to start improving environmental condition of the studied systems. The chances to get these results also bring the opportunity to generate new normative and rules for the functioning of the systems, and in this way to start a new type of environmental management for the estuaries, based not only in the human requirements but also in the corresponding ecosystem needs. The project will have 3 relevant components:

- The PHES-system, supported by several modelling tools that will describe physical and ecological processes at estuarine and basin level.
- An index analysis will play a vital part in focusing and illuminating the significance of environmental change and the progress to sustainable development. Indexes will be able to quantify information that helps to explain how the quality of the environment changes over time or varies spatially.
- All available information will be processed on a spatial decision support system (SDSS) for helping stakeholders on environmental management. A knowledge base will also be implemented for supporting the SDSS use.

7.3 PHES-system

A conceptual framework will be developed based on a physical-ecological-social system (PHES-system). The system comprises state of the art tools such as a 3D physical model coupled with an ecological model for computing transport and biological activity in the aquatic system. The anthropogenic influence on the contribution basins will be translated into inputs to the aquatic system (e.g. organic matter, nutrients, toxic substances) determined by the available data and by a land use and land cover analysis based on remote sensing. The system will be able to cover a wide range of problems affecting coastal systems (e.g. eutrophication, sediment transport, toxic substances transport and decay, habitat restoration) that were already pointed out as key issues on the study areas. Local stakeholders will help to establish study scenarios for each site concerning one or more problems such as those mentioned above.

The next paragraphs describe how the PHES-System (physical-ecological-social system) will be built and what is expected from each component of the system. Relevant innovation issues will be set on the technological solutions for dealing with different time and spatial scales and with the feedback loops of the processes linking coupled models.

7.4 Physics

7.4.1 Estuarine model

A 3D Hydrodynamic and cohesive sediment transport model will be established for the three sites. The partners involved already have done modelling work in the sites, having a good database and knowledge on the characteristics of each site.

This model will provide a way of answering to 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 is possible to couple eulerian and/or lagrangian transport modules also 3D.

The hydrodynamic model solves the three-dimensional 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 in 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 an 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 particulate matter and the internal sinks and sources (water quality). Presently the model can simulate 24 different water properties and any new property can be added very easily.

The lagrangian module (particle tracking module) is used to simulate point source pollution and residence times. This methodology avoids the problem of numerical diffusion associate to the advective term common in eulerian approaches. Another characteristic is the ability of 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 physical principles supported by the model (momentum and mass conservation) apply to all aquatic systems (estuaries, coastal waters, etc). The extraordinary differences observed emerge from the differences in boundary conditions, system geometry and bathymetry. Therefore, it is possible to apply the same physical model to almost every kind of water body.

7.4.2 Basin model

Models combined with the Geographical Information Systems (GIS), provide a convenient platform for handling, compiling and presenting large amounts of spatial data essential to river basin management. The use of GIS also makes the models results accessible to a broad range of users.
There are a number of available models tailored to model the individual processes in the river basin, i.e. models for watersheds, rivers, groundwater, etc. However, the integration of stand alone models and their results often proves to be costly and time consuming making their application inefficient and unpractical as a decision support tool because managers need results that integrate the specific effects into general conclusions. On the other hand, a combination of models sharing a common platform for data pre- and post processing provide an efficient toolbox in relation to river basin planning and management.

A short description of the components and models advantageously applied in river basin management is given in the following paragraphs and resumed in Figure 2.

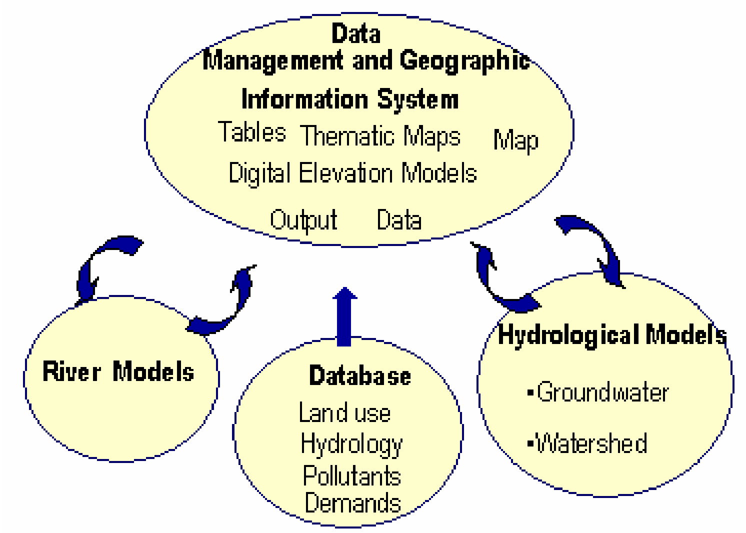


Figure 2: Tools for modeling the contribution basin

Database management system

A dynamic database management system links the stored data in the database with a GIS for display of data in maps or tables. The system comprises GIS facility and data storage.

Precipitation-runoff model

This is a deterministic, conceptual rainfall-runoff model for rural catchments; hence the model describes the behavior of the land phase of the hydrological cycle. Based on catchments data such as precipitation and potential evapotranspiration combined with model parameters for each storage (surface, intermediate and groundwater storage), the model computes runoff.

Water balance model at river basin scale

The water balance model is structured as a network model. The model describes the interaction and balance between the demands and natural supply of water in a river basin groundwater as well as river water. Specific water demands and activities can be specified such as water abstractions for irrigation, urban water supply or reservoir operations. Also, the effects on water quality may be analyzed by the model.

River models

These are one-dimensional fully dynamic models for the simulation of flood forecasting and flood control measures. In addition, models include cohesive and non-cohesive sediment transport and water quality processes. The water quality model describes biological and chemical processes relevant for nutrient dynamics and processes affecting the dissolved oxygen conditions in the river.

Hydrological models

These include physically based surface, soil and groundwater system including a detailed description of the surface water/groundwater interaction and related processes. It also includes a description of the vegetation and its interaction with surface water and water in the root zone.

7.5 Ecology

7.5.1 Estuarine model

The Ecology model deals with primary and secondary production, nutrient and organic matter cycling, oxygen availability and pathogens decay (*cf. Figure* 3). Primary producers consume nitrate, ammonia and phosphate, silica. Their remains (organic matter) are recycled and converted in to nutrient through decomposers (microbial loop), and this activity directly affects the oxygen cycle. The discharge of organic matter in estuaries 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.
The benthic subsystem will also be included, interacting with water column through deposition and resuspension processes, accounting for deposited organic matter decay and pollutants physical-chemical reactions.

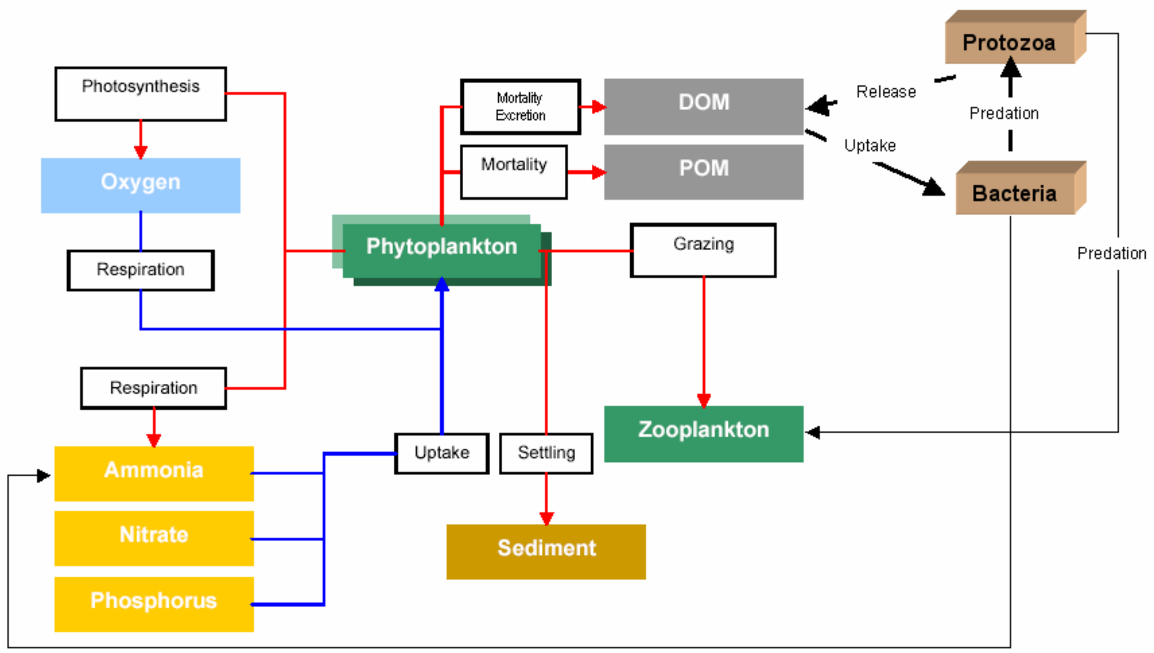


Figure 3: Ecosystem model scheme

7.5.2 Basin model

Only in recent times the importance of vegetation to regulate the biosphere cycles and biodiversity was fully recognized. In the terrestrial part of coastal zone the vegetation loss will affect the landscape biodiversity, soil protection, water circulation and the water recharge of ground water reservoirs. In the aquatic environment the vegetation loss will have negative influence to all the food chain related to fish nursery. There is an urgent need of integrating the study of vegetation in

an interdisciplinary context in coastal zones using the tools of system theory in order to understand the role of coastal vegetation in regulating the run off and the transport of pollutants and sediments to the sea. Literature on this topic is not rich. There are several papers on the description of vegetation and on methodologies to analyzing its changes. However there are few papers that are making quantitative analysis with the explicit aim to correlate vegetation patterns and processes in a broader landscape context with land use.
The research on gradients of land uses and on responses of vegetation patterns by parameters concerning plant structure and diversity is essential to develop models both in the terrestrial and aquatic environment of coastal zone.
The analysis of vegetation on terrestrial part of the coastal areas will be done in function of the land use in order to quantify the impact of land use on the processes related to ecological succession, soil erosion and water cycle.

7.6 Socio-Economy- Accounting of Human-Ecosystem Interaction

The approach to socio-economic aspects will be based on the EEA's DPSIR framework and the conceptual framework of a Integrated Environmental Assessment (EEA, 1998) following the example of the Millennium Ecosystem Assessment (Alcamo *et al*., 2003, p. 37):
"Changes in factors that indirectly affect ecosystems such as population, technology, and lifestyle (upper right corner of figure), can lead to changes in factors directly affecting ecosystems such as the catch of fisheries or the application of fertilizers to increase food production (lower right corner). The resulting changes in the ecosystem (lower left corner) cause the ecosystem services to change and thereby affect human well-being and poverty. These interactions can take place at more than one scale and can cross scales. For example, a global market may lead to regional loss of forest cover, which increases flood magnitude along a local stretch of a river. Similarly, the interactions can take place across different time scales. Actions can be taken either to respond to negative changes or to enhance positive changes at almost all points in this framework (crossbars)."

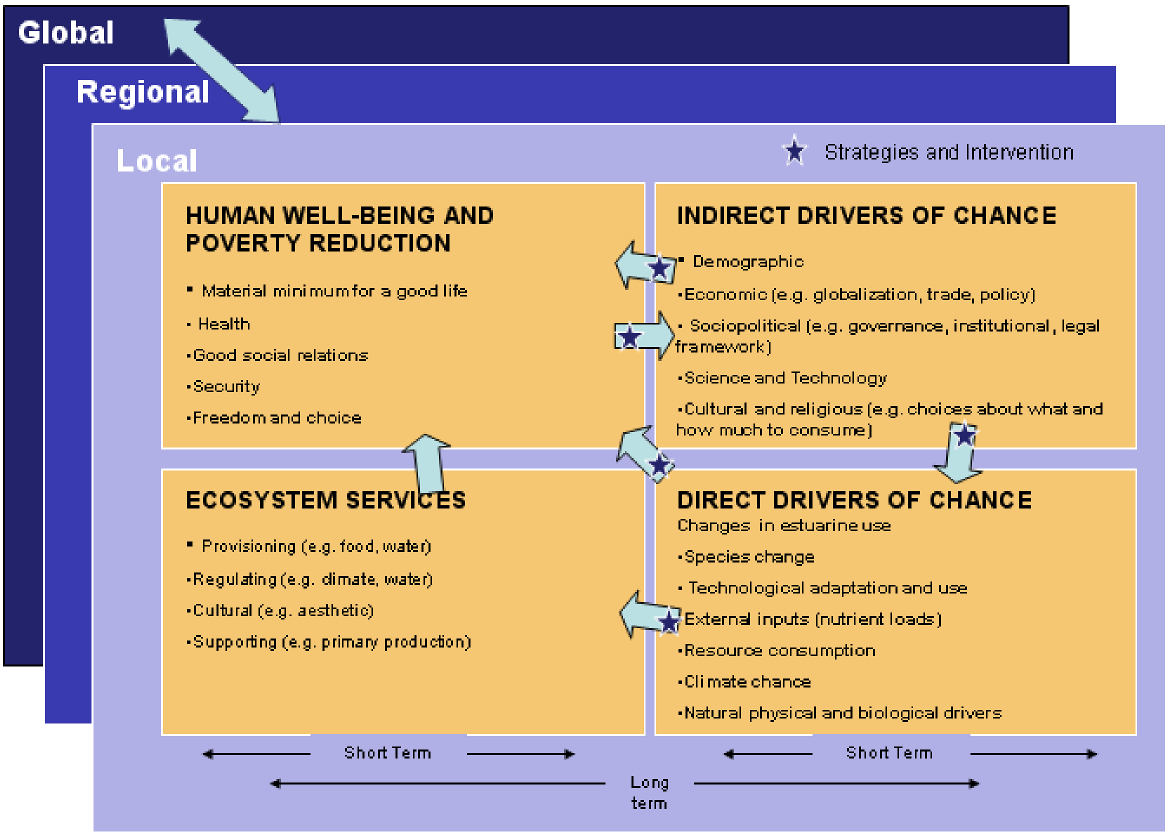


Figure 4 – Millennium Ecosystem Assessment Conceptual Framework (adapted from Alcamo *et al*., 2003, p. 37)

This is done through the following steps:

1. **Identify ecosystem services**, according to the following categories: provisioning; regulating; cultural; supporting.
2. **Identify links between these services and human society interacting with this ecosystem.** "This includes defining the components of human well-being that are affected by the services (such as health, livelihood, culture, and equity), as well as human activities that in turn affect ecosystems and the supply of services (such as population growth, consumption, and governance).
3. **Identify indirect and direct drivers.** A direct driver unequivocally influences ecosystem processes and therefore can be identified and measured to differing degrees of accuracy. Indirect drivers operate more diffusely, from a distance, often by altering one or more direct drivers. The indirect drivers of change are primarily demographic, economic, socio-political, scientific, technological, cultural and religious; the direct drivers are primarily physical, chemical and biological (Alcamo *et al*., 2003).
4. **Select indicators of ecosystem conditions, services, human well-being, and drivers.**
5. **Assess historical trends and the current state of ecosystems and their services and drivers.** The current state of ecosystems and their services is assessed by assembling and analysing data on the indicators selected. "Since ecosystems are dynamic, an important issue to be addressed is the meaning of 'current' conditions. In some cases this will refer to the most recent data collected, but for most ecosystems it must take into account year-to-year and perhaps inter-decadal variability. (For example, it is not useful to refer to the availability of fresh water for a particular year because of its strong year-to-year variability).
6. **Evaluate impact on human well-being**. This is among the most challenging tasks, since it involves the translation of information largely from the natural sciences (such as the state of fresh water, soil, and forests) into variables of concern to society (health, livelihoods, wealth, and security, for instance). One challenge is that a given service can affect several components of human well-being. Another challenge lies in sorting out the many possible trade-offs among services. Finally, the distribution of service benefits among societal groups will need careful consideration.
7. **Develop scenarios**. "Information on future trends over the medium and longer term are needed to anticipate critical changes in ecosystems and to develop response strategies. The aim of this task is to identify a set of plausible futures or 'scenarios' for ecosystems, services, and drivers."
8. **Evaluate possible responses**. "In this task, the many possible 'response options' are identified for preventing the deterioration of ecosystem services or recovering lost services. This includes evaluating the success of past response options and developing guiding principles for designing needed policies." In these part we will study human-ecosystem interaction into estuarine ecological thought the PHES-system, incorporating by example (i) loads generated from land based activities that are carried into coastal ecosystems by surface water (rivers and local discharges) and by groundwater and (ii) direct use of the coastal system for activities interacting directly with the local fauna (e.g. fishing, fish farming, dredging, waste disposal) or with its *habitat,* (iii) all other features that will be defined with the help of stakeholder that are relevant to the studied systems.
9. **Analyse and communicate uncertainty**. "Assessing and communicating the level of certainty in a clear and consistent manner is a central task."

The sequence of these tasks is shown in the next picture:

Figure 5 – The analytical approach for the ecosystem assessment and its main tasks (adapted from Alcamo *et al.*, 2003, p. 149)

Stakeholders will have a relevant role in every step of this analysis.

7.6.1 Integrating anthropogenic pressure in the system

Typically, changes on *habitat* use are incorporated in modelling tools through morphological changes (e.g. dredging or landfills) and/or estimated land-based loads as input boundary conditions. Loads estimates are derived from historical data for diffuse loads (sampling stations or automatic data acquisition) and detailed information on point discharges. In the case of diffuse loads if available data is sparse, it becomes important to understand and predict dynamically the changes on loads characteristics. Hence, solutions on watershed level need to be found.

In this project, the interaction of land based human activities with the ecosystem will be simulated explicitly implementing a straightforward watershed model, supported by local data and remote sensing data that will compute loads as a function of soil properties, land-use and meteorological conditions. This model will generate surface and groundwater loads to input in the estuarine model. The basin models will provide an insight into the present loads and will allow evaluating the modifications of the loads according to the expected evolution of land use.

On estuarine level, anthropogenic pressure will be integrated in a classic fashion through morphological changes and/or input discharges.

7.6.2 Analysing anthropogenic pressure in the system

One thing is to integrate changes in the studied system and another thing is to account for its consequences on ecological and human uses. It's also essential to be able to deliver to those who care (local decision makers, scientists, general public) an intelligible assessment of the problems.

One of the most important issues of a regional environmental assessment is integrating information from different sorts of types (e.g. sampling data, numerical modelling results, stakeholders preferences, common knowledge) to produce an index representing the overall integrity of a particular ecosystem and to prioritise political options.

A desirable objective to achieve within the framework of this task should be to develop suitable tools capable to handle extensive and diverse information that may be intelligible to the ecologists and the decision-makers. However, research on methods to integrate individual indicators of stressors and receptors into this kind of assessment is not an easy proposition.

Transport in estuarine and coastal systems is a complex function of the ocean boundary conditions, the winds, the watershed inflows, the local geometry and the bathymetry. The flow varies over the tide, over the days, the weeks, and the seasons. The flow determines nutrient availability through transport and light availability, through sediment settling and ressuspension processes and, above all, determines how long a water mass will stay in a certain place or, in other words, the water specific residence time. Ecological processes, such as primary production, only occur if the

adequate conditions are found (light, nutrients, temperature) and if there is enough time for the ecological processes to take place. The expressed complexity makes it impossible to define any kind of index without considering spatial and temporal variably.
The modelling framework developed by the consortium will support the implementation of spatially and temporarily dynamical indexes and will be able to support a way of answering to different scale predictions, complex geometries and to efficiently incorporate different data sources to define boundary and surface conditions. Indexes will help to define vulnerability areas and to compare sites with common problems (e.g eutrophication, organic matter disposal, urban pressure, agricultural pressure). In some cases indexes will be developed for local use only (for instance bathing use is only plausible in the Brazilian site). The indexes thresholds will be determined by local legislation, stakeholders, or/and EU legislation.

7.7 Innovation issues

- In none of the study sites a similar PHES system and SDSS have been applied and very few experiences are known worldwide.
- An SDSS supported by complex numerical model, including connections between the watershed and estuarine area, will be implemented on three different sites, testing the generality of its formulation.
- The application of such methodology in different countries and areas allows, beyond testing the tools robustness, to adapt it to the sensibility of stakeholders, local governance and local users.
- SDSS's are usually supported by GIS's that are adequate to represent and work on spatial variability, but are not suitable for working with data rapidly variable in time. There are critical events, associated for instance to periodic tide situations and sporadic point discharges, or even to sudden natural catastrophes such as floods, that are difficult to incorporate in a DSS.
- One of the innovations in this project concerns the use of spatial and temporal integration tools already developed by the consortium and designated as Integration Boxes. With this method, 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. 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, others) in each area defined by the box (that integrates several computing 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, about the changes caused to the habitat by each simulation scenario. Above all, this method allows synthesising information to fit in a SDSS without neglecting relevant data.
- The SDSS will be forced to deal with a large range of file types and formats. The system will necessarily be highly versatile on this level, combining several utilities in the same tool to allow an easy coupling of information.
- The main objective of integrating information from different sorts of types (e.g. sampling data, numerical modelling results, stakeholders preferences, common knowledge) is to produce an index representing the overall integrity of a particular ecosystem and to prioritise political options. The complexity associated to estuarine systems makes it impossible to define any kind of index without considering spatial and temporal variably. The modelling framework developed by the consortium will support the implementation indexes variable on 3 levels: space, time and form. In the matter of space and time variation, aspect related to the integration boxes methodologies, was already explained. 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 new acquired data, or even to change the thresholds values of the already delineated indexes.

- The physical model (estuarine and coastal circulation) 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).

7.8 Interactions between basin and estuarine models

In environmental surveys it is important to separate the contributions from various sources and to distinguish between natural variability and anthropogenic impact, as this enables efficient environmental control, and the introduction of the best management practices. The problem associated to computing input loads on estuarine systems is to account for the usually dispersed sources including household, agricultural and industrial areas. These loads are transported both on surface and underground; therefore, their account represents a real challenge. Basin models offer a solution to this problem and their results are the input loads on estuarine models.

7.9 Interactions of physical and ecological models on estuarine level

Ecological processes, such as primary production, only occur if the adequate conditions of light, nutrients and temperature are found and if there is enough time for the ecological processes to occur. In other words, physical flushing and local dispersion of a water parcel must be less than the doubling time for phytoplankton cells (*cf. Figure 6*).

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.

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).

Temperature

Water temperature is a typical physical problem, and represents the balance between transport and mixture of water at different temperatures and surface heat fluxes. Its importance to the ecological model comes from the fact that most rates are temperature dependent.

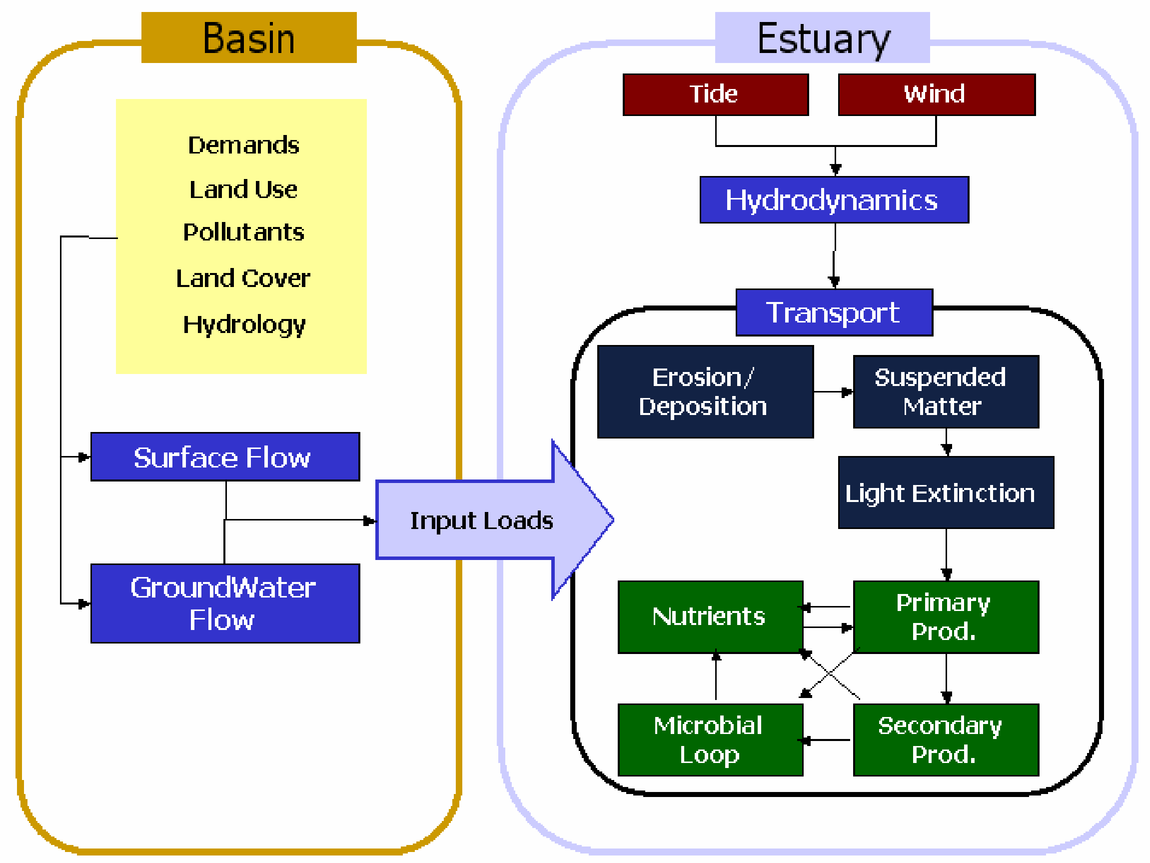


Figure 6 Interaction between models

7.10 Delivering information

The SDSS is the mean to present the compilation of qualitative and quantitative indicators computed by the PHES system and gathered by the consortium and to show the conclusions obtained from the analysis of the established indexes. The SDSS is also a powerful tool to support decision-making. The user will have full access to reference information and formulation behind indexes. This system should be dynamical, allowing the user to generate new indexes based on the available data and on new acquired data, or even to change the thresholds values of the already delineated indexes. It will be possible to carry out, detailed analysis on specific areas and to perform temporal integration of results to obtain indexes with daily or even hourly incidence.

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 as necessary to classify the ecological status of a particular water body. This classification is based on indexes that play a vital role in focusing and illuminating the significance of environmental change and the progress to sustainable development. Indicators are quantified information that helps to explain how the quality of the environment changes over time or varies spatially.

The SDSS will be built around a conceptual framework know as the DPSIR assessment framework. DPSIR stands for Driving forces, Pressures, States, Impacts and Responses. Particularly useful for policy-makers, DPSIR offers a basis for analysing the inter-related factors that impact on the environment.

The aim of such an approach is:

- to be able to provide information on all of the different elements in the DPSIR chain;
- to demonstrate their interconnectedness;
- to estimate the effectiveness of responses.

7.11 Significant Risks and Contingency Plans

The implementation of a complex system such as the one that is proposed here has associated inherent risks. Some of the identified risks are associated with data assessment and the implementation of the models and contingency plans were thought to respond in case of necessity.

7.11.1 Data assessment

The framework of the project, states that new data measures during project time should be kept to minimum, thus historical data should be sufficient for establishing all necessary models.

- Local data- the existence of local data was previously checked, and it was a considered issue when the partner's selection was decided. Nevertheless there is the risk that some information gaps can occur.
- Remote sensing data – This will be a very useful source of information, nevertheless, problems can occur, namely on acquired colour images, due to cloud cover during project time.

In the case of local data, it's guaranteed that basic topographic, bathymetric and tide information exists for all sites. Thus, physical modelling on estuarine level will surely be delivered. The lack of physical measurements to validate the model can be an issue, nevertheless the physical model used in this project have been validated in a large number of different sites by an experienced team, therefore it will be possible to establish a good level of confidence on model results. In case of lack of water properties (nutrients, salinity, temperature, chlorophyll, other, sediments) measurements, remote sensing can be very helpful, determining some of these values and using the modelling tools to compute the remaining. Nevertheless simulation scenarios can always be established based on the experience of team members. Again, although this isn't an important purpose of the project, some field campaigns are programmed.

In the case of remote sensing data, this is really not a problem because usually all data providers have large archives of acquired information from different satellites; it's just a matter of finding the right one.

7.11.2 Model

There is always a chance of occurring problems during model development and implementation.

- Development – All models were already developed and validated. Problems can occur on the coupling issue, because some models work on different time and spatial scales.
- Implementation– The models of this project have not been applied to the study sites, except for the Santos estuary. There is always the risk of finding obstacles that weren't foreseen.
- Data integration– There will be a large range of data file types being used, problems can occur on input interfaces.

The numerical tools that will be used are all "home made". This means that team members have experience on the development and implementation of such tools. Until now, all problems were solved thus the consequence of any of the problems mentioned above to is the increase working time of team members. This is also valid for data integration subject

7.11.3 Common strategy fo Socio Economic data

The project will gather two types of socio economic data for each study site: (i) basic data, (i) composite data.

Basic data concerns the description of demographics and main economic activities. The most relevant demographic variables will be: population size and rate of change over time (birth and death rates), age and gender structure of a population, household distribution by size and composition, spatial distribution (urban versus rural), migration patterns, and level of educational attainment. For the quantification of the main economic activities we will gather information, such as: rates of economic growth, description and changes on production technologies, agricultural and water management, data to establish industries, harbour activities (including artisanal fisheries), tourism, urbanization processes. Discrete cost functions (investment and operational costs) will be used to perform cost/benefit analysis and assess different development scenarios on alternative waste water treatment technologies for a certain location.

Composite data is derived from the participatory methods that will be mostly applied for interaction with stakeholders and measure of socio economic impact using adequate methodologies such as focus group technique and policy exercise (PE) approach, described in EEA (2001). With these methodologies we will be able to define preferences and gather opinions of stakeholder concerning present state and future management scenarios.

The previous information combined with data describing landscape, vegetation cover, soils and land use in the basin (which is also accessible), will serve three purposes: (i) defining the environmental state, thus the causes behind the actual equilibriums (ii)defining pressures that will be traduced in the biophysical model as boundary conditions, (iii) find sensible parameters to monitor impact, during project execution and after prokect conclusion.

7.12 Site Description

Sites to be studied differ mostly on physical properties and on the relative importance of economical activities. For all of them there is basic data for applying the model and for describing basin activities and loads. Pressures resulting from socio-economic activities taking place or planned will be quantified explicitly for activities located around the estuaries and through land use in the basin. In all the sites stakeholders located around the estuary will be considered individually or though local associations, while the users of the drainage basin will be accounted through the basin manager.

7.12.1 Argentina – Bahía Blanca

7.12.1.1 Objectives

The application of the ECOManage Project on the estuary of Bahía Blanca will allow achieving the following goals:

- To understand the natural dynamic of estuarine basic resources (i.e., nutrients and organic matter), including main forcings and constrains which can modify it.
- To assess numerically the influence of physical processes (i.e., tides, currents) on the general dynamic of the system.
- To include the effect of sediments transport on the redistribution and bioavailability of pollutants (i.e., heavy metals) within the estuary.
- To state the biological production capability of the system, including its time and space variations as well as its role in the corresponding carbon budget.
- To address the interactions between physical, chemical and biological variables within the system, to identify the main feedback loops which regulate it.
- To estimate the influence of anthropogenic activities (i.e., domestic and industrial sewage discharge, dredging, waste land fillings) on the equilibrium of the mentioned cycles.

- To evaluate the impacts on human productive activities (i.e., reduce of fisheries potential, loss of touristic movement, complications on aquaculture processes) due to changes in the biogeochemical cycles within the estuary.

7.12.1.2 Available physicochemical data

A large database will be accessible on oceanographic parameters from the estuary since the last three decades.

So, in the chemical aspects information on inorganic nutrients (NO_2, NO_3, NH_4, PO_4, SiO_2), in a twice-a-month frequency basis, exists since 1973 and up to now, as well as for organic matter, and physico-chemical variables (i.e., temperature, salinity, dissolved oxygen, pH, turbidity). Furthermore, data on heavy metals (i.e., Hg, Cd, Zn, Cu, Pb, Cr, Ni, Fe, Mn) exists in sediments, suspended particulate matter and water from the estuary, as well as in typical organisms (fish, crabs, prawns, hallophyte vegetation, phytoplankton). Finally, it is also available the information on chlorophyll and phaeopigment contents in phytoplankton of the estuary.

In the physical aspects information on tide amplitude and characteristics, main currents direction and velocity, water residence time, and sediment transport (including tidal channels build up) is also available.

Moreover, a large database of biological information of the estuary is available, including data on phytoplankton, zooplankton (macro, meso and micro), benthic fauna and fishes. Furthermore, information on sediment characteristic (i.e., grain size, texture, mineral composition, permeability) is available.

7.12.1.3 Description of the estuary

The Bahía Blanca Estuary is located in the south-eastern of Buenos Aires province, Argentine (38º45–39º40S and 61º45–62º30W). It is an estuarine environment Having unusual aspects, which include a large tidal plain with an area close to 1150 km2, a relatively small input of inland water, and with several marginal areas that seasonally function as hypersaline ones.

The middle-littoral is characterized by beaches with scarce slope and broad surface and abundantly covered by halophyle vegetation or “espartillar” (*Spartina* sp. and *Salicornia* sp.) and crab caves or “cangrejales”, basically from populations of the crab *Chasmagnathus granulata*.

The estuary is also characterized by the presence of various channels, fine sand and silt-clay sediments and low depth. Tidal oscillations of 4 m and predominant northwesterly winds create strong tidal currents, which facilitate water mixture, leading to a uniform vertical distribution of the main oceanographic parameters. At the northern boundaries of estuary various ports, towns (with a populations exceeding 350,000 inhabitants) and industries are located and several streams discharge within the area. Oil refineries and terminals, petrochemical industries, meat factories, leather plants, fish factories, textile plants, wool washing plants, silos and cereal mills discharge their effluents into the estuary with or without treatment. Moreover, this area is extensively used by fishing boats, oil tankers and cargo vessel and therefore requires regular dredging.

7.12.1.4 Pressures

The case of Bahía Blanca is challenging, considering the importance of the system (i.e., three big cities, three large ports, a very large industrial nucleus (CRI), a strong artisanal fishery): The significant role of one of its ports (Ing. White) which concentrates a large percentage of Argentina´s exportation of cereals and oil, the occurrence of a big industrial centre including the largest fertilizers factory of the country, etc. Cámara Regional de la Industria (CRI), includes the main industrial enterprises located in the area of the estuary.

There are chemical industries (i.e., INDUPA, POLISUR, PBB), fertilizers factory (PROFERTIL), petrochemical (PETROBRAS, ESSO), cereal processing plants (i.e., CARGILL, MORENO). This consortium has demonstrated to be interested in the conservation of the environmental quality of Bahía Blanca estuary. Ing. White Harbour Consortium, includes the port authorities together with

all involved actors in the harbour functioning (i.e., boat enterprises, local fishermen, etc). Also this group is actively interested in Bahía Blanca estuary environmental *status* and quality.
To the direct pressures due to economical activities developing around the estuary, the effect of the pressured due to land use in the basin will be added.

7.12.1.5 Stakeholders

A very important point in this sense is the interest as demonstrated by different organizations of Bahía Blanca community to take part of the implementation of EcoManage; so, local government, neighbour associations, university and educational system, research centres, industrial and harbour consortiums, NGOs, and general public are interested to be active participants.
The local government of Bahía Blanca will be represented by authorities of the Comité Técnico Mixto Permanente de Monitoreo (i.e., Ing Pedro Bodnariuk, Lic Marcelo Pereyra). The industrial consortium (called Cámara Regional de la Industria) will be also represented (i.e., Lic Eduardo Tommassi and Ing Raúl Muscolino (PROFERTIL), Lic Eduardo Pérez Millán (INDUPA), between others). Finally, the authorities of the Consorcio de Gestión Portuaria (which manage the ports) will represent this organization for the project. All of them will discuss the data and results of the model, providing the human dimention of the PHES-system.
NGOs from Bahía Blanca and the region will also be represented.
The educational system will be included through authorities of both basic and university levels from the region.
Basin stakeholders of the basin will be assessed indirectly though authorities in charge of managing the basin. To this authority it will be provided information on the relative importance of river discharge when compared with direct discharges in the estuary.

7.12.2 Chile – FIORDO Aisén

7.12.2.1 Objectives

The model will be implemented for FIORDO Aisén, considering river runoff and tides as the main forcing. The local partner experience in the area also suggests that transient wind conditions (i.e. wind storms) may be important in modifying the classical two layer estuarine circulation in the fjord. Thus, numerical storm experiments will be conducted. The main aim of this model will be to access the water residence time and to access the potential contribution of the pollution from the City of Aisén into the fjord. Since low velocity areas are particularly important both for the development of red tides and also for the increase in nutrient build-up, special attention will be paid to identify them in the modelling area. The model will be validated against current measurements.
Nothing has been done in relation to sediment transport within Fiordo Aisén, however reports from current studies shows that the biota may be polluted with metals of unknown origin. Thus, a sediment transport model will be implemented to assess the potential sources of the metals. The most important modelling sectors will be the shallow waters in the head of Fiordo Aisén (less than 50 m deep), since the rest of the fjord is too deep to be of any concern (> 250 m).
From an environmental point of view, most of the problems of Fiordo Aisén are related to water quality: red tides, nutrient build-up, oxygen deficiencies. The Chilean Government has invested in generating data to analyse these problems but no model has yet been generated. This project will make substantial use of the available database to investigate the plankton-nutrient dynamics. This indeed is the key ecological and political issue for Fiordo Aisén: Salmon farmers propose that the ecology of the fjord is that of a pristine system and that their influence is minimal. This position has indeed been challenged by industries such as Alumysa (the proposed aluminium factory requesting permission to operate in the area). They propose that the fjord system has already been modified by the salmon farmers (e.g. oxygen deficiencies in coastal areas subject to farming and human residues such as the Puerto Chacabuco area). Generating explanations for oxygen deficiencies within the fjord will in fact be one of the most important contributions of this project.

7.12.2.2 Description

Chile has a large estuarine system in its southern extreme, which spreads between Puerto Montt (42.5ºS) and Cape Horn (55.5ºS), a distance of about 1,400 km, and includes a great quantity of islands surrounded by innumerable channels. The basins of this estuarine system were formed as a result of erosive glacier action and by the tectonic sinking of the longitudinal valley south from Puerto Montt. After the last glacial age, the sea level rose and those basins were flooded by the sea, forming a mixed system of drowned river valleys, fjords and inner seas.

Due to the heavy rains in the area, an estuarine system was generated. This system has a high economic value, due to the great quantity and diversity of natural resources and also because of its convenience for the culture of marine species. These characteristics have brought about a quick growth of urban areas, an increase of the riverine population and the establishment of more than 360 businesses using marine culture. Among these businesses, 125 are salmon and trout growth and nursery centers.

Aysén is a fjord which is located between 45.3°-45.5°S, 72.8º-73.8ºW, with a length of about 73 km, an average depth of 142 m and an area of about 470 km^2. Its mouth is connected to the southern extreme of the Moraleda Channel which is in turn connected to the sea at its northern extreme through the "Boca del Guafo".

The Aysén River flows into the head of this fjord, and it has as principal discharges the Mañiguales (15 million m^3 day^{-1}), the Simpson (9 million m^3 day^{-1}) and the Claro (500 thousand m^3 day^{-1}) rivers. In addition, the Cuervo (9 million m^3 day^{-1}) and Lagunillas (4 million m^3 day^{-1}) rivers flow directly into the fjord. There are other rivers for which there are no flow records available but which seem to be relatively unimportant.

Due to the large freshwater contribution from rivers and rain, Aysén is characterized by a two-layer structure, separated by a strong halocline. The upper layer, which is about 25 m thick, has salinities between 0 psu at the head and 29 psu at the mouth. The lower layer is more homogeneous, with salinities between 30 and 31 psu. The upper layers are well oxygenated throughout the sound and have concentrations from 5 to 7 ml l^{-1}. However, the lower layers have concentrations about 5 ml l^{-1} in the first third of the sound, but then it rapidly decreases towards the head to values lower than 2.5 ml l^{-1} near the bottom. This situation is also seen in the pH measurements in the area, which are 7.75 at the mouth and 7.35 at the head.

Nitrate (DIN) and phosphate (DIP) also show a two-layer structure, with lower values at the surface, due to the contribution of low-nutrient rivers and biological uptake. The upper layer has concentrations of 0-1.2 μM of phosphate and 0-12 μM of nitrate. The lower layer is more homogeneous, with concentrations of 1.4-1.8 μM of phosphate and 1.2-12 μM nitrate, increasing from the mouth to the head The average N:P Redfield ratios for the sound waters, obtained by linear regression, were 10.6:1 with a correlation coefficient of 0.971.

7.12.2.3 Available physicochemical Data

From the previous description of the fjord it's obvious that a lot of work has been done on site, and that lack of information will not be a problem. Most of the data necessary to implement a 3D hydrodynamic model has already been collected, thus its guarantee that the project will have access to bathymetric and topographic data, currents, temperature, salinity and also to sediments, chlorophyll and nutrients measures. There are a number of models already applied to system including 2D hydrodynamic models, sediment transport models and simple box water quality models.

7.12.2.4 Pressures

The Aisén fjord has been used for different productive purposes such as salmon farming, mariculture, mollusk harvesting and (rather recently) industrial development. This fjord support a large salmon farming industry, it receives the liquid residues of Puerto Aisén (a town of 37000 people, located close to its head). Its also home of a large seaport (Puerto Chacabuco), and it has harmful algal bloom's problems. Recently an aluminium processing plant requested the Chilean government authorization to install a large industrial complex in the fjord, further requesting permission to evacuate its industrial residues in the fjord's water, which has been generating a large discussion in the community. Although both the central and regional Chilean governments state that one of the main characteristics of its environmental policy is wide citizen's participation, there is no stakeholders agreed model for this ecosystem. Thus, Fiordo Aisén could indeed be an important site where a PHES-system conceptual model should be implemented

7.12.2.5 Stakeholders

Stakeholders involvement will start at the onset of the project. The local government has agreed to host the preliminary workshop where the project will be launched. All stakeholders will be invited to this workshop. We anticipate generating the Fiordo Aisén PHES-SYSTEM from this workshop.

NGO's such as Greenpeace and local environmental protection organizations have been committed with aluminium issue and should also be interested in project outcome.

7.12.3 Brasil –Estuário de Santos

7.12.3.1 Objectives

The application of the project to the estuary of Santos will allow achieving the following goals:

- To understand the natural dynamic of estuarine basic resources (i.e., nutrients and organic matter), including main forcings and constrains which can modify it.
- To assess numerically the influence of physical processes (i.e., tides, currents) on the general dynamic of the system.
- To include the effect of sediment transport on the redistribution and bioavailability of pollutants (i.e., heavy metals) within the estuary.
- To state the biological production capability of the system, including its time and space variations as well as its role in the corresponding carbon budget.
- To address the interactions between physical, chemical and biological variables within the system, to identify the main feedback loops which regulate it.
- To estimate the influence of anthropogenic activities (i.e., domestic and industrial sewage discharge, dredging, waste land fillings) on the equilibrium of the mentioned cycles.
- To analyse in detail the limiting functions controlling the large mangrove areas, such as the hydrodynamic flow, sanity distribution, sediment transport, organic matter cycling, among others, in order to predict the way these areas will be affected by anthropogenic changes

7.12.3.2 Description

The region of Santos – São Vicente Estuarine Complex (23°30'-24°S - 46°05'-46°30'W) is formed by two islands (São Vicente and Santo Amaro) very close to the continent delimiting three channels: Santos, São Vicente and Bertioga. This area is located in the Southern limit of the tropical zone with mean temperatures of 22°C, pluviometric index of 2500 mm/year and is surrounded by the Serra do Mar slopes, partially recovered by the Atlantic Forest.
The coastal plains were originally recovered by extensive mangroves forests, which were gradually occupied by the industrial complex of Cubatão, established since 1940, by the urban area and by the Santos harbour (the most important Brazilian port), consequently few pristine areas remain. Currently, the Brazilian Legislation considers the mangroves as permanent preservation areas. The urban densification, the industrial pole of Cubatão and the Santos harbour, constitute a threat to the ecosystem as well as to the adjacent aquatic environment.

7.12.3.3 Available physicochemical Data

The Santos estuary as been subject to intensive field campaigns thus data will not be a problem for sure. In fact some members of this consortium have been involved in modelling studies in the area (hydrodynamic, sediment transport) and for that reason, no problems are expected on the implementation of the PHES-system locally.

7.12.3.4 Pressures

Santos Estuary is referenced as a much polluted estuary. Santos is a major port and a tourism area, located downstream from Sao Paulo (a city of 15 million people) and Cubatao, major industrial area. The Santos Estuary used to receive raw sewage from Sao Paulo and industrial and hydroelectric power plant discharges from Cubatao. High levels of oxygen-demanding substances, phenols, metals (e. g., copper and zinc), and pesticides have been detected in the water, and metals and pesticides have been found in sediments.

In 1983, the Brazilian environmental agency (CETESB) established the Program for Environmental Pollution Control to survey pollution sources, inventory emissions to the estuary, and develop environmental control plans for each industrial source in Cubatao. Public participation has been encouraged throughout the process; for example, ‘CETESB held quarterly public meetings to discuss progress of the plans. Thus far, measurable emission reductions of different pollutants (as well as improved air quality) have been recorded. The program is particularly noteworthy for its development and use of epidemiological studies, biological methods and criteria for assessing toxicity, and models for evaluating environmental risks.

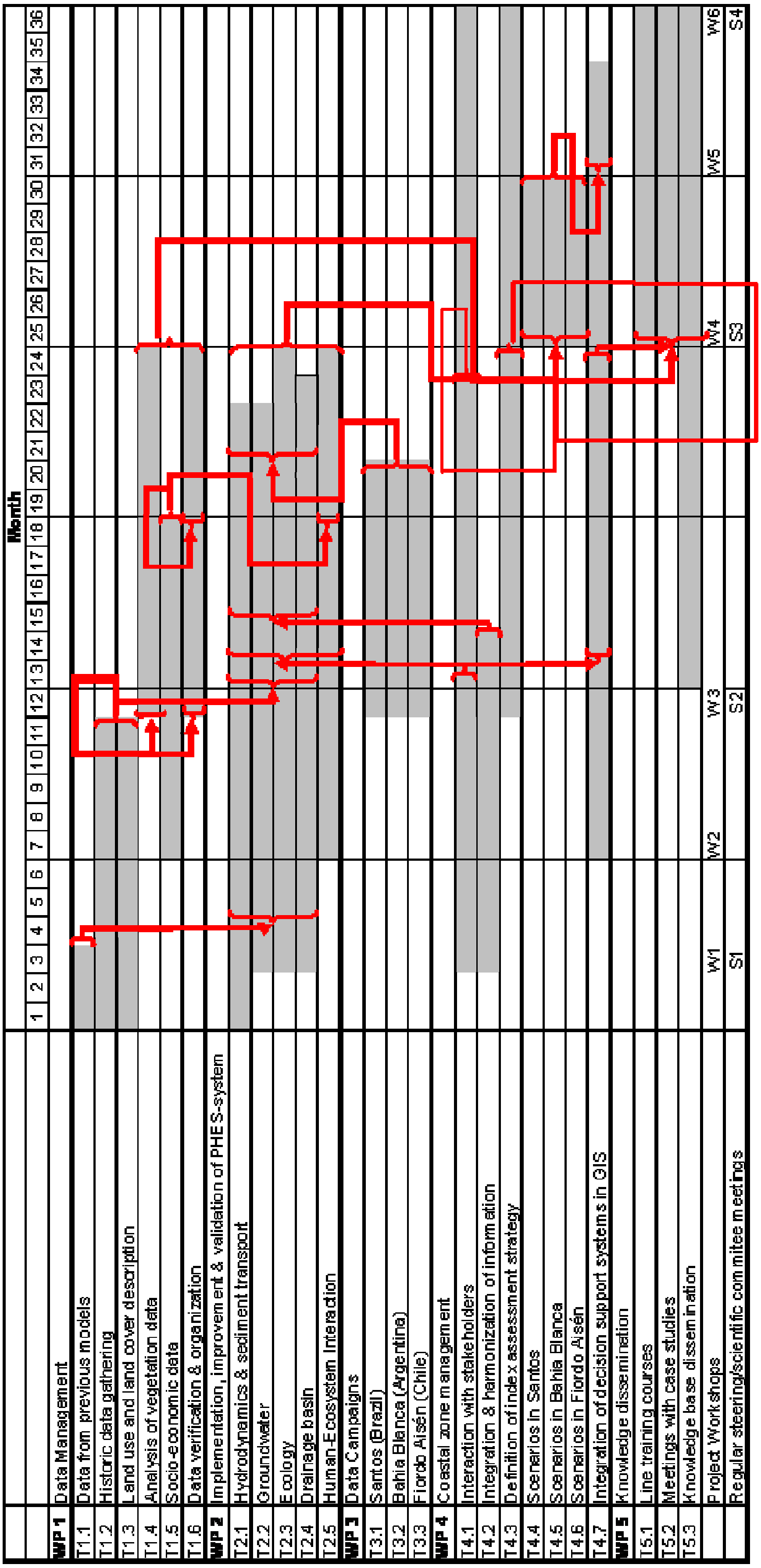
7.12.3.5 Stakeholders

At Santos there are a number of stakeholders that should be interested in the project including local government, university and educational system, industrial and harbour consortiums and NGOs (environmental protection). From these, we highlight CETESB (Brazilian environmental agency), CODESP (port authority) and CEAVI (environmental protection NGO).

7.13 Workplanning and Time

		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
WP 1	Data Management			M1.1																		M1.2															
T1.1	Data from previous models			D1.1																																	
T1.2	Historic data gathering				D1.2							D1.3																									
T1.3	Land use and land cover description				D1.4				D1.5			D1.6																									
T1.4	Analysis of vegetation data																	D1.7							D1.8												
T1.5	Socio-economic data												D1.9						D1.10																		
T1.6	Data verification & organization														D1.11								D1.12		D1.13												
WP 2	Implementation, improvement & validation of PHES-system											M2.1							M2.2						M2.3												
T2.1	Hydrodynamics & sediment transport					D2.1			D2.2					D2.3			D2.4						D2.5														
T2.2	Groundwater							D2.6								D2.7							D2.8														
T2.3	Ecology										D2.9								D2.10						D2.11												
T2.4	Drainage basin									D2.12								D2.13						D2.14													
T2.5	Human-Ecosystem Interaction														D2.15										D2.16												
WP 3	Data Campaigns												M3.1						M3.2																		
T3.1	Santos (Brazil)																D3.1				D3.2																
T3.2	Bahia Blanca (Argentina)																D3.3				D3.4																
T3.3	Fiordo Aisén (Chile)																D3.5				D3.6																
WP 4	Coastal zone management												M4.1													M4.2							M4.3				
T4.1	Interaction with stakeholders				D4.1				D4.2					D4.3										D4.4													D4.5
T4.2	Integration & harmonization of information						D4.6								D4.7																						
T4.3	Definition of index assessment strategy																D4.8								D4.9												D4.10
T4.4	Scenarios in Santos																														D4.11						
T4.5	Scenarios in Bahia Blanca																														D4.12						
T4.6	Scenarios in Fiordo Aisén																														D4.13						
T4.7	Integration of decision support systems in GIS												D4.14												D4.15							D4.16			D4.17		
WP 5	Knowledge dissemination																									M5.1									M5.2		
T5.1	Line training courses																												D5.1						D5.2		
T5.2	Meetings with case studies																																				D5.3
T5.3	Knowledge base dissemination																		D5.4							D5.5											D5.6
	Project Workshops			W1				W2					W3													W4						W5					W6
	Regular steering/scientific commitee meetings			S1									S2													S3											S4

7.14 Graphical presentation of work packages



7.15 Work package list /overview

Work-package No[1]	Workpackage title	Lead contractor No[2]	Person-months[3]	Start month[4]	End month[5]	Deliverable No[6]
1	Data Management	2	116	0	24	D1.1 – D1.13
2	Implementation, improvement & validation of PHES-system	1	223	0	24	D2.1 – D2.16
3	Data campaigns	6	36	12	20	D3.1 – D3.6
4	Coastal zone management	9	152	3	36	D4.1 – D4.17
5	Knowledge dissemination	5	48	13	36	D5.1 – D5.6
	TOTAL		575			

[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.

7.16 Deliverables list

Notes:

- The qualification "Restricted" (RE) applies to preliminary documents and documents that must have stakeholder's agreement to be public.
- The qualification "Temporary Restricted" (TRE) applies to documents and data that will be public before one year after project conclusion.

Deliverable No[1]	Deliverable Name	WP No.	Lead participant	Estimated person-months	Nature[2]	Dissemination level[3]	Delivery date[4]
D1.1	Data sets with the data already being used in models applied previously - All sites	1	2	5	O(Da)	TRE	3
D1.2	Data sets of physical parameters to complete information in hydrodynamic and sediment transport models - All sites	1	2	5	O(Da)	TRE	4
D1.3	Data sets of all gathered data - All sites	1	2	20	O(Da) /R	PU	11
D1.4	Maps of land use and vegetation cover - All sites	1	5	4	R	PU	4
D1.5	Maps of landscape descriptions according to different parameters (fractality, connectance, edge diversity etc.) - All sites	1	5	4	R	PU	8
D1.6	Vegetation data tables and graphical description of the vegetation structure along transects (profile diagrams) - All sites	1	5	5	O(Da) /R	PU	11
D1.7	Mangroves in Santos – Characterization of the vegetation's structure and floristic composition and main types of human disturbance	1	7	7	R	PU	17

[1] Deliverable numbers in order of delivery dates: D1 – Dn

[2] Please indicate the nature of the deliverable using one of the following codes:

R = Report
P = Prototype
D = Demonstrator
O = Other (**Da** = Data sets)

[3] 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).
TRE = Restricted to a group specified by the consortium (including the Commission Services), but public available before one year after project conclusion.
CO = Confidential, only for members of the consortium (including the Commission Services).

[4] 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.

Deliverable No[1]	Deliverable Name	WP No.	Lead participant	Estimated person-months	Nature[2]	Dissemination level[3]	Delivery date[4]
D1.8	Description of the vegetation in different stages of secondary succession according to parameters of structure (high, diameter, density etc) and floristic composition and main types of human disturbance. The report will include discussions based on comparative analysis on the role of the different types of vegetation in water and soil conservation – All sites	1	5	10	R	PU	24
D1.9	Socio-economic data sets and reports to characterize each site	1	7	7	O(Da) /R	PU	12
D1.10	Socio-economic prospective data to characterize each site's development strategies	1	7	8	O(Da) /R	PU	18
D1.11	Database Structure	1	1	3	R	PU	14
D1.12	Aquatic component of database - All sites	1	1	14	R/P	PU	22
D1.13	Land component of database - All sites	1	5	14	R/P	PU	24
D2.1	Preliminary hydrodynamic model application - All sites	2	2	10	R	RE	5
D2.2	Preliminary sediment transport model application - All sites	2	2	10	R	RE	8
D2.3	Calibration of the hydrodynamic model application - All sites	2	2	10	R	PU	13
D2.4	Calibration of the sediment transport model application - All sites	2	2	14	R	PU	16
D2.5	Hydrodynamic & sediment transport model - All sites	2	2	15	R	PU	22
D2.6	SIG mapping of hydrogeologic parameters, including groundwater recharge assessment and groundwater vulnerability to pollution – All sites	2	4	8	R	PU	7
D2.7	Diagnosis of the Reference Situation and the Definition a Target Situation related to Groundwater – All sites	2	4	8	R	PU	15
D2.8	Groundwater flow and transport components of the global estuary model – All sites	2	4	10	R	PU	22
D2.9	Preliminary ecological model - All sites	2	3	30	R	RE	10
D2.10	Calibration of ecological model - All sites	2	3	31	R	PU	18

Deliverable No[1]	Deliverable Name	WP No.	Lead participant	Estimated person-months	Nature[2]	Dissemination level[3]	Delivery date[4]
D2.11	Validation of ecological model - All sites	2	3	30	R	PU	24
D2.12	Preliminary basin model - All sites	2	1	6	R	RE	9
D2.13	Calibration of basin model - All sites	2	1	8	R	PU	17
D2.14	Validation of basin model - All sites		1	6	R	PU	23
D2.15	Human-ecosystem interaction – report on methodologies and modelling aproach	2	9	8	R	PU	14
D2.16	Human-ecosystem interaction – modelling for All sites	2	9	11	R	PU	24
D3.1	Results of the 1st data campaign in Santos	3	7	4	O(Da)	TRE	16
D3.2	Results of the data campaigns in Santos	3	7	10	O(Da) /R	PU	20
D3.3	Results of the 1st data campaign in Bahia Blanca	3	8	3	O(Da)	TRE	16
D3.4	Results of the data campaigns in Bahia Blanca	3	8	7	O(Da) /R	PU	20
D3.5	Results of the 1st data campaign in Fiordo Aisén	3	10	3	O(Da)	TRE	16
D3.6	Results of the data campaigns in Fiordo Aisén	3	10	7	O(Da) /R	PU	20
D4.1	Results of the meeting with stakeholders of Santos	4	7	5	R	RE	4
D4.2	Results of the meeting with stakeholders of Bahia Blanca	4	8	4	R	RE	8
D4.3	Results of the meeting with stakeholders of Fiordo Aisén	4	9	4	R	RE	13
D4.4	Proposal of development/restoration scenarios to test the PHES modelling conceptual framework - All sites	4	9	18	R	RE	23
D4.5	Conclusions of the final meetings with stakeholders of all sites	4	9	7	R	PU	36
D4.6	Preliminary report on: Data exchange criteria; spatial harmonization of modelling work; data formats.	4	1	2	R	RE	6
D4.7	Final report on: Data exchange criteria; spatial harmonization of modelling work; data formats	4	1	5	R	PU	14
D4.8	First report on index assessment strategy	4	4	1	R	PU	16
D4.9	Criteria for index application in the scenarios to study	4	4	2	R	PU	24

Deliverable No[1]	Deliverable Name	WP No.	Lead participant	Estimated person-months	Nature[2]	Dissemination level[3]	Delivery date[4]
D4.10	Final report on index assessment in coastal system	4	4	3	R	PU	36
D4.11	Results obtained with the modelling framework for the scenarios in Santos	4	7	33	O(Da) /R	PU	30
D4.12	Results obtained with the modelling framework for the scenarios in Bahia Blanca	4	8	18	O(Da) /R	PU	30
D4.13	Results obtained with the modelling framework for the scenarios in Fiordo Aisén	4	9	18	O(Da) /R	PU	30
D4.14	Definition of SDSS design after meeting with all partners	4	5	2	R	PU	12
D.4.15	A comprehensive system software tool accessible on line to the participants of the project for SDSS that integrates: Image Processing, GIS, multi-criteria analysis, Cost benefit assessment etc	4	5	5	P/R	RE	24
D4.16	Maps of simulated scenarios and corresponding data tables	4	5	5	R	PU	31
D4.17	Manual describing the SDSS structure and its use for on line training courses	4	5	7	R	PU	34
D5.1	Definition of line training courses for scenario simulation using the SDSS (Proposal to stakeholders)	5	5	4	R	PU	28
D5.2	Material for the line training courses	5	5	10	R	PU	34
D5.3	Report on meetings in each site	5	5	11	R	PU	36
D5.4	Internet knowledge base structuring	5	2	7	R	PU	18
D5.5	Internet knowledge base deployment – experimental phase	5	2	7	P	PU	25
D5.6	Internet knowledge base	5	2	7	P/R	PU	36

Codes for the nature of the deliverable:

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7.17 Work package descriptions

WP1 - Data Management

Workpackage number	1			**Start date or starting event:**			Month 0			
Participant (C is coordinator)	1	2 C	3	4	5	6	7	8	9	10
Person-months per participant:	11	13	0	2	26	16	22	15	9	2

Objectives

To gather, analyse and disseminate among partners the relevant data on the marine and land (drainage basin) areas of the three PHES-Systems: Santos, Bahia Blanca and Fiordo Aisén.

To analyse the land use and land cover patterns of the coastal areas of the study sites defined by the limits of contribution basins with the aim to identify the main sources of pollution of the soil, surface and underground waters and the sites where the land uses are inadequate. Also to evaluate the role of the coastal vegetation in the conservation of water resources, soil and plant diversity.

Description of work

Task 1. Verify data already being used in models applied to the sites. These sets of data (boundary conditions and forcing functions) should enable the use of different models in the sites, although data has to be checked for consistency before it’s introduced in new models.

Task 2. Data gathering within the partners of the project, within stakeholders and within public departments (e.g. Navy, National Environmental Authorities). The following data will be sought: Bathymetry and topography; Boundaries – Physical and biogeochemical; Point sources (rivers, wastewater discharges); Volumes and loads of dynamic variables (nutrients, detritus, pollutants); Forcing functions (Meteorology, oceanography); Initial fields for BGC variables (water column and benthic system); Boundary time series of BGC variables (climatological year); Sediments (suspension and bottom); geology; hydrogeology; quantity and quality aspects of the groundwater resources.

Task 3. The land use land cover (vegetation cover) maps for the pilot areas will be obtained by using LANDSAT and SPOT remote sensing data, integrated with available ancillary data and by truth field survey. LANDSAT TM images will be integrated with SPOT-P (panchromatic) images. SAR, ERS-1 and ERS-2 images will also be used to have information on vegetation structure. Landscape analysis to identify matrix, patches and corridors with spatial statistical methods measuring connectance, fractality, fragmentation etc. will be carried out. Vegetation description in selected representative sites of the study areas based on field work for the analysis of forests structure, physiognomy, and floristic composition.

Task 4. Analysis of vegetation data for the identification of the stages of the secondary succession, the relative degree of human disturbance and evaluation of the role of the forest in the conservation of water resources, soil and plant diversity in the study areas.

Task 5. Gathering of socio-economic data within the partners of the project, within stakeholders and within public departments (e.g. Statistics Institutes). The following data will be sought: demography; general economy (employment, activity areas, housing, health); recreation; transportation; fisheries; marine and port activities.

Task 6. Data verification and structuring in the form of site related databases. These databases will be structured in order to facilitate the access by all partners.

Deliverables

D1.1 to D1.3 – Data sets

D1.4 to D1.8 – Maps, data tables and graphical description of land use and vegetation cover

D1.9 to D1.10 – Data sets and reports

D1.11 to D1.13 - Database

Milestones[1] and expected result
M1.1 (Month 3) – Data from existing models is passed to partners
M1.2 (Month 12) – Historical data is gathered, digitized and verified for use by partners
M1.3 (Month 21) – Data from campaign measurements is treated and available to all partners

[1] Milestones are control points at which decisions are needed; for example concerning which of several technologies will be adopted as the basis for the next phase of the project.

WP2 – Implementation, improvement and validation of PHES-systems

Workpackage number	2			**Start date or starting event:**			Month 0			
Participant (C is coordinator)	1 C	2	3	4	5	6	7	8	9	10
Person-months per participant:	30	38	7	19	1	30	16	37	45	0

Objectives

Implementation of the PHES-System for the three sites.

Improvement of the modelling system in whatever way it is needed to better describe the PHES-Systems under study.

Integration in the modelling system of all the stakeholders' views gathered during the first year of the project.

Comparison of the modelling results with the data obtained in Wp1 and WP3 (calibration and validation)

Description of work

The implementation of the PHES-System to the three sites will be done. This implementation will use models already applied in each site, data gathered in WP1 and a first approach to the view of the system acquired in the workshops with the stakeholders.

The need for new improvements of the models may arise in the parameterization of some processes, introduction of new processes, in coupling the models, in boundary conditions, in forcing conditions, etc. An overall look at each system will indicate the direction of the improvements.

Coupling of models that work on different time and spatial scales will need solutions that need to be studied. Model nesting and integration boxes will be tested in order to improve interaction between models.

Historic and newly measured data from WP1 and WP3 will be included in the models in the calibration and the validation phases.

The task on human-ecosystem interaction will be devoted mainly to the definition of models to describe how changes in the ecosystem cause the ecosystem services to change and thereby affect human well-being and poverty. This task involves the translation of information such as the state of water quality, mangroves or fish into variables of concern to society (such as health, livelihoods, wealth, and security, for instance). The distribution of service benefits among societal groups will need careful consideration.

Task 1 – Hydrodynamics and Sediment transport

Task 2 - Groundwater

Task 3 – Ecology

Task 4 – Drainage basin

Task 5 – Human-ecosystem interaction

Deliverables

D2.1 to D2.5 – Hydrodynamic and sediment transport modelling

D2.6 to D2.8 – Groundwater flow

D2.9 to D2.11 – Ecologic modelling

D2.12 to D2.14 – Drainage basins modelling

D2.15 to D2.16 – Human-ecosystem interaction

Milestones and expected result

M2.1 (Month 10) – The first stage of the modelling work is terminated; data campaigns and improvement in modelling tools are defined.

M2.2 (Month 18) – Models have been calibrated with historical data

M2.3 (Month 24) – Models are set up, were improved if needed and were validated against new data

WP3 – Data Campaigns

Workpackage number	3			**Start date or starting event:**			Month 12			
Participant (C is coordinator)	1	2	3	4	5	6 C	7	8	9	10
Person-months per participant:	2	1	0	0	3	7	6	8	3	6

Objectives

Realization of two campaigns in the aquatic environment to complement the historic data obtained for each site.

Confirm the understanding of the ecosystems and clarify the main doubts still remaining.

Complementary fieldwork to land cover/land use description and to groundwater resources

Description of work

Two campaigns in the aquatic environment will be done in each site. They will be short campaigns once they are intended only to confirm the historic data obtained for each site. These campaigns will focus on the following parameters: currents, sea levels, temperature, salinity, suspended sediments, pH, Dissolved Oxygen, BOD, Nutrients (Phosphorous, Ammonia and Nitrate), and Chlorophyll-a. Associated with these campaigns, other site relevant parameters may be also measured. Parameters that are already being measured in the site (usually sea level is measured routinely) will not be measured.

Fieldwork will be done in order to describe vegetation in selected representative sites of the study areas, for the analysis of forests structure, physiognomy, and floristic composition. Also complementary fieldwork will be done to better characterize the hydrogeology, quantity and quality aspects of the groundwater resources.

Task 1 – Santos Estuary Campaigns

Task 2 – Bahia Blanca Estuary Campaigns

Task 3 – Fiordo Aisén Campaigns

Deliverables

D3.1 & D3.2 - Santos campaigns

D3.3 & D3.4 - Bahia Blanca campaigns

D3.5 & D3.6 - Fiordo Aisén campaigns

Milestones and expected result

M3.1 (Month 12) – The first campaign starts.

M3.2 (Month 18) – The second campaigns starts

WP4 – Coastal zone management

Workpackage number	4			**Start date or starting event:**			Month 3			
Participant (C is coordinator)	1	2	3	4	5	6	7	8	9 C	10
Person-months per participant:	15	10	4	7	23	17	18	24	34	0

Objectives

Development of the analytical approach for ecosystem assessment.

Development of a Spatial Decision Support System (SDSS) that will materialize the results obtained with analytical approach for ecosystem assessment that including among others: spatial databases , model results, scenarios simulations for the PHES-System, indexes able to describe the carrying capacity of the systems in face of increasing anthropogenic pressure.

Description of work

Task 1 - The interaction with stakeholders will be started with workshops. In the first year of the project, a workshop will be held in each site. In each workshop the knowledge of the PHES-Systems within the project partners will be presented to all the partners and to the stakeholders in order to adjust the conceptual model of each site. Following the approach for ecosystem assessment the next subtasks must be accomplish:

- Identify and categorize ecosystems and ecosystem services
- Identify links between human societies and ecosystem services
- Identify direct and indirect drivers
- Assess conditions and trends of ecosystems and their services

The definition of scenarios to study in tasks 4 to 6 is also defined in cooperation with stakeholders. In the end of the project, the final results will also be presented in local workshops.

Task 2. The integration and harmonization of information that will be included in the SDSS needs a common framework of data sharing. In order to integrate models and data, there has to be a common understanding of boundary locations, parameters to pass to each other, data formats and others.

Task 3. Indexes and assess of impact on human well-being, to answer specific environmental questions (such as eutrophication, contamination and habitat vulnerability) will be developed. The definition of an index assessment strategy and consequently the assess of impact on human well-being will be two of the most important tasks of the project and are also present as subtasks of the approach for ecosystem assessment framework.

Task4 to Task 6. The most important problems of each site will be addressed with the modelling framework build in the project. Each site will address specific questions that may demonstrate the use of that framework and that may help in the definition of local sustainable development policies. Following the approach for ecosystem assessment the next subtasks must be accomplish for each site:

- Develop scenarios
- Analyze response options
- Analyze uncertainty

Task 7. Definition of conceptual and numerical rules for multi-criteria analysis, cost-benefit assessments etc., based on previous tasks and WPs results, using specialised software to create DSS (e.g. DEFINITE).. Integration of technological tools of territorial analysis (GIS, RS etc.) to create an integrated Spatial DSS.

Deliverables

D4.1 to D4.3 – Conclusions of the meetings with stakeholders that will include preliminary results of the analytical approach for ecosystem assessment for each site

D4.4 – Proposal of development/restoration scenarios to test the PHES modelling conceptual framework

D4.5 – Conclusions of the final meetings with stakeholders of all sites

D4.6 & D4.7 - Data exchange criteria; spatial harmonization of modelling work; data formats.

D4.8 to D4.10 – Index assessment in coastal systems

D4.11 to D4.13 – Results of studied scenarios in the three sites

D4.14 to D4.17 –SDSS definition including selection of the PHES-system model results to be presented, definition of conceptual and numerical rules for multi-criteria analysis, cost-benefit assessments and presentation of knowledge base on pre-web format

Milestones and expected result

M4.1 (Month 12) – Initial 3 workshops with stakeholders are completed (one per site) and input from them about the PHES-Systems can be included in the modelling work for each site

M4.2 (Month 25) – The modelling framework is ready to use , the input from stakeholders on the scenarios to study is defined and the SDSS structure is developed

M4.3 (Month 32) – Presentation of results to stakeholders starts, including knowledge base dissemination and meetings with case studies.

WP5 – Knowledge dissemination

Workpackage number	5		**Start date or starting event:**		Month 15					
Participant (C is coordinator)	1	2	3	4	5 C	6	7	8	9	10
Person-months per participant:	3	6	0	2	11	5	7	7	7	0

Objectives

To disseminate the knowledge of the project within the stakeholders and the local society promoting line training courses, meetings with case studies and Internet dissemination.

To translate advanced knowledge into basic and intermediate knowledge that can be disseminated to citizens with different level of education.

Description of work

Integrated Coastal Zone Management (ICZM) must be done with the populations. This project will produce integrated knowledge about the coastal zone environment that must be taken into account in ICZM. Therefore, the question of public dissemination is address in this WP. The different levels of public dissemination (stakeholder’s technical staff, schools, low education population) will be addressed using different methodologies.

Internet publication technologies will be extensively used.

Stakeholder’s trainees will be educated in the use of the project results. The production of material adequate to the characteristics of the public, and in the local language, will be done with the cooperation of these trainees.

Task 1. Organisation of on line training courses for scenario simulation using the SDSS

Task 2. Organisation of meetings for the applications on data sets coming from the cases studies

Task 3. Knowledge base dissemination with the emphasis on producing basic and intermediate knowledge

Deliverables

D5.1 & D5.2 – Line training courses material

D5.3 - Report on meetings in each site

D5.4 to D5.6 – Internet knowledge base

Milestones and expected result

M5.1 – Beginning of the public knowledge base dissemination in Internet.

M5.2 – Line training courses available

8 - Project resources and budget overview

8.1 Efforts for the project (STREP/STIP Efforts Form in Appendix 1)

Table 1 – STREP/STIP Efforts Form

	Partners	IST	HIDROMOD	NOCTILUCA	LNEC	UNITS	IOUSP	UNISANTA	IADO	UCHILE	CEA	Total
	Research/innovation activities											
WP 1	Data Management	10	10	0	2	26	16	22	15	9	2	112
WP 2	Implementation, improvement & validation of PHES-system	27	34	7	19	1	30	16	37	45	0	216
WP 3	Data Campaigns	1	0	0	0	3	6	6	8	3	6	33
WP 4	Coastal zone management	11	8	4	7	23	17	18	24	31	0	143
WP 5	Knowledge dissemination	2	4	0	2	9	5	7	7	7	0	43
	Total research/innovation	51	56	11	30	62	74	69	91	95	8	547
	Management activities											
WP 1	Data Management	1	3									4
WP 2	Implementation, improvement & validation of PHES-system	3	4									7
WP 3	Data Campaigns	1	1				1					3
WP 4	Coastal zone management	4	2							3		9
WP 5	Knowledge dissemination	1	2			2						5
	Total management	10	12	0	0	2	1	0	0	3	0	28
	TOTAL ACTIVITIES	61	68	11	30	64	75	69	91	98	8	575

8.2 Overall budget for the project (Forms A3.1 & A3.2 from CPFs)

Contract Preparation Forms

EUROPEAN COMMISSION

6th Framework Programme on Research, Technological Development and Demonstration

Specific Targeted Research or Innovation Project

A3.1

Please use as many copies of form A3.1 as necessary for the number of partners

Proposal Number	003715	Proposal Acronym	ECOManage

Financial information - whole duration of the project

Participant n	Organisation short name	Cost model used	Estimated eligible costs and requested EC contribution (whole duration of the project)		Costs and EC contribution per type of activities: RTD or innovation related activities (1)	Demonstration activities (2)	Consortium Management activities (3)	Total (4)=(1)+(2)+(3)	Total receipts
1	IST	Full cost model	Eligible costs	*Direct Costs (a)*	161 500.00	.00	19 686.00	181 186.00	.00
				of which subcontracting	.00	.00	.00	.00	
				Indirect costs (b)	175 100.00	.00	29 314.00	204 414.00	
				Total eligible costs (a)+(b)	336 600.00	.00	49 000.00	385 600.00	
			Requested EC contribution		168 300.00	.00	49 000.00	217 300.00	
2	HIDROMOD	Full cost model	Eligible costs	*Direct Costs (a)*	243 000.00	.00	29 630.00	272 630.00	.00
				of which subcontracting	.00	.00	.00	.00	
				Indirect costs (b)	85 100.00	.00	10 370.00	95 470.00	
				Total eligible costs (a)+(b)	328 100.00	.00	40 000.00	368 100.00	
			Requested EC contribution		164 050.00	.00	40 000.00	204 050.00	
3	Noctiluca	Simplifi full-cos model	Eligible costs	*Direct Costs (a)*	94 500.00	.00	1 300.00	95 800.00	.00
				of which subcontracting	.00	.00	.00	.00	
				Indirect costs (b)	18 800.00	.00	.00	18 800.00	
				Total eligible costs (a)+(b)	113 300.00	.00	1 300.00	114 600.00	
			Requested EC contribution		56 650.00	.00	1 300.00	57 950.00	
4	LNEC	Full cost model	Eligible costs	*Direct Costs (a)*	256 300.00	.00	2 700.00	259 000.00	.00
				of which subcontracting	.00	.00	.00	.00	
				Indirect costs (b)	31 100.00	.00	.00	31 100.00	
				Total eligible costs (a)+(b)	287 400.00	.00	2 700.00	290 100.00	
			Requested EC contribution		143 700.00	.00	2 700.00	146 400.00	
5	UNITS	Additio cost model	Eligible costs	*Direct Costs (a)*	145 450.00	.00	.00	145 450.00	.00
				of which subcontracting	.00	.00	.00	.00	
				Indirect costs (b)	29 050.00	.00	.00	29 050.00	
				Total eligible costs (a)+(b)	174 500.00	.00	.00	174 500.00	
			Requested EC contribution		174 500.00	.00	.00	174 500.00	
6	IOUSP	Additio cost model	Eligible costs	*Direct Costs (a)*	95 500.00	.00	.00	95 500.00	.00
				of which subcontracting	.00	.00	.00	.00	
				Indirect costs (b)	19 000.00	.00	.00	19 000.00	
				Total eligible costs (a)+(b)	114 500.00	.00	.00	114 500.00	
			Requested EC contribution		114 500.00	.00	.00	114 500.00	
7	UNISANTA	Additio cost model	Eligible costs	*Direct Costs (a)*	237 550.00	.00	1 000.00	238 550.00	.00
				of which subcontracting	.00	.00	.00	.00	
				Indirect costs (b)	47 450.00	.00	.00	47 450.00	
				Total eligible costs (a)+(b)	285 000.00	.00	1 000.00	286 000.00	
			Requested EC contribution		142 500.00	.00	1 000.00	143 500.00	
8	IADO	Additio cost model	Eligible costs	*Direct Costs (a)*	116 000.00	.00	.00	116 000.00	.00
				of which subcontracting	.00	.00	.00	.00	
				Indirect costs (b)	23 100.00	.00	.00	23 100.00	
				Total eligible costs (a)+(b)	139 100.00	.00	.00	139 100.00	
			Requested EC contribution		139 100.00	.00	.00	139 100.00	
9	UCHILE	Additio cost model	Eligible costs	*Direct Costs (a)*	126 200.00	.00	.00	126 200.00	.00
				of which subcontracting	.00	.00	.00	.00	
				Indirect costs (b)	25 200.00	.00	.00	25 200.00	
				Total eligible costs (a)+(b)	151 400.00	.00	.00	151 400.00	
			Requested EC contribution		151 400.00	.00	.00	151 400.00	
10	CEA	Simplifi full-cos model	Eligible costs	*Direct Costs (a)*	84 800.00	.00	900.00	85 700.00	.00
				of which subcontracting	4 800.00	.00	.00	4 800.00	
				Indirect costs (b)	16 000.00	.00	.00	16 000.00	
				Total eligible costs (a)+(b)	100 800.00	.00	900.00	101 700.00	
			Requested EC contribution		50 400.00	.00	900.00	51 300.00	
TOTAL			Eligible costs		**2 030 700.00**	**.00**	**94 900.00**	**2 125 600.00**	**.00**
			Requested EC contribution		**1 305 100.00**	**.00**	**94 900.00**	**1 400 000.00**	

Contract Preparation Forms

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A3.2

Proposal Number	003715	Proposal Acronym	ECOManage

Estimated breakdown of the EC contribution per reporting period				
Reporting Periods	Start month	End month	Estimated Grant to the Budget	
			Total	In which first six months
Reporting Period 1	1	12	550 000.00	.00
Reporting Period 2	13	24	450 000.00	300 000.00
Reporting Period 3	25	36	400 000.00	250 000.00
Reporting Period 4			.00	.00
Reporting Period 5			.00	.00
Reporting Period 6			.00	.00
Reporting Period 7			.00	.00

8.3 Management level description of resources and budget.

8.3.1 Human

The consortium brought together in the current proposal combines specialised expertise in diverse fields of research and modelling. The human resources allocated to the project (*cf. Table 1*) will guarantee the accomplishment of the project objectives. University partners will allocate to the project 2 to 3 full time post-graduate students each. Full professors and researchers involved in the project are detailed in the description of each partner.

Personnel costs of the project will be around 56.1% of the overall explicit costs, plus the cost of time spent by professionals from AC cost model partners (Table 2).

8.3.2 Material

The partners of the project have the majority of the needed material to undertake the project. Nevertheless, some equipment and consumables (mainly for the data campaigns) may be required. Therefore, a small part of the local partners' budget may be allocated to such acquisitions (1.4% and 1.7 % of the overall budget, respectively).

Computers are included in the overheads costs.

8.3.3 Sub-contracts

The need for activities like laboratory analysis, boat rentals, diving or others is accounted for with sub-contracts. Therefore, some resources have been allocated to these issues representing 0.6% of the overall budget (Table 2).

Table 2 – Budget allocation

Partners	IST	HIDROMOD	NOCTILUCA	LNEC	UNITS	IOUSP	UNISANTA	IADO	UCHILE	CEA	Total	%
Personnel	137 186 €	223 630 €	82 400 €	209 600 €	100 850 €	54 500 €	183 250 €	66 100 €	88 800 €	54 900 €	1 201 215 €	56.5%
Travel & subsistance	31 000 €	31 000 €	13 400 €	27 000 €	26 800 €	23 200 €	22 300 €	22 300 €	17 800 €	13 400 €	228 200 €	10.7%
Consumables	- €	- €	- €	- €	- €	8 900 €	4 500 €	8 900 €	8 900 €	4 500 €	35 700 €	1.7%
Equipment	- €	- €	- €	- €	- €	8 900 €	10 700 €	7 100 €	- €	3 600 €	30 300 €	1.4%
Other costs (data acquisition; imagery; software)	13 000 €	18 000 €	- €	22 400 €	17 800 €	- €	17 800 €	11 600 €	10 700 €	4 500 €	115 800 €	5.4%
Sub-contracts	- €	- €	- €	- €	- €	- €	- €	- €	- €	4 800 €	4 800 €	0.2%
Overheads	204 414 €	95 470 €	18 800 €	31 100 €	29 050 €	19 000 €	47 450 €	23 100 €	25 200 €	16 000 €	509 585 €	24.0%
Total	385 600 €	368 100 €	114 600 €	290 100 €	174 500 €	114 500 €	286 000 €	139 100 €	151 400 €	101 700 €	2 125 600 €	100.0%
Cost model	FC	FC	FCF	FC	AC	AC	FCF	AC	AC	FC		
Total request from EU	217 300 €	204 050 €	57 950 €	146 400 €	174 500 €	114 500 €	143 500 €	139 100 €	151 400 €	51 300 €	1 400 000 €	
% request form EU	56.4%	55.4%	50.6%	50.5%	100.0%	100.0%	50.2%	100.0%	100.0%	50.4%	65.9%	

9 - Ethical issues

No Ethical issues are raised by this project.

Appendix A - Consortium description

A.1 Participants and consortium

Instituto Superior Técnico (IST), Portugal

Instituto Superior Técnico (IST), the Engineering School of Lisbon Technical University is the biggest Engineering School in Portugal. Its MARETEC Centre is focused on applications to the aquatic environment. Priority is given to interdisciplinary projects involving water quality, ecology and sediment transport. MARETEC staff dedicated to these subjects occupies 12 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.
In the past, it has cooperated in several projects with HIDROMOD, with Dr. J.W.Baretta (NOCTILUCA), with UNISANTA and with LNEC.

Description of its involvement in the project

It will apply the MOHID modelling system, together with HIDROMOD, and disseminate to local partners and stakeholders this application. Some of the partners will also do part of the work with MOHID. It will deeply work in the ecological modelling and socio economics tasks.
IST will coordinate the project. It will also coordinate Workpackage 2, tasks 1.5, 2.4 and 4.2, while being involved in 12 other tasks.

Key personnel

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.
Eng. 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 environments in the framework of research projects. He has focus is research in studying eutrophication processes and coupling remote sensing to numerical models.
Eng. Frank Braunschweig has a degree in Civil 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 environments in the framework of research projects. He has a large experience in software development. Coordinator of the development of the recent version of the water modeling system Mohid (www.mohid.com) in object oriented Fortran 95.

Eng. Rodrigo Fernandes has a degree in Environmental Engineering (2001 – Technical University of Lisbon). He has experience in developing WEBGIS applications using .NET language, MapServer and databases (Access and MySQL).
Eng. Pedro Galvão has a degree in Environmental Engineering (2002 – Technical University of Lisbon). He has experience in modeling ground water flow (MOHID and Hydrus) and run-off processes (SWAT).
Prof. Tiago Domingos is an Assistant Professor at IST. He has a Ph.D. in theoretical ecology and is currently working in this area and in Ecological Economics, supervising five Ph.D. students in these areas. He is a member of the steering committee of the Subglobal Assessment of Portugal for the Millennium Ecosystem Assessment (MA). He has participated in the training course on scenarios for sub-global assessments, held by the MA in Penang, Malaysia. He has broad experience in the integration of environmental and socio-economics aspects in demonstration projects involving stakeholders, namely through the past Life projects MISART and LandSTATE and the ongoing Life project EXTENSITY. He teaches Thermodynamics, Environmental Modeling and Environmental Economics.

Selected publications

Braunschweig F., Martins, F., P. Leitão e R. Neves 2003 **A methodology to estimate renewal time scales in estuaries: the Tagus Estuary case.** Accepted for publication in a special edition of *PEC2002 Ocean Dynamics*. (accepted).
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.
Martins, F., R. Neves, P. Leitão e A. Silva, **3D modelling in the Sado estuary using a new generic coordinate approach**. *Oceanologica Acta*, Vol.24, Nº1 pp. S51-S62, 2001
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.
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 Researchn* (*in Press*)
Cancino L and R Neves, **hydrodynamic and sediment suspension modelling in estuarine systems. part I: description of the numerical models**. *Journal of Marine Systems* (22, 105- 116, 1999).
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Dilão, R., T. Domingos, 2000. A general approach to the modeling of trophic chains. *Ecological Modeling* 132(3): 191-202.
Dilão, R., T. Domingos, 2001. Periodic and quasi-periodic behavior in resource dependent age structured population models. *Bulletin of Mathematical Biology* 63(2): 207-230.
Dilão, R., T. Domingos, E. M. Shahverdiev, 2004. Harvesting in a resource dependent age structured Leslie type population model. *Mathematical Biosciences* (in press).
Rodrigues, J., T. Domingos, P. Conceição, J. Belbute, 2004. Constraints on dematerialisation and allocation of natural capital along a sustainable growth path. *Ecological Economics* (accepted, subject to revisions).

HIDROMOD (Portugal)

HIDROMOD is an SME that has been working in the field of environmental modeling since 1992. It presently has six full time employees, four of which have PhD's from IST. It has been actively working with the MOHID system since it has began its activity and contributing to its development. It has done modeling studies in tens of estuaries, coastal zones, ports, oceanic regions, rivers and reservoirs in Europe, Africa and South America. These studies cover mainly hydrodynamics, sediment transport, water quality, effluent plumes and field data campaigns.

HIDROMOD's scientific and technical expertise is based on eleven years experience acquired in the application of models to real cases, in the framework of engineering and scientific projects, and on the maintenance of a close cooperation with the Technical University of Lisbon (Instituto Superior Técnico).

In the past, the company was involved in **five EU funded projects**: one in MAST Program (EUROMODEL), one in FAR Program (Development of an Ecological Model for Mollusc Rearing Areas in Ireland and Greece) and three in MAST III Program (OPCOM, INDIA and F-ECTS).

It has done several modeling studies in cooperation with other partners in the present project proposal: IST, LNEC and UNISANTA.

HIDROMOD is in the final stage of setting up its Quality Management System, having in the end of September 2003 the concession audit of the ISO 9001:2000 Norm.

Description of its involvement in the project

Hidromod will be participating also in the coordination of the project. Its technical knowledge associated with a flexible administrative structure will be of use in several management tasks. It will be involved in its areas of expertise, namely, data gathering and organization and modeling of estuaries.

Hidromod will coordinate Workpackage 1, tasks 1.1, 1.2, 2.1 and 5.3. It will contribute to 10 other tasks.

Key personnel

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 11 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. 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. 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.

Selected publications

Silva, A.J.R., Leitão P.C., Leitão J.C., Braunschweig F. & Neves R.J.J., **Ria Formosa 3D hydrodynamic model. A contribution for the understanding of the Faro-Olhão inlet processes**. Proceedings of Littoral 2002 6th Intern. Conf., The Changing Coast, Vol 2, pp 197-207, 2002.

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.

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Silva A.J. R., Delfino J. P., Leitão J.C., Leitão P.C., Pina P., Neves R.J.J., "**Operational Models - a Tool to Improve Coastal Management**", Hydraulic Engineering Software VIII, pp.405-414, WIT press ed., 2000

NOCTILUCA (Netherlands)

Noctiluca is a Dutch marine sciences consultancy, founded, owned and run by J.W.Baretta, who also is the principal scientist. Dr. Baretta has:

- Extensive experience in constructing complex marine ecosystem models of estuarine and coastal shelf systems.
- Long experience in sea-going research, both in benthic and in pelagic processes.
- Experience in managing multidisciplinary research groups in modelling projects.
- Experience in coupling general circulation models with ecological models.
- Zooplankton population dynamics, particle size distributions in marine systems, mathematical modelling of estuarine and shelf sea ecosystems.

Dr. Baretta participated in several EU projects: BASYS, MATER, MERMAIDS II, ERSEM II (scientific coordinator) and ERSEM (scientific coordinator).
He has cooperated in the past with IST in the development of ecological models.

Description of its involvement in the project

Noctiluca will be deeply involved in the ecological modeling activities. It will be responsible for task 2.3 and will participate in 7 other tasks.

Key personnel

Since 1973, Dr. Johan Wijnand Baretta held several scientist positions in Netherlands Institute for Sea Research (NIOZ), Ecological Modelling Centre (joint department of VKI Institute for the Water Environment and Danish Hydraulic Institute) and in National Institute of Coastal and Marine Management / RIKZ (The Hague, The Netherlands).

Selected publications

Baretta-Bekker, J.G., J.W. Baretta & W. Ebenhöh. 1997. **Microbial dynamics in the marine ecosystem model ERSEM II with decoupled carbon assimilation and nutrient uptake**. J. Sea Res.30: 195-212.

Ebenhöh, W., J. G. Baretta-Bekker & J.W. Baretta. 1997. **The primary production module in the marine ecosystem model ERSEM II, with emphasis on the light forcing**. J. Sea Res. 30: 173-194.
Baretta-Bekker, J.G., J.W. Baretta, A.S. Hansen & B. Riemann. 1998. **An improved model of carbon and nutrient dynamics in the microbial food web in marine enclosures**. Aquat. Microbial. Ecol. 14: 91-108.
Baretta J.W., J.G. Baretta-Bekker & P. Ruardij. 1998. **Data needs for ecosystem modelling**. ICES J. Mar. Sci. 55: 91-108.

LNEC (Portugal)

Brief description of the institution

The Laboratório Nacional de Engenharia Civil (LNEC) is a Portuguese public institution of science and technology, which is dependent of the Ministry for Public Works, Transports and Housing, covering the broad field of civil engineering. Major objectives of LNEC`s activity are innovation by the implementation of four year research plans, application of new technologies in studies under contract with a view to solve specific problems within the framework of civil engineering and the building construction industry diffusion in technical and scientific circles of the results of its activities.

LNEC has 9 departments for the implementation of its activities and its effective staff numbers 761 elements of whom 39% have a university degree and 147 are researchers with a PhD or with an equivalent degree.

LNEC's budget is about 32 million euros, of which 57% correspond to its own revenue, 33% derive from the State Budget and the remaining 10% are provided by the Government's Development, Investment and Expenditure Programme.

The Groundwater Division (NAS) has extensive experience in hydrological studies. Its research and development projects include work for outside contracts and work developed according to LNEC's programme designed to address national priorities. R&D projects represent about 50% of the funding of this Division.

NAS was involved since 1993 in the definition of groundwater environmental indicators for Portugal, in the framework of a EU LIFE project *Evaluation of the vulnerability of the reception capacity of coastal zone water resources. The receiving water bodies: groundwater systems.* (Portugal for the EU Coesion Fund). LNEC co-ordinated the EC-DGXII INCO-DC project 1996-1999 *"EU-PRChina coastal groundwater" Project, entitled Development of methodologies for the assessment and management of groundwater resources and risks in coastal zones (EU-PRC coastal groundwater).* LNEC also participated in several INCO project with PR China and India (in the first project listed also as financial coordinator) "*Measuring, Monitoring and Managing Sustainability. The Coastal Dimension*" (with Indian partners from Dez. 1998 – Nov. 2002) and *Modelling of miscible pollutant transport by underground water in non-saturated zone* (with P.R. China) EC Contract number: CI1*-CT94-0014.. These projects have been or are being developed with the UK, Ireland, The Netherlands, Germany, France, Spain, Italy, Belgium, Denmark, Sweden, Finland and Austria. In the rest of the World, projects have been or are being developed in Israel, the Cunene Basin (Angola and Namíbia), P.R. China , Russia, India and Brazil. It has been involved in the development of several groundwater databases for the Portuguese Watershed Plans, in 5 Watershed Plans and the Portuguese islands of Madeira Archipelago

The main areas of activity are: (i) Modeling of groundwater flow and pollution, (ii) Monitoring and evaluation of aquifer parameters and reclamation of polluted soil and groundwater, (iii) Evaluation of the vulnerability of groundwater to pollution, (iv) Hydrological studies and evaluation of aquifer recharge.

Description of its involvement in the project

LNEC will be involved in all aspects related to the characterization, assessment, data analysis and modeling of inland water, with emphasis on groundwater resources and diffuse pollution, aimed at the incorporation of its quantitative and qualitative aspects in the global coastal system model.
It will be responsible for tasks 2.2 and 4.3 and will participate in 5 other tasks

Key personnel

Dr.-Ing. João Lobo-Ferreira, Doktor-Ingenieur by the Technische Universität Berlin, Germany, is Principal Research Officer with Habilitation Degree and Head of the Groundwater Division of Laboratório Nacional de Engenharia Civil, Lisbon, Portugal. Coordinator of more than twenty-five National, European, and International research projects funded by National funds and the EU, author of more then 300 publications, former President of the Board of Directors of the Portuguese Water Resources Association, he was awarded the "First Prize of Research Works on the Environment" by the Portuguese Secretary of State of the Environment and Natural Resources. Areas of activity: Mathematical modeling of flow and transport of pollutants in groundwater; Mathematical modeling of water balances including groundwater recharge assessment; Assessment of groundwater vulnerability to pollution; Geographical zoning for groundwater resources protection.
Dr. Teresa Eira Leitão, is a Research Officer, Geologist from the Scientific and Technical University of Coimbra, 1988, Ph.D. in Hydrogeology, from the Faculty of Science of the University of Lisbon, 1997. Participation in 15 research project, 6 of them being EU and international projects. Coordination and/or co-coordination of 7 of them. The projects were developed under the field of expertise, involving laboratory tracer experiments of flow and solute transport, field data collection, and numerical modelling. Her areas of interest are hydrogeochemisty, groundwater quality, groundwater pollution, protection and rehabilitation of aquifers and transport of pollutants in groundwater.
Manuel José Pegado Mendes de Oliveira, is Master in Economical and Applied Geology from the University of Lisbon, 1993; Title of the dissertation: "Groundwater flow modeling and interpretation of groundwater pumping tests in fractured media"; PhD student on evaluation of aquifer recharge; Research Assistant of the Groundwater Division of Laboratório Nacional de Engenharia Civil, Lisbon, Portugal; Areas of activity: Evaluation of aquifer recharge; Groundwater flow modeling; Hydrogeology of fractured media; Vulnerability assessment.
Catarina Diamantino, is Master in Economical and Applied Geology and a Research Trainee of the Groundwater Division of Laboratório Nacional de Engenharia Civil, Lisbon, Portugal, from Foundation for Science and Technology of the Portuguese Ministry for Science and Technology, having a Master in Economic and Applied Geology; in 2003 started a PhD on artificial recharge. Areas of activity: Mathematical modeling of groundwater flow and transport (including saline intrusion); Evaluation of groundwater pollution from highways; groundwater artificial recharge.

Selected publications

Lobo-Ferreira, J.P., **Review on Aquifer Recharge and Evaluation of Groundwater Vulnerability to Pollution**. New Delhi, Tata Research Institute [TERI Discussion Paper 1/2001 Goa], Feb. 2002, 92 pp.
Feseker, T. and Lobo-Ferreira, J.P., 2001, **Delineation of Wellhead Protection Zones – A Simplified Approach**, in COASTIN A Coastal Policy Research Newsletter, Number 5, Sep. 2001. New Delhi, TERI, 5 pp.
Lobo-Ferreira, J.P. e Oliveira, M.M., **Assessment of Groundwater Vulnerability to Pollution Using the Drastic Method. Application to the Alqueva Area**, in "Innovation Issues in Irrigation and Drainage" (Ed. L. Santos Pereira e John Gowing). London, Routledge, ICID-CIID, Water and the Environment.

UNIVERSITY OF TRIESTE (Italy)

Brief description of the institution

The Department of Biology, instituted in 1984 from the fusion of the Botanical Institute and Garden and the Institute of Zoology and Comparative Anatomy, is one of the largest departments of the University of Trieste. It has 46 permanent member staff, and it is also seat of two PhD programmes with more than 20 students.

The main research topics, relevant to the project aims are:

1. Analysis of Ecological Systems. Research is carried out into processes and patterns of both terrestrial and aquatic ecological systems by methods of multivariate analysis.
2. Geographic Information Systems and Databases.
3. Remote sensing, vegetation and land use.

The group has experience from participating in other EU investigation projects, among which it may be pointed ECOMAN (*Decision Support System for sustainable development of rural areas in Atlantic Forests*), LANDSCAPE (*An Integrated Approach to Radionuclide Flow in Semi-Natural Ecosystems Underlying Exposure Pathways to Man*), *Measuring, monitoring and managing sustainability: the coastal dimension* (INCO-DC), *Sustainable use of natural resources in rural systems of Eastern Africa (Ethiopia, Kenya and Tanzania). Strategies for environmental rehabilitation.* (INCO-DC), *Desertification in the Mediterranean drylands: development of a monitoring system based on plant ecophysiology* (DEMOS - INCO-DC), *A case study for the island of Hainan (CHINA) based on Remote Sensing and GIS Technology.*(INCO-DC).

Description of its involvement in the project

Univ. of Trieste will work mostly on land use land cover analysis and on the development of a Spatial Decision Support System applied to the three sites. Also line training courses will be of its responsibility. It will coordinate Workpackage 5 and tasks 1.3, 1.4, 4.7, 5.1 and 5.2. It will participate in 6 other tasks.

Key personnel

Prof. Enrico Feoli: Full professor of general ecology; Scientific Coordinator of the International Centre for Theoretical and Applied Ecology (Gorizia, Italy) from 1987 to 1997; Scientific Coordinator of the Program Area Earth, Environment of ICS-UNIDO from 1994 to 2000; Senior Scientific Consultant of ICS –UNIDO since 2000; Director of the Department of Biology since 2002. His research work is concerned mainly with the study of vegetation patterns both on land and in the sea, by applying mathematical and statistical methods. He was visiting scientist and professor in several universities (NIJMEGEN, LONDON-ONTARIO, NEW MEXICO, LEON, UPPSALA, ADDIS ABABA, GUANGXI, BEIJING, etc.). He has published more than 120 papers many of them in international journals and some monographs on data analysis in vegetation science by KLUWER.

Dr. Alfredo Altobelli (researcher in *Ecology)* Expert in Geographic Information Systems and Databases and Remote sensing. He has developed computer programmes for the analysis of remotely sensed data (fractal indices of vegetation and of urbanisation).

Dr. Paola Ganis (Technical scientific officer). She is specialised in Databases and statistical and numerical data analysis applied to ecology and vegetation.

Dr. Massimo Dragan (Contract researcher). He is GIS/RS researcher at the Centre of Excellence in Geomatics and Spatial Information, expert of GIS and digital cartography, remote sensing and image processing, spatial decision support systems, spatial databases, landscape ecology and biodiversity conservation, Internet mapping and online spatial services, sustainable development, environmental data analysis.

Dr. Michele Fernetti (Technical Officer at the Lab of Geomatics and GIS, University of Trieste). He is expert of Digital cartography and Geographical Information Systems, spatial decision support systems, environmental data analysis, remote sensing applications, landscape ecology and sustainable development, Internet mapping applications, spatial databases.

Dr. Laura Gallizia Vuerich (Contract researcher). She is expert in ecological and vegetation databases, and techniques for vegetation analysis at territorial level as GIS, remote sensing, image processing, vegetation mapping.

Dr. Mauro Scimone (External expert), is a researcher with experience in numerical analysis of ecological data, environmental data bases, modelling of carbon assimilation, vegetation growth and diffusion of pollutants in the environment (radionuclides). He collaborates with Universities, Public Administrations, European Commission projects and FAO in many national and international projects.

Selected publications

E. Feoli & Giacomich, P., **Predicting land cover changes due to tourism.** In Noronha et Al. (eds.) Coastal tourism, Environment and Sustainable Local Development Chapter 15 pp.322-329, 2003.

E. Feoli, Giacomich, P., Mignozzi, K., Ozturk, M. & Scimone, M., **Monitoring desertification risk with an index integrating climatic and remotely-sensed data: An example from the coastal area of Turkey**. Management of Environmental Quality: An International Journal, 14: 10-21, 2003.

E. Feoli, **Industrial Ecology and Bioremediation. Theoretical framework and technological tools for sustainable development**. In A.G. Fabbri et al. (eds) Deposit and Geoenvironmantal Models for Resource Exploitation and Environmental security pp 2091-302. Kluwer Academic Publisher, 2002.

A. Altobelli, E. Feoli, & Ourabia, L., **An overview of landscape structure through the application of fractal dimension to remotely sensed images using GIS technology**. In Nienatowicz A. and Kunz M: (eds.) GIS and Remote Sensing in Studies of landscape Structure and Functioning. pp. 39-50, 2001.

M. Dragan, E. Feoli & M. Fernetti, **Advances in spatial data storage, retrieval and analysis with emphasis to developing countries needs for management of fisheries and aquaculture**. In Feoli, E. & C.E. Nauen (eds.), 2001. Proceedings of the INCO-DEV International Workshop on "Information Systems for Policy and Technical Support in Fisheries and Aquaculture", Los Baños, Philippines, 5-7 June 2000. Brussels, (Belgium) ACP-EU Fish.Res.Rep., (8): 25-35, 2001.

IOUSP (Brazil)

Brief description of the institution

The Instituto Oceanográfico da Universidade de São Paulo (IOUSP) was created in 1949 and has strong tradition and also an important role in the national oceanographic research in its various sub-areas: Biology, Physics, Chemistry and Geology, offering the first national Graduation course in Oceanography. The IOUSP is settled in São Paulo, 80 km far from the Santos City (at Southeast Brazilian coast), where is moored the IOUSP R/V "Prof. Wladimir Besnard". The IOUSP also possesses two research stations in the coast of São Paulo state, one at the North and another one in the South, both equipped with research boats. The IOUSP has active participation in international research Programs as TOGA, WOCE, SIBEX, IMW, GLOBEC and IGBP.

Some teachers at UNISANTA are cooperating with IOUSP in toxicity studies in Santos estuary.

Description of its involvement in the project

IOUSP will participate in the areas of primary production, phytoplankton, pollution and toxicology. Due to IOUSP's extensive experience in field data campaigns, it will coordinate Workpackage 3. It will also participate in 9 other tasks.

Key personnel

Prof. Dra. Eduinetty Ceci P. Moreira de Sousa is specialized in ecotoxicology and microphytobenthos at the Department of Biologic Oceanography of IOUSP.
Prof. Dra. Sônia Maria Flores Gianesella-Galvão is specialized in phytoplankton and prymary production. She is an Associate Professor at the Department of Biologic Oceanography of IOUSP.

Selected publications

Zavialov, P; Gianesella-Galvão, S; Pimenta, F; Castelão, G; Abdoullaev, S; **Diurnal variability on the continental shelf of Southern Brazil**, Continental Shelf Research, v. 20, p. 15-35, 2000
David, C., Sousa, E. & Corbisier, T., **The microphytobenthic biomass on the inner continental shelf off São Sebastião, S. Paulo, SE Brazil**, Simpósio Brasileiro de Oceanografia, São Paulo: Iousp, 2002.
Abessa, D. & Sousa, E., **Preliminary studies on the acute toxicity of marine sediments collected close to the sewage outfalls from baixada Santista**, SP, Brazil", Congresso Brasileiro de Pesquisas Ambientais, anais Santos: NPA, 2002
Abessa, D., Sousa, E., Rachid, B. & Mastroti, R., **Use of the Burrowing amphipod Tiburonella Viscana as a tool in marine sediments contamination assessment**, Brazilian Archives of Biology and Technology, v. 41, n. 2, p.225-230, 1998.
Sousa, E., C. David & Tommasi, L., **Microphytobenthic primary production, biomass, nutrients and pollutants of Santos** estuary (24 S, 46 20'w), São Paulo, Brazil, Brazilian Archives of Biology and Technology, v. 41, n. 1, p. 27-36, 1998.

UNISANTA (Brazil)

Brief description of the institution

UNISANTA is a private University with 9000 under-graduate students. It has a strong connection with local Santos society and economy. This fact is demonstrated by the projects it develops for the local Port Authority and other local institutions.
The Biology Department and the Engineering Department have several projects dealing with the estuary, from mangrove restoration to toxicity in sediments to hydrodynamic modelling studies.
UNISANTA also has a Socio-Economic Studies Unit (NESE - Núcleo de Pesquisas e Estudos Socioeconômicos) that will be involved in the project as it holds very good expertise on these matters in the Santos region. Among other studies, this Unit made a study of the socio economic transformation in Santos due to the institutional, structural and operational changes in the Port activities from 1990 until 2000.

Description of its involvement in the project

UNISANTA will be the institution that will coordinate the activities of ECOManage in Brazil. As it is located in Santos, the everyday problems of the ecosystem, and the use that the stakeholders make of it, are very close. Several research and teaching areas of UNISANTA have topics related to the pollution in the Estuary, Mangroves, Port activities, etc. This expertise will be put to the service of the project as UNISANTA will be responsible for several areas, namely, it will be responsible for tasks 3.1 and 4.4 and will participate in 12 other tasks.

Key personnel

Augusto Cesar; PhD in Ecotoxicological Assessment form the University of Murcia (Spain).
Fabio Giordano, PhD in Marine Ecology from the Instituto de Biociências – Universidade de São Paulo – USP.
Paulo Sampaio, Biologist, MsC in Botany from USP
Camilo Seabra, Biologist

Aldo Santos, Chemical Eng., MsC in Industrial Waste Transformation and Reuse from Itajauba Federal University
Gilberto Berzin, Prof. of Civil Engineering, author of several papers presented in International Congresses, mainly in the control of environmental pollution;
Julio Simões Junior, Director of the Management and Administration Faculty of UNISANTA, Supervisor of NESE and Member of the Economic Development Council of Santos;
José Pascoal Vaz, Degree in Economics, Professor at UNISANTA and researcher from NESE.

Selected publications

Cesar, A., Guirao, L. R. M., Vita, R., Marin, A., Sensitivity of Mediterranean amphipods and sea urchins to reference toxicants. Ciencias Marinas. México: , v.28, n.4, p.407 - 417, 2002.
Sánchez-Jérez, P., Cesar, A., Cortez, F.S., Pereira, D.S.C., Silva, S.L.R., Spatial distribution of the most abundant sea urchin populations of the southeast coast of São Paulo (Brasil). Ciencias marinas. Baja California - México: , v.27(1), p.139 - 153, 2001.
Cesar, A.; Guirao, L. R. M.; Vita, R. and Marin, A. Integrative ecotoxicological assessment of marine contamination in Portmán Bay (Southeast-Spain), Environmental Toxicolology and Chemical, (Submitted – 2003).
Berzin, G & Neves R.J.J. & Leitão J.C. (2000), "Hydrodynamic Modelling, A Tool for the Environmental Management of Port Areas", anais do XV ENEP – Encontro Nacional de Entidades Portuárias", Salvador – BA . (*in Portuguese*)
Rodrigues, J. &Vaz, J. P., "Port of Santos: A decade of transformations 1990-1999", UNISANTA, 2001. (*in Portuguese*).

IADO (Argentina)

Brief description of the institution

The IADO (Instituto Argentino de Oceanografía, from Argentina) is a scientific research institution which depends on CONICET (Consejo Nacional de Investigaciones Científicas y Técnicas).
It is located in Bahía Blanca city, and promotes the scientific research and development of the Argentine sea and its resources. In this oceanographic institution several areas exist: Marine Biology, Marine Geology, Physical Oceanography, Chemical Oceanography, Meteorology, and Electronics. Many scientific researchers work here, as well as many doctoral students and professionals/technicians.
IADO is formally linked with the Southern National University (Universidad Nacional del Sur - UNS), also located in Bahía Blanca city, and in fact most of IADO researchers are professors in the mentioned University. It is a usual fact that researchers from UNS participate within IADO projects, and vice versa. So, strong interaction between both institutions permanently exists guaranteeing the indirect participation in the project of UNS.

Description of its involvement in the project

Three of the senior researchers from the IADO (Dra María Cintia Piccolo, Dr Gerardo Perillo and Dr Jorge Marcovecchio) will be actively involved in the project, attending all its phases. On the other hand, Dr Marcovecchio will coordinate the activities of ECOManage in Argentina. Young researchers, doctoral students and professional/technicians from IADO will also work in the project, not only generating information and including it on the models, but also discussing with the stakeholders to get the final version and bring it to the authorities to be fully applied.
Socio economic activities linked with the project will be carried out by researchers from UNS, mainly from the Geography Department. Moreover, the topics related with the preparation of the

educative proposals as well as transference of results to the community will be coordinated by Dr Silvia De Marco (IADO - UNMdP).
Researchers and technicians from the Universidad Nacional del Sur (UNS) from Bahía Blanca will participate in the project, not only providing their information but also collaborating in the management, processing and interpretation of the results. Several of them are Dr Rubén Hugo Freije, Lic Ana M.Martínez (Dept.of Chemistry), Dra Andrea López Cazorla, Dra Patricia Leonardi (Dept.of Biology), between others.
IADO will coordinate tasks 3.2 and 4.5 and will participate in 13 other tasks.

Key personnel

Researchers: Dr Jorge Marcovecchio, Dr Gerardo Perillo, Dra M.Cintia Piccolo
Doctoral students: Lic. Sandra Botté, Lic. Carla Spetter, Lic Débora Beigth
Professional/technicians: Lic Raúl Asteasuain, Lic Nedda Chiarello, Lic Javier Arlenghi
They will developed most of the planned work, including collect of previously generated information, classification and standardization, applying of the models, etc. The structure of IADO, including buildings, laboratories and offices, scientific equipments, oceanographic vessel, library, internet connection, will be also used for a successful develop of this project. Furthermore, researchers of IADO will be trained by the European partners to use the models as well as to interpret the results.

Selected publications

Andrade, S., Pucci, A. & Marcovecchio, J., **Cadmium concentrations in the Bahía Blanca estuary (Argentina). Potential effects of dissolved cadmium on the diatom Thalassiosira curviseriata**. Oceanologia, 43 (4): 505-520, 2000.
Marcovecchio, J., Ferrer, L., De Marco, S., Gavio, A. & Pucci, A., **Trace Metals Occurrence and Geochemical Distribution in Sediments from Mar Chiquita Coastal Lagoon, Argentina**: en L.D.Lacerda, R.E.Santelli, E.K.Duursma & J.J.Abrão (eds), Facets of Environmental Geochemistry in Tropical and Subtropical Environments, Springer-Verlag, Berlin (Germany), Ch.25, 2002.
Perillo, G.M.E., Piccolo, M.C., Parodi, E. & Freije, R.H., **The Bahía Blanca estuary ecosystem: a review**. En: Coastal Marine Ecosystems of Latin America. Eds. Seeliger, U., Drudede Lacerda, L. y Kjerfve, B., Ecological Studies. Vol. 144. Springer Verlag, Heidelberg. ISBN: 3-540-67228-1: 205-217, 2000
Gómez, E. A., Grecco, L. E. & Perillo, G. M. E., **Influence in the morphodynamics of the outer Bahía Blanca Estuary due to inner channel modifications, Argentina**. Zentralblatt für Geologie und Paläontologie, Teil I, Ed. Veit et al. (Bern), E.Schweizerbart'sche Verlagsbuchhandlung (Stuttgart) (7/8): 695-707, ISBN: 3-510-66021-8, 2000.
Ferrer, L., Andrade, S., Contardi, E., Asteasuain, R. & Marcovecchio, J., **Copper and zinc concentrations in Bahía Blanca estuary (Argentina), and their acute lethal effects on larvae of the crab Chasmagnathus granulata** : Chemical Speciation & Bioavailability, 2002

UNIV CHILE (Chile)

Brief description of the institution

Universidad de Chile is the most important, both in number of academic personnel as in scientific research, state university in Chile. It includes 4600 academic staff members, 24000 students and 5000 non-academic personnel. The university graduates 4700 undergraduate and 40 Ph.D. students annually. The University has 57 master degree programs, 33 Ph.D. programs and 75 specialization programs. Its annual budget amounts to 220 million dollars, 30% provided by the Chilean Government and 70% generated by the University through grant competitions, services etc. Universidad de Chile participates both in national and international research programs. The academic staff of the university generates annually, through the grant competition of the Chilean Commission of Science and Technology (CONICYT) a total of 3.1 million dollars.

Description of its involvement in the project

Universidad de Chile will be extensively involved in the data gathering, model implementation and socio-economic analysis of the Chilean study site (Fiordo Aisén). The University will provide local internet hosting for the project, will contribute to the project at large with expertise in ecological and eco-social modelling, will participate in the conceptual development of the ECOmanage integrated approach and will provide a venue for meetings and workshops.
Universidad de Chile will coordinate Workpackage 4, tasks 4.1 and 4.6 and will participate in 12 other tasks. Dr. Victor Marin will also coordinate the activities of ECOManage in Chile. Universidad de Chile is in position of transferring knowledge and know-how related to ecological modelling to local stakeholders. Notably, the local government that has already agreed to be involved in this. This will be done through training both in Universidad de Chile and at Aisén, to government personnel and other interested stakeholders. In fact, Universidad de Chile could be a centre for training both in ecological modelling and also its transfer to stakeholders.
A team headed by Luisa Delgado will handle socio-economic issues. Other members of the team will be: Marcelo Arnold, professor of sociology and anthropology, and Luis Carlos Rodriguez, post-doc in ecological economics. This team will be in charge of gathering stakeholders' views, help incorporating those views into the modelling tasks and generate iconographic models (through interfaces such as STELLA) so stakeholders can have access to the results. The methodologies will include contingent evaluation and participatory modelling.
The Chilean contractor Universidad de Chile is already developing stakeholder's participation approaches through iconographic modelling; a project financed to Prof. Marín by the Alexander von Humboldt foundation (Germany).

Key personnel

Prof. Dr. Victor H. Marín: associate professor. Ph.D. in oceanography; coordinator of the Laboratory for Ecological Modelling; professor of ecosystem theory and ecological modelling.
Prof. Vivian Montecino: associate professor. Expert in low trophic levels
Prof. Dr. Marcelo Arnold; sociologist
Luisa E. Delgado; M. Sc. In Ecology: expert in ecosystem theory, social ecology and GIS.
Luis Carlos Rodriguez, post-doc in ecological economics.

Selected publications

Marín, V. & C. Moreno, **Wind driven circulation and larval dispersal: a review of its consequences in coastal benthic recruitment**, In: J.C. Castilla y L. Largier (Eds.), The Oceanography and Ecology of the Nearshore and Bays in Chile. Ed. Universidad Católica de Chile, pp. 47- 63, 2002.
Rojas, P., R. Escribano & V. Marín, **Fish larvae distribution off Mejillones Peninsula (northern Chile) during a coastal upwelling event in Spring 1999: interactions with the cold upwelling plume**, Fisheries Oceanography 11: 233- 244. (2002).
Marín, V., R. Escribano, L.E. Delgado, G. Olivares & P. Hidalgo. **Nearshore circulation in a coastal upwelling site off the northern Humboldt current system**, Continental Shelf Research 21: 1317-1329, 2001.
Marín, V. & L. Delgado. **A spatially explicit model of the Antarctic krill fishery off the northern shelf of the South Shetlands Islands**, Ecological Applications. 11: 1235-1248, 2001.
Marín V., **General system theory and the ecosystem concept**, Bul. Ecol. Soc. Amer., 78, (1) 102-104, 1997.

Centro de Ecologia Aplicada

Brief description of the institution

The Centro de Ecología Aplicada (CEA) started its activities in 1992, being qualified as a consulting firm on environmental issues. CEA has based its success on technological innovation, scientific progress and academic excellence. CEA comprises 25 professionals, most of them holding M.Sc. and Ph.D. degrees. Supporting personnel includes field workers, divers, photographers and drivers. CEA also has a complete and modern infrastructure both for field work and for laboratory analyses (http://www.cea.cl). The main activities of CEA are: (i) environmental impact assessment studies, (ii) follow-up studies both for biotic and abiotic variables, (iii) research projects targeted to resolve environmental problems, (iv) GIS and modelling studies, (v) water and soil quality studies and (vi) development of environmental management plans including mitigation, prevention, correction and compensation of the effects caused by development projects and risk analyses

Description of its involvement in the project

CEA will be particularly involved in the data measurement campaigns for Fiordo Aisén. CEA will coordinate task 3.3 and will participate in 4 other tasks.

Key personnel

Dr Manuel Contreras Leiva: expert on limnology and ecology of aquatic ecosystems
Dr. Ginger Martínez: expert on aquatic ecology
Ing. Alberto de la Fuente: numerical modeller

Selected publications

Montecino, V., Pizarro, G., Cabrera, S. y M. Contreras. **Spatial and temporal photosynthetic compartments in lake Kitiesh**. Polar Biol. 11:371-377, (1991).

A.2 Sub-contracting

Due to the type and amount of sub-contracting foreseen for the project, no possible contractor are described at this moment.

A.3 Third parties

Not applicable

A.4 Funding of third country participants

Not applicable