FCT Fundação para a Ciência e a Tecnologia

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

Concursos de Projectos de I&D

Calls for R&D Projects

Visão global da candidatura

Application overview

Referência do projecto

Project reference

PTDC/AAC-CLI/104913/2008 **(Lacrado a 06-02-2009 às 16:46)**

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1. Identificação do projecto

1. Project description

Área científica principal

Main Area

Ambiente e Alterações Climáticas - Alterações Climáticas

Área científica Secundária

Secondary area

Ciências Agronómicas e Florestais - Agricultura e Ambiente

Título do projecto (em português)

Project title (in portuguese)

Modelação da Estrutura e Diversidade Funcional do Ecossistema como indicadores de alerta-precoce de Desertificação e Degradação do Solo – do nível regional para o local

Título do projecto (em inglês)

Project title (in english)

Modeling Ecosystem Structure and Functional Diversity as early-warning indicators of Desertification and Land-degradation - from regional to local level

Financiamento solicitado

Requested funding

198.444,00€

Palavra-chave 1	**Keyword 1**
Desertificação e Degradação da terra	Desertification and Land-Degradation
Palavra-chave 2	**Keyword 2**
Diversidade-Funcional	Functional-Diversity
Palavra-chave 3	**Keyword 3**
Indicadores de Alerta-Precoce	Early-warning indicators
Palavra-chave 4	**Keyword 4**
Modelação espaço-temporal	Time-space modeling

Data de início do projecto Starting date	**Duração do projecto em meses** Duration in months
01-01-2010	36

2. Instituições envolvidas

2. Institutions and their roles

Instituição Proponente
Principal Contractor

Fundação da Faculdade de Ciências (FFC/FC/UL)
Campo Grande - Edificio C7 -1º Piso
1749-016Lisboa

Instituição Participante
Participating Institution

Autoridade Florestal Nacional (AFN)
Av. João Crisóstomo, 26-28
1069-040Lisboa

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

Unidade de Investigação
Research Unit

Centro de Biologia Ambiental (CBA/FC/UL)
Campo Grande, Edifício C5
1749-016Lisboa

Unidade de Investigação Adicional
Additional Research Unit

Centro de Recursos Naturais e Ambiente - Instituto Superior Técnico (CERENA/IST)
Av. Rovisco Pais
1049-001Lisboa

Instituição de Acolhimento
Host Institution

Faculdade de Ciências da Universidade de Lisboa (FC/UL)
Rua Ernesto de vasconcelos - Edifício C5 - Campo Grande
1749-016Lisboa

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)

A Desertificação e Degradação do Solo (DDS) resulta de influência climática e humana [1], e afecta mundialmente uma grande área do solo, incluindo a região SE de Portugal [24*]. Os seus efeitos no ecossistema são generalizados (4; 5; 20) e é esperado que aumentem num cenário de alterações globais (17). O nosso objectivo neste projecto é proporcionar um conjunto de ferramentas, muito necessário [2], que possibilite a detecção de sinais iniciais de DDS e até mesmo a sua

antecipação [3].

Para este efeito, utilizaremos como indicadores funcionais dos efeitos da DDS, um largo conjunto de características funcionais das plantas combinado com a avaliação da estrutura da vegetação, medidas a nível regional com alta resolução espacial e temporal. Desta forma, proporcionamos uma nova abordagem para o problema "que áreas são mais susceptíveis à desertificação, no presente e no futuro?" [3].

As características funcionais da vegetação são características passíveis de serem medidas que estão relacionadas com alguns factores ambientais e influenciam a performance dos organismos [8]. As características funcionais permitem-nos agrupar os organismos e concentrarmo-nos nos aspectos funcionais do ecossistema, proporcionando desta forma uma ferramenta robusta para a avaliação dos impactos da DDS. As características funcionais foram usadas com sucesso por muitos autores, incluindo os membros da equipa, para avaliar a função do ecossistema em relação à tolerância à seca [6*], tolerância à eutrofização [31*], poluição [10*], poeiras [11*], características relacionadas com colonização [12*] e tolerância à presença de metais [13*]. Estas características também serão exploradas neste projecto.

Para além das características funcionais da vegetação, também avaliaremos o padrão e estrutura da vegetação, analizados através de informação da Detecção Remota do passado e presente [34]. Adicionalmente, os condutores da DDS, como alterações do uso do solo e séries temporais da precipitação [33] serão quantificados e modelados no espaço e no tempo. Esta análise histórica da vegetação e uso do solo deveria suportar um modelo explicativo das tendências reais de alterações globais e efeitos da DDS no ecossistema. Finalmente, através da utilização de séries temporais, também ultrapassaremos um problema assinalado no suporte científico dos estudos de DS, a falta de uma situação de referência [3].
O objectivo final do projecto é usar indicadores funcionais e a estrutura da vegetação como sinais iniciais de DDS, não apenas para a construção de cenários do presente, como também para a sua previsão.
Através do desenvolvimento de indicadores iniciais de DDS, estaremos perante um dos maiores desafios dos estudos de previsão [2]. Para isso, informação acerca dos indicadores funcionais e da vegetação será enquadrada por dois mecanismos propostos como relacionados com o processo de DDS – o patamar/estado de equilibrio [2] e mecanismos de facilitação [14]. Finalmente, vamos aplicar estes conhecimentos a cenários relacionados com alterações globais onde se espere que a área susceptível a DDS em Portugal aumente [17*], incluindo aumento de temperatura e diminuição da precicipitação previstos para Portugal [18*]. Deste modo, é possível responder às questões "quais são actualmente as áreas susceptíveis à desertificação?" ou " num cenário de alterações globais, que áreas serão mais afectadas pela desertificação no futuro?"

*publicações da equipa de projecto

3.1.b Sumário Executivo (em inglês)

3.1.b Executive Summary (in English)

Desertification and Land Degradation (DLD) is caused by climate and human activities (1), and affects a large area of the worlds land, including the SE region of Portugal. Its effects on ecosystems are widespread (4,5,20), and are expected to increase under a global change scenario (17). The main goal of this project is to provide a much needed set of tools (2) that may will assist us in detecting early signs of DLD and even to anticipate it (3).

Due to the large impact of desertification in our society it is essential to detect the early-signs of DLD, or even to anticipate it (2). However there is little agreement on the proper way to determine the DLD status of a region or local area (3). In fact different definitions have created different methodologies and different estimates during the last 70 years (3). Even the UN convention (UN, 2000) has recognized that although great deals of data on land resources are available, it has not been possible to get a clear picture of the status of land degradation at regional or national levels.

Global climate change has being affecting all levels of ecological organization: population, life history changes, shifts in geographical range, species composition of communities and ultimately changes in the structure and functioning of ecosystems (4, 5, 20). Land-use changes are recognized as one the main driving force changing biodiversity in the near future (19). More than using the structure and functioning of ecosystems as measures of the impact of DLD on ecosystems, we propose in this project to find the best structural and functional indicators, based on vegetation, which can early warn us about subtle changes in climate, land-use changes or both in a regional area susceptible to DLD. Moreover, most vegetation studies are based in site specific studies (sampling plot level) or in very large spatial levels using low resolution data. We propose here that vegetation structure and functional traits measured in a very dense sampling grid, thus with high resolution data, both in time and space, will provide the necessary tools to allow the development of early-warning indicators of DLD.

In order to acomplish those objectives we will use a large range of plant functional traits together with assessment of vegetation structure, measured at the regional level with high spatial and temporal resolution as functional indicators of the effects of DLD. This way we will provide a new approach on the problem of "which areas are more susceptible to desertification, in the present and to the future?” (3).

Vegetation functional traits are measurable characteristics that are functional related to some environmental factor and influence organisms performance (8). Functional traits allow us to group organism and focus in the functional aspects of the ecosystem, thus providing a robust tool to assess the impact of DLD. Functional traits have been successfully use by many authors, including the team members, to assess ecosystem function in relations to tolerance to drought (6, 7*), tolerance to eutrophication [10*, 32*), pollution [10*], dust (13*), colonization-related traits (12*) and metal-tolerance (13). These traits will also be explored in this project.

Besides vegetation functional traits, we will also assess the vegetation structure and pattern, by analyzing remote sensed data from present and past (34*). Additionally, the drivers for DLD, such as the land-use changes and precipitation time-series (33*) will be quantified and modeled in space and also in time. This historical analysis of vegetation and land use should support model to understand real trends of global changes and DLD effects in the ecosystem. Moreover, by using time-series of data, we will also by-pass a serious problem normally pointed out in the scientific support of the studies of DL, the lack of a reference situation (3).

The final goal of the project is to use the functional indicators and vegetation structure as early warning indicators, not only for current day-scenarios but also in forecasting scenarios. By developing early-warning indicators of DLD we will be dealing with one of the most challenging issues for forecasting studies (2). To do so, the information on functional indicators and vegetation will be framed by two important mechanisms that have been proposed to be associated with the process of DLD-the thresholds/steady state (2) and facilitation (14) mechanisms. We will then apply this knowledge in scenarios related with global change that are expected to increase the area in Portugal susceptible to DLD, (17*) including the higher temperatures and changes in precipitation that are predicted to occur in Portugal (18*) and answer the questions on “what are currently the area more prone to desertification?” or “in a scenario of global change, which areas will be more affected by desertification in the future?”

*publications from the project team

3.2. Descrição Técnica

3.2 Technical Description

3.2.1. Revisão da Literatura

3.2.1. Literature Review

Desertification is defined by the United Nations Convention to Combat Desertification as the Land degradation (DLD) in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (1). Accordingly to the same Convention, those areas are the ones (excluding polar and sub-polar regions) where the ratio of annual precipitation to potential evapotranspiration ranges from 0.05 to 0.65.

Due to the large impact of desertification in our society it is essential to detect the early-signs of DLD, or even to anticipate it (2). However there is little agreement on the proper way to determine the DLD status of a region or local area (3). In fact different definitions have created different methodologies and different estimates during the last 70 years (3). Even the UN convention (1) has recognized that although great deals of data on land resources are available, it has not been possible to get a clear picture of the status of land degradation at regional or national levels. Desertification assessment, over time, has shifted from simple appraisals of the annual movement of desert boundaries to the present complex multivariate analysis (3).

Global climate change has being affecting all levels of ecological organization: population, life history changes, shifts in geographical range, species composition of communities and ultimately changes in the structure and functioning of ecosystems (4,5, 20). Land-use changes are recognized as one the main driving force changing biodiversity in the near future (19). More than using the structure and functioning of ecosystems as measures of the impact of DLD on ecosystems, we propose in this project to find the best structural and functional indicators, based on vegetation, which can early warn us about subtle changes in climate, land-use changes or both in a regional area susceptible to DLD.

Vegetation functional traits are measurable characteristics that are functional related to some environmental factor that influence organisms’ performance (8). Ultimately, individual species traits are responsible for determining which species survive and which do not under an environmental factor, thus effectively determining the species assemblages that represent a community (9). By relying on the use of vegetation functional traits, rather than using a blind perspective such as total species richness, we will be able to focus on ecosystem process. We will use vegetation functional traits, such as tolerance to drought and water use efficiency (6, 7*), tolerance to eutrophication (10*, 32*) and dust (11*; *31). Team experiences in using colonization related traits (12*) and metal stress trait (13*) will also be value for understanding vegetation spatial patterns as a result of DLD. We expect to find changes in the proportion of traits (tolerance to drought/sensitive to drought) along DLD gradients.

By successfully using the model of vegetation functional traits in relation with DLD gradients, we also expect to contribute significantly to a number of different theoretical and practical issues, that have been raised by several authors and that are the specific objectives of our project

1) The manner in which land moves to desertification can be a continuous or abrupt process (Kéfi et al., 2007). There has been some debate on how the process of DLD can be associated with the occurrence of sudden shifts in the ecosystem (2), such as the one that occurred in the Sahara desert c. 500 years ago (deMenocal et al., 2000). The authors (2) present a global mechanism for this phenomenon, in which an ecosystem changes between two steady states, once a threshold level is reached. Additionally to this general steady-state/threshold mechanism, another function that has been shown to be evolved in the process of DLD is facilitation. Facilitation is the way surrounding vegetated areas may contribute to the recovery of nearby areas without vegetation (14), either by positive feedback in the local water-balance or by greater seeds availability. It has been demonstrated by model simulation that this process can be important in setting up the spatial pattern that may or not lead to an increase of DLD (Kéfi et al., 2007). Previous experiences of this team include the characterization of steady states at the ecosystem level, by modeling minor fluctuations as a result of multiple environmental factors, such as carbon balance in woodlands (15*) and the identification of trade-off mechanism that may onset great changes in the ecosystem, by determining the trade-off mechanisms that trigger ecosystem changes, such as an invasive behavior of species (16*).

2) The lack of a reference situation is frequently pointed out as a serious problem for supporting the studies of DLD (3). We expect to solve this problem with an analysis of DLD effects that includes time in addition to space. To do so we rely on the analysis of remotely sensed data of the present and past (34*) as well as in the modeling of precipitation time-series data (33*). The spatiotemporal modeling will be based on geostatiscs, which allow for accounting the joint spatial and temporal continuity patterns of variables . We will use geostatistical stochastic simulation methods to assess to spatiotemporal uncertainty.

The development of early-warning signals or indicators of the process of DLD is considered to be one of the more challenging issues for forecasting studies (2). To do so we will combine the field information on functional indicators with high resolution in the spatial level together with information on vegetation structure change over time (since last XIX century) and frame it within the mechanisms of the thresholds and facilitation previously described. Doing so, will allow us creating scenarios of vegetation response to future changes in climate and land-use (socio-economical pressure). This will be done by considering all scales of analysis, space and time, and represents the main practical outcome of the project. Both climate and land-use are expected to change in the future, including higher temperatures and changes in the distribution of precipitation (17*). Therefore, in addition to the team members we included an experienced (21*) consultant for climate modeling (Ricardo Trigo) which will be most useful in providing the future scenarios for Portugal.

*publications from the project team

3.2.2. Plano e Métodos

3.2.2. Plan and Methods

The problem and the solution
Global change has large influence in all levels of ecosystems (4, 5, 20). Land-use changes have been conserved one of the future main causes of biodiversity lost (19) and may lead to desertification, that is considered the land-degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (1).

Previous work of the team (*Pereira et al., 2006) showed that the SE area of Alentejo, most specifically the left margin of the Guadiana River, was found to be not only highly susceptible to climatic to desertification and land-degradation (DLD) but, when considering the combination of climate, soil and vegetation, was shown to be one of the areas in Portugal more susceptible to biophysical desertification (Rosário, 2004). Thus, the left margin of the Guadiana River, in Alentejo present characteristics that make it ideal for this project: i) we can find a strong climatic and human pressure towards DLD, that constitutes a gradient throughout the area;
ii.) unlike most of the country (that endure a rapid urbanization) the land-use changes that occurred in the region where mainly between woodland vs pasture, making it easier to differentiate between socio-economical and climate induced changes.
iii) there was already substantial work in terms of climatic models in the region performed by members of our team (33*).

Vegetation was always seen as the evident link between DLD and the effects at the ecosystems level, because vegetation structures the ecosystem. However, most studies in DLD approach vegetation as a unique, non-functional, entity which is considered as not changing over short time periods. As a plant ecology group our question is: what is the correct approach to model DLD with changes in vegetation patterns at regional and local scale?

Highly weathered and disturbed landscapes become leaky, losing nutrients or become less efficient in carbon and water cycling changing their vegetation patterns. Many individual plant species strategies have evolved in natural disturbance regimes such as fire and soil with heavy metals, (13*) and extremes stress levels and are therefore adapted to the range of circumstances that occur in their habitats. The identification of these species and theirs functional group characteristics could become good tools as early-warning for the direction that different landscape are subjected due to different climatic changes or other, socio-economical disturbances. Altered species composition (thus plant functional groups) may be the most critical outcome of global change conditions, as it may greatly influence ecosystem function and whole-ecosystem biological diversity. So the composition i.e the different plant functional types (and also the interactions) could contribute to understand what is the direction of a landscape is taking.
More than using the structure and functioning of ecosystems as only measures of the impact of DLD on ecosystems, we propose in this project to find the best structural and functional indicators, based on vegetation change, which can early warn us about subtle changes in both climate, land-use changes or both in a regional area susceptible to DLD and model them is space and time.

We propose four major methodological innovative approaches, which we believe present a new solution for an old problem, to determine the first signs f DLD:
1) Time: at the regional level (task 2) we will considered how vegetation changes in the DLD gradient considering not only space as normally, but also time. The main objective of this task is to evaluate the changes in the horizontal structure of the vegetation patterns since the XIX up to present and relate these changes with the ones which occurred in precipitation regime and socio-economical patterns. Additionally to changes over time, changes in the spatial pattern of vegetation response to precipitation will be evaluated. This time-base analysis will provide a global model linking the changes in vegetation structure to the changes in the factors associated to DLD. Additionally, the use of factor time will also allow the results to be use as forecasting.

2) Because vegetation structure will be collected at much higher resolution than usual, we will be able to observe shifts in the different functional groups and relate those shifts with DLD gradients, namely with macroclimatic spatial model and land-use types. Additionally, due to the high spatial resolution of the data, we will be able to discuss the impact of topography, microclimatic information and soil nutrition status, on the ecosystem resilience to DLD. Task 3

3) Functional Diversity: at the local level (task 3) we will focus the analysis in the functional diversity, rather than on particular species or groups of species with small meaning to the functioning of the ecosystem. This will provide a robust solution for the problem, because it will reflect the functions of the ecosystem being affected.

4) Early-warning indicators: after completing task 2 and 3 we should have determine which of the measured variables respond better to the factors associated to DLD, and we expect that this response is strong and accurate. But additionally we have support all those results in the theories of thresholds and facilitation explained earlier. Thus, we should have been able to model the impact of DLD in vegetation, determining if they are present, the thresholds and facilitation process associated. Thus, and because DLD-factors are quantified (e.g. precipitation, or pasture) it will be possible to use those variables as early-warning indicators of DLD (task 4). This may be done in space ("what are the areas more close to desertification?") but also in time ("if DLD factors change, e.g. less precipitation, what areas will be more prone do desertification").

The work flow of the project will be as follows:
Task 1) Collecting and organizing all information already available for subsequent tasks.
Task 2) An analysis of how vegetation structure and distribution has changed through time, as a response to present and historical DLD associated factors change (task 2). This will be done by characterizing- in space and time- the DLD associated factors (climate, socio-economical pressure) and the effects in the vegetation structure and distribution (from vegetation charts, satellite images and aerial photography).
Task 3) An analysis of how vegetation functional indicators varies in the study region as a response to the DLD gradient. This will be done by considering a subsample selected from task2 and within it taking into account vegetation functional diversity (plants and lichens) and other functional parameters (vitality, isotopic analysis). Additionally, because we acknowledge that we are working in a local scale, we will complement the study of the DLD gradient by considering microclimate and soil characteristics.
Task 4) To use the information from previous tasks to set up a functional model that will help us to predict the changes that will occur in a scenario of global change. The model will consider the past and present distribution of the indicators as well as the thresholds and resilience factors of the ecosystem, considering the pressure of precipitation regime and socio-economical factors calculated before. Future scenarios, based in cellular automaton, will include the change of these factors, including the spatial distribution. A validation of the model will be achieved by evaluating the model accuracy to predict the changes occurred from past to present.

The use of existing data will provide a valuable starting point for this project, and will offer clues for most of the work in task 2: to provide an historical perspective on DLD on which to frame the work of task 1. This means that the sites selected to perform task 3 will be chosen during task 2, in order to assure that field sampling will be done in a DLD gradient. This will provide a high level of confidence for task 3, because rather than sampling randomly, we will be sampling in a real DLD gradient, therefore maximizing the possibilities of catching the effects of DLD in vegetation. .

The CBA team will mostly be responsible for assessment of vegetation, at all spatial levels. In fact, the focus in vegetation, justifies the project coordination by CBA, because, considering the effects of DLD in vegetation, at both a broad and fine scale of analysis, represents the main innovation of this work. CBA team will perform an analysis of vegetation based in aerial photography at the regional scale (task 2) both in space (i.e. for the study area) and time (i.e. considering present and past images). This will enable us to model more confidently the changes in vegetation with the DLD, and also to provide a mechanism for predicting future scenarios, because the inclusion of time may allow a verification of the model. Another level of analysis will be the sampling of vegetation at a local scale, by considering vegetation functional traits. This team has a large experience in using functional traits to successfully study ecological complex processes, as we expect DLD to be. Examples of this are the study of plant tolerance to the accumulation of metals, to understand plants distribution and rarity (13*). This team as also used lichens functional traits, namely tolerance to eutrophication, to map the impact of land-cover (10) or to determine the threshold levels to atmospheric ammonia (32*). The use of functional traits to understand the impact of DLD will be done in task3.

Team members from CERENA will mostly responsible for the regional assessment, i.e. for collecting and interpreting data from climate, major patterns in vegetation distribution and socio-economical data. Member of this team have a large experience in studying desertification (Project Sadmo, http://cmrp.ist.utl.pt/SADMO) during which a methodology was developed to acquire and validate the data necessary for an efficient modeling of the desertification phenomenon in the western Mediterranean. As a consequence the team has a high number of publications related to desertification and land degradation reported for the study area including analysis of soils (Horta et al., 2008), precipitation events (33*) and satellite imagery (Pace et al., 2008).

The AFN partner will be responsible for collecting the data from the national sources but also for providing a large framework regarding the integration of this project in the United Nations strategies for Desertification, for which Lúcio do Rosário is the Portuguese Focal Point.

3.2.3. Tarefas

3.2.3. Tasks

Lista de tarefas (4)

Task list (4)

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
TASK 1: Characterization of a deserti...	01-01-2010	30-06-2010	6	28

Descrição da tarefa e Resultados Esperados

Task description and Expected results

Objective
This task aims at making available all necessary information for the subsequent tasks. It is divided into three main sections: i.) collecting data; ii.) mapping a selected set of variables of interest; iii.) organizing data in a Geographical Information System (GIS).

Rationale
The use of pre-existing information will provide a good cost/benefit ratio allowing a large data set to be overlaid for the study area. This project will benefit from the results and information from previous projects dedicated to the desertification theme that involved researchers of the team. These background information organized in a GIS will provide the following tasks with a robust tool both for temporal (T2) and spatial (T3) analysis. The information collected on land cover will provide the data necessary for characterizing the structure of landscape (T2) and the information on precipitation will provide the basis for the establishment of a desertification and land-degradation gradient since it has been considered as one of the driving force of desertification process at the south of Portugal.

Approach
The following information will be collected and stored in a GIS:

i.) Maps of land cover, vegetation and soil (Land cover in Pery c. 1900 and SROA c. 1960, National Forestry Inventories, Corine Land Cover Map, DesertWatch Project Maps, Environmental Atlas);
ii.) aerial photography; this information will be very helpful for sampling design of field work and for validation of project results;
iii.) satellite imagery (Landsat) from which radiometric vegetation indexes such Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI) will be calculated; for this purpose images will have to be pre-processed for geometric and radiometric correction;
iv.) Maps of extreme precipitation indexes obtained from daily precipitation data; this maps will be produced using geostatistical methodologies;
v.) socio-economical data, available from INE and Agriculture Census; the lowest administrative division available for the study area will be used in this project..

Expected Results
By the end of this task we expected to have a fully spatial-explicit data set stored in the GIS. It will include not only the remote sensing images and cartographic data but also the results from the model developed for the characterization of precipitation regime of the region.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Mestre) 1; (BPD) Bolseiro de Pós-Doutoramento 1; Amilcar de Oliveira Soares; Ana Margarida Seixas Horta; Cristina Maria Branquinho Fernandes; Cristina Maria Nunes Antunes; Lúcio Pires do Rosário; Maria João Correia Colunas Pereira; Otilia da Conceição Alves Correia Vale de Gato; Pedro António Pinho Lopes; Rita de Melo Durão;

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
TASK 2: Are we looking for the first ...	01-06-2010	30-11-2011	18	45

Descrição da tarefa e Resultados Esperados
Task description and Expected results
Objective
The main objective of this task is to evaluate the changes in the horizontal structure of the vegetation patterns since the XIX up to present and relate these changes with the ones which occurred in precipitation regime and socio-economical patterns. Additionally to changes over time, changes in the spatial pattern of vegetation response to precipitation will be evaluated.

Rationale
This task is based on the hypothesis that the processes responsible for desertification and land-degradation (measured by the climatic and socio-economical variables) will cause changes in the ecosystem horizontal structure (measured by the vegetation patterns and relative occupation of space by trees, shrubs and grasses). Afterwards, by modeling the vegetation variables with the ones associated to desertification we intend to calculate:
1) Threshold levels of the ecosystem, i.e., sill values of precipitation and socio-economical indexes at which a significant change in vegetation occurs.
2) Resilience factors of the ecosystem, i.e. the characteristics associated to the ecosystem structure and spatial distribution that contribute most to processes of desertification and land degradation.

Since both the desertification process and the changes in the vegetation structure are spatial and time dependent, this task will be performed using a spatial-temporal framework; the analyze will cover a period from late XIX century (using the first national forestry and agriculture records) up to 2005 (last national forestry inventory).

Approach
The information collected in T1 will be used and interpreted in this task:
i.) Vegetation cartography (Agriculture chart, Forestry Inventory and Corine land cover map), some of which available since the XIX century, and a time-series of NDVI and NDWI images, will be analyzed for changes in time and space of the vegetation patterns such as fragmentation (shape and size of vegetation stands), using GIS tools.
ii.) Aerial photography will provide a quantification of the changes in space and time of the forest horizontal structure: a number of sampling areas (~300) will be placed using a random stratified design over the study area, within woodlands and classified by photo interpretation: in each area (~1ha) the relative cover of each vegetation stratum (trees, shrubs, and grasses) will be quantified. This will be done for several time frames in order to assess the historical evolution of each vegetation stratum.
iii.) Maps of vegetation stratums will be obtained through geostatistical estimation and/or stochastic simulation. Geostatistics provides an adequate framework to incorporate at the same model data of different types and supports. Moreover, it

provides not only images of a certain variable but also the associated uncertainty map. In this case we will incorporate all the information available such as the forestry inventory data and field data.
iv.) All previous results, i.e. the changes observed in vegetation distribution and horizontal structure will be associated with the climatic and socio-economical changes through statistical analysis and by model interpretation, to determine the ecosystem resilience factors and thresholds.

Expected Results
1.) Cartography of the horizontal structure of vegetation in the Alentejo region, both over time and space.
2.) Changes in the land-cover patterns since XIX and identification of main driving forces for the alteration detected.
3.) Relative impact of precipitation regime vs socio-economical changes, on the alterations of vegetation patterns for the study region.
4.) Selection of the sites for task 3. To do so, considering the 1ha sampling areas, a sub-set (~100) will be chosen for a more detailed analysis. This selection will be based on the functional indicators calculated for each site, in order to obtain a gradient of what is expected to be a desertification and land-degradation process.
5.) By relating climate and socio-economical indicators to vegetation structure we will provide an estimation of the threshold values, that is, we will determine the influence of the climate and socio-economical factors in vegetation structure, and determine beyond which values a change in vegetation structure has occurred.

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; (BPD) Bolseiro de Pós-Doutoramento 1; Amilcar de Oliveira Soares; Ana Margarida Seixas Horta; Cristina Maria Branquinho Fernandes; Cristina Maria Filipe Maguas Silva Hanson; Lúcio Pires do Rosário; Maria João Correia Colunas Pereira; Otilia da Conceição Alves Correia Vale de Gato; Pedro António Pinho Lopes; Rita de Melo Durão;

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
TASK 3: Modeling ecosystem functionin...	01-01-2011	30-06-2012	18	32

Descrição da tarefa e Resultados Esperados
Task description and Expected results

Objective
The objective of this task is to develop early-warning indicators of desertification and land-degradation. To do so we will consider vegetation functional traits and sample variables that will work as functional indicators of DLD, considering the gradient obtained in task2. We will then model the shifts of these indicators with the DLD-associated variables. By analyzing this model, we will ultimately be able to calculate the threshold and resilience factors of the ecosystem. However, if in task 2 the thresholds and resilience factors were calculated for a broad spatial and temporal scale, in this task they correspond to a small spatial and temporal scale, and therefore suitable for the support of the tested variables as early-warning indictors of desertification and land-degradation. However, if possible (i.e., if they show spatial continuity), they will be interpolated for the study area.

Rationale
Our hypothesis is that shifts in plant functional types are the best indicators for early warning desertification process. We expect that plant response traits will vary in response to desertification and land-degradation, which will be assessed by the characterization of ecosystem characteristics such as evaporation, transpiration and drainage. Therefore we expect that the most important traits in detecting microclimatic and macroclimatic changes are the ones related to the responses to changes in water cycle and soil characteristics.

Approach
For approaching this task a number of approximately 100 sites will be selected based the results from task2, in a way that extremes values of climate, socio-economical and vegetation structure and distribution are included. These sites will be sampled using a stratified random design sampling strategy.

In the sampling sites selected from task2 a number of short-term functional-indicators will be sampled:
1.) Epiphytic lichen diversity indexes based in functional-types: using a standard methodology (ref) that will allow the calculation of diversity and abundance indexes, namely LDV. These indicators will take into account lichens functional traits (e.g. ratios hygrophyte/xerophytes or nitrophytic/oligotrophic lichen species).
2.) Plant diversity indexes based in functional types: plant species will be identified and individuals counted, in order to obtain diversity, abundance and dominance values. This diversity will be evaluated and classified into different functional groups, which we expect will respond specifically to the studied disturbance:

i.) main life growth forms: trees (needle or broad leaf), shrubs and grasses; this would allow to have the vertical stratification of vegetation patterns along different succession stages.
ii.) raunkiaer's life forms, which relates the embryonic or meristemic tissues that remain inactive over the winter or prolonged dry period to their height above ground;
iv.) plant functional types related with reproduction strategies (Grime, 1977);
v) Plant functional types related with types of roots;
3. Plant vitality variables related with water availability will be measured using a portable spectroradiometer. Simultaneously the vitality indices related with physiological traits such as the photosynthetic activity and water relations will be evaluated with a Spectral Analysis System. The water index (WI) will be used also as a rapid and non destructive indicator of the leaf water content.

4.) Soil variables: moisture and field capacity, pH, soil depth and total carbon and nitrogen.
5.) Microclimate: temperature and relative humidity
6.) isotopic analysis of hydrogen and oxygen in lichens: will provide an insight on the water evaporation processes.
7.) NDVI and NDWI, already calculated in task2 will be used at the local level.
8.) Maps of the sampled variables will be generated by geostatistical models as long as a spatial pattern exists.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Lic. ou Bacharel) 1; (BPD) Bolseiro de Pós-Doutoramento 1; Cristina Maria Branquinho Fernandes; Cristina Maria Filipe Maguas Silva Hanson; Cristina Maria Nunes Antunes; Lúcio Pires do Rosário; Otilia da Conceição Alves Correia Vale de Gato; Pedro António Pinho Lopes;

Designação da tarefa Task denomination	**Data de início** Start date	**Data de fim** End date	**Duração** Duration	**Pessoas * mês** Person * months
TASK 4: Applying functional-indicator...	01-01-2012	31-12-2012	12	21

Descrição da tarefa e Resultados Esperados
Task description and Expected results
Objective
The objective of this task is to use the information from the previous tasks to set up a functional model that will help us to predict the changes that will occur in a scenario of global change. Moreover, because it will be a model based on simulations it will also provide us an additional way to understand the shifts in time of the desertification and land-degradation process, namely to know the importance of facilitation in that process.

Rationale
Our hypothesis is that it is possible to use all the information collected before to set up a predictive model on the identification of future critical areas. The model will consider the past and present distribution of the indicators as well as the thresholds and resilience factors of the ecosystem, considering the pressure of precipitation regime and socio-economical factors calculated before. Future scenarios will therefore include the change of these factors, including the spatial distribution. A validation of the model will be achieved by evaluating the model accuracy to predict the changes occurred from past to present.

This approach will also allow us to understand the importance of facilitation in the desertification and land-degradation process, that is, if an area with symptoms of desertification or land-degradation is more likely to recover to a "healthy" state if nearby areas area vegetated, or if the desertification and land-degradation process can be accelerated by the presence of nearby "damaged" areas.

Approach
For this task we will model a spatial explicit surface for the study region using an approach based in a cellular automaton.
i.) The entire region will be classified accordingly to its past and present conditions regarding all possible indicators calculated in task2.
ii.) Then a number of models will be applied simulating different scenarios of global change, e.g. considering only changes in climate, or considering simultaneously changes in climate and socio-economical pressures. This model will provide the rules for the cellular automat to classify the cells in the region.
iii.) At the end a number of solutions will be made available from the model.
iv.) Validation of the model will be done by comparing the "real" changes that occurred from the past to the present, to the results obtained from the model on that same situation.
v.) The future scenarios will be obtained from simulating different future pressures from climate and socio-economical factors.

Expected Results
This task will provide a way to map the areas of risk in case of future global change scenarios.

Membros da equipa de investigação nesta tarefa
Members of the research team in this task
(BI) Bolseiro de Investigação (Lic. ou Bacharel) 1; Amilcar de Oliveira Soares; Ana Margarida Seixas Horta; Cristina Maria Branquinho Fernandes; Cristina Maria Filipe Maguas Silva Hanson; Cristina Maria Nunes Antunes; Lúcio Pires do Rosário; Maria João Correia Colunas Pereira; Otilia da Conceição Alves Correia Vale de Gato; Pedro António Pinho Lopes; Rita de Melo Durão;

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

The overall coordination of the project will be undertaken by the Principal Investigator Cristina Branquinho (CB), in cooperation with two other team members with complementary expertise, Lúcio do Rosário (LR) and Maria João Pereira (MJP). The Pos-Doc grant holder will also be responsible for coordinating the data-interoperability between the partners. Overall coordination includes promoting all main project meetings (listed in milestones), coordination of reporting and dissemination of results, promotion of scientific presentations in conferences and planning of papers to be submitted to peer-reviewed publications.

The PI and the tasks' leaders will form a Steering Committee to jointly guarantee a smooth organization of individual tasks, as well as the monitoring of the whole project progress "to time and to cost". Decisions within the Steering Committee will be reached by consensus during technical meetings and an equivalent procedure applies within tasks and research area teams.

Individual task coordination will be done by the investigators with largest experience on the subject. This includes the arrangement of time schedules for fieldwork and technical meetings with the work-group.

Task 1 will be coordinated by Cristina Branquinho (CB) at CBA that will ensure that all necessary data will be available to the other partners by the end of this task.

Task 2 will centralize in the partner CERENA, and will be coordinated by Maria João-Pereira (MJP) that as large experience on GIS, handling of remote-sensed data and spatial modeling. MJP will also be responsible making available all the necessary information on the DLD gradient so that the team may select the sites for task 3.

Task 3 will be centralized in CBA, and will be co-coordinated by Cristina Branquinho and Otilia Correia (OC) that has a large experience in project coordination and in plant communities characterization and use of functional types in research.

Task 4 will be coordinated by Lúcio do Rosário (LR) with the help of the project consultant (Ricardo Trigo). These two researchers have a large experience in climate change and studies on desertification and land-degradation.

To ensure an effective communication flow and a full data interoperability of the collected data, analysis and models, the Pos-Doc and the PI will set up a system for exchange of data, results, and information material, based in the GIS.

3.2.4.b Lista de Milestones
3.2.4.b Milestone List

Data Date	**Designação da milestone** Milestone denomination
05-01-2010	kick-of meeting
Descrição Description	
Meeting between all partners to initiate the work and coordinate strategies for data storing and sharing	
Data Date	**Designação da milestone** Milestone denomination

30-06-2010	workshop 1

Descrição
Description

Meeting between all partners to evaluate the data collected during task 1; decision on the better strategies for task 2; implementation of the final GIS and information on future reporting;

Data Date	**Designação da milestone** Milestone denomination
05-01-2011	workshop 2

Descrição
Description

Meeting between the CERENA and coordinator to evaluate the results available from task 2, that will allow to establish the DLD gradient and to select the sites for task 3;

Data Date	**Designação da milestone** Milestone denomination
16-12-2011	workshop 3

Descrição
Description

Meeting to evaluate the full results from task 2 and current interaction with task 3; defining publication strategies – topics of interests, regarding task 2

Data Date	**Designação da milestone** Milestone denomination
08-06-2012	workshop 4

Descrição
Description

Meeting to evaluate all results from task 2 and 3 and indications from task 4; evaluation of previous publication success and organization of a full-project publication

Data Date	**Designação da milestone** Milestone denomination
07-12-2012	Final meeting: evaluation

Descrição
Description

Final meeting of the project to evaluate publication success and coordinate future works

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
1	1994	UN (United Nations), 1994. UN Earth Summit. Convention on Desertification. UN Conference in Environment and Development, Rio de Janeiro, Brazil, June 3–14, 1992. DPI/SD/1576. United Nations, New York.
2	2003	Scheffer M, Carpenter SR. 2003. Catastrophic regime shifts in ecosystems: linking theory to observation. Trends in Ecology & Evolution 18:648-656.
3	2006	Veron SR , Paruelo JM, Oesterheld M.2006. Assessing desertification. Journal of Arid Environments 66: 751–763
4	2000	McCarty JP, 2000. Ecological Consequences of recent climate change. Conservation Biology 15:320-331
5	2008	Woodward FI, Keiiy CK. 2008. Responses of global plant diversity capacity to changes in carbon dioxide concentration and climate. Ecology Letters 11: 1229-1237
6	2003	**Nimis, PL. 2003. TSB Lichen Herbarium 3.0. University of Trieste, Dept. of Biology. IH3.0/02.**

7	2007	Lakatos M, Hartard B, Máguas C 2007. The stable isotopes δ13C and δ18O of lichens can be used as tracers of microenvironmental carbon and water sources. In: Dawson TE, Siegwolf RTW, eds. Stable Isotopes as Indicators of Ecological Change, Terrestrial Ecology Series, Oxford, UK: Elsevier, pp. 73-88
8	2006	McGilla BJ , Enquistb BJ, Weiherc E, Westobyd M. 2006. Rebuilding community ecology from functional traits. Trends in Ecology & Evolution, 21: 178-185
9	2006	Grime JP (2006) Trait convergence and trait divergence in herbaceous plant communities: mechanisms and consequences. Journal of Vegetation Science 17, 255-260.
10	2008	Pinho P, Augusto S, Martins-Loução MA, Pereira MJ, Soares A, Máguas C, Branquinho C. 2008. Causes for change in nitrophytic and oligotrophic lichen species in Mediterranean climate: impact of land-cover and atmospheric pollutants, Environmental Pollution 154(3):380-389
11	1999	**Branquinho C, Catarino F, Brown D, Pereira MJ, Soares A. 1999. Improving the use of lichens as biomonitors of atmospheric metal pollution. Science of the Total Environment 232: 67-77.**
12	2007	Clemente A, Rego F, Correia O. 2007. Seed bank dynamics of two obligate seeders, Cistus monspeliensis and Rosmarinus officinalis, in relation to time since fire. Plant Ecology 190:175–188
13	2007	**Branquinho C, Serrano HC, Pinto MJ, Martins-Loução MA. 2007. Revisiting the plant hyperaccumulation criteria to rare plants and earth abundant elements. Environmental Pollution 146: 437-443.**
14	2003	Foley JA, Coe MT, Scheffer M, Wang GL. 2003. Regime shifts in the Sahara and Sahel: Interactions between ecological and climatic systems in northern Africa . Ecosystems 6: 524-539.
15	2006	WERNER, C.; UNGER, S.; PEREIRA, J.S.; MAIA, R.; KURZ-BESSON, C.; DAVID, T.S.; DAVID, J.S. & MÁGUAS, C. 2006. Importance of short-term dynamics in carbon isotope ratios of ecosystem respiration (?13CR) in a Mediterranean oak woodland and linkage to environmental factors. New Phytologist 172: 330-346.
16	2008	WERNER, C.; PEPERKORN, P.; MÁGUAS, C. & BEYSCHLAG, W. 2008. Competitive balance between the alien invasive Acacia longifolia and native mediterranean dune species. Plant Invasions: Ecology and Management of Alien Plant Invasions. Backhuys Publ., Leiden, The Netherlands, pp. 428.
17	2004	Rosário L. 2004. Indicadores de desertificação para Portugal Continental, Ed. DGRF, Lisboa.
18	2006	Miranda PMA, Valente MA, Tomé AR, Trigo R, Coelho MF, Aguiar A, Azevedo E. 2006. O clima de Portugal nos Séculos XX e XXI, in Santos FD, Miranda P. Alterações climáticas em Portugal - Cenários, impactos e medidas de adaptação. Gradiva (eds), Lisboa, pp. 49-113.
19	2006	SCBD- Secretariat of the Convention on Biological Diversity. 2006. Global Biodiversity Outlook 2. pp. 81 + vii.
20	2009	Garcia-Fayos P, Bochet E. 2009. Indication of antagonistic interaction between climate change and erosion on plant species richness and soil properties in semiarid Mediterranean ecosystems. Global Change Biology 15:306-318.
21	2007	Kefi S, Rietkerk M, Alados CL, Pueyo Y, Papanastasis VP, ElAich A and de Ruiter PC. 2007. Spatial vegetation patterns and imminent desertification in Mediterranean arid ecosystems. Nature 449:213-218.
22	2000	deMenocal P, Ortiz J, Guilderson T, Adkins J, Sarnthein M, Baker L, Yarusinsky M. 2000. Abrupt onset and termination of the African Humid Period: rapid climate responses to gradual insolation forcing. Quaternary Science Reviews 19:347-361
23	2007	Trigo, R.M., R. Garcia-Herrera, D. Paredes and A. Ramos, (2007) "Iberia", in State of the Climate in 2006. Arguez, A., ed., Bulletin of the American Meteorological Society, 88, S106-S107.

3.4. Publicações Anteriores

3.4. Past Publications

Referência Reference	Ano Year	Publicação Publication
31	2008	Pinho P, Augusto S, Máguas C, Pereira MJ, Soares A, Branquinho C. 2008 - Impact of neighbourhood land-cover in epiphytic lichen diversity: Analysis of multiple factors working at different spatial scales Environmental Pollution - 151(2):414-422
32	2009	Pinho P, Branquinho C, Cruz C, Tang S, Dias T, Rosa, AP, Máguas C, Martins-Loução MA, Sutton M. 2009. Assessment of critical levels of atmospherically ammonia for lichen diversity in cork-oak woodland, Portugal. Chapter: Critical Loads. In "Atmospheric Ammonia - Detecting emission changes and environmental impacts - Results of an Expert Workshop under the Convention on Long-range Transboundary Air Pollution", Mark Sutton, Stefan Reis and Samantha Baker (eds), Springer, 464p.
33	2008	Costa AC, Durão R, Pereira MJ, Soares A. 2008. Using stochastic space-time models to map extreme precipitation in southern Portugal. Natural Hazards and Earth System Sciences, 8, 763–773.
34	2008	Pace G, Laurin GV, Rosário LP, Sciortino M. 2008. Space for the UNCCD and the DesertWatch Project", in MARINI, Alberto & Mohamed TALBI ed. (2008) - Desertification and Risk Analysis Using High and Medium Resolution Satellite Data - Training Workshop on Mapping Desertification, pp 71-83, Ed. Springer.
35	2009	Unger S, Máguas C, Pereira JS, Aires LM, David TS, Werner C. 2009. Partitioning carbon fluxes in a Mediterranean oak forest to disentangle changes in ecosystem sink strength during drought. Agricultural and Forest Meteorology. In press.

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
Cristina Maria Branquinho Fernandes	Inv. Responsável	DOUTORAMENTO	25	✓
Amilcar de Oliveira Soares	Investigador	AGREGAÇÃO	10	✗
Ana Margarida Seixas Horta	Investigador	LICENCIATURA	10	✗
Cristina Maria Filipe Maguas Silva Ha...	Investigador	DOUTORAMENTO	15	✗
Cristina Maria Nunes Antunes	Investigador	MESTRADO	30	✗
Lúcio Pires do Rosário	Investigador	LICENCIATURA	30	✓
Maria João Correia Colunas Pereira	Investigador	DOUTORAMENTO	20	✓
Otilia da Conceição Alves Correia Val...	Investigador	AGREGAÇÃO	20	✗
Pedro António Pinho Lopes	Investigador	MESTRADO	30	✗
Rita de Melo Durão	Investigador	MESTRADO	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: 10

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	24	100

(BI) Bolseiro de Investigação (Mestre) 1	Bolseiro	12	100
(BPD) Bolseiro de Pós-Doutoramento 1	Bolseiro	24	100

Total: 3

5. Projectos financiados

5. Funded projects

Lista de projectos financiados

Funded projects list

Referência Reference	**Título** Title	**Estado** Status
POCI/AMB/63160/2004	Gestão da intensidade das acti...	Concluído

(Os detalhes de cada projectos estão disponíveis clicando na referência correspondente)

(Details for each project are available by clicking on the corresponding reference)

Total: 1

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	4	0	**7**
Artigos em revistas nacionais Papers in national journals	0	0	0	2	0	**2**
B - Comunicações Communications						
Comunicações em encontros científicos internacionais Communications in international meetings	0	2	3	3	0	**8**
Comunicações em encontros científicos nacionais Communications in national meetings	0	1	1	1	0	**3**
C - Relatórios Reports	0	1	1	1	0	**3**
D - Organização de seminários e conferências Organization of seminars and conferences	0	0	0	1	0	**1**
E - Formação avançada Advanced training						
Teses de Doutoramento PhD theses	0	0	0	1	0	**1**
Teses de Mestrado Master theses	0	0	0	2	0	**2**
Outras Others	0	0	0	0	0	**0**
F - Modelos Models	0	0	0	2	0	**2**

G - Aplicações computacionais Software	0	0	0	0	0	**0**
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

Dissemination of the outputs of the projects will include:
i.) Annual and final reports of the project;
ii.) Papers, submitted to international journals with referee, communications in meetings and workshops;
iii.) A site, hosted in the proponent area, to be update until the end of the project, including objectives and main results;
iv.) Press releases to local and national journals and newspapers; dissemination articles in industrial and environmental national journals;
v.) At least 4 presentation of the project results to the local community, mainly during the “Ciência Viva” actions (free attendance, highly promoted, scientific awareness program to the public), that will take place during the second and third year of the project.

7. Orçamento

7. Budget

Instituição Proponente

Principal Contractor

Fundação da Faculdade de Ciências

Descrição Description	2009	2010	2011	2012	2013	Total
Recursos Humanos Human resources	0,00	9.560,00	29.240,00	19.680,00	0,00	**58.480,00**
Missões Missions	0,00	3.000,00	16.400,00	9.600,00	0,00	**29.000,00**
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	5.000,00	13.300,00	0,00	0,00	**18.300,00**
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	4.402,00	11.788,00	5.856,00	0,00	**22.046,00**
TOTAL DESPESAS CORRENTES TOTAL CURRENT EXPENSES	**0,00**	**21.962,00**	**70.728,00**	**35.136,00**	**0,00**	**127.826,00**
Equipamento Equipment	0,00	4.450,00	0,00	0,00	0,00	**4.450,00**
Total	**0,00**	**26.412,00**	**70.728,00**	**35.136,00**	**0,00**	**132.276,00**

Instituições Participantes

Participating Institutions

Autoridade Florestal Nacional

Descrição Description	2009	2010	2011	2012	2013	Total
Recursos Humanos Human resources	0,00	0,00	0,00	0,00	0,00	**0,00**
Missões Missions	0,00	3.000,00	7.500,00	6.500,00	0,00	**17.000,00**
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	700,00	500,00	0,00	0,00	**1.200,00**
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	1.040,00	1.600,00	1.300,00	0,00	**3.940,00**
TOTAL DESPESAS CORRENTES TOTAL CURRENT EXPENSES	**0,00**	**4.740,00**	**9.600,00**	**7.800,00**	**0,00**	**22.140,00**

Equipamento Equipment	0,00	1.500,00	0,00	0,00	0,00	**1.500,00**
Total	**0,00**	**6.240,00**	**9.600,00**	**7.800,00**	**0,00**	**23.640,00**

Instituto Superior Técnico

Descrição Description	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
Recursos Humanos Human resources	0,00	12.940,00	0,00	0,00	0,00	**12.940,00**
Missões Missions	0,00	3.000,00	4.900,00	6.100,00	0,00	**14.000,00**
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	6.250,00	750,00	0,00	0,00	**7.000,00**
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	4.738,00	1.130,00	1.220,00	0,00	**7.088,00**
TOTAL DESPESAS CORRENTES TOTAL CURRENT EXPENSES	**0,00**	**26.928,00**	**6.780,00**	**7.320,00**	**0,00**	**41.028,00**
Equipamento Equipment	0,00	1.500,00	0,00	0,00	0,00	**1.500,00**
Total	**0,00**	**28.428,00**	**6.780,00**	**7.320,00**	**0,00**	**42.528,00**

Orçamento Global
Global budget

Descrição Description	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
Recursos Humanos Human resources	0,00	22.500,00	29.240,00	19.680,00	0,00	**71.420,00**
Missões Missions	0,00	9.000,00	28.800,00	22.200,00	0,00	**60.000,00**
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	11.950,00	14.550,00	0,00	0,00	**26.500,00**
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	10.180,00	14.518,00	8.376,00	0,00	**33.074,00**
TOTAL DESPESAS CORRENTES TOTAL CURRENT EXPENSES	**0,00**	**53.630,00**	**87.108,00**	**50.256,00**	**0,00**	**190.994,00**
Equipamento Equipment	0,00	7.450,00	0,00	0,00	0,00	**7.450,00**

Total	**0,00**	**61.080,00**	**87.108,00**	**50.256,00**	**0,00**	**198.444,00**

Plano de financiamento
Finance plan

Descrição Description	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
Financiamento solicitado à FCT Requested funding	0,00	61.080,00	87.108,00	50.256,00	0,00	**198.444,00**
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**	**61.080,00**	**87.108,00**	**50.256,00**	**0,00**	**198.444,00**

8. Justificação do orçamento
8. Budget rationale

8.1. Justificação dos recursos humanos
8.1. Human resources rationale

Tipo Type		**Nº de pessoas** No. of persons
(BI) Bolsa de Investigação (Lic. ou Bacharel)		1
Duração (em meses) Duration (in months)	**Custo envolvido (€) *(calculado)*** Total cost (€) *(estimated)*	**Outros custos (€)** Other costs (€)
24	17.880,00	2.360,00

Justificação do financiamento solicitado
Rationale for requested funding

The Research grant – Licentiate will develop most of his/her work in tasks 3. It will work mostly in field sampling that will be time-consuming. Additionally it is expected that he/she will participate and acquire experience in task 4, in modeling and data analysis. This Research grant – Licentiate will be supervised by CBA/FFCUL partner and work closely with the Post-doctoral grant, that will ensure that the data is collect and organized by this grant can be merged properly with the data from other tasks.Other cost are the insurances.

Tipo Type		**Nº de pessoas** No. of persons
(BI) Bolsa de Investigação (Mestre)		1
Duração (em meses) Duration (in months)	**Custo envolvido (€) *(calculado)*** Total cost (€) *(estimated)*	**Outros custos (€)** Other costs (€)
12	11.760,00	1.180,00

Justificação do financiamento solicitado
Rationale for requested funding

The Research-grant – Master will develop most of his/her work in task 1 and 2. It will work mostly in the collection and organization of the remote-sensing data (aerial photos and satellite) and climate data (both collecting and modeling). It will be responsible for registering and processing those data into the GIS of the project. The Research grant – Master will work for 12 months and will be supervised by the IST/CERENA partner and work closely with the Post-doctoral grant. Other cost are the insurances.

Tipo Type	**Nº de pessoas** No. of persons
(BPD) Bolsa de Pós-Doutoramento	1

Duração (em meses) Duration (in months)	**Custo envolvido (€) *(calculado)*** Total cost (€) *(estimated)*	**Outros custos (€)** Other costs (€)
24	35.880,00	2.360,00

Justificação do financiamento solicitado
Rationale for requested funding

The Post-doctoral grant will work in tasks 1, 2, 3. It will be a key element in the project, directly responsible for some of the work in these tasks (where the grant-holders do not possess expertise) and for articulating the work-flow and data among the partners, being in close contact with all (CBA, CERENA and AFN). Accordingly, it will set up and manage the GIS and ensure data interoperability (mostly between remote-sensing and field data). It is also expected that he/she will provide guidance to the other grant-holders and acquire project management expertise. Other costs are insurances.

8.2. Justificação de missões

8.2. Missions rationale

Tipo Type	**Nº de deslocações** No. of participations
Participação em congressos	4
Local Venue	**Custo envolvido (€)** Cost (€)
National Congresses	3.600,00

Justificação do financiamento solicitado
Rationale for requested funding

Going to National Congress and Meetings is an important way of disseminating the work and collect new ideas to apply during the Project execution. The dissemination of the project knowledge is also intended to be done in the target area of execution of the project (Alentejo).

Tipo Type	**Nº de deslocações** No. of participations
Participação em congressos	4
Local Venue	**Custo envolvido (€)** Cost (€)
International Congresses	8.400,00

Justificação do financiamento solicitado
Rationale for requested funding

Going to International Congress is an essential part of the dissemination of the project results and ideas, mostly does related to the development of models and with the advance in the ecological theories that are the framework of the project.

Tipo Type	**Nº de deslocações** No. of participations
Trabalho de campo	340
Local Venue	**Custo envolvido (€)** Cost (€)
Field-work in Alentejo	34.000,00

Justificação do financiamento solicitado
Rationale for requested funding

Field trips are one of the back-bones of this project work. They are necessary to all project partners, but manly to CBA, that will be uncharged of most of the work in the field, including sampling vegetation structure, functional types, and vitality, soil, microclimate and sample collection for isotopic analysis (task3). Some of these sampling required returning to the site several times. For the other partners field trips are also necessary for verifying remote-sensed data, and obtaining training areas for satellite calibration (task 2)

Tipo Type	**Nº de deslocações** No. of participations
Estágios de curta duração	5
Local Venue	**Custo envolvido (€)** Cost (€)
Uni. Berkley, USA	7.500,00

Justificação do financiamento solicitado
Rationale for requested funding

Short-term scientific training period will most useful to give the students and grant-holder some of the skills related to the project, namely those related to water use-efficiency by vegetation.

Tipo Type	Nº de deslocações No. of participations
Cursos associados à temática do projecto	6
Local Venue	**Custo envolvido (€)** Cost (€)
National courses	6.500,00

Justificação do financiamento solicitado
Rationale for requested funding

Summer-courses in thematic related to the project, such as botany and statistical courser will provide the students and grant-holders of the project an additional training that will help in the development of the project.

8.3. Justificação de consultores

8.3. Consultants rationale

Nome completo
Full name

Ricardo Machado Trigo

Instituição
Institution

Centro de Geofísica da Universidade de Lisboa

Fase do projecto Project phase	Custo (€) Cost (€)
task 4	0,00

Justificação do financiamento solicitado
Rationale for requested funding

Ricardo Trigo will provide a broad scale perspective of the climate issues, given his experience in climatology,which will be most useful in providing the future scenarios.

Página na Internet onde pode ser consultado o CV do consultor
Web page where the consultant's CV can be accessed

http://www.cgul.ul.pt/Ricardo/

8.4. Justificação de aquisição de bens e serviços

8.4. Service procurement and acquisitions

Tipo Type	Custo (€) Cost (€)
Isotopic analysis of oxigen	5.000,00

Justificação do financiamento solicitado
Rationale for requested funding

Isotopic analysis: The analysis of isotopes of oxygen will provide data on the evaporative demands of the atmosphere in the study region. Because we expect that such data will have a spatial structure we will interpolate it for the region, for which a reasonable number of samples is required. This will be done in the 100 sites sampled during task 3. The price includes the replicas of samples.

Tipo Type	Custo (€) Cost (€)
Aerial photography	4.700,00

Justificação do financiamento solicitado
Rationale for requested funding

The processing and analysis of aerial photography will be the crucial part of task2, and will include an analysis in space (in the 300 sampling points) and in time (in those same points but in older images. The price shown is approximate, and should be understood as the average price for all sampling sites, including the acquisition and digitalization of older photos, and the cost of acquisition of more recent ones, for the time periods for which photos are not freely available. The price does not include the cost of processing or georeferencing the photos, which will be done by the team when necessary.

Tipo Type	Custo (€) Cost (€)
Satellite images	5.500,00

Justificação do financiamento solicitado
Rationale for requested funding

The satellite images will provide us the information missing in the aerial photography, namely the information contained in the spectral bands. It will be used to calculate vegetation and water indexes (NDVI and NDWI), that will be considered both at the regional (task2) and local (task3) level of analysis. This analysis will also be done in time, thus requiring the use of multiple images of the same area at different times. The price shown is approximate and should be understood as an average price for all scenes and all date of analysis.

Tipo Type	**Custo (€)** Cost (€)
Technical books	2.200,00

Justificação do financiamento solicitado
Rationale for requested funding

The books will be necessary as bibliographic sources to the project, to provide support for the interpretation of the results and ideas resulting from the project.

Tipo Type	**Custo (€)** Cost (€)
Office consumables	800,00

Justificação do financiamento solicitado
Rationale for requested funding

These are necessary for normal office activities, and are mainly referent to paper and printer toner

Tipo Type	**Custo (€)** Cost (€)
Carbon/Nitrogen analysis	5.000,00

Justificação do financiamento solicitado
Rationale for requested funding

The analysis of the C/N of the soil will provide an key information on the impact of DLD, because it will help us intreprete the results obtain during task 2 and 3. This will be done in the 100 sites sampled during task 3. The price includes the replicas of samples.

Tipo Type	**Custo (€)** Cost (€)
Equipment maintenance	3.300,00

Justificação do financiamento solicitado
Rationale for requested funding

The values here are correspondent to the general maintenance of the equipments already available for the project, including batteries for microclimatic-sensors and for the isotopic analyzer.

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

Tipo de equipamento Equipment type	**Fabricante** Manufacturer	**Modelo** Model	**Ano** Year
Software	ESRI	ArcMap 9.3	2009
Microclimatic sensors	Maxim	iButton DS1923	2007
Stable Isotope Mass Spectrometer	Micromass	ISOPRIME	2001
Elemental Analyser	EuroVector	EuroEA 3000 HT	2001

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 (€)

PC and monitor	Surprides	Premium Evolution	4.500,00

Justificação do financiamento solicitado
Rationale for requested funding

This project will rely heavily on computers with during its entire execution. They will be used to store all GIS-related information, which is expected to occupy a large storing space in hard-drives. Additionally the GIS processing, the development of models, and the future scenarios, are also expected to demand high processing capabilities. Each of the three partners will require a computer to properly store and process the GIS data.

Tipo de equipamento Equipment type	**Fabricante** Manufacturer	**Modelo** Model	**Custo (€)** Cost (€)
GPS	Garmin	GPSMAP 60CSx	450,00

Justificação do financiamento solicitado
Rationale for requested funding

A portable GPS device will be acquired use during all field samplings to georeference all sampled sites (in task 3) and to verify position during the field verification of photography in task 2.

Tipo de equipamento Equipment type	**Fabricante** Manufacturer	**Modelo** Model	**Custo (€)** Cost (€)
Microclimatic sensors	Maxim	iButton DS1923	2.500,00

Justificação do financiamento solicitado
Rationale for requested funding

The microclimate sensors, capable of measuring and storing data of relative humidity and temperature will be used to characterize the climate pattern in the study region. They will be placed in the 100 sampling sites during task 3, for which we are taking into account already owned sensors.

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
timeline.pdf	53Kb

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