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Referência do projecto
Project reference
PTDC/MAR/107939/2008

1. Identificação do projecto

1. Project description -

Área científica principal
Main Area
Ciências e Tecnologias do Mar

Área científica Secundária
Secondary area
Engenharia Civil e de Minas

Título do projecto (em português)
Project title (in portuguese)
DyEPlume: Dinâmica Estuarina e Propagação de Plumas na Costa Portuguesa – Impactos de Alterações Climáticas

Título do projecto (em inglês)
Project title (in english)
DyEPlume: Estuarine Dynamics and Plume Propagation in the Portuguese Coast – Impacts of Climate Change

Financiamento solicitado
Requested funding
140.698,00€

Palavra-chave 1
Dinâmica Estuarina

Keyword 1
Estuarine Dynamics

Palavra-chave 2
Biogeoquímica

Keyword 2
Biogeochemistry

Palavra-chave 3
Plumas Estuarinas

Keyword 3
Estuarine Plumes

Palavra-chave 4
Modelação numérica

Keyword 4
Numerical modelling

Data de início do projecto
Starting date
01-01-2010

Duração do projecto em meses
Duration in months
36

2. Instituições envolvidas

2. Institutions and their roles -

Instituição Proponente
Principal Contractor
Universidade de Aveiro (UA)
Campus Universitário de Santiago
3810-193Aveiro

Instituição Participante
Participating Institution
Instituto Superior Técnico (IST/UTL)
Av. Rovisco Pais
1049-001Lisboa

Unidade de Investigação
Research Unit
Centro de Estudos do Ambiente e do Mar (CESAM/UA)
Campus Universitário de Santiago
3810-193Aveiro

Unidade de Investigação Adicional
Additional Research Unit
Centro de Ambiente e Tecnologia Marítimos (MARETEC/IST/UTL)
Avenida Rovisco Pais
1049-001Lisboa

Instituição de Acolhimento
Host Institution
Universidade de Aveiro (UA)
Campus Universitário de Santiago
3810-193Aveiro

3. Componente Científica
3. Scientific Component

-

3.1. Sumário
3.1 Summary

3.1.a Sumário Executivo (em português)
3.1.a Executive Summary (in Portuguese)

Este projecto tem como principal objectivo o estudo integrado da hidrodinâmica e biogeoquímica de sistemas acoplados estuário-costa, com especial ênfase na dinâmica de plumas estuarinas. Pretende ainda avaliar as alterações induzidas pelos seus principais forçamentos (maré, caudais fluviais e condições meteorológicas), visando o desenvolvimento e utilização de modelos numéricos costeiros de alta resolução. Esta proposta ambiciona também avaliar a forma como as alterações climáticas irão afectar a dinâmica de três dos principais sistemas estuarinos Portugueses (estuários do Douro e do Tejo e Ria de Aveiro), bem como a respectiva zona costeira adjacente. Estes estuários foram escolhidos como locais de estudo devido a estarem inseridos em zonas de elevada densidade populacional e por terem nas suas margens ou vizinhança importantes portos comerciais e de pesca. Adicionalmente, representam três tipos diferentes de estuários: (1) um é dominado pela acção do rio (Douro); (2) uma laguna costeira (Ria de Aveiro) e (3) um estuário clássico (Tejo) (Figuras 1, 2 e 3, respectivamente).
Nos últimos anos, o estudo de sistemas estuarinos e costeiros tem sido efectuado de forma independente para os estuários e para a zona costeira adjacente. Este projecto pretende dar uma visão mais abrangente e integrada de como alterações nos principais forçamentos induzem mudanças na hidrodinâmica e nos processos biogeoquímicos destes sistemas.
Os estuários interagem com a costa adjacente na forma de plumas, afectando a física e biogeoquímica destas regiões costeiras. Orton e Jay (2005) mostram que os rios injectam água doce na região costeira onde processos de mistura ocorrem, afectando o transporte e transformação de matéria dissolvida e particulada na zona costeira. Eventos extremos de caudal fluvial associados a chuvas torrenciais e diferentes cenários de ventos afectarão o balanço destes sistemas estuarinos e costeiros (Choi and Wilkin, 2006, Guo and Levinson, 2007, Lihan et al., 2008).
De acordo com as conclusões extraídas do relatório do IPCC (2007), o clima do sul da Europa será, no futuro, mais seco, existindo porém eventos de chuvas torrenciais mais frequentes, aumentando as descargas fluviais. Consequentemente, existirá um aumento dos processos de erosão e descargas de material particulado para os estuários, levando a uma diminuição da penetração da luz na coluna de água e assim afectando a produção primária nestes sistemas. Nas regiões costeiras, alterações no regime de ventos mudam a turbulência e a advecção de nutrientes para a camada eufótica. Estas alterações afectam estes sistemas de transição tornando-os mais vulneráveis a tempestades, que por sua vez induzem correntes mais fortes que misturam a coluna de água (Li et al., 2006). O aumento do nível médio do mar causará mudanças dentro dos estuários, nomeadamente nas zonas intertidais, afectando a sua hidrodinâmica e os fluxos de água e nutrientes exportados para a zona costeira adjacente.

Com base nestes cenários, torna-se importante avaliar os tópicos seguintes:
- A subida do nível médio do mar afectará (ou não) a hidrodinâmica de regiões estuarinas e costeiras de Portugal?
- Qual o impacto de eventos extremos de caudal fluvial na circulação estuarina e na propagação da pluma estuarina?
- Como é que a propagação da pluma estuarina afecta a distribuição de sedimentos finos e consequentemente a produção primária?

Os objectivos deste projecto são:
- Estudar o impacto de eventos extremos de caudal fluvial e efeitos da subida do nível médio do mar na circulação estuarina e na dinâmica de sedimentos finos.
- Avaliar processos de mistura em plumas estuarinas considerando diferentes cenários de caudal fluvial e de vento.
- Avaliar como as descargas de sedimentos finos e as mudanças nas zonas intertidais afectam a produção primária em estuários e

zonas costeiras adjacentes,
- Estudar o destino dos sedimentos finos exportados para a zona costeira adjacente aos estuários do Douros e Tejo a da Ria de Aveiro.

Para responder a estas questões a presente proposta propõe o recurso a uma forte componente de modelação numérica, sendo utilizado o modelo de circulação Mohid (Leitão et al., 2005). Dados de campo e de satélite (modis.gsfc.nasa.gov/) serão usadas para validar os resultados dos modelos e estudar a propagação das plumas estuarinas. As descargas fluviais serão obtidas a partir de resultados de modelos de bacia hidrográfica (SWAT e Mohid Land, www.mohid.com). Serão efectuadas simulações de valores meteorológicos diários (vento à superfície, precipitação e temperatura) para a zona costeira portuguesa, para os períodos 1971-2000 e 2071-2100, com especial ênfase no cenário do IPCC A2 SRES.
O projecto adoptará uma perspectiva multidisciplinar através da integração de metodologias de diversos domínios: climatologia, hidrologia, hidrodinâmica e biogeoquímica estuarina e costeira, e modelação numérica. Esta permitirá à equipa desenvolver e aplicar uma abordagem científica integradora e diversificada de conhecimento para a atingir os objectivos propostos.

3.1.b Sumário Executivo (em inglês)

3.1.b Executive Summary (in English)

The main goal of this proposal is the integrated study of coupled estuarine-near coastal systems in terms of hydro and biogeochemical patterns, with especial emphasis on estuarine plumes dynamics. Is also intends to evaluate the changes induced by modifications in the major forcing factors (tide, freshwater inflow and meteorological conditions), through the development and use of high-resolution numerical models. This project will also focus on how climate changes will affect the dynamics, in terms of physical and biogeochemical properties, of three major Portuguese estuarine systems (Tagus, Douro and Ria de Aveiro lagoon) and their adjacent coastal waters. These estuaries are inserted in heavily populated regions and in the vicinity of important commercial and fishing ports (Leixões, Aveiro and Lisbon). Moreover they represent three different types of estuaries: (1) a river dominated estuary (Douro); (2) a costal lagoon (Ria de Aveiro) and (3) a classical shaped estuary (Tagus) (Figures 1, 2 and 3, respectively).
The study of estuarine and coastal regions is been usually performed independently for estuaries and the adjacent coast. This project seeks a wider and integrated assessment of how changes in the major forcing factors affect the hydrodynamics and the biogeochemical response of coupled Portuguese estuarine-coastal systems, highlighting the interaction between them.
Estuaries impact the adjacent marine environment through the estuarine plumes, affecting a wide range of physical and biogeochemical variables. According to Orton and Jay (2005), major rivers inject freshwater onto the adjacent shelf where mixing of these river plumes takes place, affecting the transport and transformation of dissolved and particulate materials at the coastal margin. Therefore, extreme events of river discharge associated to torrential rain episodes and to different wind scenarios, will affect the balance of these systems (coupled estuary-near-shelf system) (Choi and Wilkin, 2006, Guo and Levinson, 2007, Lihan et al., 2008).
According to recent climate change scenarios (IPCC, 2007) southern Europe will tend to become dryer despite winter torrential rain events becoming more frequent, increasing freshwater discharges. Consequently, erosion processes and material loads are expected to increase, leading to an aggravation of light-limiting conditions to phytoplankton and consequently to primary production. In coastal regions, changes in wind speed and direction are known to alter turbulence and upwell nutrients to the euphotic layer. Changes in meteorological patterns can affect these transition systems making them vulnerable to storm-surge events which, in turn, may induce strong currents and unstratify the water column (Li et al., 2006). Sea level rise is also expected to cause changes inside estuaries (intertidal areas), affecting the hydrodynamics of these transition systems.
Given these scenarios, there should be a national interest in addressing the following issues:
- How will the estimated global sea level rise affect the hydrodynamic of some of the highly populated Portuguese estuarine regions?
- What is the impact of extreme freshwater events on estuarine circulation and on the propagation of the estuarine plume?
- How does plume propagation affects fine sediment distribution and consequently how is primary production distribution in estuaries and near coastal waters affected?
This project will:
- Study the impact of extreme freshwater inflow (low and high river runoffs) events and of the sea level rise on estuarine circulation and fine sediment dynamics.
- Assess buoyancy and mixing processes/effects in estuarine plumes considering different scenarios of river runoff and wind regime.
- Assess how the loads of fine sediments and changes in intertidal areas would affect primary production in estuaries and coastal areas.
- Study the fate of the fine sediments exported to the coast by estuarine plumes.
To reach these goals the current proposal follows a strong numerical approach using state-of-the-art numerical marine models (Mohid, Leitão et al., 2005)). Available field data and remote sensing observations (modis.gsfc.nasa.gov/) will be used to validate the numerical models and complement the study of river plumes. Freshwater discharge from the major tributaries will be monitored using watershed models (SWAT and Mohid Land, www.mohid.com) that can identify peaks of water flow. Simulated daily meteorological data (near-surface wind, rainfall, temperature) for the Portuguese coastal zone, for the 1971-2000 and for the 2071-2100 periods will be prepared, with special emphasis on the IPCC A2 SRES scenario, to force the numerical models.
The project will adopt a multidisciplinary perspective by integrating methodologies of climatology, hydrology, coastal and estuarine hydrodynamics and biogeochemistry, and numerical modelling, taking advantage of the integrated approach and multiple expertise of the research team to achieve the proposed goals.

3.2. Descrição Técnica

3.2 Technical Description

3.2.1. Revisão da Literatura

3.2.1. Literature Review

This project combines the team capability to simulate and characterize the behaviour of estuarine and coastal systems through the use of hydro and biogeochemical models and also remote sensing analysis, with the climate change skills of the Consortium. Previous research has highlighted the autonomous response of estuaries and coastal waters to changes in freshwater inflow and nutrient inputs, i.e. in most of the modelling studies the numerical tools are prepared to study only the estuary (Banas et al., 2005; Vaz et al., 2005, 2009) or just the adjacent coast (Otero et al., 2008). This project seeks a wider assessment of the circulation and biogeochemistry patterns of the three main Portuguese coupled estuary-adjacent coast regions simulated simultaneously and also the characterization of their estuarine plumes. Tagus and Douro estuaries, as well as Ria de Aveiro show a strong interaction between the estuarine waters and the adjacent coastal waters (Figures 4, 5 and 6, respectively.)

Currently, no projects are available for the Portuguese estuaries and adjacent coast that accounts simultaneously for both physical (tides, waves, freshwater inflow and climatology) and water quality processes (nutrients, chlorophyl, suspended sediments) in an integrated way. At IST/MARETEC, Leitão et al. (2005) and Vaz et al. (2009) have applied one of the methodologies proposed in this project to study the Southern Portuguese coast dynamics and the Tagus River plume, respectively. Some international projects have addressed the dynamics of coupled estuarine-adjacent coastal systems. For example, CORIE (www.ccalmr.ogi.edu/CORIE/) uses a nowcast-forecast system to evaluate the dynamics of the Columbia River estuary and adjacent coast. The RISE project (www.ocean.washington.edu/rise/index.htm), uses numerical modelling, in-situ data and satellite imagery in order to study the impact of the buoyant discharge of the Columbia River onto the coast in terms of the role of the dissolved silicate and iron to the phytoplankton growth.
Estuaries and the adjacent shelf are very complex and highly dynamic regions subject to enormous natural and anthropogenic stress. Their dynamics is determined by a complex interaction between tides, waves, wind conditions and buoyancy inputs from rivers. Then, in order to overcome difficulties in measuring physical and biogeochemistry properties of these transition systems the use of numerical models and remote sensing imagery is of great importance (Banas et al., 2005; Orton and Jay, 2005). 3D hydrodynamical and water quality modelling systems are among the most accurate tools for estuarine and coastal processes analyzes (Vaz et al., 2009; Oliveira et al., 2009). In the scope of recent and on-going projects, funded by the FCT, the Consortium has been making a considerable effort in the last years toward the development of state-of-the-art applications for physical en biological processes for the Tagus estuary and Ria de Aveiro Lagoon (Mateus and Neves, 2008; Dias and Lopes, 2006; Vaz et al., 2009). Also, for the Tagus estuary, a research prototype of a nowcast-forecast system for its hydrodynamics was developed at IST/MARETEC (http://www.mohid.com/tejo-op/).
Most of the observed climate changes since de mid-20th century are very likely due to observed increase in anthropogenic greenhouse gas concentrations and similar future changes are expected to affect the natural coastal systems through sea-level rise, increased storminess and changes in the temperature, wind and rainfall (and consequently on the rivers freshwater discharges) (IPCC, 2007). These changes will surely modify the estuarine and adjacent coastal hydrodynamics and biogeochemical response. Major rivers inject freshwater on the adjacent shelf where mixing of these river/estuarine plumes takes place, affecting the transport and transformation of dissolved and particulate materials in coastal margins. Therefore, extreme events of river discharge associated to torrential rain episodes and to different wind scenarios will affect the balance of these systems (coupled estuary-near-shelf system) (Choi and Wilkin, 2006; Guo and Levinson, 2007; Lihan et al., 2008). Moreover, the exchange between the sea and inner areas determines the level of DO within these systems, determining the life maintenance and avoiding the possibility of their eutrophic transition.
Depending on tidal characteristics, the availability of marine sediment, and the rate of sea-level rise, the estuarine tidal flats may either be further drowned, or their relative level in the tidal frame may be maintained, as shown by several tidal basins in the Dutch Wadden Sea (Dronkers, 2005). A projected increase in the intensity of tropical cyclones and other coastal storms could alter bottom sediment dynamics, organic matter inputs, phytoplankton and fisheries populations, salinity and oxygen levels, and biogeochemical processes in estuaries (Paerl et al., 2001).
Climate change model-based projections consider a range of six different greenhouse gas emission scenarios (IPCC, 2007), with considerable differences on the expected changes. In Portugal there is limited research on climate change effects at regional scales (coastal, estuarine and lagoon systems). The SIAM II Project (Santos & Miranda, 2007) reports the climate change effects in Portugal, but the presented results show very low resolution close to the coast and are only based on simulations performed with Hadley Centre model (HADCM3), under the IS92C scenario. Ferreira et al. (2008) evaluated only the effects of the mean sea level rise on coastal Portuguese areas.
In order to obtain an integrated view of how changes in the major forcings can modify the hydrodynamic and biogeochemical response of these estuarine systems, several modelling tools will be available. Following the procedure from Trancoso et al. (2009), a watershed model will be used to compute freshwater inflow into the estuaries. Mohid (Leitão et al., 2005; Mateus and Neves, 2008; Vaz et al., 2009;) will be used to study circulation and the biogeochemical response of estuaries. Finally, on the coastal region, circulation and biogeochemical models for the regions chosen as study sites will be implemented (Leitão et al., 2005; Vaz et al., 2009). The atmospheric forcing and future climate change scenarios will be simulated using the models available at University of Aveiro (http://www.climetua.fis.ua.pt).

3.2.2. Plano e Métodos

3.2.2. Plan and Methods

Knowledge of estuarine dynamics and the coupling between hydrodynamics and biogeochemistry is crucial to understand coastal dynamics. In recent years several studies have been undertaken using numerical models and measured data to study estuarine systems. However, one of the limitations of such studies is the fact that they do not consider the adjacent areas, i.e., estuarine studies do not include the coastal region and vice-versa.

This proposal intends to bring together state-of-the-art modelling tools and data analysis (in-situ and remote sensing imagery) to overcome the challenging task consisting in integrating coastal and estuarine models, in order to address questions such as:
- How does the biogeochemistry of the coupled estuarine-near coastal systems, proposed here (refer to abstract) respond to changes in stratification, circulation strength and different residence times?
- Is possible, based on local scenarios, to predict the impact of future climate change on the hydrodynamics and biogeochemistry of coastal systems?

The answer to these questions for Douro and Tagus estuaries and for Ria de Aveiro and adjacent coasts is a challenging task due to the uncertainties associated to most of the forcings, and to the numerical complex relationships and interactions between the watershed, hydrodynamic and biogeochemistry models:
- Climate change will affect most of the driving agents, including the mean sea level, the characteristics of storms (strength, duration, and frequency), coastal wave climatology, temperature and rainfall (hence river flow). It is therefore necessary to define local present climate conditions, their recent evolution, and expected climate changes to develop a comprehensive definition and understanding of their effects on estuarine dynamics and plume propagation in the Portuguese coast.
- There are strong correlations between the freshwater inflow (barely known for the Portuguese estuaries), and the hydrodynamic and biogeochemistry in estuarine-near coastal systems. The numerical coupling between the watershed and estuarine and coastal models is crucial to accurately represent the estuarine dynamics and plume propagation in the Portuguese coast.

This research proposal approaches the issue of estuarine dynamics and plume propagation in the Portuguese coast in response to the local climate change effects adopting a multidisciplinary perspective. It integrates methodologies of climatology, hydrology, coastal and estuarine hydrodynamics and biogeochemistry, and numerical modelling, taking advantage of the integrated approach and

multiple expertise of the research team to achieve the proposed goals and advance the present state of art.

The research plan for this proposal comprises 8 Tasks, most of them interconnected (Figure 7, Timeline.pdf). The methodology defined includes the definition of a coordinator for each of the tasks, which is responsible for assuming responsibility for timely delivering the project deliverables and milestones within each Task of DyEPlume.
As the beginning of this project will most probably not take place in the next 12 months, Task 1 is proposed to review the last advances on the state of the art. The corresponding inputs will be integrated into the proposed work plan. The data relevant for the subsequent tasks will be collected and analysed within this task.
The methodology that will be followed in this proposal is focused on a regional scale, and comprises the definition in Task 2 of local coastal meteorological and wave climate change scenarios considering simulated data obtained for various IPCC climate models and recent scenarios (especial emphasis on IPCC A2 SRES), and addressing differences between present climate and future climate. This approach goes well beyond previous studies (SIAM II, Santos & Miranda, 2007; Ferreira et al., 2008), by increasing the resolution of the models, considering more detailed interactions between processes, and simulating more recent scenarios.
In order to compute freshwater inflows and nutrient loads from the rivers, watershed models will be developed and implemented in Task 3. The models used will be SWAT and Mohid Land. SWAT (Arnold and Fohrer, 2005) is a continuous time model that operates on a daily time step at basin scale. MOHID LAND (Trancoso et al. 2009) is a more recent model which has the advantage of being object oriented programmed, allowing easy introduction of new processes and coupling models, and it is more physical based then the SWAT model as it calculates explicitly infiltration, capillary rise and aquifer flow.
The models described previously will be set-up for the 3 estuaries and coastal areas under study, and will incorporate the hindcast and forecast rainfall and temperature climate change scenarios. The results from these models will be integrated in order to study how different meteorological, freshwater inflow and sea level scenarios can affect estuarine circulation, primary production (in estuaries and near coast), plume propagation and the fate of fine sediments exported by these estuaries.
This project will use a marine model, MOHID (www.mohid.com, Leitão et al., 2005) comprising a hydrodynamic and biogeochemical modules in order to evaluate how scenarios of future climate change can modify estuarine circulation and primary production, in three estuarine-coastal regions of Portugal: the Douro and Tagus estuaries and the Ria de Aveiro Lagoon. These models will be developed, calibrated and validated in Tasks 4 and 5.
The estuarine-coastal circulation water modelling system, MOHID is a 3D baroclinic model and has been used in oceanic and coastal applications (Leitão et al., 2005) nested to Mercator models (oceanic boundary conditions) and forced by results from meteorological variables.
The MOHID system includes two ecological models, reflecting different modelling philosophies and level of detail. One of these models consists of an improved version of the US Environmental Protection Agency WASP model (www.mohid.com). The other model was recently developed by Mateus (2006) to capture the state-of-the-art in marine pelagic processes modelling. This model takes the “functional group approach”, dividing the biota in the ecosystem into three functional types: primary producers, consumers and decomposers. Primary producers and consumers are also sub-divided into functional types. Physiological and population processes are described by fluxes of carbon and nutrients (N, P, Si) between functional groups and organic matter components). The model also accounts for variable stoiquiometric relations and changing C:Chla ratios as a function of adaptation to ambient light.
In order to study the re-suspension of fine sediments in the estuarine-adjacent coastal systems studied, wave regime from models WaveWatch III and SWAN will be used. WaveWatch III is a third generation wave model. This model has been set up for 3 domains: North Atlantic Ocean, Iberian Peninsula and Portuguese Coast. These 3 domains are nested and all of them forced with the GFS wind forecasts with 0.5º resolution. The SWAN model is a third-generation stand-alone (phase-averaged) wave propagation model for the simulation of waves in waters of deep, intermediate and finite depth. It is also suitable for use as a wave hindcast/forecast model. These model’s results are available at IST/MARETEC, and will be forced by the wind fields available from Task 2 for the different climate change scenarios.
Models validation will be undertaken using available hydrographic data (salinity, water temperature, fine sediment concentration, chlorophyl-a) and water velocity data (from ADCP and currentmeter surveys). Freshwater discharge from the major tributaries will be monitored using INAG's data (www.snirh.pt). Peak water flows are also available from validated SWAT and Mohid Land watershed models. Data from remote sensing observations obtained in Task 6 shall also be used to validate model results (as well as to study plumes), as they provide additional spatial and temporal coverage to other data.
In Task 7 it will be investigated how estuaries respond to changes to their forcing, i.e, how stratification and circulation respond to changes in the mean sea level rise, river input and wind conditions determined in Task 2. The changes in the intertidal areas will also be assessed, in order to investigate how it affects primary production in estuaries and coastal areas. This will be followed by an investigation into how the estuaries interact with the adjacent coast (its Region of Freshwater Influence, ROFI). Interaction between estuaries and ocean can occur through tides and river plumes. River plumes transport particulate and dissolved material into the coastal region affecting primary production and consequently the abundance (or lack) and composition of fish stocks. An accurate knowledge of the fine sediment dynamics (their re-suspension) is also important to study the effect of light extinction over the water column in order to study the re-suspension of nutrients (chl-a and carbon).
In order to study estuarine and coastal dynamics due to changes in the main forcing two set of simulations will be performed:
1) Retrospective analysis of estuarine circulation, based on drought/flood periods. The information from the model simulation results such as circulation patterns, thermohaline dynamics, water level, fine sediment dynamics, intertidal areas and water quality, once validated through comparison to historical data, will be analyzed allowing a better integrated understanding of the influence of global change in these ecosystems.
2) Scenarios of future regimes of estuarine-near coastal circulation.
It is possible to study the influence of future scenarios of estuarine-near coastal circulation based on available projections of local climate change provided by Task 2, and based on widely accepted standard IPCC (2007) scenarios used in impact evaluations. The influence of those scenarios on estuarine circulation, river plume dynamics, fine sediments dynamics, intertidal areas and primary production, will be analyzed. Different scenarios of wind conditions, freshwater discharge and temperature will be used to study the estuarine dynamics and biogeochemistry and also the outflow plume area.
The final Task of the project (Task 8) will comprise the evaluation of the project results and the elaboration of recommendations fur future research in the coupled estuarine-coastal systems studied.

3.2.3. Tarefas
3.2.3. Tasks

Lista de tarefas (8)
Task list (8)

Designação da tarefa Task denomination	Data de início Start date	Data de fim End date	Duração Duration	Pessoas * mês Person * months
Task 1 - Revision of the state-of-the...	01-01-2010	30-04-2010	4	10,6

Descrição da tarefa e Resultados Esperados
Task description and Expected results

Objectives:
- to improve understanding of the drivers of estuarine and adjacent coastal dynamics (climate change, hydrographic, fluvial and coastal processes) and of estuarine plumes;
- to collect data relevant for carrying on the subsequent tasks

Task description:
The literature relevant for the project objectives will be updated and the corresponding inputs integrated into the proposed work plan. Consequently, the tasks projection will be revised and corrections introduced if needed.
The large quantity of data important to the project implementation available at UA and IST will be organized, as well as will be collected from other sources, in order to elaborate a database with the data for/to be used in Task 2 (“Meteorological conditions on the Portuguese coast, for present climate and future climate scenarios“), Task 3 (“Application of a numerical model to compute water and nutrient flows from watersheds”), Task 4 (“Hydrodynamic modelling of estuarine circulation and adjacent coast”) and Task 5 (“Estuarine and adjacent coast biogeochemistry modelling”).
In particular, it will be collected data for Tagus and Douro estuaries and for Ria de Aveiro, concerning:
- Tidal elevations and current velocities (within estuaries and adjacent coast).
- Hydrographic data (salinity and water temperature, within estuaries and adjacent coast).
- Nutrient and suspended sediment data within estuaries and adjacent coast.
- International and national journal and conference papers regarding the issues under study in this project.

The local Harbors Administrations, as well as other local authorities, will collaborate in this task, providing the relevant data.

Expected results:
- actualization and revision of the Project objectives
- tasks update and correction
- elaboration of a database concerning relevant data for the following tasks
- report on state-of-the-art on estuarine and adjacent coastal dynamics

Articulation with others tasks:
This Task will give support for most of the following tasks, with especial emphasis on Tasks 2, 3, 4 and 5.

Role of partners:
This task will be conducted by all the project researchers and by the research fellows engaged, which will perform the research necessary to achieve the proposed goals, under the leadership of João Dias (IR) that will drive the research activities.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task

(BI) Bolseiro de Investigação (Lic. ou Bacharel) 1; (BI) Bolseiro de Investigação (Mestre) 1; (BI) Bolseiro de Investigação (Mestre) 2; Alfredo Moreira Caseiro Rocha; João António de Almeida Serôdio; João Miguel Sequeira Silva Dias; Juan Gabriel de Almeida Ferreira; Marcos Duarte Mateus; Nuno Alexandre Firmino Vaz; Pedro Chambel Filipe Lopes Leitão;

Designação da tarefa Task denomination	Data de início Start date	Data de fim End date	Duração Duration	Pessoas * mês Person * months
Task 2 – Meteorological conditions on...	01-01-2010	31-03-2011	15	16,2

Descrição da tarefa e Resultados Esperados
Task description and Expected results

Objectives:
To provide the meteorological conditions for the rivers basin, Portuguese coast and the North Atlantic Ocean, addressing differences between present climate and future climate. The present climate reports to the 1971-2000 period. Future climate reports to the 2071-2100 period. The IPCC A2 SRES scenario is considered. Eventually, other scenarios will be considered also. Simulated data are obtained for various IPCC climate models (CCSM3 from NCAR (USA), CGCM3.1 from CCCma (Canada), CNRM-CM3 from Météo France, MIROC3.2 (Japan) and the ECHAM5 from the Max Planck Institute (Germany)).

Task description:
2.1 Analysis of Storminess in the North Atlantic
Statistical analysis of storminess over the North Atlantic Ocean will be performed using various storm indices/derived quantities. This will be performed, for the present climate, using ERA-40 (ECMWF), reanalysis datasets, and for the future climate using data simulated by various climate models which participated in the IPCC 4th Report. 6 hourly data will be used in the analysis. It will be determined the statistical properties of frequency, intensity, duration and location of storms over the North Atlantic region for both climates. Particular relevance will be given to storm which may affect the Portuguese coast. This will be achieved by using the cyclone tracking software developed by the University of Melbourne.

2.2 Analysis of storm surges in the Portuguese coast
2.2.1. Calculation of hydrostatic (atmospheric pressure dependent) and dynamic (surface wind-stress driven) storm surge components for coastal locations along the Portuguese coastal zone, for the present climate. Storm surge calculated data are based on atmospheric pressure and near-surface wind observed data and are to be validated against measured data at available tide-gauges. This comparison will be performed for all days with available observed data. Analysis of the statistical properties of the resultant time series will be performed.
2.2.2. Calculation of hydrostatic (pressure dependent), dynamic (wind driven) and total storm surge along the Portuguese near-

coastal zone, based on simulated atmospheric pressure and wind data, for the present and future climates. Comparison between the statistical properties of storm surge time series derived for the present climate and those obtained in 2.2.1. Comparison between the statistical properties of storm surge time series calculated based on model simulations for the present climate and future climates. Particularly the frequency, duration and intensity of storm surge events for each month and season will be considered.

2.3 Preparation of wind, precipitation and temperature data to drive the watershed and hydrodynamic models
Near-surface wind data, precipitation and temperature with a time interval of 6 hours will be prepared for the rivers basin, Portuguese coast and the North Atlantic Ocean, to force the watershed models and the coastal hydrodynamic models for present and future climate scenarios.

Expected results:
• Storminess statistics database of various storm characteristics over the North Atlantic.
• Storm surge database for the Portuguese coastal region.
• Wind, precipitation and temperature database to be used in subsequent numerical modelling tasks.

Articulation with others tasks: Tasks 3, 4, 5 and 7 are strongly dependent on the results produced in this task. Results from Task 1 will provide valuable information for running this task.

Role of partners: This task will be performed by UA/CESAM researchers. Alfredo Rocha (that will drive the research activities), Juan Almeida and the research fellow will perform this task.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Lic. ou Bacharel) 1; Alfredo Moreira Caseiro Rocha; Juan Gabriel de Almeida Ferreira;

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
Task 3 - Application of numerical mod...	01-01-2010	31-03-2011	15	12,8

Descrição da tarefa e Resultados Esperados
Task description and Expected results

Task 3 - Application of numerical models to compute water and nutrient flows from watersheds

Objectives:
The main objective of this task is the computation of freshwater flow and nutrient fluxes from watersheds using a numerical modeling approach.

Task description:
Flow and nutrients can be obtained from measurements in the rivers, which have several years of data made available by INAG (http://snirh.pt/). Some rivers have monthly measurements of nutrient concentration since 1990, but frequently they have these measurements since 2000. Daily measurements of flow exist in some rivers from 1930 onwards. Between 1990 and 2000 there is a period of scarcity of flow data, but from year 2000 onwards automatic stations were implemented in many of the rivers. These automatic stations provide sub-daily measurements of water level, however some of these new stations do not have proper flow rating curves to estimate accurate river flows based on water level or they are very far from the river mouth, and therefore are useless to provide boundary conditions for numerical hydrodynamic estuarine models.
On the other hand, INAG makes available daily values of precipitation until 2000, covering all national territory. From year 2000 onwards precipitations stations also became automatic, which means that also sub-daily values of precipitation are available for this task.

Watershed models are useful tools to complement the gaps in measurements of flow and concentration. They also explain measurements obtained in the rivers and connected them with weather and socioeconomic conditions.
SWAT and Mohid Land will be runned in this Task with SRTM topography (available from USGS), Corine 2000 land use land cover, European Union soil map (both available from EEA), rainfall, temperature, wind, relative humidity and radiation (climatic data is available in INAG). As results they produce spatially detailed outputs such as river flow, soil moisture fields, plant growth, etc. SWAT model has the advantage of explicitly calculating plant growth, which means that climate change scenarios can produce unexpected increase of plant growth, reducing for example nutrient exports from watershed. On the other hand MOHID LAND has the advantage of calculating sub-daily infiltration and flows, which will allow understanding sub-daily dynamics of peak flow.
These models results will be compared with measurements for calibration.
After calibration the models will be applied to produce outputs based on climate change scenarios. The environmental literature considers abrupt weather changes, with an higher frequency of extreme events, having deep impact on environment, including water resources (IPCC, 2007). For Portugal was predicted an increase of the water withdrawal to availability relation. Additionally a frequency increase of heavy precipitation events will increase the peak flows. Considering this, three types of scenarios will be produced based on the meteorological data provided by Task 2: i) Scenarios of increased temperature which will increase evapotranspiration (and a consequent decrease of overall flows) ii) decrease of average precipitation (with a similar effect to previous scenario) iii) Increase of peak precipitation events with a consequent increase of peak flows.

The Douro and Tagus Rivers have in their watersheds several dams that control the natural flow from the river. Another common characteristic of these watersheds is that they have more than half of its area in Spanish territory, where the availability of precipitation and flow data is low. These features will limit the results to be obtained for these rivers. On the other hand, Rio Vouga, which is the main freshwater inflow of Ria de Aveiro (Dias et al., 1999), has enough data available to understand the water flow and nutrient dynamics.

Expected results:

Water flow and nutrient fluxes data for Douro, Vouga and Tagus rivers, for several climate change scenarios

Articulation with others tasks:
This task depends on the data collected in Task 1 and on the meteorological data simulated in Task 2, and will supply data essential for the following tasks, with especial emphasis on Tasks 4, 5 and 7.

Role of partners:
This task will be performed by IST/MARETEC researchers and research fellow, under the leadership of Pedro Chambel Leitão.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 2; Nuno Alexandre Firmino Vaz; Pedro Chambel Filipe Lopes Leitão;

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
Task 4 - Hydrodynamic modelling of es...	01-05-2010	30-06-2011	14	21,5

Descrição da tarefa e Resultados Esperados
Task description and Expected results

Objectives:
The primary goal of this task is the development and implementation of circulation models of the Douro and Tagus estuaries and of the Ria de Aveiro lagoon and respective adjacent coastal areas.

Task description:
The most efficient way to accomplish this task is by taking advantage of previous knowledge of the hydrodynamics and of the previous modelling efforts of the Ria de Aveiro (Dias et al., 2003; Dias and Lopes, 2006; Vaz et al 2009) and Tagus estuary (Mateus and Neves, 2008; Vaz et al., 2009) and respective adjacent coast held by the members of the research team. Acquired experience will be transferred to the Douro Applications.

The hydrodynamic model MOHID (Leitão et al., 2005) will be the first choice to perform this task, given its excellent properties of computational efficiency and mass conservation. Due to the extent and complexity of the domains, very large grids will be used. Computational efficiency is of primary concern. Simultaneously, mass conservation of the hydrodynamic runs must also be taken into account as it may damage the accuracy of the overall modelling effort.

In order to perform this task, two approaches will be followed:
(1) Implementation of 3D circulation models for the estuaries and adjacent coastal regions.
(2) Implementation of a nested coastal circulation model which is based on the approach followed by Leitão et al. (2005), using the results of 2D estuarine circulation model (already developed) results as landward boundary conditions. These 2D estuarine models will run in an offline mode and their outputs will be imposed as boundary conditions to the coastal model. The results of these two approaches will be compared and validated against available data sets.

In order to validate the circulation models, in-situ available data will be used:
For the Douro estuary ADCP, CTD and suspended sediments data measured in the scope of a previous research project will be used.

For the Ria de Aveiro lagoon, sea surface data from a survey undertaken in 1987/88 (IH, 1991) and 2002/03 (Araújo, 2006) and current velocity and hydrographic data measured in 1997 and 2003/04 (Aveiro\'s University team) will be used.

For the Tagus estuary and adjacent coast, in-situ data available on IST/MARETEC will be used. In fact, hydrographic and ADCP data measured at the Region of Freshwater Influence under the scope of the monitoring campaigns of the Guia Outfall will be used. Data measured within the estuary is also available. These data sets comprise current velocity, salinity and water temperature as well as nutrient data (from a YSI probe).

Surface boundary conditions for vertical diffusion of momentum and turbulent kinetic energy can be computed based on wind velocity fields obtained from Task 2 (www.climetua.fis.ua.pt). Heat fluxes will be computed using atmospheric data (wind velocity, air temperature, solar radiation, relative humidity and cloud cover). As landward boundary conditions, the model uses freshwater discharges from INAG (www.snirh.pt) or from available watershed models (SWAT and Mohid Land, www.mohid.com) determined in Task 3, that once validated can identify peaks of water flow. A null mass and momentum flux is also imposed.

The validation of the large-scale results of the hydrodynamic models will be made using the available remote sensing imagery acquired in the scope of Task 6.

This procedure will allow a simultaneous inter-comparison between the results of the two setups for the coastal region and help to consolidate the knowledge of the hydrodynamics of these coastal systems.

Expected results:
This task will provide the calibrated and validated hydrodynamic model to be used for the three coupled estuarine-coastal systems under study serving as a base to the set-up of the ecological models.

Articulation with others tasks:
This task depends on the data collected in Tasks 1 and 6, as well as on Task 2 and 3 outputs. It will supply the numerical models essential for Tasks 5 and 7.

Role of partners:

This task will be performed by the numerical modelling researchers and research fellows from IST/MARETEC and UA/CESAM under the leadership of Nuno Vaz.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 1; (BI) Bolseiro de Investigação (Mestre) 2; João Miguel Sequeira Silva Dias; Marcos Duarte Mateus; Nuno Alexandre Firmino Vaz;

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
Task 5 - Calibration and validation o...	01-08-2010	31-08-2011	13	21,3

Descrição da tarefa e Resultados Esperados
Task description and Expected results
Objectives:
This task intends to calibrate and validate the ecological models of the Douro and Tagus estuaries, the Ria de Aveiro and respective adjacent coasts.

Task description:
The ecological model runs over the hydrodynamic model, which means that the hydrodynamic results are not affected by the biogeochemical results. However, the ecological model is coupled to the hydrodynamic model, which drives the water circulation.

A water quality model, called Mohid.Life (Mateus, 2006), will be implemented. This ecological model captures the state-of-the-art in marine pelagic processes modeling taking a “functional group approach” by dividing the biota in the ecosystem into three functional types: primary producers, consumers and decomposers. Primary producers and consumers are also sub-divided into functional types. Physiological and population processes are described by fluxes of carbon and nutrients (N, P, Si) between functional groups and organic matter components). Variable stoiquiometric relations and changing C:Chla ratios as a function of adaptation to ambient light, is also accounted for. This model has a decoupled carbon–nutrients dynamics with explicit parameterization of carbon, nitrogen, phosphorus, silica, and oxygen cycles (see Figure 8).

Effects on the primary productivity of estuarine intertidal areas (microphytobenthos) will be assessed by simulating changes in light exposure during low tide periods, following the assumptions that benthic productivity is mostly driven by solar radiation availability and not-nutrient limited (Serôdio & Catarino, 2000).

Because ecological models need longer runs, several tests will be made in order to assess the computational time for estuarine applications. In order to maintain the best computational time for the estuarine applications, the application of the ecological model in a 2D or 3D mode will remain an open issue. In estuarine regions, the model\'s implementation will follow the methodology proposed by Mateus and Neves (2008).

On the coast, the model will run in a 3D mode, following the methodology proposed by Leitão et al. (2005). In summary these ecological models act as an independent module of the Mohid- Water Modelling System.

River inflow and nutrient inputs from the watersheds will be introduced in the model. These data will be available from Task 3.

The ecological models will be validated using nutrient data available for the estuaries and coastal regions under study. The gathering of this data will be made under the scope of Task 1. Moreover, the large-scale results will be validated using the remote sensing imagery obtained in the scope of Task 6.

Expected results:
This task will provide the calibrated and validated ecological model to be used for the three coupled estuarine-coastal systems under study.

Articulation with others tasks:
This task depends on the data collected in Tasks 1 and 6, on Task 2 and 3 outputs, as well as on the hydrodynamic numerical models developed in Task 4. It will supply the numerical models essential for Task 7.

Role of partners:
This task will be performed by numerical modeling researchers and research fellows of IST/MARETEC and UA/CESAM under the leadership of Marcos Mateus.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 1; (BI) Bolseiro de Investigação (Mestre) 2; João António de Almeida Serôdio; Marcos Duarte Mateus; Nuno Alexandre Firmino Vaz;

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
Task 6 - Acquisition and analysis of ...	01-01-2011	30-04-2012	16	11

Descrição da tarefa e Resultados Esperados
Task description and Expected results

Objectives:
The main objective of this task is to gather remote sensing data in order to validate the large- scale model results (Tasks 4 and 5) as well as to study the dynamics and the spatial distribution of Suspended Particulate Matter (SPM) within the river plume outflow area

(Task 7).

Task description:
Satellite observations provide synoptic and frequent overview of coastal areas allowing for a better spatial and temporal coverage of ocean processes and properties. Sea Surface Temperature (SST) and ocean colour (chlorophyll and suspended sediment concentrations) parameters can be obtained through satellite observations in the visible and infra-red wavelength. In addition, observations of sea surface roughness (Bragg-backscatter) can also provide useful quantitative and qualitative information on upwelling events, waves and river plumes, amongst others. Most of these images are available on-line (http://oceancolor.gsfc.nasa.gov) or through other databases (e.g. European Space Agency (ESA), http://www.esa.int/esaEO/). Research by Nezlin et al. (2007, 2005) and Valente and Silva (2008) are good examples of how remote sensing observations can be used to detect and study freshwater plumes

Available Moderate Resolution Image Spectroradiometer (MODIS), Sea-view Wide Field-of viewing Sensor (SeaWiFS), and Medium Resolution Image Spectrometer (MERIS) images will be used to obtain suspended sediment and chlorophyll concentrations, SST data. Advanced Synthetic Aperture Radar (ASAR) will be acquired in case cloud cover restricts the number of passive sensor images. Data from active radar sensors is not limited by cloud cover, however, these data are not as readily available as those from passive sensors.

All data will be used in the validation of the hydrodynamic and biogeochemistry models using either a: (1) qualitative approach, where satellite observations are visually compared to the model horizontal field results; or (2) a quantitative approach where, the radiances from images are quantified. The satellite images will be concurrent with the periods simulated in the model, chosen in the scope of Tasks 4, 5 and 7.

The satellite images will be processed using either SeaDAS (open code, http://oceancolor.gsfc.nasa.gov/seadas/), a comprehensive image analysis package for the processing, display, analysis, and quality control of ocean colour data or BEAM (http://www.brockmann-consult.de/beam/) an equivalent toolbox.

Expected results:
SST and ocean colour satellite images concurrent with the periods simulated in the hydrodynamic and biogeochemistry models.

Articulation with others tasks:
This task will provide data for Tasks 4, 5 and 7.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 1; (BI) Bolseiro de Investigação (Mestre) 2; Nuno Alexandre Firmino Vaz; Pedro Chambel Filipe Lopes Leitão;

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
Task 7 - Scenarios (case) studies and...	01-08-2011	30-09-2012	14	24,1

Descrição da tarefa e Resultados Esperados
Task description and Expected results

Objectives:
The main goal of this task is to improve the knowledge about the estuarine circulation and biogeochemistry, as well as the river plume propagation along the Portuguese coast, evaluating their modifications induced by climate changes.

Task description:
The models developed in Tasks 4 and 5 will be applied to perform an analysis of the effect of the influence of tide, freshwater inflow and meteorological conditions on estuarine/coastal circulation and biogeochemistry. Influence of global climate change scenarios in the hydrodynamics and ecology of these areas, will also be investigated, based upon the climate change scenarios provided by Task 2 and on the mean sea level rise determined by IPCC (2007), Santos and Miranda (2007) and Ferreira (2008).

This task will focus on the following issues:
- Study the impact of climate changes, namely extreme freshwater inflow and storm surge events and of the sea level rise on: estuarine circulation (stratification and mixing processes), fine sediment dynamics inside estuaries and near-shelf, exchanges between the sea and the estuaries, and reduction of intertidal areas in estuaries.
- Assess the opposite effect between buoyancy and mixing in estuarine plumes with respect to different scenarios of river runoff and wind regime.
- Assess how fine sediments loads; changes to ocean-estuary exchanges; and the changes in intertidal areas would affect primary production in estuaries and near-shelf, and alter the relative contribution of phytoplankton to primary production (water column).
- Evaluate the importance of the re-suspension of the fine sediments transported from the estuaries to the coast to light availability in the water column and consequently the implication to chlorophyl and carbon concentrations.
- Study the fate of the fine sediments transported to the near-shelf by estuarine plumes.

These issues will be address by investigating estuarine circulation considering two scenarios:
1) Retrospective analysis of estuarine-near coastal circulation, based on drought/flood periods and on present forcing conditions. The products from the model simulations, such as circulation patterns, thermohaline dynamics, water level, fine sediment dynamics, intertidal areas and water quality, once validated through comparison to historical data, will be analyzed allowing a better understanding of the influence of climate change in these ecosystems (study areas referred in the abstract), in an integrated way.
2) Future regimes of estuarine-near coastal circulation. It is possible to study the influence of future scenarios based on available climate projections produced in Task 2, as well as on the mean sea level rise scenarios described by IPCC (2007), Santos and Miranda (2007) and Ferreira (2008). The influence of those scenarios on estuarine circulation, river plume dynamics, fine sediments

dynamics, intertidal areas and primary production will be analyzed. Different scenarios of wind conditions and freshwater inflow will be considered in order to study fine sediment dynamics within the estuary and estuarine outflow plume. Changes in intertidal areas will be evaluated in response to the mean sea level rise and to the changes in extreme storm surges.

Extreme values of freshwater inflow will be determined through literature revision and from data measured by INAG (www.snirh.pt) or by using the results obtained by the watershed model (Task 3), that will forecast values based on the climate change scenarios provided by Task 2. Wind and storm surge scenarios will be generated based on the results provided by Task 2 (http://climetua.fis.ua.pt/main/intro.php).

Expected results:
A comprehensive knowledge about the estuarine circulation and biogeochemistry as well as the plume propagation along the Portuguese coast under different climate change scenarios, with especial emphasis in the costal zones adjacent to Douro and Tagus estuaries and to Ria de Aveiro.

Articulation with others tasks:
This task depends on meteorological data simulated in Task 2, on the watershed model developed in Task 3, and on hydrodynamic and biogeochemistry numerical models developed in Tasks 4 and 5.

Role of partners:
This task will be performed by researchers and research fellows from IST/MARETEC and UA/CESAM under the leadership of João Dias.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 1; (BI) Bolseiro de Investigação (Mestre) 2; João António de Almeida Serôdio; João Miguel Sequeira Silva Dias; Marcos Duarte Mateus; Nuno Alexandre Firmino Vaz; Pedro Chambel Filipe Lopes Leitão;

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
Task 8 - Evaluation of the project re...	01-09-2012	31-12-2012	4	8,1

Descrição da tarefa e Resultados Esperados
Task description and Expected results
Objectives:
To evaluate the project results and make recommendations fur future research in the coupled estuarine-coastal systems studied

Task description:
This final task will be used to bring together all the results from the different Tasks of the Project in order to assess the Projects achievements which will lead to recommendations on further research in the coupled estuarine-coastal systems (Douro and Tagus estuaries and Ria de Aveiro lagoon).

Expected results:
A report is expected with the final achievements and recommendations of the project.

Articulation with others tasks:
This task depends on the results of all the previous tasks, with especial emphasis on Task 6.

Role of partners: This task will be performed by all the researchers and research fellows from IST/MARETEC and UA/CESAM, under the leadership of João Dias.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 1; (BI) Bolseiro de Investigação (Mestre) 2; Alfredo Moreira Caseiro Rocha; João António de Almeida Serôdio; João Miguel Sequeira Silva Dias; Juan Gabriel de Almeida Ferreira; Marcos Duarte Mateus; Nuno Alexandre Firmino Vaz; Pedro Chambel Filipe Lopes Leitão;

3.2.4. Calendarização e Gestão do Projecto
3.2.4. Project Timeline and Management

3.2.4.a Descrição da Estrutura de Gestão
3.2.4.a Description of the Management Structure

Project management will be based on the successful approach used by the IR in other projects with multidisciplinary teams. The methodology that will be followed intends to ensure the accomplishment of the project activities in accordance to the project work plan and budget, and to will be the key engine which drives all other tasks in the project implementation cycle.
The project has been designed on the basis of 8 tasks most of them interconnected (Figure 7, Timeline.pdf), which have precise objectives and methodologies. The diversity of scientific domains, data and outputs was responsible for the definition of a Leader for each of the tasks. Each task Leader will coordinate his task and is responsible for assuming responsibility for timely delivering the project deliverables and milestones within each Task of the project.
This methodology will be implemented particularly in order to develop the tasks; check the progress of the work; co-ordinate the specific research teams; co-ordinate the preparation of the technical reports; and permit exchanges of information between the partners.
Annual meetings with all the team members will verify the development of tasks and the achievement of milestones and the need for

readjustments, establish and organize the activities and the interdependences between them for the next year.
In between annual meetings, the coordinator will promote sectorial meetings for each task, to guarantee that problems are solved early and that the flow of information and results between tasks is working properly. IT tools such as dotproject (www.dotproject.net/) will be used to organize all relevant information and keep the team updated on the global development of the project and milestone delivery status. Besides the technical and financial reports required annually by FCT, the team will develop a report for each milestone accomplished.
Kick-off and final project workshops will be organized regularly taking advantage of the videoconference facilities at the partner institutions (University of Aveiro and IST). These sessions will be dedicated to discuss problems, choose priorities, and establish strategic goals as well as evaluating the consistency of the work done according to the plans and other administrative and financial issues.
This solid management structure will ensure the successful implementation of the project work plan.

3.2.4.b Lista de Milestones

3.2.4.b Milestone List

Data Date	**Designação da milestone** Milestone denomination
01-05-2010	M1 - Review of the state of the art and data collection

Descrição
Description

This milestone establishes the basic conditions for the following tasks. It concerns the improvement of the understanding of the drivers of estuarine and adjacent coastal dynamics and of estuarine plumes, and the collection of data relevant for carrying on the subsequent tasks.

Data Date	**Designação da milestone** Milestone denomination
01-09-2010	M2 - Meteorological data hindcast

Descrição
Description

This milestone will provide the meteorological data for the Portuguese coast and rivers basin for present climate, to run the watershed model to use in Task 3.

Data Date	**Designação da milestone** Milestone denomination
01-04-2011	M3 - Meteorological and river freshwater scenarios

Descrição
Description

This milestone will provide the necessary meteorological and river freshwater for the Portuguese coast and rivers basin, for the various scenarios considered, that will be used to force the numerical models in Tasks 4, 5 and 7.

Data Date	**Designação da milestone** Milestone denomination
01-09-2011	M4 - Hydrodynamic and biogeochemistry models

Descrição
Description

This milestone will provide the calibrated and validated hydrodynamic and biogeochemistry models for the three coupled estuarine-coastal systems under study to be used in Task 7.

Data Date	**Designação da milestone** Milestone denomination
01-10-2012	M5 - Case studies and integration of results

Descrição
Description

This milestone will established the final outcomes of this project, namely the comprehensive knowledge about the estuarine circulation and biogeochemistry as well as the plume propagation along the Portuguese coast under different climate change scenarios.

3.2.4.c Cronograma

3.2.4.c Timeline

Ficheiro com a designação "timeline.pdf", no 9. Ficheiros Anexos, desta Visão Global (caso exista).
File with the name "timeline.pdf" at 9. Attachments (if exists).

3.3. Referências Bibliográficas

3.3. Bibliographic References

Referência Reference	**Ano** Year	**Publicação** Publication
Araújo	2005	Araújo, I.G.B., 2005. Sea Level Variability: Examples From the Atlantic Coast of Europe. Phd Thesis, School of the National Oceanography Centre, Southampton, UK.
Arnold and Fohrer	2005	**Arnold, J.G. and Fohrer, N., 2005. SWAT2000: current capabilities and research opportunities in applied watershed modeling. Hydrol. Process. 19, 563–572.doi:10.1002/hyp.5611**
Banas and Hickey	2005	**Banas, N.S. and Hickey, B.M., 2005. Mapping exchange and residence time in a model of Willapa Bay Washington, a branching, macrotidal estuary. Journal of Geophysical Research 110 (C11011), doi: 10.1029/2005JC002950.**
Choi and Wilkin	2007	**Choi, B.J. and Wilkin, J.L., 2007. The Effect of Wind on the Dispersal of the Hudson River Plume. Journal of Physical Oceanography, 37, 1878-1897. doi:**

		10.1175/JPO3081.1.
Dias et al.	1999	**Dias, J.M., Lopes, J.F. and Dekeyser, I., 1999. Hydrological characterisation of Ria de Aveiro, Portugal, in early summer. Oceanologica Acta 22 (5), 473–485.**
Dias et al.	2003	**Dias, J.M., Lopes, J.F. and Dekeyser, I., 2003. A numerical system to study the transport properties in the Ria de Aveiro lagoon. Ocean Dynamics 53, 220–231. doi: 10.1007/s10236-003-0048-5.**
Dias and Lopes	2006	**Dias, J.M. and Lopes, J.F., 2006. Implementation and assessment of hydrodynamic, salt and heat transport models: The case of Ria de Aveiro Lagoon (Portugal). Environmental Modelling and Software 21, 1–15. doi:10.1016/j.envsoft.2004.09.002.**
Dronkers	2005	Dronkers, J., 2005: Dynamics of Coastal Systems.Advanced Series on Ocean Engineering. 25.World Scientific Publishing Company, Hackensack, 519 pp.
Ferreira et al.	2008	**Ferreira, O., Dias, J.A. and Taborda, R., 2008. Implications of sea-level rise for continental Portugal. Journal of Coastal Research, 24(2), 317–324.**
Guo and Valle-Levins	2007	**Guo, X. and Valle-Levinson, A., 2007. Tidal effects on estuarine circulation and outflow plume in the Chesapeake Bay. Continental Shelf Research, 27, 20-42. doi: 10.1016/j.csr.2006.08.009.**
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IPCC	2007	IPCC, 2007. Climate Change 2007: The Physical Science Basis. Contribution of the Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z.Chen, M.Marquis, K.B. Averyt, M.Tignor and H.L. Miller (eds.)]. Cambridge University Press, Cambridge, Uninted Kingdom and New York, Ny, USA, 996 pp.
Leitão et al.	2005	**Leitão, P., Coelho, H., Santos, A. and Neves, R., 2005. Modelling the main features of the Algarve coastal circulation during July 2004: A downscaling approach. Journal of Atmospheric and Ocean Science 10 (4), 1-42. Doi: 10.1080/17417530601127704**
Lihan et al.	2008	**Lihan, T., Saitoh, S.I., Iida, T., Hirawake, T. and Iida, K., 2008. Satellite-measured temporal and spatial variability of the Tokachi River plume. Estuarine, Coastal and Shelf Science, 78, 237-249. doi: 10.1016/j.ecss.2007.12.001.**
Li et al.	2006	**Li, M., Zhong, L., Boicourt, W.L., Zhang, S. and Zhang, D.L., 2006. Hurricane-induced storm surges, currents and destratification in a semi-enclosed bay. Geophysical Research Letters, vol. 33, L02604. doi: 10.1029/2005GL024992.**
Magalhães et al.	2005	**Magalhães, C.M., Joye, S.B., Moreira, R.M., Wiebe, W.J. and Bordalo, A.A., 2005. Effect of salinity and inorganic nitrogen concentrations on nitrification and denitrification rates in intertidal sediments and rocky biofilms of the Douro River estuary, Portugal. Water Research 39 (2005) 1783–1794. doi:10.1016/j.watres.2005.03.008.**
Mateus	2006	Mateus, 2006. A process-oriented biogeochemical model for marine ecosystems: Development, numerical study, and application. PhD Thesis. IST, Lisboa.
Mateus and Neves	2008	**Mateus, M. and Neves, R., 2008, Using a process-oriented ecological model to evaluate light limitation and nutrient limitation in the Tagus estuary. Journal of Marine Engineering and Technology 12:43-54**
Mucha et al.	2004	**Mucha, A.P., Bordalo, A.A. and Vasconcelos, M.T.S.D., 2004. Sediment quality in the Douro river estuary based on trace metal contents, macrobenthic community and elutriate sediment toxicity test (ESTT). J. Environ. Monit., 6, 585-592. doi: 10.1039/b401855a.**
Oliveira et al.	2009	**Oliveira, P.B., Nolasco, R, Dubert, J., Moita, T. and Peliz, A., 2009. Surface temperature,chlorophyll and advection patterns during a summer upwelling event off central Portugal. Continental Shelf Research. doi:10.1016/j.csr.2008.08.004.**
Orton and Jay	2005	**Orton, P.M. and Jay, D.A., 2005. Observations at the tidal plume front of a high-volume river outflow. Geophysical Research Letters, Vol. 32, L11605, doi:10.1029/2005GL022372.**
Otero et al.	2008	**Otero, P., Ruiz-Villarreal, M. and Peliz, A., 2008. Variability of river plumes off Northwest Iberia in response to wind events. Journal of Marine Systems, 72 (2008) 238–255, doi:10.1016/j.jmarsys.2007.05.016.**
Paerl et al.	2001	Paerl, H.W., J.D. Bales, L.W.Ausley, C.P. Buzzelli, L.B. Crowder, L.A. Eby, J.M. Fear,M. Go and Co-authors, 2001. Ecosystem impacts of three sequential hurricanes (Dennis, Floyd, and Irene) on the United States' largest lagoonal estuary, Pamlico Sound, NC. Proc. Natl. Acad. Sci. U.S.A., 98, 5655-5660.
Santos and Miranda	2007	Santos, F.D. and Miranda, P., 2007. Alterações Climáticas em Portugal. Cenários, Impactos e Medidas de Adaptação, Projecto SIAM II, Gradiva, Lisboa, 506 pp
Serôdio and Catarino	2000	**Serôdio, J. and Catarino, F., 2000. Modelling the primary production of intertidal microphytobenthos: time scales of variability and effects of migratory rhythms. Marine Ecology Progress Series 192, 13-30.**
Trancoso et al.	2009	**Trancoso, A.R., Braunschweig, F., Chambel-Leitão, P., Obermann, M., and Neves, R., 2009. An advanced modelling tool for simulating complex river systems. Sci Total Environ, doi:10.1016/j.scitotenv.2009.01.015.**
		Valente, A.S. and Silva, J.C.B., 2009. On the observability of the fortnightly cycle of

Valente and Silva	2009	the Tagus estuary turbid plume using MODIS ocean colour images, Journal of Marine Systems 75 (2009) 131–137
Vaz et al.	2009	Vaz, N., Dias, J.M. and Leitão, P.C., 2009. "Three-dimensional modelling of a tidal channel: the Espinheiro Channel (Portugal)". Continental Shelf Research, 29, 29-41. doi:10.1016/j.csr.2007.12.005.
Vaz et al.	2009	Vaz, N., Fernandes, L., Leitão, P.C., Dias, J.M. and Neves, R., 2009b. "The Tagus estuarine plume as a response to wind and river runoff: Winter 2007 case study". Submitted: Journal of Coastal Research

3.4. Publicações Anteriores
3.4. Past Publications

Referência Reference	Ano Year	Publicação Publication
Mateus and Neves	2008	Mateus, M. and Neves, R., 2008. Using a process-oriented ecological model to evaluate light limitation and nutrient limitation in the Tagus estuary. Journal of Marine Engineering and Technology 12:43-54
Rocha et al.	2008	Rocha A., Melo-Gonçalves P., Marques C., Marques C., Ferreira J. and Castanheira J.M., 2008. High frequency precipitation changes in southeastern Africa due to anthropogenic forcing. International Journal of Climatology. 28, 1239-1253.
Serôdio et al.	2008	Serôdio, J., Vieira, S. and Cruz, S., 2008. Photosynthetic activity, photoprotection and photoinhibition in intertidal microphytobenthos as studied in situ using variable chlorophyll fluorescence. Continental Shelf Research. 28, 1363-1375.doi: 10.1016/j.csr.2008.03.019.
Trancoso et al.	2009	Trancoso, A.R., Braunschweig, F., Leitão, P.C., Obermann, M. and Neves, R., 2009. An advanced modelling tool for simulating complex river systems. Sci Total Environ, doi:10.1016/j.scitotenv.2009.01.015
Vaz et al.	2009	Vaz, N., Dias, J.M. and Leitão, P.C., 2009. Three-dimensional modelling of a tidal channel: the Espinheiro Channel (Portugal). Continental Shelf Research, 29, 29-41. doi:10.1016/j.csr.2007.12.005.

4. Equipa de investigação
4. Research team

4.1 Lista de membros
4.1. Members list

Nome Name	Função Role	Grau académico Academic degree	%tempo %time	CV nuclear Core CV
João Miguel Sequeira Silva Dias	Inv. Responsável	DOUTORAMENTO	25	☐
Alfredo Moreira Caseiro Rocha	Investigador	AGREGAÇÃO	10	☐
João António de Almeida Serôdio	Investigador	DOUTORAMENTO	10	☐
Marcos Duarte Mateus	Investigador	DOUTORAMENTO	10	☐
Nuno Alexandre Firmino Vaz	Investigador	DOUTORAMENTO	25	☐
Pedro Chambel Filipe Lopes Leitão	Investigador	MESTRADO	10	☐
Juan Gabriel de Almeida Ferreira	Bolseiro	LICENCIATURA	10	☐

(O curriculum vitae de cada membro da equipa está disponível clicando no nome correspondente)
(Curriculum vitae for each research team member is available by clicking on the corresponding name)

Total: 7

4.2. Lista de membros a contratar durante a execução do projecto
4.2. Members list to hire during project"s execution

Membro da equipa Team member	Função Role	Duração Duration	%tempo %time
(BI) Bolseiro de Investigação (Lic. ou Bacharel) 1	Bolseiro	12	100
(BI) Bolseiro de Investigação (Mestre) 1	Bolseiro	36	100
(BI) Bolseiro de Investigação (Mestre) 2	Bolseiro	36	100

Total: 3

5. Projectos financiados
5. Funded projects

Lista de projectos financiados
Funded projects list

Referência Reference	Título Title	Estado Status
POCI/AMB/57928/2004	Monitorização Avançada e Diagn...	Em curso
POCI/ECM/59958/2004	Estudo da Morfodinâmica da Emb...	Em curso

(Os detalhes de cada projectos estão disponíveis clicando na referência correspondente)
(Details for each project are available by clicking on the corresponding reference)

Total: 2

6. Indicadores previstos
6. Expected indicators

Indicadores de realização previstos para o projecto
Expected output indicators

Descrição Description	2009	2010	2011	2012	2013	Total
A - Publicações Publications						
Livros Books	0	0	0	0	0	**0**
Artigos em revistas internacionais Papers in international journals	0	1	2	3	0	**6**
Artigos em revistas nacionais Papers in national journals	0	0	0	0	0	**0**
B - Comunicações Communications						
Comunicações em encontros científicos internacionais Communications in international meetings	0	1	2	2	0	**5**
Comunicações em encontros científicos nacionais Communications in national meetings	0	1	1	1	0	**3**
C - Relatórios Reports	0	3	3	2	0	**8**
D - Organização de seminários e conferências Organization of seminars and conferences	0	0	0	0	0	**0**
E - Formação avançada Advanced training						
Teses de Doutoramento PhD theses	0	0	0	2	0	**2**
Teses de Mestrado Master theses	0	0	1	1	0	**2**
Outras Others	0	0	0	0	0	**0**
F - Modelos Models	0	0	3	3	0	**6**
G - Aplicações computacionais Software	0	0	3	3	0	**6**
H - Instalações piloto Pilot plants	0	0	0	0	0	**0**
I - Protótipos laboratoriais Prototypes	0	0	0	0	0	**0**
J - Patentes Patents	0	0	0	0	0	**0**
L - Outros Other						
	0	0	0	0	0	**0**
	0	0	0	0	0	**0**
	0	0	0	0	0	**0**

Acções de divulgação da actividade científica
Scientific activity spreading actions

To disseminate the main outcomes of the project is anticipated the organization of a final public workshop to disseminate the project outcomes to end-users, academics and representatives of local, regional and national organizations (e.g., INAG, ARH, Harbour administrations, etc), and to the general public.
A web page describing the project structure, presenting the team involved, the main goals and achievements of the project will also be elaborated in order to publicize DyEPlume scientific activity.
The scientific results of DyEPlume will be disseminated through the usual channels, including national and international journal papers and conference presentations. The good publishing record of the research team in journals indexed in the Web of Science guaranties a good publication output from the project.
According to the local and national interest of the topic under research in this project, it is anticipated the divulgation of the DyEPlume outcomes and activities through local and national newspapers, radio stations and television channels. Namely, reports on the University of Aveiro programmes CLICK (on the national radio station ANTENA 1) and 3810 UA (on the national television channel RTP2) are predictable, taking into account the previous experiences of the IR.

7. Orçamento
7. Budget

Instituição Proponente
Principal Contractor

Universidade de Aveiro

Descrição Description	2009	2010	2011	2012	2013	Total
Recursos Humanos Human resources	0,00	20.278,00	15.329,00	12.859,00	0,00	**48.466,00**
Missões Missions	0,00	2.250,00	3.750,00	3.750,00	0,00	**9.750,00**
Consultores Consultants	0,00	0,00	0,00	0,00	0,00	**0,00**
Aquisição de bens e serviços Service procurement and acquisitions	0,00	1.500,00	1.500,00	1.500,00	0,00	**4.500,00**
Registo de patentes Patent registration	0,00	0,00	0,00	0,00	0,00	**0,00**
Adaptação de edifícios e instalações Adaptation of buildings and facilities	0,00	0,00	0,00	0,00	0,00	**0,00**
Gastos gerais Overheads	0,00	5.466,00	4.116,00	3.622,00	0,00	**13.204,00**
TOTAL DESPESAS CORRENTES TOTAL CURRENT EXPENSES	**0,00**	**29.494,00**	**24.695,00**	**21.731,00**	**0,00**	**75.920,00**
Equipamento Equipment	0,00	3.300,00	0,00	0,00	0,00	**3.300,00**
Total	**0,00**	**32.794,00**	**24.695,00**	**21.731,00**	**0,00**	**79.220,00**

Instituições Participantes
Participating Institutions

Instituto Superior Técnico

Descrição Description	2009	2010	2011	2012	2013	Total
Recursos Humanos Human resources	0,00	12.796,00	12.827,00	12.859,00	0,00	**38.482,00**
Missões Missions	0,00	1.250,00	2.750,00	2.750,00	0,00	**6.750,00**
Consultores Consultants	0,00	0,00	0,00	0,00	0,00	**0,00**
Aquisição de bens e serviços Service procurement and acquisitions	0,00	1.000,00	1.000,00	1.000,00	0,00	**3.000,00**
Registo de patentes Patent registration	0,00	0,00	0,00	0,00	0,00	**0,00**
Adaptação de edifícios e instalações Adaptation of buildings and facilities	0,00	0,00	0,00	0,00	0,00	**0,00**
Gastos gerais Overheads	0,00	3.609,00	3.315,00	3.322,00	0,00	**10.246,00**
TOTAL DESPESAS CORRENTES TOTAL CURRENT EXPENSES	**0,00**	**18.655,00**	**19.892,00**	**19.931,00**	**0,00**	**58.478,00**
Equipamento Equipment	0,00	3.000,00	0,00	0,00	0,00	**3.000,00**
Total	**0,00**	**21.655,00**	**19.892,00**	**19.931,00**	**0,00**	**61.478,00**

Orçamento Global
Global budget

Descrição Description	2009	2010	2011	2012	2013	Total
Recursos Humanos Human resources	0,00	33.074,00	28.156,00	25.718,00	0,00	**86.948,00**
Missões Missions	0,00	3.500,00	6.500,00	6.500,00	0,00	**16.500,00**
Consultores Consultants	0,00	0,00	0,00	0,00	0,00	**0,00**
Aquisição de bens e serviços Service procurement and acquisitions	0,00	2.500,00	2.500,00	2.500,00	0,00	**7.500,00**
Registo de patentes Patent registration	0,00	0,00	0,00	0,00	0,00	**0,00**
Adaptação de edifícios e instalações Adaptation of buildings and facilities	0,00	0,00	0,00	0,00	0,00	**0,00**
Gastos gerais Overheads	0,00	9.075,00	7.431,00	6.944,00	0,00	**23.450,00**
TOTAL DESPESAS CORRENTES TOTAL CURRENT EXPENSES	**0,00**	**48.149,00**	**44.587,00**	**41.662,00**	**0,00**	**134.398,00**

Equipamento Equipment	0,00	6.300,00	0,00	0,00	0,00	**6.300,00**
Total	**0,00**	**54.449,00**	**44.587,00**	**41.662,00**	**0,00**	**140.698,00**

Plano de financiamento
Finance plan

Descrição Description	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
Financiamento solicitado à FCT Requested funding	0,00	54.449,00	44.587,00	41.662,00	0,00	**140.698,00**
Financiamento próprio Own funding	0,00	0,00	0,00	0,00	0,00	**0,00**
Outro financiamento público Other public-sector funding	0,00	0,00	0,00	0,00	0,00	**0,00**
Outro financiamento privado Other private funding	0,00	0,00	0,00	0,00	0,00	**0,00**
Total do Projecto Total of the project	**0,00**	**54.449,00**	**44.587,00**	**41.662,00**	**0,00**	**140.698,00**

8. Justificação do orçamento
8. Budget rationale

-

8.1. Justificação dos recursos humanos
8.1. Human resources rationale

Tipo
Type
(BI) Bolsa de Investigação (Mestre)

Nº de pessoas
No. of persons
1

Duração (em meses)
Duration (in months)
36

Custo envolvido (€) *(calculado)*
Total cost (€) *(estimated)*
35.280,00

Outros custos (€)
Other costs (€)
3.202,00

Justificação do financiamento solicitado
Rationale for requested funding

UA:
36 months of BI fellowship – This fellowship is for a master graduated that will be engaged in all the numerical modeling research in Tasks 4, 5 and 7. Additionally, he will collaborate in the project management and coordination under the supervision of the IR, as well as collaborate in the development of Tasks 1, 6 and 8, assuring the connection between a large number of tasks in cooperation with the IR.

Tipo
Type
(BI) Bolsa de Investigação (Mestre)

Nº de pessoas
No. of persons
1

Duração (em meses)
Duration (in months)
36

Custo envolvido (€) *(calculado)*
Total cost (€) *(estimated)*
35.280,00

Outros custos (€)
Other costs (€)
3.202,00

Justificação do financiamento solicitado
Rationale for requested funding

IST:
36 months of BI fellowship – This fellowship is for a master graduated that will be engaged in all the numerical modeling research in Tasks 3, 4, 5 and 7. Additionally, he will collaborate in the development of Tasks 1, 6 and 8, assuring the connection between a large number of tasks in cooperation.

Tipo
Type
(BI) Bolsa de Investigação (Lic. ou Bacharel)

Nº de pessoas
No. of persons
1

Duração (em meses)
Duration (in months)
12

Custo envolvido (€) *(calculado)*
Total cost (€) *(estimated)*
8.940,00

Outros custos (€)
Other costs (€)
1.044,00

Justificação do financiamento solicitado
Rationale for requested funding

UA:
12 months of BI fellowship – This fellowship is for a graduate student that will be engaged in Task 2 works, under the supervision of Alfredo Rocha. He will also collaborate in the development of Tasks 1 and 2.

8.2. Justificação de missões
8.2. Missions rationale

Tipo
Type
Participação em congressos

Nº de deslocações
No. of participations
6

Local
Venue
to be determined

Custo envolvido (€)
Cost (€)
8.000,00

Justificação do financiamento solicitado
Rationale for requested funding

UA:
Attendance to several conferences during the project are anticipated to present the results and products of the project

Tipo
Type
Trabalho de campo

Nº de deslocações
No. of participations
15

Local
Venue
Tagus and Douro estuaries, Ria de Aveiro and adjacent coasts

Custo envolvido (€)
Cost (€)
1.750,00

Justificação do financiamento solicitado
Rationale for requested funding

UA:
Several trips to the Tagus and Douro estuaries, Ria Aveiro lagoon and adjacent coastal areas will be performed to get an updated overview of the system, collect relevant data and in situ evaluate the models results

Tipo
Type
Participação em congressos

Nº de deslocações
No. of participations
4

Local
Venue
to be determined

Custo envolvido (€)
Cost (€)
5.500,00

Justificação do financiamento solicitado
Rationale for requested funding

IST:
Attendance to several conferences during the project are anticipated to present the results and products of the project

Tipo
Type
Trabalho de campo

Nº de deslocações
No. of participations
10

Local
Venue
Tagus and Douro estuaries, Ria Aveiro and adjacent coasts

Custo envolvido (€)
Cost (€)
1.250,00

Justificação do financiamento solicitado
Rationale for requested funding

IST:
Several trips to the Tagus and Douro estuaries, Ria Aveiro lagoon and adjacent coastal areas will be performed to get an updated overview of the system, collect relevant data and in situ evaluate the models results

8.3. Justificação de consultores
8.3. Consultants rationale

(Vazio)
(Void)

8.4. Justificação de aquisição de bens e serviços
8.4. Service procurement and acquisitions

Tipo
Type
Current Expenses

Custo (€)
Cost (€)
4.500,00

Justificação do financiamento solicitado
Rationale for requested funding

UA:
- Purchase of software licenses
- Purchase of related books and other publications
- Computer and office goods and other current expenses

Tipo
Type
Current Expenses

Custo (€)
Cost (€)
3.000,00

Justificação do financiamento solicitado
Rationale for requested funding

IST:
- Purchase of software licenses
- Purchase of related books and other publications
- Computer and office goods and other current expenses

8.6. Justificação do Equipamento
8.6. Equipment rationale

8.6.1. Equipamento já disponível para a execução do projecto
8.6.1 Available equipment

(Vazio)

(Void)

8.6.2. Discriminação do equipamento a adquirir

8.6.2. New equipment requested

Tipo de equipamento Equipment type	Fabricante Manufacturer	Modelo Model	Custo (€) Cost (€)
Desktop PC	To be determined	To be determined	1.500,00

Justificação do financiamento solicitado

Rationale for requested funding

UA:

A personal computer to be used by the MSc Research Fellow working on the Physics Department in the numerical modeling studies and in the data exploration in Tasks 1, 4, 5, 6, 7 and 8.

Tipo de equipamento Equipment type	Fabricante Manufacturer	Modelo Model	Custo (€) Cost (€)
Laptop PC	To be determined	To be determined	1.800,00

Justificação do financiamento solicitado

Rationale for requested funding

UA:

This equipment will be used to visualize simulations results at the team meetings, and until month 15 it will also be used by the BSc Research Fellow working on UA in Task 2.

Tipo de equipamento Equipment type	Fabricante Manufacturer	Modelo Model	Custo (€) Cost (€)
Desktop PC	To be determined	To be determined	1.500,00

Justificação do financiamento solicitado

Rationale for requested funding

IST:

A personal computer to be used to implement Mohid Land and SWAT to the watersheds of the Douro and Tagus estuaries and for the Vouga River (major freshwater source of the Ria de Aveiro Lagoon). This computer will be used by Pedro Chambel Leitão and by the MSc Research Fellow in the scope of the watershed modelling task of DyEPlume.

Tipo de equipamento Equipment type	Fabricante Manufacturer	Modelo Model	Custo (€) Cost (€)
Desktop PC	To be determined	To be determined	1.500,00

Justificação do financiamento solicitado

Rationale for requested funding

IST:

A personal computer to be used to perform the runs of the biogeochemical models of the estuarine-coastal systems proposed at study sites in the scope of DyEPlume. Due to the large numerical grids that shall be used, and because biogeochemical models runs over hydrodynamic applications it is necessary the purchase of one computer in order to run the biogeochemical applications of DyEPlume.

8.7. Justificação de registo de patentes

8.7. Patent registration

(Vazio)
(Void)

8.8. Justificação de adaptação de edifícios e instalações

8.8. Adaptation of buildings and facilities

(Vazio)
(Void)

9. Ficheiros Anexos

9. Attachments

-

Nome Name	Tamanho Size
EMERA Evaluation Report.pdf	7Kb
Figure 1.pdf	320Kb
Figure 2.pdf	247Kb
Figure 3.pdf	221Kb
Figure 4.pdf	135Kb
Figure 5.pdf	272Kb
Figure 6.pdf	433Kb
Figure 7.pdf	13Kb
Figure 8.pdf	21Kb
Timeline.pdf	67Kb

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Financiado por fundos estruturais da UE e fundos nacionais do MCTES