| **Project Title:** | ECOPOTENTIAL: IMPROVING FUTURE ECOSYSTEM BENEFITS THROUGH EARTH OBSERVATIONS |

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Final list of data delivered by PAs

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Executive summary

The aim at this work was to identify in the frame of ECOPOTENTIAL a relevant list of data available at protected areas. The approach was focused on two directions, first was to identify the data sources providing ready to use data for remote sensing and modelling purposes and the second was to find specific data available or existing at the protected areas.

There were identified a number of 23 data portals categorized on the basis of provided data type into seven categories as following: boundary of protected areas, habitat and species distribution, soil type distribution, climate data, land use land cover, European regional sea data, and metadata publishers. These data can be used for setting-up and testing of some models (e.g. hydrological, species distribution etc.).

Protected areas involved in the project grouped their research and management questions in relation with different ecosystem services into narratives called storylines.

Beside generic data, specific data provided by protected areas (in their description or in the storylines) were analysed and classified into "data products". A "data products" being an intermediate upper level between a variable and a more general category. The aim of using this approach is to facilitate the communication between data holders and data users. Also, grouping data into data products is useful to harmonize different names or definitions of the same variable.

The task resulted in a table of available data products needed for the different storylines developed in the ECOPOTENTIAL project, but also starting with a documentation of all available data at the different protected areas.

Our analysis of presented storylines revealed a number of 130 variables that could be grouped into 54 "data products". In addition the documentation of data products using the web based metadata catalogue DEIMS was initiated. Additional 95 data products linked to a number of different datasets were documented. The information on the protected areas and the data products can be used to assess the applicability of research questions and the identification of data gaps. The similarity analysis tested in the current context could be used.

1   Introduction

Providing sufficient information, knowledge and data about the environment is an important pre-requisite for any research activity as well as for decision support resulting from scientific results. Protected areas in Europe, but also on a global scale, not only have an important role in preserving natural resources (e.g. biodiversity) but also are important areas for long term observations and experiments. Getting an overview on available in-situ data is an important task in order to foster reuse and sharing. Despite many efforts on harmonising the information flows from different data providers, the overview on available data across the different PAs is still missing in many respects.

Data portal like WALTER[1] on the Wadden Sea is a good example on how access to data and knowledge from the protected areas could be organised. One of the aims of the ECOPOTENTIAL project is to link remote sensing and in-situ data in order to allow for cross scale and cross domain analysis. The provision on sufficient and meaningful metadata[2], a good description of the data contents[3] as well as establishment of data quality routines for data and metadata[4] are important pre-requisites in this process. The development of a common interface to data discovery and access is one of the aims of the ECOPOTENTIAL project.

To create an overview on existing in-situ datasets and available data sources relevant for the assessment and evaluation of past and future developments of protected areas was the first step. The aim at this work was to identify, based on the needs for ECOPOTENTIAL, relevant in-situ datasets available at protected areas.

The data documented were referred as '*in-situ data*' defined as data observed or sample collected within a given location or ecosystem. In terms of ecological observations this refers to subjects like biodiversity, meteorological observations or local sensor based observation (e.g. within-stand LIDAR). One of the results of the current work is a draft list of data topics (or data products)[5] which can be used to compare the data availability from different data providers or data sources.

 The approach structured according to the following aspects:

a) Update the information on protected areas using a standardised documentation schema
b) Identify and assess the data needs from the different stakeholders within the project context
c) Create an overview on available data sources and data products relevant to the project

The current report describes the concepts applied as well as the results. In addition the DEIMS platform as well as the developed discovery portal of the ECOPOTENTIAL Virtual Research Environment (VRE) can be used to discover available data.

1.1   Metadata concepts

In order to provide a more complete documentation of available information sources not only the datasets as the basic entity should be described but also information on the context of the observation should be

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[1] see http://www.walterwaddenmonitor.org/tools/dataportaal/

[2] see ECOPOTENTIAL Task 5.3 on Metadata Models

[3] See ECOPOTENTIAL Task 5.6 Semantic Backbone for in-situ data

[4] see ECOPOTENTIAL Task 5.5 Data Quality Evaluation

[5] See Annex I – List of Data Products

provided. To do this the information model developed for the DEIMS Site and Dataset Catalogue[6] was applied. Fig. 1.1 shows the different level of metadata.
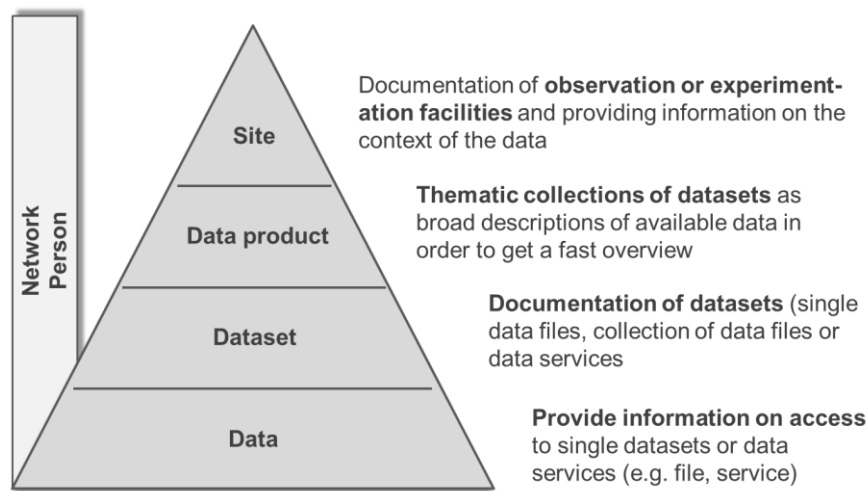
Fig. 1.1 DEIMS basic Metadata Information Model
(Information can be provided either by a person as an individual or by a network representative)

Starting from the site, as the context of the observation, down to the data, as the single value of the observation, more detailed information is provided. This conceptual model is also subject to the linked work of task 5.3 on the metadata. The basic outline of the model was developed within the EnvEurope project and implemented to the DEIMS Site and Dataset Catalogue.

Within ECOPOTENTIAL WP5 this conceptual information model was adopted and used to collect information on available in-situ data.

1.1.1 Concept 'Site'

The basic concept in DEIMS is the '**site**'. This is defined as the location where short or long term observations and/or experimentations take place. A site clusters a series of different observations plots together, which are managed by one or more communities. A site is either the area of investigation (e.g. a catchment) or an area of interest (e.g. a socio-ecological defined region).

A full description of the SITE Metadata model (MD) is provided in the documentation section of DEIMS[7]. There also the list of mandatory fields is defined resulting from discussions within the long term ecological research community. This basic metadata model was adopted for ECOPOTENTIAL and adapted to its needs.

In this respect a **protected area** can be seen as 'site' and can by this be described using the MD model SITE in DEIMS. For ECOPOTENTIAL a minimum set of information needs to be provided, but more information is welcome. For all protected areas addressed in ECOPOTENTIAL the basic information was available in the site catalogue was updated with expert knowledge from the local site managers.

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[6] See https://data.lter-europe.net/deims/

[7] See https://data.lter-europe.net/deims/documentation/site

1.1.2 Concept 'Data product'

The concept of '**data product**' was added in order to allow a summarised description of a collection of datasets. A 'data product' can be e.g. 'Deposition data', which contains a range of different parameters and time series. Instead of describing each single dataset or parameter the 'data product' can be described as a whole. The related datasets (by its MD) can be linked to the data product.

By applying this concept, a fast overview on available data sources in a protected area can be created without providing a full description of each single dataset. This is needed in a second step in order to ensure the reusability of the data.

Applying the concept of the data product, a prioritisation in the creation of metadata (if not available) and provision of datasets (e.g. in common data formats) can be made. This allows for a targeted data provision policy.

If no complete dataset MD are provided via the ECOPOTENTIAL VRE, the data products forms should be used in order to provide aggregated information on the available data.

Definition of data products

A data product is a product that facilitates an end goal through the use of data. In the specific case of ECOPOTENTIAL the 'data product' represents a summarised description of a series of data aimed at presenting the available data sources in a protected area without a full description of each single dataset. It should be seen as something between a broad class (e.g. biodiversity) and a detailed dataset (e.g. abundance of a species within 0.1 hectare plot). For instance, 'deposition data' can be a 'data product' that contains several parameters measured with different temporal frequencies and spatial scales. The advantage of using this approach is that instead of describing each single dataset or parameter the 'data product' can be described as a whole. The related datasets can be linked to the data product through its metadata. In this way the protected areas as data holders don't have to document with detailed metadata every dataset they are collecting. Also, the modellers or remote sensing experts can find out different types of data they can use. Once a specific datasets was identified as needed for modelling, for example, the associated metadata have to be documented by its owner.

Data products identification

On the basis of the information provided by each protected area involved in the project we were able to identify and categorize data products considering an intermediate upper level of information where the data set can fit in without losing its meaning. Information used for data products identification were those provided by protected areas in their description, storylines and other available sources (e.g. modelling needs, internet search). Data products identification was done keeping in mind the need for harmonization of different type of variables (i.e. names, meaning). A hierarchical reference list of data products and the associated variables was created and it can be found as **chapter 6.1** Annex 1. Reference list of data products to this deliverable.

1.1.3 Concept "Dataset"

A dataset is a single data file or a series of data files which are described by a metadata (MD) record. This can be either a physical file (e.g. excel, csv, shape) or a data service (e.g. OGC WFS, OGC SOS). For

datasets metadata as specified in the DEIMS community profile (link to INSPIRE and EML) or the INSPIRE MD Specification need to be provided.

Currently the community profile of the Dataset MD Model defined in DEIMS is adopted in ECOPOTENTIAL. This can be found within DEIMS data model documentation[8].

1.2 Storylines

The storylines are narratives developed by scientific partners in the project and are aimed at contextualize the overall workflow of ECOPOTENTIAL in particular ecological, management and policy settings. In total, 20 storylines were developed (Tab 1.1) 10 for mountain ecosystems, seven for aquatic ecosystems (sea, coastal lagoons and deltas) and three for arid/semi-arid ecosystems. A storyline links real-life issues which have broad relevance to many Protected Areas included in the ECOPOTENTIAL project. The storylines will specify the needs for Earth Observation data and in-situ data for ecosystem modelling, ecosystem services, cross-scale topics, demands for future protections, policy and capacity building. While storylines do not have to cover actions in all the Work Packages of the project, they are aimed to be broad yet locally relevant, engaging with stakeholders and decision-makers. Each storyline is focused within at least one Protected Area and it puts the basis for further operational work in the field, adding specifics, defining a work plan, assigning tasks, and allocating resources (person-months) among partners. Storylines are iterative processes whose flow of activity and practical implementation evolves with the increase of knowledge and the demands by stakeholders.

Table 1.1 List of storylines and their associated protected areas
(http://www.ecopotential-project.eu/2016-05-24-14-52-12/storylines)

ID	Title	Focal Areas	Lead Author
Mountains			
M1	Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification	Gran Paradiso National Park (Italy), Hardangervidda National Park (Norway)	CNR, UIB
M2	Managing mountain forests undergoing changing disease / disturbance dynamics	Northern Limestone National Park (Austria)	EAA
M3	Interaction between climate change driven bark beetle outbreaks and forest decline and nitrogen deposition driven inertia in ecosystem succession in mountain ecosystems	Bavarian Forest National Park (Germany)	UBT
M4	Mountain biodiversity as a sentinel of environmental change	Gran Paradiso National Park (Italy)	CNR/PNGP

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[8] See https://data.lter-europe.net/deims/documentation/dataset

M5	Ecosystem services and biodiversity crisis across mountain lakes	Ohrid/Prespa (Macedonia) Gran Paradiso National Park (Italy)	CNR
M6	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Swiss National Park, Landschaft Davos (Switzerland)	ETH
M7	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain PAs	Peneda-Gerês (Portugal)	ICETA
M8	Ancient irrigation channels as management tools to buffer the impact of climate change in Sierra Nevada ecosystem services	Sierra Nevada (Spain)	UGR
M9	Temporal evolution of ecosystem services in Sierra Nevada	Sierra Nevada (Spain)	UGR
M11	Structure, trends and drivers for the sub-arctic northern treeline in face of climate change and pathogen outbreaks in Abisko National Park, Sweden	Abisko National Park (Sweden)	UBT
Coastal/Marine			
O1	Improving coastal lagoon benefits under multiple pressures	Wadden Sea (The Netherlands)	DELTARES
O2	Ecosystem services provided by cetaceans in the Mediterranean	LME Mediterranean	UBO
O3a	Conserving dynamic wetlands under combined global, regional and local stressors - The case of Camargue	Camargue (France)	TdV
O3b	Conserving dynamic wetlands under combined global, regional and local stressors - The case of Doñana	Doñana (Spain)	CSIC
O4	The impact of aquatic ecosystems provisioning services on tourism	Danube Delta (Romania)	UB
O6	Cross-scale management of ecosystem services in the Mediterranean Large Marine Ecosystem	LME Mediterranean	PoliMi
O7	Invasive species impacting the functioning and services of island protected areas through losses of endemic species	La Palma (Spain)	UBT
Arid/semi-arid			
A1	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Har HaNegev (Israel)	BGU

A2	Spatial-temporal dynamics of savanna ecosystems (tree-grass interactions, grass quality/quantity, biodiversity) as a life support system to wildlife and livestock production in and around Kruger National Park	Kruger National Park (South Africa)	CSIR
A4	Mediterranean wood-pasture for people and nature	Alentejo Natura 2000 sites (Portugal)	IST

2 Methods and materials

2.1 Identification of data needs

A first step of the process was to identify the data needs of the different stakeholders within the ECOPOTENTIAL project. These are:

- WP3 and WP4 dealing with remote sensing products and using in-situ data for calibration and ground-truthing
- WP6 dealing with modelling and using in-situ data as input to the models

For this, available project documents, e.g. the storylines defining the scientific scope of WP6, were analysed and compared. Data needs of the models applied in WP6 were analysed together with scientists.

Wherever possible, data needs formulated by the protected area managers were documented in addition.

2.2 Identification of available data sources

Based on the data needs available information resources were analysed. These included

a) the creation of an overview of relevant data portals
b) the documentation of datasets and data products based on project documents and updates from the protected areas.

The result is summarised in this report, but also will be continuously updated using the DEIMS web catalogue.

2.3 Authoring of metadata

The DEIMS Site and Dataset Catalogue (http://data.lter-europe.net/deims/) is a web based editor and discovery catalogue for research sites as well as the related datasets collected at these locations. It is implemented in Drupal 7 and is based on the *DEIMS Dataset Metadata Editor* developed by US LTER[9]. The European branch of DEIMS was further developed in a number of European scale projects[10] linking site information to the resulting dataset. Currently DEIMS is used within LTER Europe and ILTER to manage the list of research sites and observation facilities.

In ECOPOTENTIAL the DEIMS editor is used to document and describe the network of protected areas. This only can be done together with the protected area managers. In addition, the dataset metadata catalogue is linked to the ECOPOTENTIAL VRE using harvesting interfaces and a CSW endpoint.

DEIMS was established in order to collect and manage information on long term observation and experimentation facilities and their resulting datasets. DEIMS by definition is not only restricted to the LTER/ILTER community but tries to include all kinds of relevant information. Part of the protected areas included in the ECOPOTENTIAL project are part of the LTER Europe network and by this documented in the DEIMS catalogue.

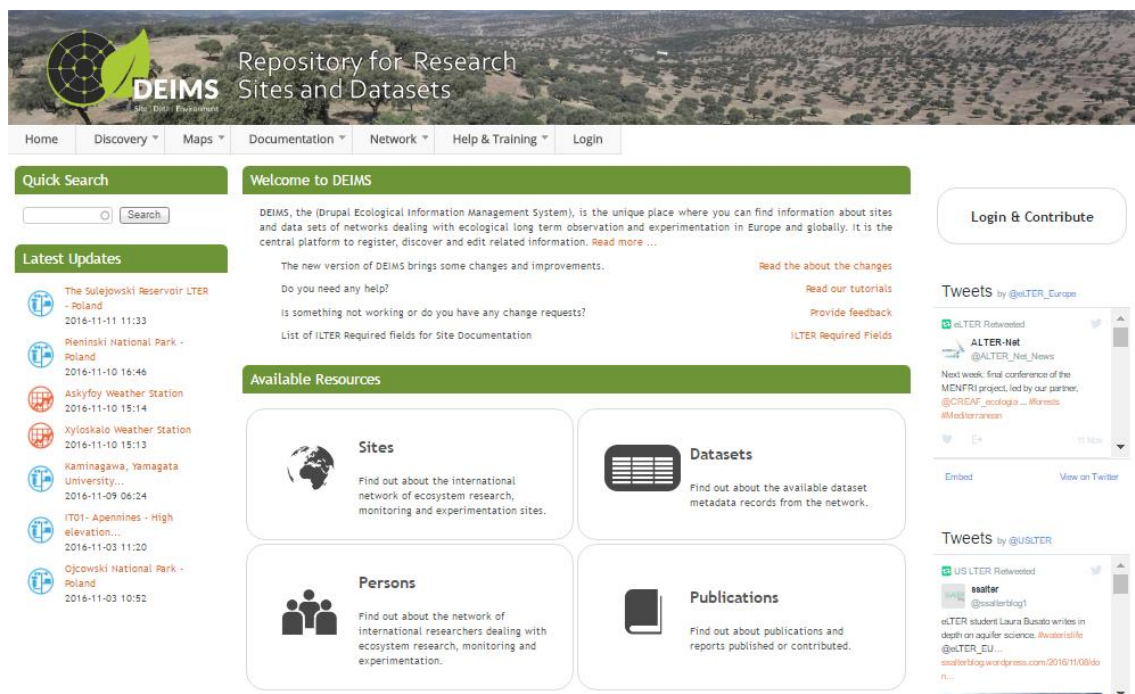[9] See http://im.lternet.edu/projects/DEIMS

[10] E.g. EnvEurope (LifePlus), ExpeER (FP7), eLTER (H2020)

DEIMS allows managing and sharing information on a wide range of elements within an observation network following a basic conceptual model (see chapter 1.1):

- **Network**, which is defined as the organisational entity which organises activities at a given site in addition to the managing organization.
- **Site**, which is defined as the location where a series of observations (mostly long term) or experimentations take place. Mostly a site is equipped with energy supply and permanent observation facilities. A single e.g. weather station would be an 'observation facility' which could be grouped together with other infrastructures to a 'site'
- **Data product**, which is defined as generic information object (e.g. monitoring activity) which generates a data stream. This was included in order to provide the possibility of a fast overview on available information for a given location.
- **Dataset**, which is defined as a single or a series of information objects (e.g. data files, images, observations, etc.) which are described with a consistent metadata (MD) record. A 'dataset' metadata record describes a physical existing file.
- **Person** information, which is defined as information on persons and organisations which are linked to site, dataset, data products or networks.

The different MD models are linked using a UUID as unique identifier for the sites, persons, datasets and networks.
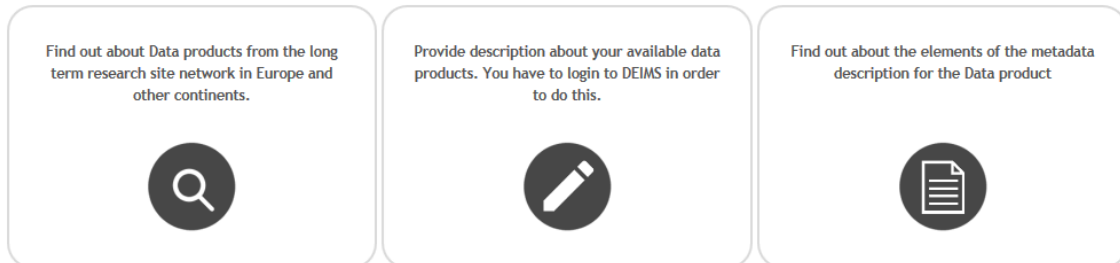
Fig. 2.1 provides and overview on the start page of the DEIMS web application. DEIMS can be used to create, update and discover metadata.

Fig. 2.1 Start page of the DEIMS Site and Dataset Catalogue

2.3.1 DEIMS capabilities

DEIMS provides not only editing functionalities, but also allows to share information with other systems by exposing the managed metadata. The basic capabilities of the DEIMS Catalogue are (a) editing, (b) discovery, (c) exchange, and (d) providing documentation on the documented objects (Fig 2.2).

Find out about Data products from the long term research site network in Europe and other continents.

Provide description about your available data products. You have to login to DEIMS in order to do this.

Find out about the elements of the metadata description for the Data product

Fig. 2.2 Functionalities in DEIMS

As web based portal DEIMS provides landing pages linking the different MD contents within a single viewing page. Thus allows the user an easy access to all information provided via DEIMS.

2.3.1.1 Metadata editing

DEIMS provides web forms to create, edit and update metadata for the different elements. The metadata models defined for the different elements are implemented in these forms, also checking mandatory elements for the different communities.

Editing of metadata requires authentication in the system. For ECOPOTENTIAL an own user profile and user was created in order to edit and update the information provided within the project.

The web based forms allow a structured input of the data. When saving the records the mandatory and required fields are checked. Publishing a record is only possible when all required information is provided. Fig. 2.3 provides an example for creating a metadata record for a data product. The web forms for the sites, datasets and networks are designed in a similar way.

The different metadata elements are grouped into thematic groups in order to enhance usability of the editing process. Wherever possible reference lists are used to populate the fields. These reference lists (e.g. list of data product types or parameters) are managed by the EnvThes Controlled Vocabulary[11].

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[11] See http://vocabs.ceh.ac.uk/evn/tbl/envthes.evn

Create Data Product

A 'data product' can be e.g. 'Deposition data', which contains a wide range of parameters and a long time series. Instead of describing each single dataset or parameter the 'data product' can be described as a whole. The related datasets (by its MD) can be linked to the data product.

Title

Identification *

General Information *
(active tab)

Data Resolution *

Availability *

Contact

Data Product Type *

- Please select -
Meteorology
Air chemistry
Deposition
Topography
Geology and Geomorphology
Hydrology and water budget
Land Cover and habitats
Aquatic systems characteristics
Marine systems characteristics
Terrestrial systems characteristics
Social systems characteristics
Nature conservation and management
Disturbance and desaster events
Remote sensing data products

☐ ecosystem measure
☐ biological measure
☐ atmospheric measure
☐ experimental measure
☐ genetic measure

Fig. 2.3 DEIMS Edit form for data product

Each MD record is authored by a responsible person designated by the data provider and registered as a user in DEIMS. Defined by the role, only this user can edit and update the MD records that belong to him. When saving the metadata record a landing page is provided showing the content of the metadata record (see Fig. 2.4).

Doñana_waterbird_counts

View | Edit | Delete | Clone this data product

Basic Information

Data Product Type: Bird
Related Site: Doñana Long-Term Socio-ecological Research Platform - Spain
Abstract:
Data on bird presence and abundance in Doñana is available since the 50ties, even before its protection. EBD-CSIC started standardized monitoring by aerial counts in the 70ties, initially focused on wintering birds but since de early 80ties counts are conducted monthly, and up to 50 bird species are identified in 52 counting areas within the marshes. Terrestrial bird count of main bird concentrations of Doñana have been conducted at the same time (both EBD-CSIC and Park Management) but were not standardized until 2002 by EBD-CSIC. Since then, monthly surveys have been conducted covering about 87 water bodies of the marshes and from fixed observation points (up to 196 water bird species are included). Additionally, each month, a transect (30 km) count of birds (all non-passerine species and Corvus corax) present at the beach and sea shore is done by car. Furthermore, during spring, colonial water bird nests are located and chicks ringed when possible. Several colonies have been monitored since the 80ties. Non-colonial waterbird nests are located monthly during the breeding season using linear transects on horse in the marshes, totalling about 65 km. These transects data are being collected since 2003. Earlier data on non-colonial breeding waterbirds are more disperse, although ringing activities have been done since the 70ties on regular bases.

Parameters:
ecosystem measure   population and community properties   community composition   diversity measure
biotic diversity   faunistic diversity   species composition   population size   species presence measure
presence of birds
Date Range: Monday, January 1, 1973 to Tuesday, October 11, 2016
Responsible Party: Guyonne Janss
              Javier Bustamante
              Luis E. Santamaria Galdon
              Carlos Rodriguez
              Manuel Mañez
UUID: 50249e7c-756c-4af9-a7a5-56d56525e907

Bounding Box

Taken from the listed site(s), as no direct bounding box is provided for the data product.

Extended Information

Temporal Resolution: monthly

Spatial Resolution: full area coverage

Fig. 2.4 Landing page for a metadata record – data product

2.3.1.2 Metadata discovery

DEIMS also provides discovery forms for the different elements (e.g. site, datasets, data products). Based on a pre-defined list of fields the user can query the information and view the metadata records in the html-forms.

For dataset and sites also faceted search is implemented using an Apache Solr index to optimise the query time. For sites in addition a map view is provided (see Fig. 2.5)

a)

b)

Fig. 2.6 DEIMS Discovery page – (a) example simple query dataset, (b) DEIMS Map Viewer for Sites

2.3.1.3 Metadata exchange

Within DEIMS, dataset metadata can be exported in the following formats. The following formats are supported:

- ISO 19115-2 North American Profile
- ISO 19139 Inspire Profile
- BDP BDP
- EML EML 2.1.1

Each of those formats can be exported and downloaded individually. The conversion from the database to XML is done using custom Drupal modules written in PHP by US LTER and extended by LTER Europe. In addition harvesting lists has been implemented for ISO 19115-2 North American Profile and EML 2.1.1.Harvesting of EML files is realised through a harvest list (see Fig. 2.6).

Fig. 2.7 Example for ISO19139 INSPIRE compliant MD record for dataset

Within task 5.3 a mapping of the DEIMS metadata elements to INSPIRE Environmental Monitoring Data Specification[12] is done and tested. This should allow the exchange of meta information on the organisation and scientific configuration of the research locations based on services.

2.3.1.4   *Metadata Model Documentation*

The underlying metadata models and metadata elements are documented in DEIMS. Fig. 2.8 provides an example for the data product metadata model (DPMM)[13]. The documentation is provided for all metadata concepts in DEIMS (e.g. site, dataset, etc.) and consists of the following information:

- Element name
- Definition of the metadata element
- Recommendations and hints for the use of the element
- Format of the entry (e.g. Text(255) or reference list value)
- Multiplicity of the entry (e.g. [0..1] or [1])
- Required – if the element is mandatory (e.g. yes). If different communities have different mandatory elements in addition the community is listed.
- Example for a filled metadata element
- Reference list – if applicable, the reference list used for the MD element is documented

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[12] See http://inspire.ec.europa.eu/documents/Data_Specifications/INSPIRE_DataSpecification_EF_v3.0.pdf

[13] See https://data.lter-europe.net/deims/documentation/activity

In the documentation changes in the metadata models are also documented and references to previous metadata models (e.g. in the site metadata model) are documented. This allows to make transformations between the different versions or the metadata.

Fig. 2.8 DEIMS Documentation pages – example Data Product [DP]

2.3.2   DEIMS Metadata Models

Based on the implemented metadata models a set of mandatory metadata elements for the different objects were defined. The mandatory metadata elements were implemented within the current production instance of DEIMS (https://data.lter-europe.net/deims/). In this chapter an overview on the mandatory metadata elements is given.

The current implemented metadata models are subject to discussion in task 5.3 within ECOPOTENTIAL and will be adapted to the long term needs for protected areas.

2.3.2.1   Documentation of Protected Areas [PA]

The following information should be provided (mandatory fields are checked during the MD entry, and a MD record can only be published, when all information is provided):

- Name and general description
  - Site name, Short name (abbreviations), and Site code
  - General site description
  - Size in ha
  - Images (recommended, but not mandatory)
  - Keywords
- Contact details

- o Site manager and Site owner
- o Web link
- Metadata provider
- Geographic location
    - o Center coordinates and Bounding box
    - o Elevation range
    - o Shape file (if available, not mandatory)
- Ecosystem and environmental characteristics
    - o Annual air temperature and precipitation range
    - o Biome and ecosystem type (global classification)
    - o Biogeographic region and habitats (European classification)
- Network affiliation
    - o Status in ILTER network (normally non-LTER)
    - o Other networks (select 'ECOPOTENTIAL (H2020)')
- Status and history
    - o Site status and year of establishment
    - o Focus, design and scale of site
    - o Research topics and observed parameters (as indication of available data at the protected area)
- Protection status and resource management
    - o Protection program and cover
- Infrastructure and operation
    - o Infrastructure (special focus on data infrastructure) including Infrastructure notes
- Data sharing policy
    - o Data request format, General data policy, and Data policy notes
- Data management
    - o Data storage locations, Number of data storage locations, and Data notes

For each of the metadata records a landing page is provided all linked information on the research location, e.g. protected area (see Fig. 2.9).

Fig. 2.9 Example of basic documentation of a Protected Area
(see https://data.lter-europe.net/deims/site/49515dda-1198-4013-8f43-c33e107af081)
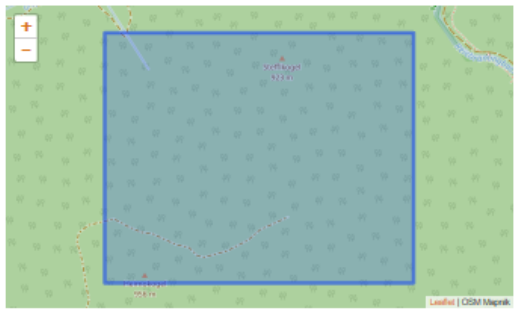
2.3.2.2   Documentation of Data Products [DP]

A data product contain the following information (see Fig 2.9)

- Title - title of the data product
- Site / Protected area - reference to the protected area(s) in which the data were generated
- Data product classification - classification of the data product based on a taxonomy
- Abstract - textual description of the content of the data and the methods used

- Parameter (optional) - more detailed information on the parameters provided in the data product
- Keywords - providing keywords (based on EnvThes) to annotate the data product and allow the user a more targeted search and discovery
- Time period - in which the data are generated
- Temporal resolution - temporal resolution of the data
- Spatial resolution - spatial resolution of the data collection
- Data digital available - are the data available in digital format
- Link to the data portal
- Data publically available – [yes/no]
- Data available for ECOPOTENTIAL – [yes/no]
- Contact person

Fig. 2.10 Example for basic documentation of a data product
(see https://data.lter-europe.net/deims/content/LTER-Z%C3%B6belboden-Austria-deposition).

For each data product a MD record is created and referenced to the site/protected area. In addition, if available, dataset MD can also be linked to the data product.

2.3.2.3 Documentation of Datasets [DS]

The DEIMS community profile adopted by ECOPOTENTIAL contains the following metadata fields for a dataset (see Fig. 2.10). The community profile is based on the INSPIRE MD Model and EML.

- Title and Identifier
- Creator and contact points
- Metadata provider and Metadata date
- Publication date
- Dataset language (of the data)
- Dataset abstract
- Keyword set
- Data use and sharing
  - Access and use constraints
  - Intellectual rights

- Online distribution links or Data Source (documentation of data file)
- Geographic reference (Bounding box and elevation range)
- Temporal extent
- Taxonomic coverage
- Method description
  - Methodology, instrumentation and sampling
  - Quality assurance
- Legal obligation and reporting

Fig. 2.11 Example for basic documentation of a dataset
(see https://data.lter-europe.net/deims/node/8944)

Within the task 5.3 extensions of the current community profile will be defined and implemented in a later version of the DEIMS MD editor.

3   Results

3.1   Identification of data needs

3.1.1   Data needs by models

Work package 6 identified a set of models that would be developed for some protected areas considering their previous use in other similar protected area or their generic applicability (i.e. hydrological modelling, statistical modelling etc.) (see Tab. 3.1). The models are aimed at describing fundamental ecological processes (e.g. biogeochemical cycles, hydrology, sediment transport etc.), habitat suitability for certain species and distribution of different ecosystem services. These models require data both in their set-up phase as well as in their calibration phase.

Tab. 3.1 List of models identified by WP6 and their applicability

No	Model name	Applicability
1	Delft3d-Flow Zuno-Coarse	Process based model (applied for Wadden Sea / Dutch Delta)
2	Generic Ecological Model (GEM) Zuno-Coarse	Model for short-term prediction of Southern North Sea algal dynamics with remote sensing images
3	General Ocean Turbidity Model 4.0 (GOTM)	Process based model used for marine and lake ecosystems
4	General Estuarine Transport Model (GETM)	Process based model used for ocean and seas
5	European Regional Seas Ecosystem Model (ERSEM)	The North Sea, Northwest European Shelf
6	HABITAT (Spatial analysis tool)	North Sea
7	EcoSim with EcoPath (EwE)	North Sea
8	SEHR – ECHO	Spatially Explicit Hydrologic Response model for ecohydrologic applications – process based model
9	Pan-European Soil Erosion Risk Assessment (PESERA)	Process based model spatially distributed model applicable at Europe scale.
10	(Maximum Entropy Modelling) MaxEnt	Statistically based model useful for habitat suitability modelling, applied in Samaria National Park
11	MOHID Land	Process based model - simulate hydrographic basin and aquifers
12	MOHID Water	Process based model - a three-dimensional numerical program to simulate surface water bodies (oceans, estuaries, reservoirs).
13	LandscapeDNDC	A process model for simulation of biosphere-atmosphere-hydrosphere exchange processes

Data needed to run the models are generally linked with physical characteristics of the environment, chemistry of water, and meteorological parameters. In the next phase an overview of the needed variables should be produced by WP 6, 7, 9, and compared to the available datasets (see 6.4).

3.1.2 Data needs by earth observation/ remote sensing validation

There were identified 41 types of passive and active airborne or satellite sensors ranging from very high to low spatial resolution, panchromatic to hyper-spectral (see Tab. 3.2). These sensors were used to derive over 73 variables aimed at detection of physical characteristics of protected areas landscape elements (see Tab. 3.3).

Tab. 3.2 List of sensors/missions available at different protected areas

No	Sensor / Mission
1	Aerial photos
2	ALOS PALSAR
3	ALOS PALSAR-2
4	APEX
5	ASTER
6	AVHRR
7	Corona
8	ESA SMOS
9	GOSAT
10	High or very high resolution images
11	Hyperion
12	Hyperspectral from ground, drone, airborne sensors
13	IGN ortho-photographs
14	JERS-1
15	Landsat
16	Landsat
17	LiDAR
18	LULC maps SIOSE Andalucía[1]
19	MERIS
20	MODIS (AQUA/TERRA)
21	NASA SMAP

No	Sensor / Mission
22	Pléiades
23	Proba-V VGT-P
24	Quickbird
25	RapidEye
26	RGB and IR orthophoto
27	Sentinel 2A MSI
28	Sentinel-1
29	Sentinel-2
30	Sentinel-3
31	SPOT
32	SPOT 5 / VGT
33	SPOT-5
34	SPOT-5 HRG
35	SRTM
36	Tandem-X data
37	TerraSAR-X
38	TRMM
39	Version 1 Nighttime VIIRS Day/Night Band Composites
40	Version 4 DMSP-OLS Nighttime Lights Time Series
41	WorldView-2

Tab. 3.3 Total number of remote sensing datasets available for different storyline.

Storylines	Number of Sensor / Missions
Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	8
Conserving dynamic wetlands under combined global, regional and local stressors	10
Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification	4
Ecosystem services and biodiversity crisis across mountain lakes	7
Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	10
Managing mountain forests undergoing changing disease / disturbance dynamics	6

Mediterranean wood-pasture for people and nature	2
Mountain Biodiversity as a sentinel of environmental change	8
Spatial-temporal dynamics of savanna ecosystems (tree-grass interactions, grass quality/quantity, biodiversity) as a life support system to wildlife and livestock production in and around Kruger National Park	7
The impact of aquatic ecosystems provisioning services on tourism	5
Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	6
Ancient irrigation channels as management tools to buffer the impact of climate change in Sierra Nevada ecosystem services.	4
Temporal evolution of ecosystem services in Sierra Nevada	4
Ecosystem functional types of ECOPOTENTIAL PAs	To be defined
Total of RS derived products	**73**

3.2 Overview on Protected Areas [PA]

ECOPOTENTIAL focuses its activities and pilot actions on a targeted set of internationally recognised Protected Areas in Europe, European Territories and beyond. These Protected Areas include mountain, arid and semi-arid, and coastal and marine ecosystems, blending Earth Observations from remote sensing and field measurements, data analysis and modelling of current and future ecosystem conditions and services. Fig. 3.1 shows the geographic distribution of the protected areas included in the ECOPOTENTIAL project.

Fig. 3.1 Map of Protected Areas [PA] included in ECOPOTENTIAL

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In addition to the general description of the protected area on the project website[14] a more detailed documentation of the protected areas can be found in DEIMS. A total of 27 protected areas are documented in DEIMS. These are listed in the Tab. 3.4.

Tab. 3.4 List of Protected Areas [PA] documented in DEIMS

Protected area	Site code	Country
Kalkalpen National Park - Austria	LTER_EU_AT_008	Austria
Camargue Biosphere Reserve - France	ECOPOT_FR_001	France
Cap Corse MPA - France	ECOPOT_FR_002	France
Réunion National Park - France	ECOPOT_FR_003	France
NP Bayerischer Wald - Germany	LTER_EU_DE_015	Germany
Samaria National Park - Greece	ECOPOT_GR_001	Greece
LTSER Northern Negev - Israel	LTER_EU_IL_005	Israel
Gran Paradiso National Park - Italy	LTER_EU_IT_109	Italy
Murgia Alta - Italy	ECOPOT_IT_001	Italy
Lithuanian Coastal Site (LT-04 Nagliai, Curonian Spit NP) - Lithuania	LTER_EU_LT_004	Lithuania
Ohrid and Prespa - Macedonia	ECOPOT_MK_001	Macedonia
LTSER Dutch Wadden Sea Area - Netherlands	LTER_EU_NL_001	Netherlands
Hardangervidda National Park - Norway	ECOPOT_NO_001	Norway
Tatra National Park - Poland	ECOPOT_PL_001	Poland
LTsER-Montado - Portugal	LTER_EU_PT_001	Portugal
Montado in Alentejo Natura 2000 sites - Portugal		Portugal
Peneda-Gerês - Portugal	ECOPOT_PT_001	Portugal
Danube Delta Biosphere Reserve - Romania	LTER_EU_RO_001	Romania
Kruger National Park - South Africa	ECOPOT_ZA_001	South Africa
Doñana Long-Term Socio-ecological Research Platform - Spain	LTER_EU_ES_001	Spain
La Palma Island - Spain	ECOPOT_ES_001	Spain
Sierra Nevada / Granada (ES- SNE) - Spain	LTER_EU_ES_010	Spain
Abisko National Park - Sweden	ECOPOT_SE_001	Sweden
Caribbean LME - Transnational	ECOPOT_TNA_004	Transnational
Mediterranean LME - Transnational	ECOPOT_TNA_002	Transnational

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[14] See http://www.ecopotential-project.eu/2016-05-24-14-52-12/protected-areas

Protected area	Site code	Country
Pelagos Sanctuary - Transnational	ECOPOT_TNA_001	Transnational
Tatra Mountains Biosphere Reserve PL-SK - Transnational	ECOPOT_TNA_003	Transnational

In order to find out what are the implemented strategies for data management, a questionnaire was developed and applied to all protected areas involved in the project.

We found out that most of the protected areas provide data in relational databases (n=10) or structured files or spreadsheet (n=9). Also the use of spatial data is quite widespread (n=14 in total). Fig. 3.2 shows an overview of the current data in DEIMS. Still there is a need to update the information on the data management infrastructure for all protected areas.
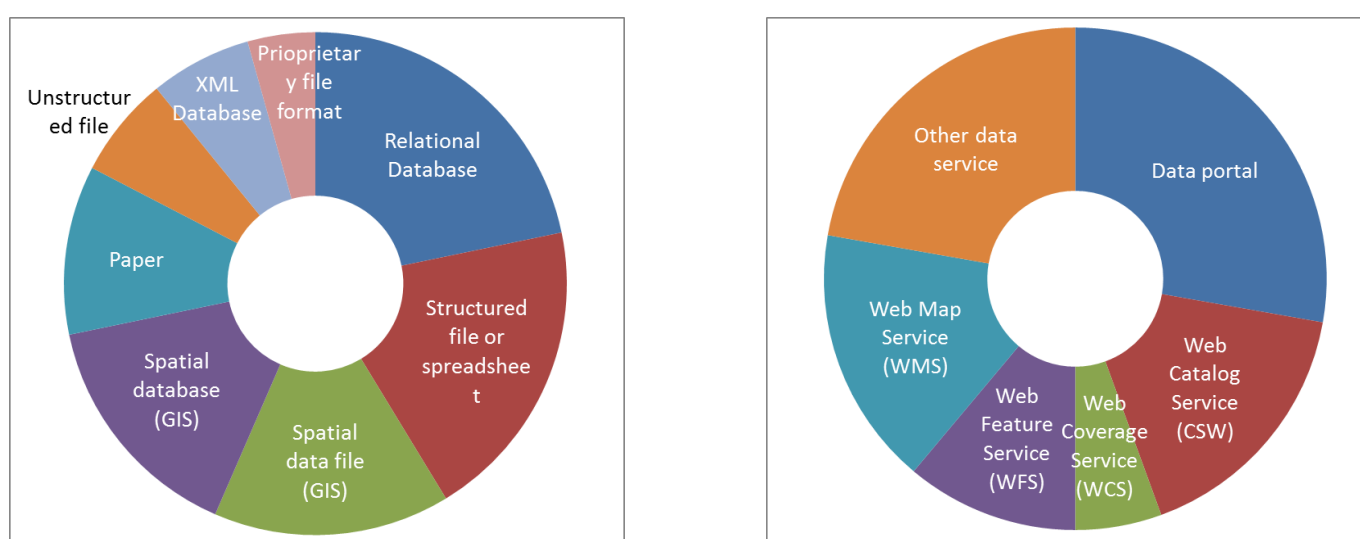
(a) Data storage formats (n=46)   *(b) Data services (n=18)*

Fig. 3.2 Implementation of data storage formats and data services at the different protected areas (filtered to ECOPOTENTIAL Protected Areas in DEIMS)[15]

In terms of data provision it shows, that still quite a number of protected areas focus on the file based exchange of information. Only 5 of the protected area listed having a data portal (see Fig. 3.2) and even a smaller number (between 1 and 3) having data services implemented. Even the implementation of catalogue services is quite scarce.

When dealing with data requests most of the protected areas (n=19) offered only an offline data request via email or telephone and only a smaller number (n=8) provided online resources to either access directly via service or via download to the data.

The data are managed in most protected areas in a central location (n=15). Only 2 protected areas stated that the data management is distributed within the organisation and 5 stated that data management is distributed over different organisations. Five protected areas did not provide any information on the data management location.

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[15] Downloaded from https://data.lter-europe.net/deims/site/statistics/data_infrastructure_ecopot

The results of the questionnaire showed that for most of the protected areas a controlled access to data (mostly stored in a central location) is possible. Data portals and direct data download are the most frequent means of data provision.

3.3 Overview on relevant existing in-situ data

3.3.1 Data portals

Considering the aim of the project, an extensive search on relevant data portals was conducted in order to provide an overview of important data sources for the project implementation process. Search criteria took into account the description of activities from the work packages and tried to identify relevant data sources.

Most data portals do not provide data specifically on a certain protected area but allow access to e.g. interpolated in-situ data (e.g. reconstruction of historic climatic situations) or observations (e.g. species occurrence). A reference to a protected area is mostly missing and only implicit by spatial overlap. Nevertheless these data portals provide important information on the context of the protected areas.

The effort resulted in a total of 23 relevant data portals. The current result is only a preliminary step and should be updated throughout the project runtime.

The data sources were identified so that it covers information related to spatial distribution and boundaries of protected areas and their designation status, data regarding the abiotic drivers (e.g. soil type, meteorological data), and habitat and species distribution. The result was grouped into the following categories:

- Boundary of protected areas (3)
- Habitat and species distribution (2)
- Soil distribution (1)
- Climate data (7)
- Land use/land cover (1)
- European regional sea data (1)

The results of the activity can be found in **chapter 6.3** Annex 3. List of relevant data portals. Basic information on the content (short description), web link and access restrictions is given.

Also, specific metadata/data publishers and data repositories were listed. Some examples are

Freshwater Biodiversity Data Portal (http://data.freshwaterbiodiversity.eu/fmj/): The Freshwater Metadata Journal (FMJ) is fully electronic and Open Access. Metadata provider publish their data in FMJ without paying any fees or charges and readers access the content for free. (Restrictions: Open access)

Ecological Archives (http://esapubs.org/archive/): The Ecological Archives publishes materials that are supplemental to articles that appear in the ESA journals (Ecology, Ecological Applications, Ecological Monographs, Ecosphere, Ecosystem Health and Sustainability and Bulletin of the Ecological Society of America), as well as peer-reviewed data papers with abstracts published in the printed journals. Ecological Archives is published in digital, Internet-accessible form. (Restrictions: Open access)

DataOne (https://search.dataone.org/#data/page/0): Data Observation Network for Earth (DataONE) is the foundation of new innovative environmental science through a distributed framework and sustainable cyberinfrastructure that meets the needs of science and society for open, persistent, robust, and secure access to well-described and easily discovered Earth observational data. (Restrictions: Open access)

GEOSS Portal (http://www.geoportal.org/): The 'GEOSS Portal' offers a single Internet access point for users seeking data, imagery and analytical software packages relevant to all parts of the globe. It connects users to existing data bases and portals and provides reliable, up-to-date and user friendly information – vital for the work of decision makers, planners and emergency managers. For users with limited or no

access to the Internet, similar information is available via the 'GEONETCast' network of telecommunication satellites. (Restrictions: Open source)

DEIMS Site and Dataset Catalogue (https://data.lter-europe.net/deims/): DEIMS, the (Dynamic Ecological Information Management System), is community effort coordinated by the European and Global LTER network to document and discover information about sites and data sets of networks dealing with ecological long term observation and experimentation in Europe and globally. It is the central platform to register, discover and edit related information. (Restrictions: Open access)

European Union Open Data Portal (http://data.europa.eu/euodp/en/data): The European Union Open Data Portal is the single point of access to a growing range of data from the institutions and other bodies of the European Union (EU). Data are free for you to use and reuse for commercial or non-commercial purposes. By providing easy and free access to data, the portal aims to promote their innovative use and unleash their economic potential. It also aims to help foster the transparency and the accountability of the institutions and other bodies of the EU. The EU Open Data Portal is managed by the Publications Office of the European Union. Implementation of the EU's open data policy is the responsibility of the Directorate-General for Communications Networks, Content and Technology of the European Commission.[16] (Restrictions: Open access)

Digital Observatory for Protected Areas (http://dopa.jrc.ec.europa.eu/): The Digital Observatory for Protected Areas (DOPA) is a set of web services and applications that can be used primarily to assess, monitor, report and possibly forecast the state of and the pressure on protected areas at multiple scales. The data, indicators, maps and tools provided by the DOPA are relevant to a number of end-users including policy makers, funding agencies, protected area agencies and managers, researchers and the Convention on Biological Diversity (CBD). The information can be used, for example, to support spatial planning, resource allocation, protected area development and management, and national and international reporting. Using global reference datasets, the DOPA supports global assessments but also provides a broad range of consistent and comparable indicators at country, ecoregion and protected area level. (Restrictions: Open access)

3.3.2 Datasets [DS] and Data products [DP]

Beside an overview on generic data on the protected areas as provided by thematic or general data portals, the work aimed on providing an overview on in-situ data provided by protected areas. As defined in the method section, the work focused on two aspects:

a) Analysis of the data listed in the storyline description;
b) Provide an overview on available data using the DEIMS metadata editor.

Whereas the first approach is based on existing project documents, the latter is a classic metadata collection request. The storyline description does not always allow for the distinction between the available data for a given protected area and general data needs for the research questions addressed in the storyline. Nevertheless, the storyline descriptions provide a valuable input into the effort and a good starting point for creating an overview on the available data.

The second approach is based on the findings of the first step and allows a continuous update of metadata using a web based metadata catalogue.

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[16] Taken from http://data.europa.eu/euodp/en/about

Tab. 3.5 Number of data products per storyline

Storylines	Number of DP
Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	11
Conserving dynamic wetlands under combined global, regional and local stressors	26
Cross-scale management of ecosystem services in the Mediterranean Large Marine Ecosystem	1
Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification	9
Ecosystem services and biodiversity crisis across mountain lakes	15
Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	21
Managing mountain forests undergoing changing disease / disturbance dynamics	7
Mediterranean wood-pasture for people and nature	2
Mountain Biodiversity as a sentinel of environmental change	5
Spatial-temporal dynamics of savanna ecosystems (tree-grass interactions, grass quality/quantity, biodiversity) as a life support system to wildlife and livestock production in and around Kruger National Park	6
The impact of aquatic ecosystems provisioning services on tourism	14
Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	13
Ancient irrigation channels as management tools to buffer the impact of climate change in Sierra Nevada ecosystem services.	15
Temporal evolution of ecosystem services in Sierra Nevada	20
Ecosystem functional types of ECOPOTENTIAL PAs	To be defined
Total	**130**

To create an overview of the available data the concept of 'data products' was used in order to get a trade-off between effort of metadata collection for the protected area managers and the needed information for the scientists. A data product [DP] (see chapter 1.1.2) can be seen as thematic data catalogue, being an intermediate level between a variable (or parameter, e.g. breast height diameter as forest stand characteristics) and a more general data category (e.g. forestry data). The aim of using this approach is to facilitate the communication between data holders and data users. Also, grouping data into data products is useful to harmonize different names or definitions of the same variable.

Our analysis of presented storylines revealed a number of 130 variables that could be grouped into 54 "data products" (Tab. 3.5). Due to a very high heterogeneity of definition and nomination of the variables an upper level of semantic aggregation was needed (i.e. data products). In this way we were able to aggregate the variables into 54 data products. The storylines considered for analysis were those finalised on April 2016 that respected a standardized format. Fig. 3.3 shows an overview on the distribution of the different data product categories. Most of the data referenced in the storylines are parameters describing terrestrial (35%) or aquatic (28%) system characteristics. Within these groups the data topic 'biodiversity and species richness' was mentioned most frequently. Also data on ecosystem use and management (5%) was quite frequently mentioned.
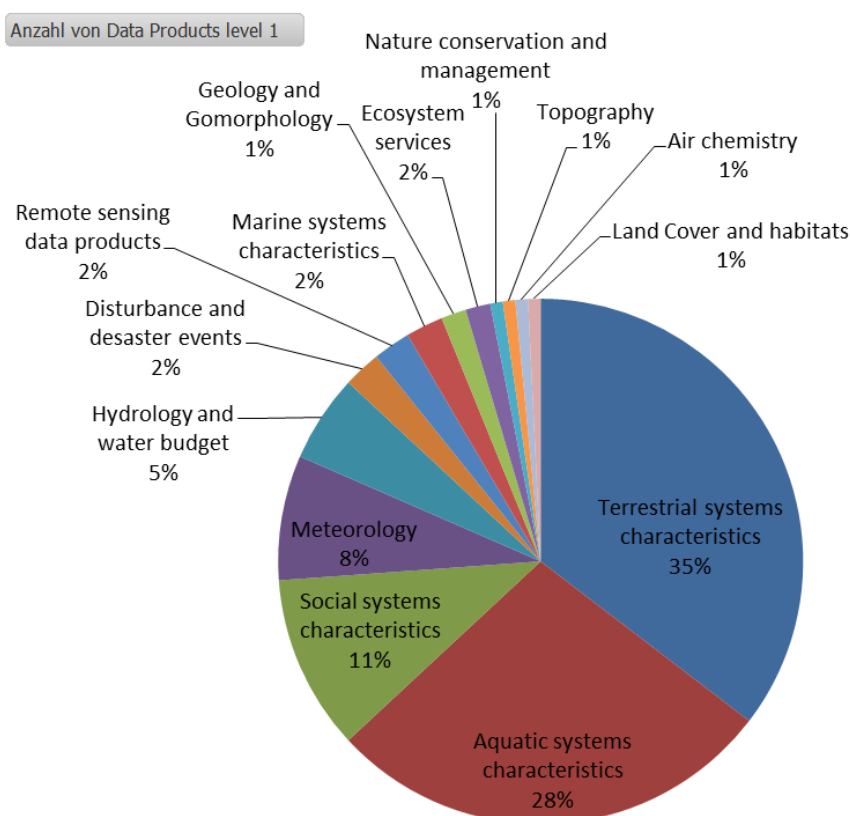
Fig. 3.3 Distribution of first level data products based on the analysis of the storylines (n=130)

Nevertheless we think that this description give a good overview on the mostly used data, but are lacking a complete overview on the available data, which would be needed, if in future research questions are changing.

So the original list of data products [DP] were analysed and extended using expert knowledge in order to conduct a more systematic collection of information on the available data from the different protected areas. The list of data products, their resolution (temporal/spatial), format and availability to the consortium is presented in the **Annex 4. List of data products per storyline.** This work has started and still needs to be continued.

Tab. 3.6 Documented Data Products per Protected Areas (Source DEIMS, 2016-11-14)

Protected Areas [PA]	Number of DP
Doñana Long-Term Socio-ecological Research Platform - Spain	4
Danube Delta Biosphere Reserve - Romania	7
Hardangervidda National Park - Norway	7
La Palma Island - Spain	8
Sierra Nevada / Granada (ES- SNE) - Spain	9
Zöbelboden LTER IM master site (ICP_IM_AT01) - Austria	9
Kalkalpen National Park - Austria	12
Tatra National Park - Poland	14
Montado in Alentejo Natura 2000 sites - Portugal	25
Total	**95**

Currently, in total 95 data products from 10 out of the 27 protected areas are documented in DEIMS (Tab 3.6). Fig. 3.4 provides an overview on distribution of data product types (level 1) for the data products documented in DEIMS. This is additional information to the data products documented for the storylines (see Fig. 3.3). In **Annex 5. List of data products documented in DEIMS** the list of data products per protected area is provided (status 2016-11-30).
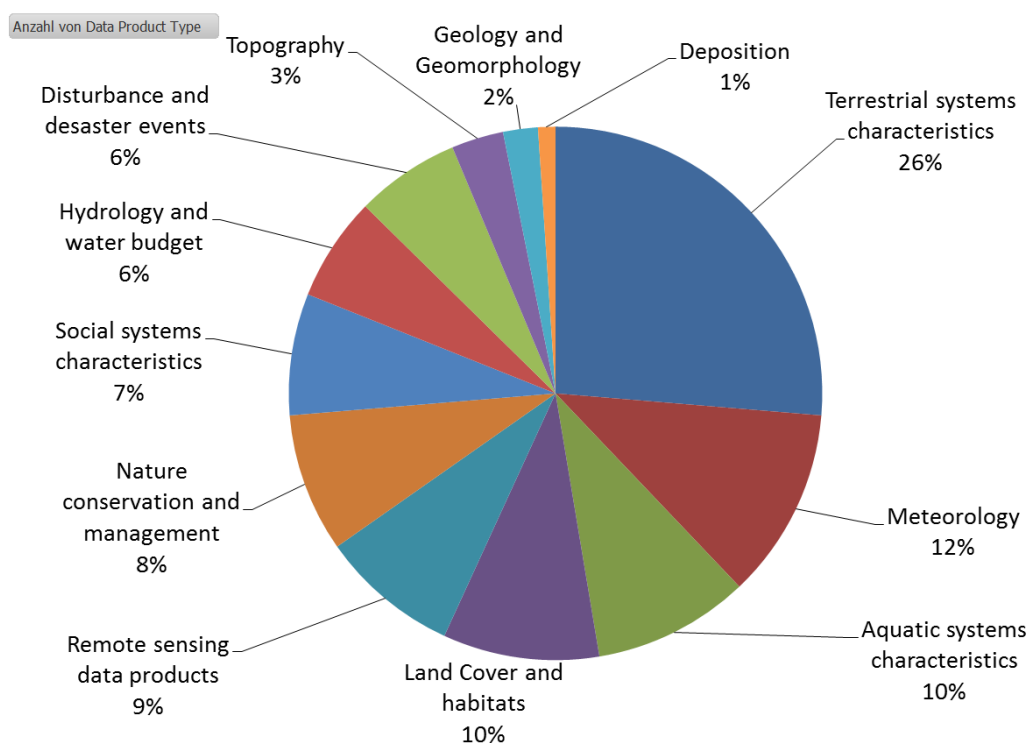
Fig. 3.4 Distribution of first level data products based on the data products documented in DEIMS (n=95)

There are many similarities in the distribution of data products, but also some differences. Whereas data on terrestrial, aquatic, and social system characteristics as well as meteorology as still the most frequent data product types the relative share of the other types is differing. This is mainly due to the fact, that the purpose of collecting information on available information was different.

A storyline is focussing on the definition of the research question and the needed information and data. This leads to a targeted view on the in-situ data from the viewpoint of the data needs. DEIMS is used to document available in-situ data applying the viewpoint of data provision. This leads to differences in the listed data, where the DEIMS listing should be more complete in the future.

In the next month all data products available for the different protected areas should be provided using the DEIMS Metadata Catalogue.

4   Discussion

4.1   Harmonisation of data products and parameter naming's

There is a need for common terms, e.g. as defined in controlled vocabularies, in order to enable and foster cooperation's between and also within different communities. As example for the medical or juristic discipline, standardized names for diseases, chemical elements and compounds, units and dimensions, or legal aspects are well known examples. The simplest forms of controlled vocabularies are agreements between specialists without any formal annotation, very similar to common languages of people, which existed long before they have been formally fixed. Those mutual agreements are vague and ambiguous, why the annotation of vocabularies together with more or less detailed descriptions found their way into (scientific) communities.

Dictionaries, reference documents and Taxonomies have been established and published in order to support the unambiguous exchange of knowledge. It is not surprising, that those vocabularies, which have been published as books got digitized in a very early stage of the development of IT, deployed by all sorts of data carrier depending on the actual technical stage.

In an increasingly connected information society, semantic gaps even within the same language still disrupt the exchange of knowledge, information and data. The need for shared information, based on common understanding, entails the demand for a shared vocabulary. This is as true for conversations between individuals as for the exchange of information (knowledge, data) in scientific co-operations and for transboundary data evaluation in general. A good way to guarantee a standardised scientific language is to control the used vocabulary with thesauri and/or ontologies (which in this context can be seen as extended thesauri).

A thesaurus or ontology provides us with an agreed assemblage of terms, meanings and relations to express our knowledge in an unambiguous way. This knowledge model can be used for a wide range of purposes, especially for the harmonization and integration of data:

- •   Unambiguous interpretation of topics, tasks, goals, preconditions,
- •   Description of data sources, dataflow, portal functions
- •   Design of discovery processes and related metadata (thesaurus as mediator)
- •   Reference lists
- •   Support for the mapping of local data / metadata to global data and metadata
- •   Support of discovery processes (thesaurus as mediator between user knowledge and specific domain knowledge)

For the current task, based on the monitoring activities defined by the UNECE Integrated Monitoring programme and work done for the common controlled vocabulary Envthes, a list of data product types was defined in order to harmonise and group information on available data (see Chapter 6.1. Annex 1. Reference list of data products). Linking this information to variables and parameters observed in the data help to further detail the knowledge and make it more useful for the discovery and the assessment of the data. This work is, and needs to be linked to the work done within ECOPOTENTIAL. Especially task 5.6 on data harmonisation as well as 5.3 on metadata definition needs to be linked to the current activity. Providing a well-defined framework for the documentation and use of in-situ data from the different protected areas as well as from long term observation sites fosters the sharing and re-usability of the data.

Additional tools can support the discovery of any information resources needed to implement e.g. analysis workflows to answer a particular research question.

4.2 Supporting integrated discovery

Getting sufficient and well documented in-situ data from long-term observation sites and protect areas is one of the key factors for modelling and assessing the effects of global change on ecosystems and their characteristics. A series of approaches are building big meta-databases and subsequently providing access to these data using data services. Still the process of discovery and evaluation is mainly driven by single researchers sending their data requests to data portal.

One aspect to enhance the use and linking of available meta-information is to apply machine based comparisons of data needs between documented information objects (e.g. protected areas, research sites, data products, or datasets) to data needs by research (e.g. defined in models or storylines). By this metadata on model specifications and data needs should be used to select most appropriate research sites and datasets (see Fig. 4.1). The approach uses a semantic knowledge base in order to link information from the research sites to the model specification.
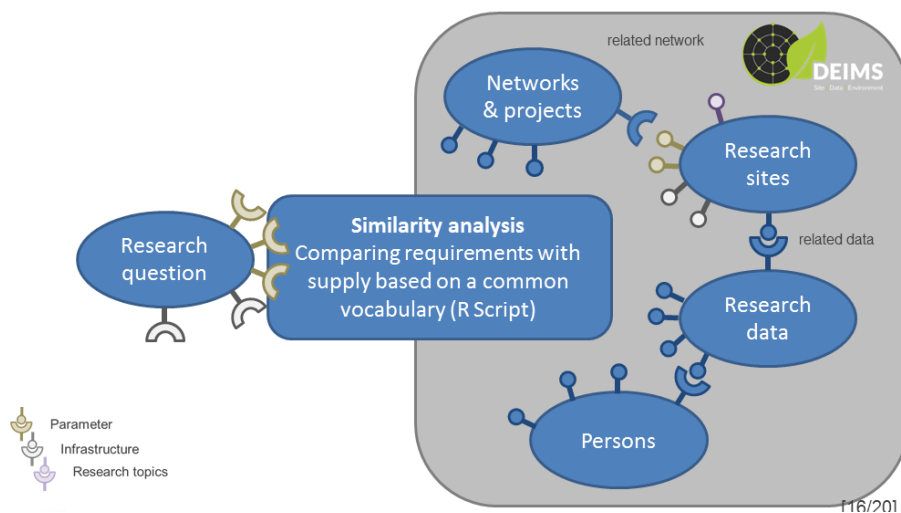
Fig. 4.1 Supporting discovery of data based on available information

A first test was implemented in R using the specification for VSD+, which is used to analyse the nitrogen cycles in relation to climate variables. Using simple text matching algorithms comparing a defined list of needed parameter (see Tab. 3.1) already shows first results (Tab 4.1) Future work will be done on that.

Tab. 4.1 Example R-script to match data needs to metadata provided by DEIMS (Research sites)

```
# Read in data from the url
data <- read.table("https://data.lter-europe.net/deims/site/export/parameters.csv", sep=";",
stringsAsFactors = F, header = T)

# Setting the must-have variables
must_have <- c("atmospheric measure", "soil measure","ecosystem measure", "air temperature",
"precipitation")

# Quick way to set the nice-to-have variables and their weights
# nice_have <- c("NOx concentration", "Ozone concentration", "SO2 concentration", "air specific
humidity",
#               "air temperature", "air water vapour pressure", "methane concentration", "vapor
pressure deficit (VPD)",
#               "atmospheric pressure", "water interception")
# nice_weights <- c(5, 2, 18, 26, 3, 22, 31, 60, 41, 52)
```

```
# Slow but safer way for manually setting the values
nice_have_input <- numeric()
nice_have_input["throughfall"] <- 45
nice_have_input["acidity"] <- 5
nice_have_input["base saturation"] <- 6
nice_have_input["bulk density"] <- 60
nice_have_input["C/N ratio"] <- 50
nice_have_input["Soil PH"] <- 55
nice_have_input["soil solution chemistry"] <- 10
nice_have_input["soil texture"] <- 40
nice_have_input["thickness of soil horizon"] <- 15
nice_have_input["total organic carbon"] <- 59
nice_have_input["radiation"] <- 25
nice_have_input["air quality"] <- 4
nice_have_input["tree measure"] <- 52
nice_have_input["plant species composition"] <- 35

nice_have <- names(nice_have_input)
nice_weights <- unname(nice_have_input)

# Create a regular expression and filter the data for the must-have variables
filter_regexp <- paste0("^",paste0("(?=.*\\b", must_have,"\\b)", collapse = ""), ".*$")
matches <- grep(filter_regexp, data[,3], perl=TRUE, value=FALSE)
subdata <- data[matches,]

# Aggregate the normalized weights for all elements of the subset of the data
subdata$Relevance <- 0
norm_nice_weights <- nice_weights/sum(nice_weights)

for(i in 1:length(nice_have)) {
  submatches <- grep(nice_have[i], subdata[,3], perl=TRUE, value = FALSE)
  subdata[submatches,]$Relevance <- subdata[submatches,]$Relevance + norm_nice_weights[i]
}

# Sort filtered data by relevance in descending order
subdata <- subdata[order(subdata$Relevance, decreasing = TRUE),]
write.csv(subdata, file = "QueryResults.csv", row.names = FALSE)
write.table(subdata, file ="QueryResults2.csv", row.names = FALSE, sep = ";", dec=",")
```

For the test the data specification (see variable specification in the script) was compared to all research sites documented on the DEIMS Site and Dataset Catalogue. The procedure results in a 'relevance' value, which is defined as the degree of fit to the data needs (Tab 4.2).

Tab. 4.2 Results of the similarity analysis

Title	UUID	
Alptal-Nitrogen-addition - Switzerland	a8b05bd1-2fb0-422f-8b99-4e18f180395e	1,00
Lange Bramke - Germany	8e24d4f8-d6f6-4463-83e9-73cac2fd3f38	1,00
Zöbelboden LTER IM master site (ICP_IM_AT01) - Austria	8eda49e9-1f4e-4f3e-b58e-e0bb25dc32a6	1,00
Alice Holt - United Kingdom	d47ec839-5d20-4315-9f88-1e9edbab22e8	0,98
Brasschaat - De Inslag - Belgium	68e6a8e5-d6d2-4c8c-91c4-10e7f87ac556	0,92
LTSER Veluwe - Netherlands	bef0bbd2-d8a9-4672-9e5b-085d049f4879	0,90
LWF Jussy – Switzerland	fa36576a-6409-41d4-96ae-67f2a3d7e085	0,85
Miyazaki University Forests - Japan	57117377-210b-420f-bf61-b2addb38ca1b	0,83
Yr Wyddfa/Snowdon - United Kingdom	8b5da977-eed8-459f-b663-f3835aa0b356	0,80
Dinghu Mountain Research of Forest Ecosystem - China	9b883551-d6a5-42be-9c46-d785a1e38911	0,80
Cairngorms (ECN site) - United Kingdom	5a04fee1-42aa-47e9-abfc-043a3eda12ac	0,79
Porton Down - United Kingdom	0f05a86f-0f7a-4b81-8268-6818a6064428	0,79
Rothamsted - United Kingdom	cb340d4c-e6e5-465a-b0cb-d6c613fa5541	0,79
Weitra (WEI) – Austria	9d008e2a-5b49-4ffe-b73a-87da4ab8ee31	0,77
Gammtratten, IM-site SE16 - Sweden	27415652-8de8-40e7-92c1-f82526116a2d	0,72
Yucheng Comprehensive Experiment Station - China	5b374ace-5bc3-4e07-8dbc-ff0914302ae6	0,71
LTSER Platform Koiliaris Critical Zone Observatory - Greece	65d7bf15-841a-4fb7-a36e-6f4d95a8d64e	0,69
Drayton - United Kingdom	00eb83ef-c965-462d-8022-7f7ff75ccd14	0,67
Gårdsjön, IM-site SE04 - Sweden	c7f490fb-76a4-4d6c-ba3e-2fd2f33822ec	0,64
Luquillo Long-Term Ecological Research - Puerto Rico	bd0b5bcf-4f2e-4038-8275-629ffa5bf2aa	0,64
La Robinette – Belgium	450ecc48-b748-49da-8b33-7955854bda78	0,57
Achenkirch-Mühleggerköpfl (ACH-Mue) - Austria	d2e91d98-4970-4d71-8d76-d8164542b694	0,55
Tönnersjöheden and Skarhult experimental forests (LTER) - Sweden	ac383c6d-4caa-481d-af71-bf040255ec1f	0,54
Shiiba Research Forest; Kyushu University - Japan	5a5e3c04-2ed0-42f8-910e-bc41e540248c	0,52
Spanish ICP-Forests Level II Plots Network (Plot code 05 Ps) - Spain	6b5ea4b7-c31d-4418-9dd5-233188df1114	0,49

Further steps needs to be taken in order to implement the similarity comparison and the documentation of the data models into the metadata catalogue. But using information on the available data products documented by the protected areas as well as the documentation of research activities at the sites will lead to a more targeted discovery of data. This is supported by the use of the web based documentation of information sources.

4.3 Identification of data gaps

Using the concept of the storylines as well as the needs for data models data gaps can be identified. This will be the next logical step. This requires the availability of a complete overview on available data, which is often a difficult task. Therefore for the current project, the concept of the data products was introduced in order to balance between documentation effort and usefulness of the metadata. The data products provide an overview on the thematic catalogue of data available.

Applying procedures, e.g. as introduced in chapter 4.2, or using classical discovery interfaces, e.g. as implemented for the ECOPOTENTIAL data discovery, will lead to the definition of data gaps. These data gaps can either be filled by using proxy data, e.g. resulting from remote sensing procedures, or by implementing additional field work.

5   Summary

The current task resulted in an overview on available data products and the assessment of data needs. This was done based on project documents on the one side and the documentation of the protected areas on the other. The resulting information is summarised in the annexes attached to this report.

The development of a consistent list of data product types was the first step in order to collect and share information on the available data. Linking this information to the observed parameters is an important step to be done. By this the re-usability of the information is ensured.

The identification of data gaps will be done during the project task also identifying possible proxy data, e.g. derived from remote sensing data. The overview on the available data products is the first step in creating a platform of shared and curated in-situ data.

Data products provide a first level of thematic overview. Within the task 130 data products were identified to be relevant for the storylines and additional 95 documented for the protected areas. The work has setup a workflow and a web based documentation system using the DEIMS Site and Dataset Catalogue which can be updated used beyond the runtime of the project. ECOPOTENTIAL therefore has laid the basis for shared and open research data. Sharing metadata is the needed first step to enable an overview on the available resources.

6 Annex

6.1 Annex 1. Reference list of data products

Level	Data product taxonomy
0	Meteorology
1	-Air temperature
1	-Precipitation
1	-Wind speed and direction
1	-Air humidity
1	-Air pressure
1	-Radiation
2	--Global radiation
2	--UV-Radiation
2	--Photosynthetic active radiation (PAR)
2	--Surface radiation budget
0	Air chemistry
1	-Ozone
1	-Carbon flux
0	Deposition
1	-Precipitation chemistry
1	-Through fall chemistry
1	-Stem flow chemistry
1	-Heavy metal deposition
1	-Nitrogen deposition
1	-Sulphur deposition
0	Topography
1	-Elevation model
1	-Surface elevation model
2	--Lidar
2	--SRTM
2	--AsterGDEM
2	--EUDEM
2	--Other Surface Elevation data (please specify)
0	Land Cover and habitats
1	-Historic land cover and habitats
1	-Current land cover and habitats
0	Geology and Geomorphology
1	-Geological map
1	-Landforms map
0	Hydrology and water budget
1	-Groundwater
2	--Groundwater levels
2	--Groundwater chemistry
1	-Runoff and discharge
2	--River discharge and water level

Level	Data product taxonomy
2	--Lake discharge and water level
2	--Evapotranspiration
2	--Runoff water chemistry
1	-Snow cover and duration
1	-Water use
0	Aquatic systems characteristics
1	-Running water (River and streams)
2	--River water chemistry
2	--River water physics (temperature, velocity, depth, suspended solids)
2	--Hydrobiology of rivers
3	--Chlorophyll concentration in rivers
3	--Phytoplankton
3	--Zooplankton
3	--Macrophytes
3	--Fishes
3	--Benthic fauna
1	-Standing water (Lakes)
2	--Lake water chemistry
2	--Lake water physics (incl. temperature, depth, hydroperiod, turbidity)
2	--Hydrobiology of lakes
3	--Chlorophyll concentration in lakes
3	--Phytoplankton
3	--Zooplankton
3	--Macrophytes
3	--Fishes
3	--Benthic fauna
1	-Wetlands
2	--Wetland chemistry
2	--Wetland physics (temperature, depth, hydroperiod, surface, turbidity)
2	--Hydrobiology of wetlands
3	--Chlorophyll concentration in wetlands
3	--Phytoplankton
3	--Zooplankton
3	--Macrophytes
3	--Palustrine vegetation
3	--Fishes
3	--Benthic fauna
0	Terrestrial systems characteristics
1	-Glaciers and ice caps
2	--Ice sheets
2	--Permafrost
2	--Albedo
1	-Soil
2	--Soil map
2	--Soil moisture
2	--Soil carbon

Level	Data product taxonomy
2	--Soil temperature
2	--Soil water chemistry
2	--Soil physical characteristics
2	--Soil chemistry
1	-Biodiversity and species richness (incl. population)
2	--Invasive species
2	--Algae and bacteria
2	--Vascular plants
2	--Lichens and epiphytes
2	--Mammal
2	--Bird
2	--Fish
2	--Amphibians
2	--Insects
2	--Other animals
1	-Vegetation structure and species cover
1	-Habitat types and biotopes (e.g. Natura 2000)
1	-Ecosystem biomass and structure
2	--Ecosystem carbon fluxes
2	--Forest biomass and growth
2	--Herbaceous biomass and growth (e.g. grass)
2	--Ecosystem structure
2	--Leaf area index (LAI)
2	--Vegetation index (NDVI, SAVI)
2	--Primary productivity
2	--Secondary productivity
1	-Phenology
1	-Plant and foliage chemistry
1	-Litter fall chemistry
0	Marine systems characteristics
1	-Marine biodiversity and species richness (incl. population)
1	-Marine species biomass
1	-Marine topography and dynamics
2	--Bathymetry
2	--Sea Surface Height
2	--Hydrodynamics
2	--Wind velocity
2	--Currents
2	--Seawater velocity
2	--Frontal Zone (affects NPP)
1	-Sea water physics
2	--Sea surface temperature (SST)
2	--Suspended sediment concentration
1	-Sea water chemistry
2	--Salinity
2	--Seawater pH

Level	Data product taxonomy
2	--Seawater O2
1	-Other marine data (specify)
1	-Marine management and fishery
2	--Fish catch (marine)
2	--Fish stock (marine)
2	--Fishermen and fleet
0	Social systems characteristics
1	-Economic data
2	--Transportation (incl. infrastructure)
2	--Housing (incl. infrastructure)
2	--Industry (incl. infrastructure)
1	-Administrative Units
1	-Human population (incl. density)
1	-Ecosystem use and management
2	--Agriculture and forestry
3	--historical land use
3	--domestic livestock
3	--agricultural management practices
3	--agricultural yield
3	--forest harvest and management
3	--Forest disease
3	--Hunting data
2	--Fishery
3	--Fishing data (freshwater)
1	-Ecosystem services
2	--Provisioning services
2	--Regulating services
2	--Cultural services
2	--Supporting services
2	--Existence Value
2	--Tourism (Use value)
2	--Recreational Value
2	--Educational Value
2	--Other ecosystem services
0	Disturbance and disaster events
1	-Floods
1	-Fire disturbance
1	-Avalanches
1	-Infestation
0	Nature conservation and management
1	-Focal species
1	-Governance and planning
1	-Visitors
1	-Engagement with local partners
0	Remote sensing data products
1	-Original images

Level	Data product taxonomy
2	--Landsat TM
3	--Landsat TM raw data
3	--Landsat TM corrected
2	--Landsat 5
3	--Landsat 5 raw
3	--Landsat 5 corrected
2	--Landsat 7
3	--Landsat 7 raw
3	--Landsat 7 corrected
2	--Landsat 8
3	--Landsat 8 raw
3	--Landsat 8 corrected
2	--Sentinel 1
3	--Sentinel 1 raw
3	--Sentinel 1 corrected
2	--Sentinel 2
3	--Sentinel 2 raw
3	--Sentinel 2 corrected
2	--Sentinel 3
3	--Sentinel 3 raw
3	--Sentinel 3 corrected
2	--Sentinel 4/5
3	--Sentinel 4/5 raw
3	--Sentinel 4/5 corrected
2	--Airborne Images
3	--Airborne Images raw
3	--Airborne Images corrected
2	--Other Remote Sensing data (please specify)
1	-Derived EO Data products
2	--Land Cover
3	--CORINE
3	--LCCS
3	--EAGLE
3	--Other Land cover (please specify)
2	--Biomass (EO derived)
2	--Derived indices

6.2 Annex 2. List of earth observation useful for validation of remote sensing products or ground truthing

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
Soil	Surface Soil Moisture									
		Land cover from e.g Corine								
		Land cover (e.g Corine, Globcover); DEM (e.g. SRTM 90m Digital Elevation data); soil texture (e.g. Harmonized World Soil Database; National/Regiona					**near surface volumetric soil moisture of the top surface layer, i.e. 0.0-5.0 cm**	**500m**	**continuous measurements (ground stations) or synchronized with satellite passages 6-12 days**	**regular grid / transect**

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
		l/Continental Maps)								
	Soil Moisture Volumetric Water content									
	Spectral Soil Quality Index (SSQI)									
	Soil sealing (Imperviousness)									
		E.g. distinction artifact surfaces from bare rock	many ancillary data, especially maps							

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
Physical Land	Surface Albedo									
	Land Surface Temperature (LST)									
	Digital Elevation Model (DEM)									
In-Land Water (includes Snow)	Water bodies delineation (coverage)									
						validation data (presence of water bodies)				

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
	Water turbidity (inland waters)					**validation data (turbidity measurements)**				
	Hydroperiod (seasonal water bodies)					**validation data (river discharge)**				
	Total Suspended Solids (TSS)									
	Snow cover maps (snow cover area+snow status wet/dry)									
	Snow cover (snow cover maps, snow cover duration maps)	Land cover (forest) from e.g Corine								

	Variable/Product	Expert knowledge needs (product production) *(e.g. phenology)*	In-situ data needs (product production)				In-situ data needs (product validation)				
			Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design	
LU/LC	Land cover/land use	Phenology, vegetation elevation/texture									
		Phenology, vegetation elevation/texture									

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
	Land Cover Change (LCC)									
	Habitat Mapping	Expert knowledge to characterize the habitats	Enough samples (stratified) for algorithm training			**Enough samples (stratified) for algorithm testing**				

	Variable/Product	Expert knowledge needs (product production) *(e.g. phenology)*	In-situ data needs (product production)			In-situ data needs (product validation)				
			Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
		Phenology, agricultural practices, water coverage (in wetland areas), pattern zonation	FAO-LCCS Environmental Attributes				**in-situ reference samples (points or poligonal areas)**	**according to sensor grain and scale of analysis**	**close to the date of input data analyzed**	**stratified random sampling**
Biological terrestrial	Leaf area index (LAI)	Land cover from e.g Corine								
			LAI	30 m						
	NDVI									
	Landscape (e.g. Fragmentation)	Parameters for landscape measure extraction				**Validated LC/habitat maps**				

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
						used as input				
	Biodiversity indicators									
	Forest biomass		Biomass measurement plots (>1ha)				**Biomass measurement plots (>1ha)**			
			Biomass	25 m						
	Forest disturbances (annual)	Forest cover information if available								
	Herbaceous biomass		Grass biomass	6 - 30 m						
	Gross Primary Production (GPP)									

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
			leaf nitrogen - grass quality	6 - 30 m						
	Vegetation wetness (Vegetation water content (VWC) or Equivalent Water Thickness (EWT), NDWI, Tasseled Cap)									
	Vegetation height and structure (e.g. Canopy Height Models (CHM))		Enough samples (stratified) for algorithm training			**Enough samples (stratified) for algorithm testing**				

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
			LIDAR reference measurements for calibration							
			Tree height							
	Fire impact (forest canopy)									
	Phenology (start and end of the season, length of the season)	Expert knowledge on when the phenologcal phases are, e.g. greenup, maturity, senescence, dormancy				**Enough samples to validate the phenological stages spatially**				

		Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
			(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
		Land cover from e.g Corine									
		Land cover from e.g Corine									
Physical Sea/Marine		Shoreline change detection									
		Bathymetry (marshes, inland waters)		training data			**validation data**				
				GCPs: x, y & depth			**GCPs: x, y & depth**				
		Sea Surface Temperature									
		See surface Wind Speed and Direction		In situ data are not needed							

	Variable/Product	Expert knowledge needs (product production) *(e.g. phenology)*	In-situ data needs (product production)			In-situ data needs (product validation)				
			Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
	Marine oil spill detection and characterization									
Biological sea/marine	Sea bed classification	Expert knowledge to characterise habitats	Samples for algorithm training			**Samples for algorithm testing**				
		Expert knowledge to characterize the habitats	Enough samples (stratified) for algorithm training							
	Coloured Dissolved Organic Matter (CDOM)									
	Chlorophyll-a Concentration									
Preprocessing	Geometric correction (optic)									
	Geometric correction (radar)									

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
	Radiometric correction (optic)									
	Radiometric correction (radar)									
	Automated spectral ground measurements for validation									
Data mining	Long time series analysis data mining									
Other activities	Correct and complete metadata elaboration and semantic harmonization									
	Quality and uncertainty parameterization									
	Adjusting (generalization) of parameters of the EODESM modules									

	Variable/Product	Expert knowledge needs (product production)	In-situ data needs (product production)			In-situ data needs (product validation)				
		(e.g. phenology)	Type of measurement	Grain	Repetition	Sampling design	Type of measurement	Grain	Repetition	Sampling design
	Provide direct access to data									
	Provide and prepare data for protected sites detection									
	Provide and prepare data for future protected sites detection									

6.3 Annex 3. List of relevant data portals

1. Boundary of protected areas

Name	Limits of Natura 2000 sites
Link	http://www.eea.europa.eu/data-and-maps/data/natura-6#tab-gis-data
Description (incl. data products)	Official limits of EU Natura 2000 sites as shape files, At the same link there are additional data contained by standard data forms associated with each site
Restrictions	Open

Name	Nationally designated areas (CDDA)
Link	http://www.eea.europa.eu/data-and-maps/data/nationally-designated-areas-national-cdda-10#tab-gis-data
Description (incl. data products)	The European inventory of nationally designated areas holds information about protected areas and the national legislative instruments, which directly or indirectly create protected areas.
Restrictions	open

Name	Protected planet
Link	http://www.protectedplanet.net/
Description (incl. data products)	ProtectedPlanet.net is the online interface for the World Database on Protected Areas (WDPA), a join project of IUCN and UNEP, and the most comprehensive global database on terrestrial and marine protected areas. ProtectedPlanet.net lets you discover the protected areas of the world through exploring the maps and intuitive searching, feeding you information from the WDPA, photos from Panoramio and text descriptions from Wikipedia.
Restrictions	Open

2. Habitat and species distribution

Name	Eionet (European Topic Centre on Biological Diversity)
Link	http://bd.eionet.europa.eu/activities/Reporting/Article_17/Reports_2013 http://bd.eionet.europa.eu/activities/Reporting/Article_12/Reports_2013
Description (incl. data products)	Natura 2000 reporting under EU Habitat Directive article 17 and EU Bird Directive article 12 (spatial distribution of habitats and species of conservation interest and their conservation status)
Restrictions	open

Name	*Global Biodiversity Information Facility*
Link	http://www.gbif.org/occurrence
Description (incl. data products)	Species occurrence data
Restrictions	*open*

Name	*European Biodiversity Data Portal*
Link	http://api.eurogeoss-broker.eu/eu-bon-portal
Description (incl. data products)	Data portal of the EU funded project EU-BON (FP7). The aim is to offer a unique service for analysing and understanding biodiversity change. Users can explore how relative abundance of species (within a larger group) changes in big data mediated by GBIF. It includes also a spatial browser for locating datasets in any part of the world which may be usable for computing the EBVs for species populations. Furthermore, an online analytical data processing (OLAP) toolbox has been included in new release.
Restrictions	open

3. Soil distribution

Name	High resolution soil grids

Link	http://www.soilgrids.org/ http://esdac.jrc.ec.europa.eu/content/esdac-map-viewer
Description (incl. data products)	Soil spatial relevant data
Restrictions	open

4. Climate data

Name	Climate interpolated data,
Link	http://www.worldclim.org
Description (incl. data products)	Spatial relevant data raster on climate data globally distributed on the past, current and future data
Restrictions	open

Name	Climate interpolated data
Link	https://www.climond.org/
Description (incl. data products)	Spatial relevant data, Current and Future Data:
Restrictions	open

Name	Climate interpolated data
Link	http://www.prism.oregonstate.edu/ http://www.earthsystemgrid.org/home/home.htm http://dx.doi.org/10.6084/m9.figshare.878253
Description (incl. data products)	Spatial relevant data, Current Data:
Restrictions	open

Name	*Paleoclimatology Modeling*

Link	http://www.ncdc.noaa.gov/data-access/paleoclimate-data/datasets/paleoclimate-modeling http://pmip2.lsce.ipsl.fr/
Description (incl. data products)	*National Centres for Environmental Information Paleoclimatology Modelling and Paleoclimate Modelling Intercomparison Project Phase II*
Restrictions	*open*

Name	*Climate Change, Agriculture and Food Security*
Link	http://www.ccafs-climate.org/
Description (incl. data products)	*Future climate*
Restrictions	*open*

Name	*Bio-ORACLE*
Link	http://www.oracle.ugent.be/
Description (incl. data products)	*Current and future climate interpolated data for oceans*
Restrictions	*open*

Name	*National Centres for Environmental Information -NOAA*
Link	*https://gis.ncdc.noaa.gov/map/viewer/#app=cdo*
Description (incl. data products)	*Daily observed climate data by land meteorological stations*
Restrictions	*open*

5. Land use/land cover

Name	*Copernicus Land Monitoring Services*

Link	*http://land.copernicus.eu*
Description (incl. data products)	*Land use land cover raster and vector data, some high resolution raster format (forest, aquatic ecosystems etc.), High resolution Land Cover data for some Natura 2000 sites*
Restrictions	*open*

6. European regional sea data

Name	*The Marine Operation Ecology data portal*
Link	*http://portal.marineopec.eu/*
Description (incl. data products)	*On-line data portal providing model simulated ecosystem data for European Regional Seas.*
Restrictions	*Open*

7. Metadata publishers

Name	*Freshwater Biodiversity Data Portal*
Link	*http://data.freshwaterbiodiversity.eu/fmj/*
Description (incl. data products)	*Freshwater Metadata Journal (FMJ) is fully electronic and Open Access. Metadata provider publish their data in FMJ without paying any fees or charges and readers access the content for free.*
Restrictions	*Open access*

Name	*Ecological Archives*
Link	http://esapubs.org/archive/
Description (incl. data products)	*Ecological Archives publishes materials that are supplemental to articles that appear in the ESA journals (Ecology, Ecological Applications, Ecological Monographs, Ecosphere, Ecosystem Health and Sustainability and Bulletin of the Ecological Society of America), as well as peer-reviewed data papers with abstracts published in the printed journals. Ecological Archives is published in digital, Internet-*

	accessible form.
Restrictions	*Open access*

Name	*DEIMS Repository for research sites and datasets*
Link	https://data.lter-europe.net/deims/
Description (incl. data products)	*DEIMS, the (Drupal Ecological Information Management System), is the unique place where you can find information about sites and data sets of networks dealing with ecological long term observation and experimentation in Europe and globally. It is the central platform to register, discover and edit related information.*
Restrictions	*Open access*

6.4 Annex 4. List of data products per storyline

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Alentejo	Mediterranean wood-pasture for people and nature	Remote sensing data products	Airborne images	Airborne Images corrected	MMU – 1ha		Several years; for the past 50y	Yes (paid)
Alentejo	Mediterranean wood-pasture for people and nature	Remote sensing data products	Derived EO Data products	Derived indices	30-m		12 -days	Yes*
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Birds	Annual or bi-annuall	Digital form, not publicly available	Since 1980	Yes
Camargue	Conserving dynamic wetlands under combined global, regional	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Birds	Annual	Digital form, not publicly available	Since 1970	Yes

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	and local stressors							
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Birds	Annual	Digital form, not publicly available	Since 1947	Yes
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Birds	Annual	In digital form, publicly available	Since 1970	Yes
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Birds	Once monthly from Sept to April	In digital form, not publicly available	Since 1965	Yes
Camargue	Conserving dynamic wetlands under	Social systems characteristics	Agriculture and forestry	Domestic livestock	7 surveys	In digital form, publicly available	Since 1555	Yes

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	combined global, regional and local stressors							
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Social systems characteristics	Agriculture and forestry	Domestic livestock	5 surveys	In digital form, publicly available	Since 1830	Yes
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Fishes	Monthly	In digital form, not publicly available	Since 1988	Yes
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Hydrology and water budget	Hydrology and water budget	Hydrology and water budget	Once montlhy	Digital data	2000-to date	Yes

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Social systems characteristics	Ecosystem use and management	Land use	Annual	Yes	1958 to date	Y
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Mammal	Twice a year	In digital form, not publicly available	Since 1998	Y
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Meteorology	Meteorology	Meteorology	Daily	Digital form, not publicly available[1]	1944-to date	Y
Camargue	Conserving dynamic wetlands under combined global, regional	Hydrology and water budget	River discharge and water level	River discharge and water level	Daily mean	Yes	Since 1987	Y

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	and local stressors							
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Marine systems characteristics	Sea water chemistry	Salinity	Monthly	Digital form, not publicly available	Since 1970	Y
Camargue	Conserving dynamic wetlands under combined global, regional and local stressors	Marine systems characteristics	Marine topography and dynamics	Sea Surface Height	Daily min-max	Partially in digital form, publicly available	Since 1905	Y
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Birds	Year	digital data not publicly available		Not known
Danube Delta	The impact of aquatic ecosystems provisioning	Aquatic systems characteristics	Chlorophyll	Chlorophyll			1982-2014	

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	services on tourism							
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Fishes	Seasonally	no	1920-1924; 1960-2014	yes
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Hydrology and water budget	River discharge and water level	River discharge and water level	monthly	yes	1932-2014	Yes
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Riverwater chemistry	Riverwater chemistry		no		Not known
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Riverwater chemistry	Riverwater chemistry				

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Running water (River and streams)	Riverwater physics (temperature, velocity, depth, suspended solids)				
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Riverwater physics (temperature, velocity, depth, suspended solids)	Riverwater physics (temperature, velocity, depth, suspended solids)	Year		1840-2002	Yes
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Riverwater physics (temperature, velocity, depth, suspended solids)	Riverwater physics (temperature, velocity, depth, suspended solids)				
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Running water (River and streams)	Riverwater physics (temperature, velocity, depth, suspended solids)	monthly		1995-2009	Yes

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Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Running water (River and streams)	Riverwater physics (temperature, velocity, depth, suspended solids)			2003-2004	Yes
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Ecosystem services	Ecosystem services	Tourism (Use value)	Seasonally	yes	1985-2014	yes
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Running water (River and streams)	Water chemistry		no		Yes
Danube Delta	The impact of aquatic ecosystems provisioning services on tourism	Aquatic systems characteristics	Running water (River and streams)	Water chemistry				

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Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Doñana	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Birds	Annual	Y	2004-to date	Y
Doñana	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Birds	Annual	Y	2004-to date	
Doñana	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Birds	monthly	Y	1973-to date	Y
Doñana	Conserving dynamic wetlands under combined global, regional	Aquatic systems characteristics	Chlorophyll	Chlorophyll	Twice a year	Y	2004-to date	Y

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	and local stressors							
Doñana	Conserving dynamic wetlands under combined global, regional and local stressors	Social systems characteristics	Agriculture and forestry	Domestic livestock	Annual	digital data not publicly available	1992-to date	requires authorisation of Nat. Park administratio n
Doñana	Conserving dynamic wetlands under combined global, regional and local stressors	Hydrology and water budget	Groundwater	Groundwater levels				¿?
Doñana	Conserving dynamic wetlands under combined global, regional and local stressors	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Mammal	Annual	Y	2005-to date	Y
Doñana	Conserving dynamic wetlands under	Meteorology	Meteorology	Meteorology	Daily	Y [1]	1978-to date	Y

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	combined global, regional and local stressors							
Doñana	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Running water (River and streams)	Riverwater physics (temperature, velocity, depth, suspended solids)		digital data not publicly available	2003-to date	Y
Doñana	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Running water (River and streams)	Riverwater physics (temperature, velocity, depth, suspended solids)			2003-to date	Y
Doñana	Conserving dynamic wetlands under combined global, regional and local stressors	Aquatic systems characteristics	Running water (River and streams)	Water chemistry	Twice a year		2004-present, incomplete	

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Gran Paradiso National Park	Mountain Biodiversity as a sentinel of environmental change	Remote sensing data products	Airborne images	Airborne Images corrected		Digital form	2015	yes
Gran Paradiso National Park	Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Birds	every 5 years	digital form	from 2006	yes
Gran Paradiso National Park	Mountain Biodiversity as a sentinel of environmental change	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Birds	From biweekly to seasonally, during summer	digital form;	from 2006;	yes
Gran Paradiso National Park	Dynamics of high-altitude environments as a life-support	Terrestrial systems characteristics	Vegetation structure and species cover	Herbaceous biomass and growth (e.g. grass)	every 2 weeks during the	written reports	from 2012	yes

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification				growing season			
Gran Paradiso National Park	Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification	Social systems characteristics	Ecosystem use and management	Hunting data	Yearly	Digital form	1979 (HNP)	yes
Gran Paradiso National Park	Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling,	Terrestrial systems characteristics	Insects	Insects	every 5 years	digital form	from 2006	yes

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	biodiversity and landscape modification							
Gran Paradiso National Park	Mountain Biodiversity as a sentinel of environmental change	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Insects				
Gran Paradiso National Park	Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Mammal	Yearly	digital form	from 1956 (GPNP)/ 1997 (HNP)	yes
Gran Paradiso National Park	Mountain Biodiversity as a sentinel of environmental change	Meteorology	Meteorology	Meteorology	Hourly	Digital form	From 2006 (only summer records)	yes

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Gran Paradiso National Park	Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification	Meteorology	Meteorology	Meteorology	daily	digital form	from 1960	yes
Gran Paradiso National Park	Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Other animals		Digital form	From 2005	Yes
Gran Paradiso National Park	Dynamics of high-altitude environments as a life-support	Terrestrial systems characteristics	Vegetation structure and species cover	Phenology	daily	Not yet	from 2009	Not yet

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification							
Gran Paradiso National Park	Mountain Biodiversity as a sentinel of environmental change	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Vegetation structure and species cover	Seasonally	Digital from	From 2006	yes
Gran Paradiso National Park	Dynamics of high-altitude environments as a life-support system to wild herbivores: carbon and moisture cycling, biodiversity and landscape modification	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Vegetation structure and species cover	Approx. yearly	Not yet		Not yet
Har HaNegev	Impact of residential settlements on	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Birds	Annual	Y	1990-	Y

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	the life supporting capacity of Har HaNegev arid environment							
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Hydrology and water budget	Runoff and discharge	Evapotranspiration	Point	Y		M
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Disturbance and desaster events	Disturbance and desaster events	Floods		Y		
Har HaNegev	Impact of residential settlements on the life supporting	Terrestrial systems characteristics	Nature conservation and management	Focal species				

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Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	capacity of Har HaNegev arid environment							
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Geology and Gomorphology	Geology and Gomorphology	Geology and Gomorphology	Point	Y		M
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Social systems characteristics	Economic data	Housing (incl. infrastructure)				
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har	Social systems characteristics	Human population (incl. density)	Human population (incl. density)	Point	Y		Y

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Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	HaNegev arid environment							
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Terrestrial systems characteristics	Insects	Insects	Point	Y		M
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Insects	Point	Y		M
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Social systems characteristics	Ecosystem use and management	Land use	Point	Y		Y

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Social systems characteristics	Ecosystem use and management	Land use	Point	Y	2016	M
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Mammal	Annual	Y	1990-	Y
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Mammal	Point	Y		M
Har HaNegev	Impact of residential	Meteorology	Meteorology	Meteorology	Month	Y	1965 -	Y

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	settlements on the life supporting capacity of Har HaNegev arid environment							
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Meteorology	Meteorology	Meteorology	Point	Y		M
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Other animals	Point	Y		M
Har HaNegev	Impact of residential settlements on the life	Terrestrial systems characteristics	Ecosystem biomass and structure	Primary production	Point	Y		M

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	supporting capacity of Har HaNegev arid environment							
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Terrestrial systems characteristics	Soil	Soil moisture	Point	Y		M
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Terrestrial systems characteristics	Topography	Topography	Point	Y		Y
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har	Ecosystem services	Ecosystem services	Tourism (Use value)	Point	Y		Y

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	HaNegev arid environment							
Har HaNegev	Impact of residential settlements on the life supporting capacity of Har HaNegev arid environment	Social systems characteristics	Economic data	Transportation (incl. infrastructure)	Point	Y		Y
Kruger National Park	Spatial-temporal dynamics of savanna ecosystems (tree-grass interactions, grass quality/quantity, biodiversity) as a life support system to wildlife and livestock production in and around Kruger National Park	Terrestrial systems characteristics	Air chemistry	Carbon flux	TBD	No	2016 onward	Not yet, planned

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Kruger National Park	Spatial-temporal dynamics of savanna ecosystems (tree-grass interactions, grass quality/quantity, biodiversity) as a life support system to wildlife and livestock production in and around Kruger National Park	Terrestrial systems characteristics	Ecosystem biomass and structure	Forest biomass and growth		No	2008-2016	Not yet
Kruger National Park	Spatial-temporal dynamics of savanna ecosystems (tree-grass interactions, grass quality/quantity, biodiversity) as a life support	Terrestrial systems characteristics	Vegetation structure and species cover	Herbaceous biomass and growth (e.g. grass)	Specific season– 2009 – 2014	No	2009 - 2014	Not yet

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	system to wildlife and livestock production in and around Kruger National Park							
Kruger National Park	Spatial-temporal dynamics of savanna ecosystems (tree-grass interactions, grass quality/quantity, biodiversity) as a life support system to wildlife and livestock production in and around Kruger National Park	Terrestrial systems characteristics	Plant and foliage chemistry	Plant and foliage chemistry	Specific season – 2009 - 2014	No	2009-2014	Not yet
Kruger National Park	Spatial-temporal dynamics of savanna ecosystems	Terrestrial systems characteristics	Ecosystem biomass and structure	Vegetation index (NDVI, SAVI)	8 daily	No	2001-2016	Yes

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	(tree-grass interactions, grass quality/quantity, biodiversity) as a life support system to wildlife and livestock production in and around Kruger National Park							
Kruger National Park	Spatial-temporal dynamics of savanna ecosystems (tree-grass interactions, grass quality/quantity, biodiversity) as a life support system to wildlife and livestock production in and around	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Vegetation structure and species cover	Field 2012, LIDAR 2008, 2010, 2012	No	2008-2012	Not yet

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	Kruger National Park							
Mediterranean Large Marine Ecosystem	Cross-scale management of ecosystem services in the Mediterranean Large Marine Ecosystem	Marine systems characteristics	Marine biodiversity and species richness (incl. population)	Marine biodiversity and species richness (incl. population)	Population dependent spatio-temporal resolution*	Yes/No	Species-specific	No
Northern Limestone National Park	Managing mountain forests undergoing changing disease / disturbance dynamics	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Birds	Point data	Potentially available upon request	1995-2010	P
Northern Limestone National Park	Managing mountain forests undergoing changing disease / disturbance dynamics	Terrestrial systems characteristics	Ecosystem biomass and structure	Forest biomass and growth	100 m resolution	Potentially available upon request		P

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Northern Limestone National Park	Managing mountain forests undergoing changing disease / disturbance dynamics	Terrestrial systems characteristics	Insects	Insects	Point data	Available upon request	?	P
Northern Limestone National Park	Managing mountain forests undergoing changing disease / disturbance dynamics	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Insects	Point data	Available upon request	?	P
Northern Limestone National Park	Managing mountain forests undergoing changing disease / disturbance dynamics	Meteorology	Meteorology	Meteorology	Half hourly	Available upon request	(1900 - only monthly data), 1090-2016	A
Northern Limestone National Park	Managing mountain forests undergoing changing disease /	Terrestrial systems characteristics	Soil	Soil map	100 m resolution	Potentially available upon request		P

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	disturbance dynamics							
Northern Limestone National Park	Managing mountain forests undergoing changing disease / disturbance dynamics	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Vegetation structure and species cover	Point data	Available upon request	1993 – 2015	P
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Amphibian	Seasonally during summer	written reports	from 2006;	yes
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Air chemistry	Carbon flux	Carbon flux	yearly	digital form	2012-2015	yes
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Fishes	Seasonally	digital form	1998 – 2015	yes

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Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Hydrology and water budget	Hydrology and water budget	Hydrology and water budget	yearly	digital form		yes (balance by literature)
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Invasive species	Seasonally	digital form	1998 – 2015	yes
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Standing water (Lakes)	Macrophytes	Seasonally	digital form	1998 – 2015	yes
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Meteorology	Meteorology	Meteorology	Daily ;	digital form ; ;	from 1960;	yes;
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Standing water (Lakes)	Phytoplankton	Seasonally	digital form	1998 – 2015	yes

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Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Phytoplankton	From weekly to seasonally during summer;	digital form;	from 2006;	yes;
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Phytoplankton	Seasonally	digital form	1998 – 2015	yes
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Standing water (Lakes)	Water chemistry	From weekly to seasonally during summer;	digital form;	from 2006;	yes;
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Standing water (Lakes)	Water chemistry	Seasonally or one for year	digital form	2000 – 2015	yes
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Standing water (Lakes)	Zooplankton	Seasonally	digital form	1998 – 2015	yes

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Zooplankton	From weekly to seasonally during summer;	digital form;	from 2006;	yes;
Ohrid/Prespa, Gran Paradiso National Park	Ecosystem services and biodiversity crisis across mountain lakes	Aquatic systems characteristics	Biodiversity and species richness (incl. population)	Zooplankton	Seasonally	digital form	1998 – 2015	yes
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Biodiversity and species richness (incl. population)	-	No	2000 - present	A
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Social systems characteristics	Economic data	Economic data	10 years	Yes	1999 / 2009	A

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Disturbance and desaster events	Fire disturbance	Fire disturbance	Annual	Yes	2003 / 2013	A
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Geology and Gomorphology	Geology and Gomorphology	Geology and Gomorphology	-	Yes	1973 / 2005	A
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Nature conservation and management	Governance and planning	Governance and planning	Annual	Yes	2006/ 2015	A
Peneda-Gerês	Vegetation Dynamics as a	Hydrology and water budget	Hydrology and water budget	Hydrology and water budget	Annual	Yes (snirh.pt)	Depends on the	A

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas						station (until 2010)	
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Invasive species	-	No	2006-2014	A
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Land Cover and habitats	Land Cover and habitats	Land Cover and habitats				A
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological	Social systems characteristics	Ecosystem use and management	Land use	5 years	Yes	1990 / 2012	A

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	Transitions and Future Societal Benefits in Mountain Pas							
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Meteorology	Meteorology	Meteorology	Hourly, daily, monthly	No	Depends on the station	A
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Topography	Surface Elevation Model	Photogrammetry	-	Yes	2008 / 2010	
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal	Terrestrial systems characteristics	Soil	Soil physical characteristics	-	Yes	1994/ 2004	A

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	Benefits in Mountain Pas							
Peneda-Gerês	Vegetation Dynamics as a Proxy of Socio-ecological Transitions and Future Societal Benefits in Mountain Pas	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Vegetation structure and species cover	day	No	2013	A
Swiss National Park	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Disturbance and desaster events	Avalanches	Avalanches	yearly	1949-present	A	
Swiss National Park	Comparing ecosystem services provided by protected areas with non-	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Birds		2012		

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	protected areas in mountainous areas of Europe using EO							
Swiss National Park	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Terrestrial systems characteristics	Vegetation structure and species cover	Herbaceous biomass and growth (e.g. grass)		1982	A	
Swiss National Park	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Social systems characteristics	Ecosystem use and management	Land use				

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Swiss National Park	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Social systems characteristics	Ecosystem use and management	Land use	1900, 1929, 1949, 1965, 1982	1900 – 1982	A	
Swiss National Park	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Mammal		2012		
Swiss National Park	Comparing ecosystem services provided by protected areas with non-	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Mammal		1982	A	

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	protected areas in mountainous areas of Europe using EO							
Swiss National Park	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Mammal		2014		
Swiss National Park	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Meteorology	Meteorology	Meteorology	daily		A	

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Swiss National Park	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Vegetation structure and species cover		1982 (Davos); 1994 (SNP)	A	
Swiss National Park	Comparing ecosystem services provided by protected areas with non-protected areas in mountainous areas of Europe using EO	Terrestrial systems characteristics	Biodiversity and species richness (incl. population)	Vegetation structure and species cover		2014	A	
Sierra Nevada	Temporal evolution of ecosystem services in Sierra Nevada	Meteorology	Meteorology	Meteorology	daily	Yes	2010-2015	Yes

Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Sierra Nevada	Temporal evolution of ecosystem services in Sierra Nevada	Terrestrial systems characteristics	Vegetation cover	Vegetation maps	Year	Yes	1956, 1977, 1984,1999, 2003 and 2007	Yes
Sierra Nevada	Temporal evolution of ecosystem services in Sierra Nevada	Terrestrial systems characteristics	Soil properties	Maps of physical and hydrological soil properties	Year	Yes	2007	Yes
Sierra Nevada	Temporal evolution of ecosystem services in Sierra Nevada	Social systems characteristics	Agricultural management practices	Crop types, farming practices and yield for Sierra Nevada	Year	Yes	1993 to 2015	Yes
Sierra Nevada	Ancient irrigation channels as management tools to buffer the impact of climate change in Sierra Nevada ecosystem services	Terrestrial systems characteristics	Topographical properties	Maps of topographical properties	Year	Yes	2007	Yes

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Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
Sierra Nevada	Ancient irrigation channels as management tools to buffer the impact of climate change in Sierra Nevada ecosystem services	Terrestrial systems characteristics	Soil properties	Soil profiles in Andalusia	Year	Yes	2007	Yes
Sierra Nevada	Ancient irrigation channels as management tools to buffer the impact of climate change in Sierra Nevada ecosystem services	Terrestrial systems characteristics	Soil cover	Soils maps of Sierra Nevada	Year	Yes	2007	Yes
Sierra Nevada	Ancient irrigation channels as management tools to buffer the impact of climate change in Sierra Nevada	Hydrological systems characteristics	Hydrological data from rivers and irrigation channels in Sierra Nevada	Flow and time operating data	Year	Yes	2014 until the present.	Yes

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Protected area	Storyline	Data Products level 1	Data Products level 2	Data Products level 3	Temporal resolution	Already in digital form - publicly available at a web site	Period covered	Available to consortium
	ecosystem services							
Sierra Nevada	Ancient irrigation channels as management tools to buffer the impact of climate change in Sierra Nevada ecosystem services	Social systems characteristics	Distribution of irrigation channels of Sierra Nevada		-	Yes	-	Yes
Sierra Nevada	Ancient irrigation channels as management tools to buffer the impact of climate change in Sierra Nevada ecosystem services	Social systems characteristics	Hydrological data	Potential hydrological impact of irrigation channels of Sierra Nevada	-	Yes	-	Yes

6.5 Annex 5. List of data products documented in DEIMS

A detailed documentation of the data products can be downloaded from https://data.lter-europe.net/deims/activity/list.

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Land cover	Current land cover and habitats	1990 to 2016	
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Dynamic	Disturbance and desaster events	2016	Dynamic processes like fire and avalanches
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Geology and geomorphology	Geology and Geomorphology	2016	GIS maps of geology and geomorphology
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Bark Beetle	Infestation	2016	Gis layers with the management points over the national park from 2010 - 2015
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Aerophoto 2009/2010/2013	Original images	2016	
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Water	Running water (River and streams)	2016	Spatial layer of running water
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Human infrastructure	Social systems characteristics	2016	GIS-layers of roads, buildings and parking places
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Soil	Soil map	2004	Modelled combined soil depth-soil type map
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Topographie	Topography	2011 to 2014	Airborne Laserscanning data (Elevation, surface model)
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Biotope mapping	Vegetation structure and species cover	2016	

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Forest	Vegetation structure and species cover	2016	
Kalkalpen National Park	Austria	Kalkalpen National Park (Austria) - Wild animal management	Vegetation structure and species cover	2016	
Zöbelboden LTER IM master site (ICP_IM_AT01)	Austria	LTER Zöbelboden Austria aerial data	Airborne Images	1995 to 2016	Aerial photographs and LiDAR data of the LTER Zöbelboden catchment
Zöbelboden LTER IM master site (ICP_IM_AT01)	Austria	LTER Zöbelboden Austria forest disturbance map	Disturbance and desaster events	1993 to 2014	Maps of (annual) forest disturbance (wind throw, bark beetle infestation) at the catchment of LTER Zöbelboden, Austria
Zöbelboden LTER IM master site (ICP_IM_AT01)	Austria	LTER Zöbelboden Austria catchment runoff	Hydrology and water budget	1995 to 2015	Runoff and runoff chemistry at LTER Zöbelboden, Austria
Zöbelboden LTER IM master site (ICP_IM_AT01)	Austria	LTER Zöbelboden Austria land cover and habitats	Land Cover and habitats	1995 to 2016	Land cover and habitats map for the LTER Zöbelboden catchment
Zöbelboden LTER IM master site (ICP_IM_AT01)	Austria	LTER Zöbelboden Austria meteorology	Meteorology	1993 to 2015	Meteorological data from LTER Zöbelboden
Zöbelboden LTER IM master site (ICP_IM_AT01)	Austria	LTER Zöbelboden Austria deposition	Precipitation chemistry	1993 to 2015	Deposition data from LTER Zöbelboden. The data comprises monthly wet only and bulk precipitation chemistry from an open area and canopy throughfall chemistry from 2-3 forest plots

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Zöbelboden LTER IM master site (ICP_IM_AT01)	Austria	LTER Zöbelboden Austria soil, soil water, soil respiration data	Soil	1992 to 2015	Soil data of LTER Zöbelboden, Austria. Soil inventory is carried out since 1992 on regular positions (approx 65) in the catchment measuring soil chemistry. Soil water chemistry is measured in forest plots (2-3) using lysimeter sampling and analyses on a bi-weekly to monthly basis. Soil hydraulic characterizations exist for the major soil types in the catchment. Soil CO_2 and N_2O respiration data is available for some years
Zöbelboden LTER IM master site (ICP_IM_AT01)	Austria	LTER Zöbelboden Austria forest structure	Terrestrial systems characteristics	1992 to 2014	Forest inventory data of LTER Zöbelboden. Beginning in 1992 permanent plots (64-70) have been recorded approximately every 5 years. The data comprises tree species identity and status, tree height, canopy height, breast diameter among other parameters describing forest structure.
Zöbelboden LTER IM master site (ICP_IM_AT01)	Austria	LTER Zöbelboden Austria vegetation structure and species cover	Vegetation structure and species cover	1993 to 2014	Resurvey data of vascular plants, epiphytic lichens and bryophytes at LTER Zöbelboden, Austria. First records started in 1993 and all permanent plots are being resurveyed on a regular basis every couple of years. Permanent plots for forest understorey are 10x10 m; epiphytic lichens and bryophytes are recorded on tree trunks (with some bryophytes plots on the forest floor)
Hardangervidda National Park	Norway	Hardangervidda (Norway) Temperature	Air temperature	1957 to 2016	Air temperature (daily and monthly) 1957-present
Hardangervidda National Park	Norway	Hardangervidda (Norway) Orthophotos	Airborne Images corrected	2016	Orthophotos from 2013
Hardangervidda National Park	Norway	Hardangervidda (Norway) DEM	Elevation model	2016	10 x 10 meter Digital Elevation Model
Hardangervidda National Park	Norway	Hardangervidda (Norway) Reindeer Population Structure	Focal species	1995 to 2015	Number of wild reindeer by year, including population structure (males, females and calves, some age classes)

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Hardangervidda National Park	Norway	Hardangervidda (Norway) Reindeer Hunting Data	Hunting data	1979 to 2016	Annual hunting quota and number of killed individuals
Hardangervidda National Park	Norway	Hardangervidda (Norway) Precipitation	Precipitation	1957 to 2016	Precipitation (daily and monthly) 1957-present
Hardangervidda National Park	Norway	Hardangervidda (Norway) Vegetation cover & diversity	Vegetation structure and species cover	2016	Field data: 30 x 30 meter plots (n=28). Biodiversity of vascular plants and lichens. Percent cover of rock & bare ground, grasses & sedges, shrubs, other woody species, lichens, and mosses.
Tatra National Park	Poland	Tatra National Park (Poland) - hydrographic data	Aquatic systems characteristics	2016	GIS thematic layers on the Park's hydrography: mountain lakes/ponds, streams. Bathymetric data, boundary of catchments, waterfalls, water resources, water uptake points, etc. Also available spatial hydrogeology data (springs).
Tatra National Park	Poland	Tatra National Park (Poland) - forest types	Current land cover and habitats	2016	GIS layer - map of forest types. Forest typology based on abiotic habitat parameters such as soil fertility and moisture, widely used by the forestry sector. Also available are thematic GIS layers showing historic forest and forestry data, as well as more current data on forest management (incl. timber harvesting) and such parameters as dominant species: height, age, trunk circumference (standard breast level measurement), proportion of coverage, etc.
Tatra National Park	Poland	Tatra National Park (Poland) - Natura 2000 habitats	Current land cover and habitats	2016	GIS thematic layer of distribution and basic characteristics of Natura 2000 habitats in the Polish Tatra Nat. Park. Altogether, 32 Natura 2000 habitats have been identified.
Tatra National Park	Poland	Tatra National Park (Poland) - plant communities	Current land cover and habitats	2016	GIS thematic layer of plant communities in the Tatra National Park. Overall, as many 49 non-forest plant communities were identified, in addition to approx. 17 major forest plant

Site Name	Country	Title	Data Product Type	Date Range	Abstract
					communities. Many of them are specific of the Tatras since associated with high sub-alpine and alpine environments.
Tatra National Park	Poland	Tatra National Park (Poland) - human activity (tourism, infrastructure, land mgmnt. etc.)	Economic data	2016	GIS thematic data on human activity and infrastructure in the Park, covering a.o. (1) tourism infrastructure and activity (trails, shelters, campsites, caves accessible to tourists, museums, sports and leisure infrastructure, educational facilities, etc. - as well as tourist traffic counts); (2) roads and other transport facilities (incl. cable car); (3) buildings (dense housing and individual objects), (4) geodetic/cadastral layers, land parcels, (5) cultural heritage (historic monuments incl. religious objects, remnants of past mining activity, historic sheep/cattle grazing infrastructure such as shepherd huts, etc.); (6) other infrastructure (e.g. power lines, water takeup points, meteo stations, etc.). Also, data on anthropogenic pressure: environmental impact and damage of human activity available.

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Tatra National Park	Poland	Tatra National Park (Poland) - on-going nature monitoring - animals	Focal species	2016	Regular monitoring activities of the Park's fauna has so far comprised 3 bird species: the golden eagle, peregrine falcon and capercaillie, and 3 mammal species: the Tatra marmot, the chamois, and the brown bear. GIS data layers collected on marmot colonies, preferred areas of occurrence of the chamois (and its range above tree line), as well as roaming areas and occurrence of brown bears (as well as of bear-human conflict hotspots). For birds, spottings, areas of occurrence, number of nesting individuals were monitored. This monitoring will be continued and expanded (to include more species of Community Importance) in a new, currently implemented Park monitoring regime under the new Park Protection Plan (to enter into force soon, as of August 2016).

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Tatra National Park	Poland	Tatra National Park (Poland) - PLANNED nature monitoring - ANIMALS	Focal species	2016	PLANNED (as of August 2016) regular monitoring activities of the Park's Natura 2000 habitats are specified in the new Park Protection Plan (currently in the final project stage, pending final approval and implementation resolution by the Minister of Environment). They'll altogether comprise 19 bird species, 8 mammal species (incl. 2 sp. of bats, wolf, brown bear, lynx, Tatra marmot, chamois), 2 amphibian species and 2 invertebrate species (beetles). Methodology-wise, depending on the species, they'll be conducted as 1 to several monitoring rounds/inspections performed annually or at several-year intervals, in most cases in a season-dependent manner, and will involve various, species-specific methods (field observations, tracking, transect counts, site inspection, counting/inventory of nests, colonies or dens/burrows, analysis of habitat area or condition, genetic sampling, etc. etc.). For the purpose of the Park's Protection Plan, nature inventory and assessment of the current state of conservation of the above-mentioned species was conducted and indicated by FV or U1 (no U2s or XXs, luckily) with respect to 3 parameters: population, habitat, future prospect - plus the cumulative value. The data may be available at the Park.

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Tatra National Park	Poland	Tatra National Park (Poland) - PLANNED nature monitoring - Natura 2000 habitats	Focal species	2016	PLANNED (as of August 2016) regular monitoring activities of the Park's Natura 2000 habitats are specified in the new Park Protection Plan (currently in the final project stage, pending final approval and implementation resolution by the Minister of Environment). They'll altogether comprise 32 habitats of Community Importance occurring in the Park, both forest and non-forest. The planned monitoring regime will involve appropriate monitoring grid/s of various resolutions (500, 250, 100, 1000 m - depending on the habitat) and established permanent observation plots according to the national biodiversity monitoring methodology applied countrywide by the Polish Chief Inspectorate for Environmental Protection (GIO?). The temporal regime: mostly every 5-6 years (sometimes every 3, 4 or 2 years). Usually the chief monitored parameter will be area of the habitat and its state (Natura 2000: FV, U1, U2), in some cases also presence and influence of invasive alien species. For the purpose of the Park's Protection Plan, nature inventory and assessment of the state of the above-mentioned 32 habitats, i.e. FV or U1 (no U2s or XXs, luckily) related to (a) habitat area, (b) habitat structure and function, and (c) future prospect - plus (d) the cumulative value - was conducted.

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Tatra National Park	Poland	Tatra National Park (Poland) - PLANNED nature monitoring - PLANTS	Focal species	2016	PLANNED (as of August 2016) regular monitoring activities of the Park's selected vascular plant species are specified in the new Park Protection Plan (currently in the final project stage, pending final approval and implementation resolution by the Minister of Environment). They're planned to comprise 6 rare species of Communnity Importance occurring in the Park at few locations (from 1 to 19). Monitoring activities are planned to be conducted in principle once a year, in selected cases every 2-3 years, seasonally. They'll be based on counting and controlling the sites, searching for new sites, as well as counting plant shoots (total and generative shoots). For the purpose of the Park's Protection Plan, nature inventory and assessment of the state of the above-mentioned 6 plant species, i.e. FV or U1 (no U2s or XXs, luckily) related to (a) habitat area, (b) habitat structure and function, and (c) future prospect - plus (d) the cumulative value - was conducted and data may already be available at the Park.
Tatra National Park	Poland	Tatra National Park (Poland) - conservation zoning	Governance and planning	2016	GIS layer with current spatial delimitation and conservation zoning of the Tatra National Park. Also archival data on zoning available from as early as 1955 (beginning of Park operation).
Tatra National Park	Poland	Tatra National Park (Poland) - MaB zoning	Governance and planning	2016	GIS layer of MaB zoning related to the Polish portion of the UNESCO MaB Tatra Mountains site, covering the Polish Tatra Nat. Park and its surroundings.
Tatra National Park	Poland	Tatra National Park (Poland) - mountain meadows	historical land use	2016	GIS thematic layers with archival data (1955, 1977, 2004) on distribution of mountain meadows - remnants of past low-impact human activity (mostly sheep grazing, some cattle

Site Name	Country	Title	Data Product Type	Date Range	Abstract
					grazing, hay harvesting, etc.). Currently largely undergoing secondary succession (overgrowth by tree/bush vegetation).
Tatra National Park	Poland	Tatra National Park (Poland) - bark beetle infestations	Infestation	2016	GIS thematic layer with historic (1992, 2001) data on bark beetle (Ips typographus L.) infestations of Park's forests.
Tatra National Park	Poland	Tatra National Park (Poland) - wind damages to forests	Other disturbance	2016	GIS layers showing historic data (21st Century) on windstorm damages to forest ecosystems of the Park.
Montado in Alentejo Natura 2000 sites	Portugal	Time series of predicted values (Mohid) - Transpiration	Air humidity	1979 to 2009	Model Output for a number of points (csv, excel)
Montado in Alentejo Natura 2000 sites	Portugal	Meteorological parameters for modelling (Mohid) - Pressure	Air pressure	1979 to 2009	Daily predictions based on meteorological forecast model - NetCDF.
Montado in Alentejo Natura 2000 sites	Portugal	Meteorological parameters for modelling (Mohid) - Temperature	Air temperature	1979 to 2009	Daily predictions based on meteorological forecast model - NetCDF
Montado in Alentejo Natura 2000 sites	Portugal	Birds Diversity	Bird	2015	Database built by volunteers from the Portuguese Society for the Study of Birds. Each row is a validated record of an observed species. The information on the number of individuals of that species is not reliable.
Montado in Alentejo Natura 2000 sites	Portugal	Corine land Cover	CORINE	2006	The same as http://land.copernicus.eu/pan-european/corine-land-cover/view, clipped for PA Montado and projected using EPSG:3763 (ETRS89/Portugal TM6)
Montado in Alentejo Natura 2000 sites	Portugal	Corine Land Cover Change - 1990/2000/2006/2012	CORINE	2006	The same as http://land.copernicus.eu/pan-european/corine-land-cover/view, clipped for PA Montado and projected using EPSG:3763 (ETRS89/Portugal TM6)
Montado in Alentejo Natura 2000 sites	Portugal	Burnt area	Fire	1990 to 2014	Georeferenced areas burnt by wildfires, recorded by the Portuguese Institute for Nature Conservancy and Forests, a series from 1990-2014

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Montado in Alentejo Natura 2000 sites	Portugal	Meteorological parameters for modelling (Mohid) - Solar radiation	Global radiation	1979 to 2009	Daily predictions based on meteorological forecast model - NetCDF
Montado in Alentejo Natura 2000 sites	Portugal	Biomass herbaceous layer	Herbaceous biomass and growth (e.g. grass)	2016	Field work - plot measurements (n=18)
Montado in Alentejo Natura 2000 sites	Portugal	Vegetation biomass	Herbaceous biomass and growth (e.g. grass)	1979 to 2009	Modeled with Mohid
Montado in Alentejo Natura 2000 sites	Portugal	Portuguese Land Cover Map	Historic land cover and habitats	2007	A map produced by the Portuguese Geographic Institute with a minimum spatial unit of representation of 1 ha. Spatial accuracy 5.5 m and thematic accuracy 85.13%, with an error of 2% for a confidence level of 95%. There are several levels of detail, concerning land occupation. For the moment, only Level 2 is publicly available.
Montado in Alentejo Natura 2000 sites	Portugal	Forest Cover Map - 2000/2006	Other Land cover (please specify)	2000 to 2006	As in http://forest.jrc.ec.europa.eu/activities/forest-mapping/forest-cover-map-2000/ clipped for PA Montado and projected using EPSG:3763 (ETRS89/Portugal TM6).

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Montado in Alentejo Natura 2000 sites	Portugal	Portuguese Land Cover Map - COS Level 2	Other Land cover (please specify)	2007	A map produced by the Portuguese Geographic Institute with a minimum spatial unit of representation of 1 ha. Spatial accuracy 5.5 m and thematic accuracy 85.13%, with an error of 2% for a confidence level of 95%. There are several levels of detail, concerning land occupation.
Montado in Alentejo Natura 2000 sites	Portugal	Root depth	Phenology	1979 to 2009	Modeled with Mohid
Montado in Alentejo Natura 2000 sites	Portugal	Specific Leaf Area	Phenology	2016	Field work - plot measurements (n=18)
Montado in Alentejo Natura 2000 sites	Portugal	Vegetation water content - herbaceous layer	Plant and foliage chemistry	2016	Field work - plot measurements (n=18)
Montado in Alentejo Natura 2000 sites	Portugal	Vegetation water content - tree layer	Plant and foliage chemistry	2016	Field work - plot measurements (n=18)
Montado in Alentejo Natura 2000 sites	Portugal	Soil Organic Matter	Soil	2008 to 2012	Field work - repeated measurements and multiple point measurements
Montado in Alentejo Natura 2000 sites	Portugal	Soil water content	Soil	1979 to 2009	Modeled with Mohid
Montado in Alentejo Natura 2000 sites	Portugal	Soil moisture (surface, 5-10 cm)	Soil moisture	2016	Field work - plot measurements (n=18)

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Montado in Alentejo Natura 2000 sites	Portugal	Canopy height	Vegetation structure and species cover	1979 to 2009	Modeled with Mohid
Montado in Alentejo Natura 2000 sites	Portugal	Shrub control - area under intervention	Vegetation structure and species cover	2011 to 2014	Areas of Project Terraprima "Shrub Control" (http://www.terraprima.pt/en/projecto/1) with identification of the year and month of intervention
Montado in Alentejo Natura 2000 sites	Portugal	Shrub cover	Vegetation structure and species cover	2016	Field work - plot measurements (n=18, 50 m x 50 m)
Montado in Alentejo Natura 2000 sites	Portugal	Tree cover	Vegetation structure and species cover	2016	Field work - plot measurements (n=18, 50 m x 50 m)
Montado in Alentejo Natura 2000 sites	Portugal	Meteorological parameters for modelling (Mohid) - Wind speed	Wind speed and direction	1979 to 2009	Daily predictions based on meteorological forecast model - NetCDF
Danube Delta Biosphere Reserve	Romania	Danube Delta river water level	Hydrobiology of rivers	1932 to 2014	River water level measured monthly at different stations for the period 1932-2014
Danube Delta Biosphere Reserve	Romania	Danube Delta water depth	Lakewater physics (incl. temperature, depth, hydroperiod, turbidity)	1995 to 2009	Monthly water depth (cm) obtained from surveys for the period 1995-2009
Danube Delta Biosphere Reserve	Romania	Danube Delta suspended solids	Riverwater physics (temperature, velocity, depth, suspended solids)	1840 to 2002	Yearly water turbidity data from 1840 to 2014 from a network of stations located on Danube River and Danube Delta.
Danube Delta Biosphere Reserve	Romania	Danube Delta Water turbidity	Riverwater physics (temperature, velocity, depth, suspended solids)	2003 to 2004	Water turbidity data based on survey (at different stations located inside the Danube Delta) measured in NTU for the period 2003-2004

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Danube Delta Biosphere Reserve	Romania	Danube Delta nutrients	Weltand chemistry	2000 to 2014	Nutrient survey (N and P concentrations)
Danube Delta Biosphere Reserve	Romania	Danube Delta alkalinity, TOC, pH, conductivity, water temperature	Wetland physiscs (temperature, depth, hydroperiod, surface, turbidity)	2000 to 2014	Alkalinity TOC (total organic carbon), water temperature, pH, conductivity
Danube Delta Biosphere Reserve	Romania	Danube Delta bird census	Wetlands	2000 to 2014	Bird census survey (abundance and diversity)
Doñana Long-Term Socio-ecological Research Platform	Spain	Doñana_waterbird_counts	Bird	1973 to 2016	Data on bird presence and abundance in Doñana is available since the 50ties, even before its protection. EBD-CSIC started standardized monitoring by aerial counts in the 70ties, initially focused on wintering birds but since de early 80ties counts are conducted monthly, and up to 50 bird species are identified in 52 counting areas within the marshes. Terrestrial bird count of main bird concentrations of Doñana have been conducted at the same time (both EBD-CSIC and Park Management) but were not standardized until 2002 by EBD-CSIC. Since then, monthly surveys have been conducted covering about 87 water bodies of the marshes and from fixed observation points (up to 196 water bird species are included). Additionally, each month, a transect (30 km) count of birds (all non-passerine species and Corvus corax) present at the beach and sea shore is done by car. Furthermore, during spring, colonial water bird nests are located and chicks ringed when possible. Several colonies have been monitored since the 80ties. Non-colonial waterbird nests are located monthly during the breeding season using linear transects on horse in the marshes, totalling about 65 km. These transects data are being collected since 2003. Earlier data on non-

Site Name	Country	Title	Data Product Type	Date Range	Abstract
					colonial breeding waterbirds are more disperse, although ringing activities have been done since the 70ties on regular bases.
Doñana Long-Term Socio-ecological Research Platform	Spain	Doñana_Groundwater	Groundwater levels	1974 to 2016	In Doñana official groundwater level and recharge monitoring is done by the Guadalquivir Water Authority (Confederacion Hidrografica del Guadalquivir CHG). Levels are recorded monthly at 195 measurement points distributed throughout the whole area (unsaturated zone) with starting dates between 1974 and 1994. Additional measurements related with groundwater recharge and chemical composition, covering different periods and areas, are made by research entities. Geological and Mining Institute of Spain (IGME) installed soil moisture sensors and piezometers in the sandy soils of Doñana in 2008 and one lysimeter has been installed in 2016
Doñana Long-Term Socio-ecological Research Platform	Spain	Doñana_Herbivore_counts	Mammal	1986 to 2016	In Doñana both wild and domestic ungulates are present. Livestock (cows, horses, sheep) is controlled by the Park Management authority (Regional Ministry of Environment) through direct counts conducted each month and by sanitary control of cattle (tuberculosis) that is mandatory. EBD-CSIC collects data on wild ungulates (wild boar, red deer and fallow deer) through seasonal (winter, spring and late summer) line transect counts (distance sampling), done by car at the end of the day and beginning of the night. Twelve transects (15 km each) cover different areas of Doñana. Four transects located in the marshes can only be counted in the dry season (late summer). Apart from ungulates, also rabbits and hares are recorded. Park Management conducts additional counts of red deer and fallow deer (population counts) once a year during the mating season (late summer)

Site Name	Country	Title	Data Product Type	Date Range	Abstract
					dividing the National Park into 20 regions. Summaries are all published in annual reports of the Park.
Doñana Long-Term Socio-ecological Research Platform	Spain	Doñana_Meteorology	Meteorology	1978 to 2016	In Doñana a manual weather station exists since 1978 equiped with analogical instruments from which EBD-CSIC personnel once a day, records maximum and minimun air temperature and total precipitation. This manual station has been supervised by the State Meteorological Agency (AEMET) until 2008. Since 2008, on the same site, AEMET has installed a new measurement station with modern instrumentation that allows automated data recording (temperature, precipitation, wind, humidity, etc.). Since November 2008 EBD-CSIC installed additional weather stations on different sites and varying time intervals, consisting of a multisensor of VAISALA brand. At some of these measure points other data related to the study of climate (soil humidity, soil temperature, solar radiation, CO2 flow, etc.) are being recorded. Additional weather stations in or near the Doñana area are managed by the Ministries of Agriculture and Environment of the Junta de Andalucía and by research entities like the National Institute for Aerospace Tecnology (INTA) and the Geological and Mining Institute of Spain (IGME)
La Palma Island	Spain	Geology	Geology and Geomorphology	2016	Erosion classes (1-9), geological map, mountains (mountain regions, area, range, property)
La Palma Island	Spain	Land Use Land Cover	Historic land cover and habitats	2016	Layers of different land use land cover types (natural and anthropogenic)
La Palma Island	Spain	Hydrology	Hydrology and water budget	2016	Hydrological infrastructure (artifical canals, ponds, rivers, catchments), water use by municipalities
La Palma Island	Spain	Climate	Meteorology	1969 to 1998	Climatic rarity (100x100m), different precipitation parameters (47 to 214 meteorological stations (AEMET), 1968-1998, interpolated, 100x100m), solar radiation (derived from DEM,

Site Name	Country	Title	Data Product Type	Date Range	Abstract
					2x2m), temperature (47 to 214 meteorological stations (AEMET), 1968-1998, interpolated, 100x100m)
La Palma Island	Spain	Protected Area	Nature conservation and management	2016	Protected Area shapefiles
La Palma Island	Spain	Cartography	Remote sensing data products	2016	Cartography (1:5000, 1:25000), ortophoto (2003, 1x1m, RGB Bands), shoreline
La Palma Island	Spain	Vegetation Data	Terrestrial systems characteristics	2016	Presence/absence data for spermatophytes (from 2009 to 2015, 1921 circular plots of 100m diameter), potential natural vegetation map, vegetation classification map, occurence data for Aenocarpus, Aeonium, and Opuntia, endemic species diversity (gridded), species occurence data on lava flows (including mosses and lichens) and roadsides, occurence of other invasive species, data on herbivory and fire, treeline, facilitation
La Palma Island	Spain	Topography	Topography	2016	Aspect (100x100m), DEM (2x2m), elevation bands (10 and 100m steps), slope (100x100m), topographic complexity (100x100m)
Sierra Nevada / Granada (ES-SNE)	Spain	Land use / land cover	Current land cover and habitats	2007	Land uses and vegetation cover, based on photo interpretation of aerial photographs from 2007.
Sierra Nevada / Granada (ES-SNE)	Spain	Land use / land cover	Historic land cover and habitats	1956	Land uses and vegetation cover, based on photo interpretation of aerial photographs from 1956.
Sierra Nevada / Granada (ES-SNE)	Spain	Weather data from meteorological stations Sierra Nevada	Meteorology	2008 to 2016	It contains the raw data obtained from the multiparameter stations Sierra Nevada.
Sierra Nevada / Granada (ES-SNE)	Spain	Crop yield	Provisioning services	2007	Production of the variety of agricultural materials collected by the rural economy

Site Name	Country	Title	Data Product Type	Date Range	Abstract
Sierra Nevada / Granada (ES-SNE)	Spain	Grazing	Provisioning services	1956	Pasture areas as a proxy of grazing at 1956.
Sierra Nevada / Granada (ES-SNE)	Spain	Grazing	Provisioning services	2007	Pasture areas as a proxy of grazing at 2007.
Sierra Nevada / Granada (ES-SNE)	Spain	Runoff	Runoff and discharge	2007	Runoff generated under different historical scenarios of vegetation cover and soil uses (1956-2007)
Sierra Nevada / Granada (ES-SNE)	Spain	Runoff	Runoff and discharge	1956	Runoff generated under different historical scenarios of vegetation cover and soil uses (1956-2007)
Sierra Nevada / Granada (ES-SNE)	Spain	Ancient irrigation channels	Water use	2016	The network of irrigation channels that are still working in Sierra Nevada was designed ?and built by Arabs, to assure water for agriculture, pastures and forests in summer time, ?when there is no rain in Mediterranean mountains.

6.6 Annex 6. Guidelines to update metadata

Project Title: ECOPOTENTIAL: IMPROVING FUTURE ECOSYSTEM BENEFITS THROUGH EARTH OBSERVATIONS

Project number: 641762

Project Acronym: ECOPOTENTIAL

Proposal full title: IMPROVING FUTURE ECOSYSTEM BENEFITS THROUGH EARTH OBSERVATIONS

Type: Research and innovation actions

Work program topics addressed: SC5-16-2014: "Making Earth Observation and Monitoring Data usable for ecosystem modelling and services"

Documentation of Protected Areas
Using DEIMS as site and dataset repository

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http://data.lter-europe.net/deims/

Table of content

1. Background

The EcoPotential project aims to provide information to analyse effects of global and regional threats, e.g. climate change and deposition, within protected areas along a geographic gradient. Data provided by the protected areas themselves (termed as in-situ data) as well as information derived from remote sensing (termed as EO data) are going to be used in this excercise.

In order to get an overview on the data and organisation of the protected areas the DEIMS (Dynamic Ecological Information Management System) is used in order to collect information on characteristics of the protected areas, as well as data generated there.

DEIMS (http://data.lter-europe.net/deims/) is a product developed by LTER Europe and US LTER in order to provide an editor and discovery interface along the following conceptual models:

> (a) site, which is defined as the location where a series of observations (mostly long term) or experimentations take place. Mostly a site is equipped with energy supply and permanent observation facilities. A single e.g. weather station would be an 'observation facility' which could be grouped together with other infrastructures to a 'site'
>
> (b) dataset, which is defined as a single or a series of information objects (e.g. data files, images, observations, etc.) which are described with a consistent metadata (MD) record. A 'dataset' metadata record describes a physical existing file.
>
> (c) data product, which is defined as generic information object (e.g. monitoring activity) which generates a data stream. This was included in order to provide the possibility of an fast overview on available information for a given location.
>
> (c) network, which is defined as the organisational entity which organises activities at a given site in addition to the managing organization.
>
> (d) person information, which is defined as information on persons and organisations which are linked to site, dataset, data products or networks.

The different MD models are linked using a UUID as unique identifier for the sites, persons, datasets and networks.

In EcoPotential the DEIMS Site Editor is used to document and describe the network of protected areas. This only can be done together with the protected area managers. Therefore the web-based editing tools of DEIMS is used. In the following the important conceptual models used in EcoPotential are described in a bit more detail.

1.1 Concept 'Protected area'

One basic concept in DEIMS is the 'site'. This is defined as the location where short or long term observations and/or experimentations take place. A site clusters a series of different observations plots together, which are managed by one or more communities. A site is either the area of investigation (e.g. a catchment) or and area of interest (e.g. a socio-ecological defined region).

In this respect a **protected area** can be seen as **'site'** and can by this be described using the MD model SITE in DEIMS.

The description of the SITE MD model can be found in DEIMS following the link https://data.lter-europe.net/deims/documentation/site.

For EcoPotential a minimum set of information needs to be provided, but more information is welcome.

The following information should be provided (mandatory fields are checked during the MD entry, and a MD record can only be published, when all information is provided):

- Name and general description
    - Site name
    - Short name (abbreviations)
    - Site code
    - Size ín ha
    - General site description
    - Images (recommended, but not mandatory)
    - Keywords
- Contact details
    - Site manager
    - Site owner
    - Web link
- Metadata provider
    - Metadata provider
- Geographic location
    - Center coordinates
    - Bounding box
    - Elevation range
    - Shape file (if available, not mandatory)
- Ecosystem and environmental characteristics
    - Annual air temperature range
    - Annual precipitation range
    - Biome and ecosystem type (global classification)
    - Biogeographic region and habitats (European classification)
- Network affiliation
    - Status in ILTER network (normally non-LTER)
    - Other networks (select 'EcoPotential (H2020)')
- Status and history
    - Site status
    - Year of establishment
- Focus, design and scale of site
    - Research topics
    - Parameters
- Protection status and resource management
    - Protection program and cover
- Infrastructure and operation
    - Infrastructure (special focus on data infrastructure)
    - Infrastructure notes
- Data sharing policy
    - Data request format
    - General data policy
    - Data policy notes
- Data management
    - Data storage locations
    - Number of data storage locations

○   Data notes

For all protected areas addressed in EcoPotential the basic information was already entered into the system. So additional information needs to be provided together with the site managers.

1.2 Concept 'Data product'

The concept of 'data product' was added in order to allow a summarised description of a series of data. By this a fast overview on available data sources in a protected area can be created without a full description of each single dataset. This should be the logical second step.
A 'data product' can be e.g. 'Deposition data', which contains a wide range of parameters and a long time series. Instead of describing each single dataset or parameter the 'data product' can be described as a whole. The related datasets (by its MD) can be linked to the data product.

A data product contain the following information
- Title - title of the data product
- Site / Protected area - reference to the protected area(s) in which the data were generated
- Data product classification - classification of the data product based on a taxonomy
- Abstract - textual description of the content of the data and the methods used
- Parameter (optional) - more detailed information on the parameters provided in the data product
- Keywords - providing keywords (based on EnvThes) to annotate the data product and allow the user a more targeted search and discovery
- Time period - in which the data are generated
- Temporal resolution - temporal resolution of the data
- Spatial resolution - spatial resolution of the data collection
- Data digital available - are the data available in digital format
- Link to the data portal
- Data publically available - yes/no
- Data available for Ecopotential - yes/no
- Contact person

For each data product a MD record is created and referenced to the site/protected area. In a later phase dataset MD can also be linked to the data product.

The data product should also allow to prioritise the creation and provision of datasets and the related MD, because user can ask more specifically to the data user. If no complete dataset MD are provided via the EcoPotential VRE, the data products forms should be used in order to provide aggregated information on the available data.

1.3 Concept "Dataset"

A dataset is a single data file or a series of data files which are described with the MD record. This can be either a physical file or a data service. For datasets metadata as specified in the DEIMS community profile (link to INSPIRE and EML) or the INSPIRE MD Specfication need to be provided.

A detailled descritpion of the DEIMS community profile for datasets can be found in DEIMS at https://data.lter-europe.net/deims/documentation/dataset.

2. Working with DEIMS

2.1 Where I can find DEIMS?

DEIMS (Dynamic Ecological Information Management System) is a web-based online editor for site and dataset metadata. It can be found at the web-adress http://data.lter-europe.net/deims/.
Discovery and view can be done as anonymous user without login. In order to create or edit content you have to login.

2.2 How to login to DEIMS?

If you are part of the national LTER network, please use your credentials for the national LTER network.
If you are participant in the EcoPotential project please use the following credentials:

User: ecopotential
Pwd: ecosystems_rule!

Press the Login & Contribute button and provide the credentials on the following page.
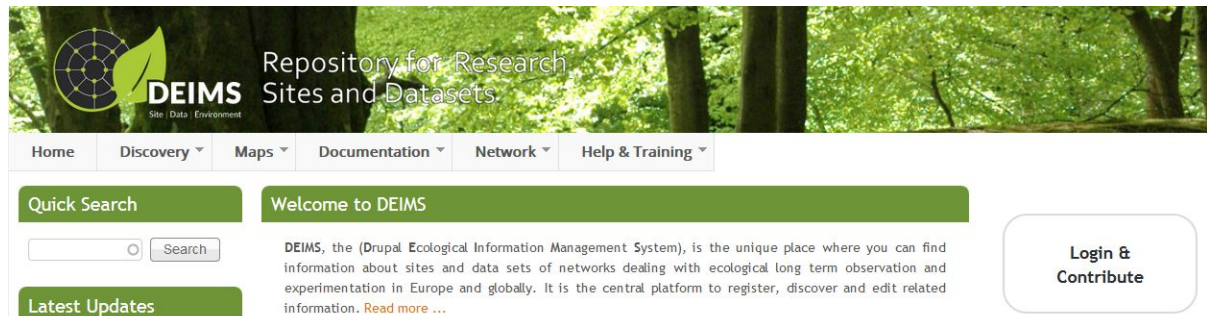
Figure 2.2.1 'Login & Contribute' button

Figure 2.2.2 Provide credentials

When logged in you get a new tab 'EDIT'.

2.3 Basic structure of DEIMS

DEIMS is structured according to two aspects (a) services and (b) content.
The basic menu (see Fig. 2.3.1) provides you with the main functionalities needed when working with DEIMS.

Figure 2.3.1 Basic menu of DEIMS

The menu item 'Home' always bring you back to the main page.

The basic content types allow you browse from the main page into the different contents, which are interlinked (see Fig. 2.3.2).

Figure 2.3.2 Basic content types in DEIMS

2.4 How to get help?

If you need support you can either use the 'Provide Feedback' link which is shown at every page, or directly send an email request to
johannes.peterseil@umweltbundesamt.at
christoph.wohner@umweltbundesamt.at

Figure 2.4.1 Provide feedback button at the bottom of each page

3. Update Site Documentation

For EcoPotential the different protected areas are already pre-entered with basic information. This needs to be updated in order to geta proper documentation of the sites.
In order to update the information you have to
1. login to DEIMS (see Chap. 2.2) in order to be able to edit the MD records
2. Select your protected area or site
3. Edit the site documentation

How to do that you can find in this chapter.

3.1 How to select my protected area or site?

For EcoPotential all protected areas were pre-entered into DEIMS with basic information which needs to be updated. In order to find the information there are two ways:

1. Select based on the user
2. Select based on the network or project

3.1.1 Selection based on user

In DEIMS all MD entries are assigned to the user. When going to the menu item '***Edit / Site / My Sites***' all MD entries which were created by the user are listed. Clicking on the name opens the ***view page*** of the MD entry or using the ***EDIT*** direct link in order to directly open the MD entry in the ***edit page***.

Figure 3.1.1 Selection of the site based on the user

Site or protected areas, which are part of a national LTER network are not listed, as they are listed under user name of the national LTER network. For these sites the second option for selection needs to be used.

3.1.2 Selection based on the network or project

One of the MD fields in the site content type is the assignment to a ILTER network as well as to other relevant networks or projects. This includes "***EcoPotential (H2020)***" in the field 'Other networks (in addition to ILTER)". All protected areas listed in the proposal were assigned to the project "***EcoPotential (H2020)***".
By this also protected areas which were already listed in a national LTER network can be found.

Goto the menu item '***Discovery / Site / Simple Search***" which shows you a list of all sites documented in DEIMS. Based on the different facets the selection can be made. Please add "***EcoPotential (H2020)***" in the field ***Other networks*** in order to filter for the protected areas listed for EcoPotential.

The list can be sorted according to the Name of the protected area (Title), the site code and the contry.

A site / protected area can be selected when clicking on the title of the site. This will open the site / protected area in the ***view page***. From there the content can be edited.

Figure 3.1.2 Selection based on the network or project

Each site is identified by the UUID which can be used to directly access a site MD record, e.g. https://data.lter-europe.net/deims/site/e4b06c68-9a26-4b9a-9fe6-dc65a87c0b63 for La Palma (Spain).

3.2 How to edit a protected area

When a protected area is selected normally the *view page* opens. This is also true when accessing a site record as anonymous user. When you are logged in and have edit rights on a MD record you can edit the content by pressing the *Edit* button at the top of the page (see Fig. 3.2.1).

In the following section it will be described on how to edit the different sections of the site documentation.

When accessing the *edit page* (see Fig. 3.2.2) the form is structured in two sections. On the left part it shows the content of the form, which groups together a series of fields in order to make navigation in the form.
In the right section the fields for editing can be found. Mandatory fields are marked with a red asterisk. Nevertheless, when trying to save a record mandatory fields are checked. A record can only be published if all mandatory fields are provided.

La Palma Island - Spain

View   Edit   Revisions

Basic Information

Site Name : La Palma Island
Site Code : ECOPOT_ES_001
Country (Site Location): Spain
LTER National Network: Non-LTER
Contact: Site Manager: Carl Beierkuhnlein

Keywords originating from EnvEurope Thesaurus:
Protected sites biodiversity ecosystem ecology ecopotential
ecosystem services

General Site Description:
Today the whole island of La Palma is under the status of a UNESCO
biosphere reserve, after initially in 1983 the laurel forest of Los Tilos
was established as a first biosphere reserve, which was the first on all
Canary Islands. It is an outstanding fact that in this reserve a complete
terrestrial surface is protected including large surfaces of absolutely
pristine ecosystems and a legacy of human influenced habitats. Since
2011 the island represents the first UNESCO starlight reserve
worldwide. The central part of the island is preserved as a national
park "Caldera de Taburiente" established
... Show more

Metadata Update Date: Tuesday, July 12, 2016
UUID: e4b06c68-9a26-4b9a-9fe6-dc65a87c0b63

Information Detail Level

64% complete

Filling out *Web Address* will bring Site to 66%.

Photos

Figure 3.2.1 View page of a site MD record with EDIT button

Edit Site La Palma Island - Spain

View   **Edit**   Revisions

You have to fill in all required fields in order to be able to save and publish your changes. You can, however, save a "draft" without having filled in all required fields when adding a new site.
For a list of changes to the site form please click here. Please don't create the same person/organization over and over again. Use the search fields to look for already existing entries.
Video demonstration on How to Add a Site.

Name And General Description * (active tab)		**Name and Description**
Contact Details		Site Name *
Metadata Provider		La Palma Island
Geographic Location *		Short name
Ecosystem and Environmental Characteristics		⊹ * La Palma
Network affiliation		
Site Classification		⊹
Status and History *		⊹
Focus, Design and Scale of Site *		SHORT NAME: Enter either a site's short name or acronym or other site name. These fields can be used to provide up to three names that site in other networks or projects or are used for internal reference. For example, in the US-LTER, the Virgina Coast ...

Figure 3.2.2 Edit page of s site MD record

For the protected area you are responsible, please provide updated information on the characteristics.

3.2.1 How to add a new person

If you cannot find (based on autocomplete field) a person or organisation, please press the **Create person** link and a new form is opened (see Fig. 3.2.1). Provide information and the save. The information will directly be added to the site form.

Figure 3.2.1 Pop-up form to add a new person

3.2.2 How to provide geographic location

For each protected area the center coordinates must and the bounding box should be provided. If you do not see the map in the interface, please resize the screen. This is a problem of the map widget used, which will be solved in the next version. After resizing you see the map and can draw the bounding box with the map tools shown at the bottom of the map.

Figure 3.2.2 Widget to edit the bounding box

3.2.3 What ecosystem information should be provided?

In order to provide information about the protected areas valid for different scales both the global classifications:
- ILTER Biome (defined as the global vegetation zone)
- GEO BON Biomes
- Ecosystem type (defined as the current vegetation)

and the European classifications:
- Biogeographic region
- EUNIS Habitat categories

The ecosystem types and habitats can be more than one, and please provide at least the most important ones for the site / protected areas.

In "additional" provide textual descriptions you can use the ***Additional characteristics*** about Geology, Hydrology, Soils or the Vegetation (including fauna).

3.2.4 What is the network affiliation of my protected area?

If your protected area is part of a national LTER network, e.g. LTER Austria, then in field ***LTER national Network*** the national network is listed. In case your site / protected area is NOT part of the LTER Network please select "***Non-LTER***" (see Fig. 3.2.4).

Figure 3.2.4 Network affiliation

In the field ***Networks (in addition to / other to ILTER)*** the entry "***EcoPotential (H2020)***" in order to link the site / protected area to the EcoPotential project.

3.2.5 What information to provide about Focus, design and scape of site?

For each site / protected area the ***Research Topics*** need to be provided, which addresses the scientific and monitoring aspects for the area.
For ***Parameter*** it depends, if the data products are provided, here at least on a higher level information on the monitoring parameters (as list) should be provided.Please select the relevant parameters from the list.

If you need additional concepts in the reference list, please use the **Provide feedback** to suggest additional entries in the reference list. The DEIMS team will deal centrally with this and add new concepts to the reference lists.

3.2.6 What information should be provided about infrastructure?

Please provide information at least for the **Data infrastructure** which is one of the branch in the infrastructure taxonomy. Please provide information on
- Metadata standards
- Data storage
- Data services

If you need additional concepts in the taxonomy please use **Provide feedback** to request changes. This requests will be dealt in the DEIMS Team centrally.
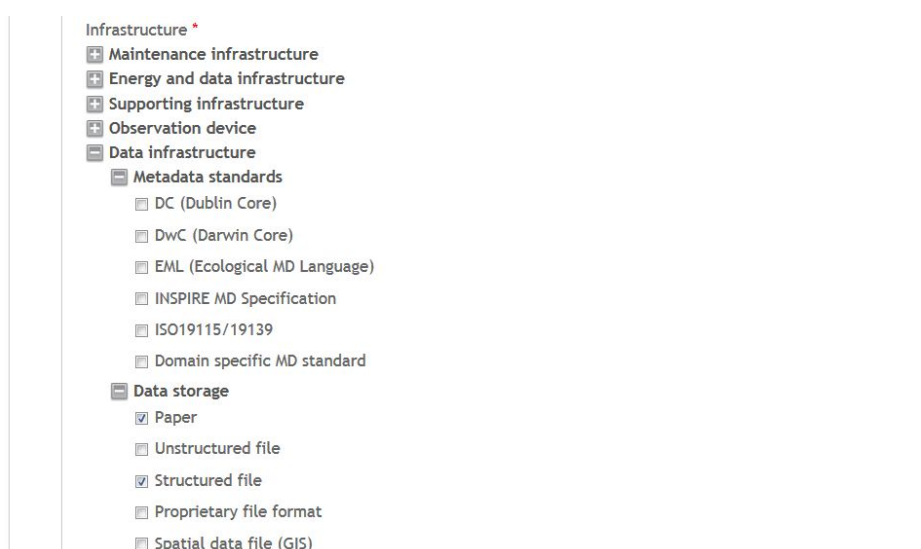
Figure 3.2.5 Select from reference list on infrastructure elements

3.2.7 How to save a record?

If you editing a new record, you have the option to **Save as draft**. By doing this the entry can be seen by the logged in user, but not by an anonymous user.

If you press **Publish** the record will be published and the mandatory fields will be checked.

Once a record is published you can edit and save the changes. When press **Unpublish** a record can be unpublished again, only beiing able to be seen by the user.

3. Provide information on 'Data products'

For EcoPotential an overview on data available at the different sites / protected areas should be provided. The data products also provides the possibility to list 'external data' and provide

link to existing dataset MD records. This needs to be updated in order to get a good updated overview on available data from the sites.

In order to update the information you have to
1. login to DEIMS (see Chap. 2.2) in order to be able to edit the MD records
2. Select your data product or select a new one
3. Edit the site documentation

How to do that you can find in this chapter.

3.1 How to add a new data product?

If you go to *Edit / Data Product / Add Data Product* the *Edit page* for a new data product record is opened. How the different fields can be filled is described in the next section.

<insert image>

Figure 3.1.1 Create a new data product MD record

In addition and existing data product record can be cloned for creating a new copy (to be changed) by pressing the *Clone* button.

3.2 How to select and edit an existing data product?

In DEIMS all information objects are assigned to the user. If you go to *Edit / Data Product / my Data Products* (see Fig. 3.1.1) you can select from the list of data products edited by your user. You can either select it to *Edit* which opens the *Edit page* for the MD record or *Clone* the MD record and make a copy.

Secondly you can go to *Discovery / Data Product / Simple Search* to discover MD records and filter e.g. on your site / protected area. Your can then select a data product MD record,

<insert image>

Figure 3.2.1 Select a data product for view and editing

3.3 How to edit a data product MD record?

In the left section of the edit page you find the content of the edit forms. Each of the items contain a group of fields for the dataset MD record. Please go throught the form and provide the information needed.
The data product should provide an fast overview on data available for a certain site / protected area. Later this container could be described and linked with dataset MD records.

Figure 3.3.1 Edit page for data products

3.3.1 What information needs to be provided for a data product?

The fields **Paramter** and **Keywords** are optional fields. This information is recommended to be provided in order to enhance the usability of the data product MD record.

3.3.2 How to link existing dataset MD to the data product?

This feature is currently under development. The idea is to just list MD URL/URI for the data product. This MD URL/URI can be any web resource providing a link to a MD record (e.g. https://data.lter-europe.net/deims/node/9118/iso19139).

The implementation of the feature will be announced.

4. Provide information on 'Datasets'

For EcoPotential an overview on data available at the different sites / protected areas should be provided. The datasets describes concrete existing data files or services which can be provided to the users. The MD record NEEDS to point to a single or a series of endpoints where data can be retrieved. Retrievel could be password secured and not open. Metadata shoud be provided also for this datasets.

In order to update the information you have to
4. login to DEIMS (see Chap. 2.2) in order to be able to edit the MD records
5. Select your dataset or add a new one
6. Edit the site documentation

How to do that you can find in this chapter.

4.1 How to select my datasets for editing?

In DEIMS all information objects are assigned to the user. If you go to **Edit / Dataset / my Datasets** (see Fig. 4.1.1) you can select from the list of datasets edited by your user. You can either select it to **Edit** which opens the **Edit page** for the MD record or **Clone** the MD record and make a copy.

Secondly you can go to **Discovery / Dataset / Simple Search** to discover MD records and filter e.g. on your site / protected area (see Fig. 4.1.2). Your can then select a MD record,

which opens the **View page**, were you can edit the MD record when the edit rights are granted to you.

Figure 4.1.1 Select myDataset based on the user

Figure 4.1.2 Simple search for the dataset

4.2 How to create a new MD record for my dataset?

If you go to **Edit / Dataset / Add Dataset** the **Edit page** for a new dataset MD record is opened. How the different fields can be filled is described in the next section.

Figure 4.2.1 Create a new dataset MD record

In addition and existing dataset MD records can be cloned for creating a new copy (to be changed) by pressing the **Clone** button.

4.3 How to edit the dataset MD record?

In the left section of the edit page you find the content of the edit forms. Each of the items contain a group of fields for the dataset MD record. Please go throught the form and provide the information needed.

The dataset MD model is based on a community profile for the observation and monitoring community and provides a minimum set of information which needs to be provided for a dataset record.

Figure 4.3.1 Edit page for the dataset MD record

The field **Related site** allows you link to the site / protected area, where the observation was taken. More than one sites / protected areas can be selected.

4.3.1 How to create a bounding box for the dataset MD record?

In the section **Geographic** the bounding box for the dataset should be provided. This is a mandatory information. In order to reuse the information of the bounding box, the concept **Research site** is used, which describes the actual observation location, e.g. a series of plots.

So either select an existing **Research site** (=observation location) from the list by start typing the name. The autocomplete field will give you the appropriate values to select.
If you do not find an appropriate **Research site** (= observation location), then create a new one by pressing the **Create Research Site** link. A separate form opens, where the user can add the bounding box information.

Figure 4.3.2 Adding bounding box using the Research site concept

The name/title for the **Research site** should be constructed using the following template: <name of site / protected area>_<plot>,which needs to be added by the user.

4.3.2 How to save a dataset MD record?

You can save and publish the dataset MD record when pressing the button **Publish** or save as draft for later further editing. When the record is published all mandatory fields are checked.

Figure 4.3.3 Save a dataset MD record

4.3.3 How to view a dataset MD record?

When a dataset MD record is successfully saved the record is shown in the **View page**. A html version of the content is shown. In addition the MD record can be viewed (and is exported) as EML, ISO19115 (North American Profile), IOS19115 (INSPIRE Profile) and BDP Profile.

Figure 4.3.4 View page of the dataset MD record

5. Summary

If you have recommendation to enhance usability and new feature please use ***Provide feedback*** in DEIMS or send a email to johannes.peterseil@umweltbundesamt.at or christoph.wohner@umweltbundesamt.at.