



D1.2 Use Case scenarios v2

WP1 – Wildlife Scenarios

Deliverable Lead: CLS

Dissemination Level: Public

Deliverable due date: 30/06/2017

Actual submission date: 29/06/2017

Version 1.0



| Document Control Page | |
|-----------------------|--|
| Title | D1.2 Use Case scenarios v2 |
| Creator | Garance Weller (CLS) |
| Description | This document is the second version of deliverable 1 of WP1: Wildlife scenario. It is the most possible exhaustive transcription of Use Case Leaders feedbacks in terms of requirements for the EO4wildlife platform |
| Publisher | EO4wildlife Consortium |
| Contributors | Jean Michel Zigna (CLS), Elizabeth Lambert (CLS), Marion Sutton (CLS), Ana Bertoldi (BirdLife), Alan Rees (UNEXE), Susan Gallon (AFB) |
| Creation date | 30/05/2017 |
| Type | Text |
| Language | en-GB |
| Rights | copyright "EO4wildlife Consortium" |
| Audience | <input checked="" type="checkbox"/> Public <input type="checkbox"/> Confidential <input type="checkbox"/> Classified |
| Status | <input type="checkbox"/> In Progress <input type="checkbox"/> For Review <input type="checkbox"/> For Approval <input checked="" type="checkbox"/> Approved |

Disclaimer

This deliverable is subject to final acceptance by the European Commission.

The results of this deliverable reflect only the author's view and the Commission is not responsible for any use that may be made of the information it contains.

Statement for open documents

(c) 2017 EO4wildlife Consortium

The EO4wildlife Consortium (<http://eo4wildlife.eu>) grants third parties the right to use and distribute all or parts of this document, provided that the EO4wildlife project and the document are properly referenced.

Table of Contents

| | |
|--|----|
| EO4wildlife Project Overview | 5 |
| Executive Summary | 6 |
| 1 Scenarios requirements | 7 |
| 1.1 Data requirements..... | 7 |
| 1.2 Geographical coverage | 9 |
| 1.3 Wildlife scenarios..... | 9 |
| 1.3.1 Bird scenario | 9 |
| 1.3.2 Marine mammal scenario | 10 |
| 1.3.3 Marine turtle scenario | 11 |
| 1.3.4 Fish scenario | 12 |
| 2 System and service description..... | 14 |
| 2.1 Actors..... | 14 |
| 2.2 Use cases | 14 |
| 2.2.1 Use cases overview | 14 |
| 2.2.2 Nomenclature | 15 |
| 2.2.2.1 Use case Nomenclature | 15 |
| 2.2.2.2 Requirement nomenclature..... | 16 |
| 2.2.3 General requirements..... | 16 |
| 2.2.4 Description and upload Use cases | 17 |
| 2.2.4.1 Use case Describe Product: UC-DescProd | 17 |
| 2.2.4.2 Use case Describe Service UC-DescServ..... | 19 |
| 2.2.4.3 Use case Upload Service UC-UplServ | 21 |
| 2.2.5 Discover, run and display use cases..... | 22 |
| 2.2.5.1 Use case Discover Product UC-DiscProd | 22 |
| 2.2.5.2 Use Case Discover Service UC-DiscServ | 23 |
| 2.2.5.3 Use Case Run Service UC-RunServ | 24 |
| 2.2.5.4 Use Case Display and on-line tools UC-Display | 27 |
| 2.2.6 Administration use cases | 29 |
| 2.2.6.1 Use case Validate Product or Service metadata UC-ValMeta..... | 30 |
| 2.2.6.2 Use case Invalidate Product or Service metadata UC-InvMeta | 31 |
| 2.2.6.3 Use case Test the uploaded service UC-TstServ..... | 31 |
| 2.2.6.4 Use case Manage the users UC-ManUser | 31 |
| 2.3 Metadata and Service State diagram | 32 |
| 2.3.1 Metadata state diagram | 32 |
| 2.3.2 Service deployment state diagram | 33 |
| 2.4 Traceability matrix | 34 |
| References..... | 37 |
| Annex 1: EO data description | 38 |
| Annex 2: Detailed list of services to implement..... | 40 |

List of Figures

| | |
|--|----|
| Figure 1: Bird scenario..... | 10 |
| Figure 2: From the estimated locations (crosses) to the track | 12 |
| Figure 3: Description and Upload Use case diagram..... | 17 |
| Figure 4: Discover, run and display Use case diagram | 22 |
| Figure 5: Administration Use case diagram | 30 |
| Figure 6: Metadata state diagram..... | 32 |
| Figure 7: Service deployment state diagram..... | 33 |

List of Tables

| | |
|--|----|
| Table 1: Earth observation data and derived products..... | 8 |
| Table 2: In situ observation data | 9 |
| Table 3: Areas of Interest | 9 |
| Table 4: Bird scenario keywords | 10 |
| Table 5: Marine mammal scenario keywords | 11 |
| Table 6: Marine turtle scenario keywords | 12 |
| Table 7: Fish scenario keywords..... | 13 |
| Table 8: Traceability matrix..... | 36 |
| Table 9: List and details of most requested EO data..... | 38 |
| Table 10: List and details of complementary EO data | 39 |

EO4wildlife Project Overview

EO4wildlife main objective is to bring large number of multidisciplinary scientists such as biologists, ecologists and ornithologists around the world to collaborate closely together while using European Sentinel Copernicus Earth Observation more heavily and efficiently.

In order to reach such important objective, an open service platform and interoperable toolbox will be designed and developed. It will offer high level services that can be accessed by scientists to perform their respective research. The platform front end will be easy-to-use, access and offer dedicated services that will enable them process their geospatial environmental simulations using Sentinel Earth Observation data that are intelligently combined with other observation sources.

Specifically, the EO4wildlife platform will enable the integration of Sentinel data, ARGOS archive databases and real time thematic databank portals, including Wildlifetracking.org, Seabirdtracking.org, and other Earth Observation and Met Ocean databases; locally or remotely, and simultaneously.

EO4wildlife research specialises in the intelligent management big data, processing, advanced analytics and a Knowledge Base for wildlife migratory behaviour and trends forecast. The research will lead to the development of web-enabled open services using OGC standards for sensor observation and measurements and data processing of heterogeneous geospatial observation data and uncertainties.

EO4wildlife will design, implement and validate various scenarios based on real operational use case requirements in the field of wildlife migrations, habitats and behaviour. These include:

- Management tools for regulatory authorities to achieve real-time advanced decision-making on the protection of protect seabird species;
- Enhancing scientific knowledge of pelagic fish migrations routes, reproduction and feeding behaviours for better species management;
- Enable researchers better understand the movement behaviour of sea turtle populations; and
- Setting up tools to assist marine protected areas and management.

Abbreviations and Glossary

A common glossary of terms for all EO4wildlife deliverables, as well as a list of abbreviations, can be found in the public document “EO4wildlife Glossary” available at EO4wildlife.eu.

In this case, it has been updated with the terminology used to describe the EO4wildlife system and service (Section 2).

Executive Summary

The goal of this document is to describe the user's requirements of the EO4wildlife system as a result of the first phase of the task T1.1 Scenario requirement. During the first phase of T1.1 in early 2016, representatives of final end users of different scientific communities have been interviewed in order to collect information and build dedicated scenarios. Each of those scenarios being later implemented in the EO4wildlife platform and validated. The challenge was mainly to understand, compile and organize feedbacks from four Use Case Leaders. Although all of them are involved in wildlife tracking and animal behaviour, feedbacks could be heterogeneous. Thus, in order to guide them and with the objectives of being able to retrieve the common requests as well as keeping specific ones, a guideline was distributed at early stage of this phase.

A second phase of T1.1 was conducted in the first half of 2017. The objective of this second phase was to update the end users requirements after one year run of the EO4wildlife project and considering the first year achievements of the project.

The same guideline was distributed again to the Use Case leaders to retrieve the new requirements. Emphasis was made on the use case expressed by the *Agence Française pour la Biodiversité*, which was not mature enough to be described in details in the first version of the Requirements. Thus the objective of this use case is double. The first objective is to take into consideration the recommendations received from the first Advisory Board meeting held in October 2016 in Toulouse, and to focus on components that differentiate this use case from the other three. The second objective is to take benefit from the Additional Copernicus datasets in order to extend the use of Optical Earth Observation data in the platform. This latter objective also relies on the potential collaboration with another H2020 project named ECOPOTENTIAL.

This document is composed of two main parts: the first one is organized in verbal scenarios from each Use Case Leader while the second part is a system and service oriented translation of the user's requirements using the Unified Modelling Language use case. According to the work carried out in the second phase of T1.1, both parts of the document have been updated in v2 including: new information of data requirements, update of the Wildlife scenarios sections (with additional details in the Bird and Marine mammal scenarios), and update of the use case section. Finally the new version includes as a new annex a detailed list of services to implement.

It addresses the following main aspects of the use cases:

- What do users want to do?
- With which data?
- What type of results do they need?

In order to simplify the text in the following paragraphs, it is agreed that:

- the *bird scenario* is the one expressed by Birdlife International, representative of a wide community of ornithologists;
- the *marine turtle scenario* is the one expressed by University of Exeter, representative of a wide community of biologists involved in marine turtles studies;
- the *marine mammal scenario* is the one expressed by l'Agence Française pour la Biodiversité;
- the *fish scenario* is the one expressed by CLS, representative of an important community of scientists involved in light based geo location of pelagic species.

In terms of collaborative work, a preliminary version of the scenarios has been discussed during a project meeting session at mid phase. The marine mammal scenario has been discussed during a project meeting held in early 2017 and also through collaborative discussions with participants of the Ecopotential project. This document written by CLS - leader of the work package WP1 Wildlife Scenario and leader of the task T1.1 Scenario requirement - has been reviewed by all Use Case Leaders as well as other partners involved in the development of the platform and the tools for behaviour analytics.

1 Scenarios requirements

As mentioned above, a list of topics to be assessed was released to the Use Case Leaders, covering the following characteristics of the EO4wildlife platform:

- User objectives
- Data requirements
 - Must have
 - Nice to have
 - Geographical area
- Data discovery
- Data manipulation
 - Basic tools
 - Advanced functionalities
 - Advanced functionalities for gridded EO data
 - Functionalities for tracks and positions
 - Functionalities for any other data
- Fusion-Cross correlation
- Enrichment
- Extraction
- Thematic analytics
- Getting results
 - Downloading functionalities
 - Reports
 - Maps
- Visualisation

The feedbacks from topics “User Objectives” and “Thematic analytics tools” of the guideline were quite specific to each Use Case Leaders and constituted the most part of the scenarios to be implemented. Other topics will contribute to the scenarios as well but much more as common functionalities of the EO4wildlife platform.

The scenarios requirements are identified in brackets along the description by an identifier which nomenclature is Xn where X is the scenario identifier, B for bird, F for Fish, M for marine mammals, T for turtle.

1.1 Data requirements

A list of existing and available products has been prepared and released to help Use Case Leaders in the description of their requirements. This list is containing a description of the type of products (satellite, instrument, physical parameter retrieved), the provider, the geographical coverage and the temporal coverage available on the portals.

Preference was made for data from EU satellite missions, Sentinel’s mission, and from the EU Copernicus Services (Marine, Atmosphere or Land). Some specific data of interest were listed as well, available from owner data base or private operators.

This list of products and corresponding details is in Annex 2 of the document.

Below, the first table summarises the feedback from Use Case Leaders in terms of satellite EO data for the EO4wildlife platform. This is a compilation of physical parameters, usually retrieved directly from raw satellite measurements and derived products. It also gives a level of priority for accessing these data.

Priority one (1) being the most important data to have access to; priority 2 being the datasets that would be valuable to the platform but not necessary for the use cases

For each parameter required, the status of its availability is also mentioned. TBC indicates that the parameter is not directly available from existing data providers as a dataset but needs to be calculated (To Be Calculated).

| Parameter | Data availability | Scenarios requirements | | | |
|--------------------------|-------------------|------------------------|----------------|----------------|-------|
| | | Fish | Marine Turtles | Marine mammals | Birds |
| Sea surface temperature | x | 1 | 1 | 1 | 1 |
| Temperature at depth | x | | | | |
| Chlorophyll-a | x | 1 | 1 | 1 | 1 |
| Bathymetry | x | 1 | 1 | 1 | 1 |
| Sea Surface Height | x | | 1 | 1 | 1 |
| Sea level anomaly | x | | | 1 | 1 |
| Sea state | | | | 1 | |
| Wind intensity | x | | | 1 | 1 |
| Wind pressure | x | | | | 1 |
| Wind direction | x | | | 1 | 1 |
| Convergence zones | TBC | | 1 | | 1 |
| Eddies | TBC | x | 2 | 1 | 1 |
| Frontal structures | TBC | x | 1 | 1 | 1 |
| Eddy Kinetic Energy | TBC | | | 1 | 1 |
| Salinity | x | 2 | 1 | | |
| Dissolved Oxygen | x | 2 | | | |
| Chlorophyll persistence | x | | X | | 1 |
| Net Primary Production | x | 1 | 1 | 1 | 1 |
| Micronekton biomass | x | 1 | | 1 | |
| Magnetic field intensity | x | 2 | | | |
| Ice coverage | x | | | 2 | 1 |
| Sea currents | x | | 1 | 1 | 1 |
| HR optical imagery | x | | 2 | 2 | 2 |

Table 1: Earth observation data and derived products

The following table summarises the list of in situ observation data that are required from Use Case Leaders.

| Observation/scenario | Fish | Marine Turtles | Marine mammals | Birds |
|-----------------------|------|----------------|----------------|-------|
| ARGOS tracking data | X | X | X | X |
| Other tracking data | | X | X | X |
| Aerial observations | | | X | |
| Sighting observations | | X | X | X |

Table 2: In situ observation data

The following table resumes the list of areas of interest/delineations requested by Use Case Leaders.

| Areas/scenario | Fish | Marine Turtles | Marine mammals | Birds |
|--------------------------|------|----------------|----------------|-------|
| EEZ | X | X | X | X |
| MPAs | | X | X | X |
| Proposed protected sites | | X | | X |
| Marine renewable sites | | X | | X |

Table 3: Areas of Interest

1.2 Geographical coverage

It is agreed between all Use Case Leaders that EO4wildlife platform must handle downloading and manipulation of all types of data at global scale (worldwide geographical coverage). Individual scenarios are implemented at regional scale mainly due to the availability of regional dataset of tracking data.

1.3 Wildlife scenarios

The following paragraphs describe the four wildlife scenarios implemented in the EO4wildlife platform, as expressed by the Use Case Leaders in this requirement phase.

Each scenario shows some specificity in terms of tracking data and locations data to manipulate, geographical area covered, Earth Observation parameters to correlate and models to implement (species orientated). Besides those specificities, many functionalities as well as output results to produce are common to all scenarios and are described further in part 2 of the document.

Interoperability of EO4wildlife platform with other platforms (SeaTurtle.org, SeabirdTracking.org, ARGOS, Track&Loc) is required and thus mentioned below. A White Paper describes in details the expected interactions between the EO4wildlife platform and the listed external platforms, with respect to the users' requirements. [10] It describes the possibility to upload CSV file from the external databases in the EO4wildlife platform.

1.3.1 Bird scenario

General objective of this scenario is to be able to predict distribution [B1] of species of birds in order to develop effective management frameworks taking into consideration threats and pressure. To reach this goal, it is crucial to understand the factors that influence their distribution and habitat preferences [B2], and thus be able to detect change over space and time.

In terms tracking data, it is expected to manipulate ARGOS tracking data [B3] as well as other data from different technologies (geo locators from data logger, GPS/GSM locator) [B4]. While ARGOS database can

be interoperable with EO4wildlife platform, the other sources of tracking data must be uploaded by scientists on EO4wildlife platform.

Another option to consider is to launch processing from SeaBirdTracking platform hosting those tracking data [B5].



Figure 1: Bird scenario

The Bird Model Application is the result of the above workflow [B6], which shows the different phases of model development. At each stage decisions are required to help achieve the best model output.

The bird scenario focus on species tracked from colonies in the Atlantic Ocean where extensive tracking datasets are available. These include about 10 years of data and tens of thousands of bird locations [B7]. Potential study species include the Cory’s Shearwater and Black-browed Albatross. This scenario experiments **big data solutions for scientists involved in wildlife tracking and animal behaviour analysis**. Corresponding space and time satellite Earth Observation dataset are made available in order to assess EO4wildlife performance on big dataset.

A range of models [B8] to analyse animal behaviour have been explored and are being implemented in EO4wildlife platform:

- Kernel analysis to identify areas of greatest use and significance
- A series of home range estimation methods
- Exploration of EO data
- Habitat models (e.g. GLM, GAM, etc.)

| B1 | B2 | B3 | B4 | B5 | B6 | B7 | B8 |
|----------------------|---------------------|---------------------|--|--|---------------|----------|--------|
| Predict distribution | Habitat preferences | ARGOS tracking data | Non Argos geolocation and GPS/GSM data | Services accessible from seabirdtracking.org | Bird workflow | Big data | Models |

Table 4: Bird scenario keywords

1.3.2 Marine mammal scenario

The objective of this scenario is to help the conservation of marine mammals by improving the knowledge of many aspects of their population ecology. This scenario takes place in some of the Marine Protected Areas in French EEZ. Three areas are considered for this use case: the Indian Ocean, the AGOA Sanctuary of Guadeloupe and New Caledonia.

This scenario will manipulate data of marine mammals' observations from aerial survey campaigns [M1] (LTS, Line Transect Surveys). An important dataset of at-sea and aerial surveys are available for the scenario. Tracking data will be manually uploaded by scientists on their user workspace.

LTS are used to estimate the abundance and density of cetacean populations [M3]. LTS will be used to develop 'habitat-based density models' [M4] that relate cetacean densities to environmental covariates. Modelled relationships will then be used to predict cetacean densities in fine-resolution spatial grids spanning surveyed areas [M4]. This scenario requires the implementation of a range of analysis models:

- Transect segmentation (Roberts et al (2016))
- Model of sighting rates
- GLM/GAM fit model

In terms of satellite Earth Observation data and derived product, sea surface temperature, primary production and micronekton might be the most relevant parameters for studying marine mammals behaviour related to food presence.

The use of Very High Resolution optical images [M4] for marine mammals conservation in large and isolated MPAs can be of high interest to survey marine mammals remotely. VHR images will be acquired in 2017 thanks to the Copernicus program for EU projects. In the frame of collaboration with the Ecopotential EU funded project (<http://ecopotential-project.eu>), these optical data will be pre-processed in the platform to allow scientists to exploit the images [M6].

The challenge of this scenario will be the **heterogeneity of data to handle and the multi technology approach** using optical imagery [M7] to analyse behaviour of marine mammals.

| M1 | M2 | M3 | M4 | M5 | M6 | M7 |
|-----------------------|---------------|---------------------|--------|-----------------------------|--------------------|------------------------|
| Line-transect surveys | Manual upload | density of cetacean | Models | Very high resolution images | VHR pre-processing | Marine mammal workflow |

Table 5: Marine mammal scenario keywords

1.3.3 Marine turtle scenario

The final objective of this scenario is to support scientists involved in marine turtles studies in predicting turtles' distribution (define habitat preferences [T1] and environmental niches [T2]) using environmental data to inform dynamic management scenarios [T3].

An important point is to set interoperability with SeaTurtle.org platform[T4], which is gathering most of these scientists spread over the entire world and offer most of the functionalities proposed by SeaTurtle.org (described further in part 2). The main step forward expected with EO4wildlife platform is to **handle multiple tracks approach/project approach** [T5]. This will make an important difference with other existing facilities available for scientists.

This scenario requests implementation of a set of home range and behaviour analysis models [T6]:

- Minimum Convex analysis
- Alpha-hulls
- Local Convex hull
- Kernel Density Estimator
- Brownian bridge movement model
- State space model [1]

| T1 | T2 | T3 | T4 | T5 | T6 |
|---------------------|----------------------|--------------------|-------------------------------------|----------------------|--------|
| Habitat preferences | Environmental niches | Dynamic management | Interoperability with Seaturtle.org | Multi track approach | Models |

Table 6: Marine turtle scenario keywords

1.3.4 Fish scenario

The first objective of this scenario enables fish scientists to track pelagic species with light based geo localization devices and to get a state of the art estimation of the fish trajectory.

For this, the scientists either provide or have access via the platform to data recorded by the device attached to the fish. Data recorded by the tag are observation data. The fish locations are estimated via the measurement of the light level, and errors of positioning can be huge.

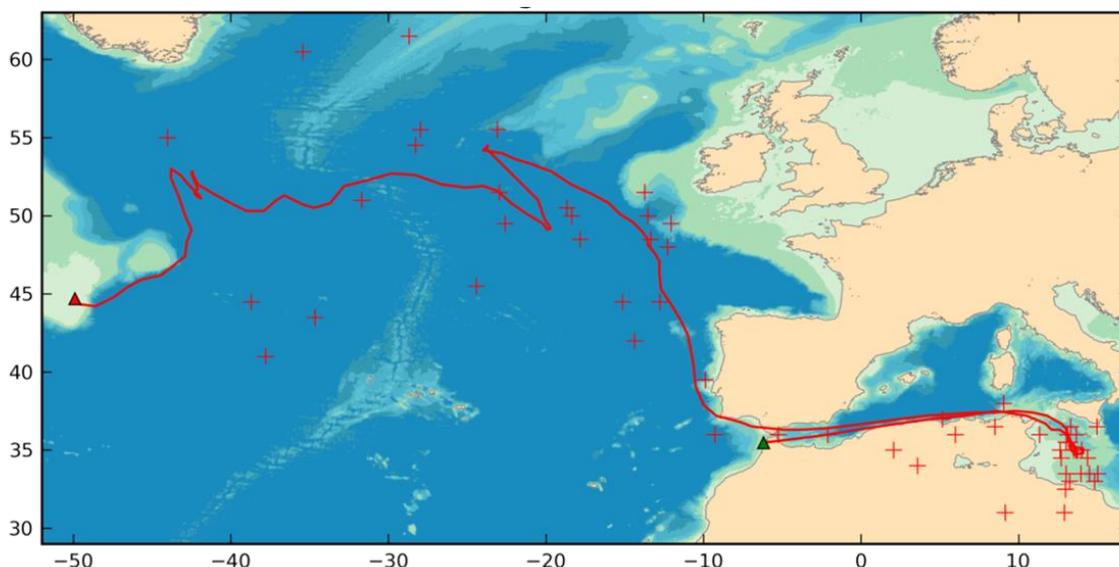


Figure 2: From the estimated locations (crosses) to the track

A range of correlations, constraints, models and filters associated to comparative data from satellite Earth Observation enable to optimize the estimation of the fish trajectory. The purpose of this scenario is to provide to the scientists the **possibility to run such algorithms themselves directly from the EO4wildlife platform** [F1] and to generate a set of results. Such algorithms will be provided by CLS to EO4Wildlife platform.

For this, the platform needs to access and manipulate daily satellite Earth Observation data of sea surface temperature, as well as a high resolution bathymetry file and a magnetic field intensity model output [F3]. Users of the platform for this scenario will have to provide some essential parameters [F2] online via a dedicated interface to compute the processing.

The second objective of this scenario is to enable analysing and understanding blue fin tuna behaviour [F4] or appearance [F5] correlated to environmental of salinity, primary production and sea surface temperature during spawning season in the Mediterranean Sea (summer season). An important dataset of tagged blue fin tunas is available during the project in order to implement and validate relevance of a range of dedicated models [F6] such as:

- Kernel analysis: areas of greatest use
- Time sent per cell/highest density cell

- Home range estimation methods

A list of references is available in References ([2] to [9]).

| F1 | F2 | F3 | F4 | F5 | F6 |
|-----------------------|------------|---------------|----------------|-----------------|--------|
| Automation of service | Parameters | Daily EO data | Fish behaviour | Fish appearance | Models |

Table 7: Fish scenario keywords

2 System and service description

The UML method is used for the functional and dynamic modelling of the EO4wildlife system.

In this context a use case is like a function of a system.

There are four sub sections:

- Presentation of the actors of the EO4wildlife system, users who are interacting with the system
- Presentation of the use cases: the main functions of the system
- Presentation of the dynamic modelling of product/service metadata and service deployment
- Traceability matrix between scenarios and user requirements

2.1 Actors

Here below are identified the actors of the EO4wildlife system:

User: is any user of the different scientific communities (biologists, ecologists, scientists, ornithologists, etc) who has an access to the EO4wildlife system. The access to the system is the same for all users, whether they are specialized in certain field or not.

Service provider: describes and uploads services into the EO4wildlife system

Product provider: describes the product he makes available in the system and the services to access them.

Administrator: validates the product and service metadata and tests the uploaded services. He also monitors the EO4wildlife system and users.

It should be noted that the service provider, the product provider and administrator are also users.

2.2 Use cases

2.2.1 Use cases overview

The main purpose of the EO4wildlife system is to improve existing services, to create new ones and share them by facilitating the access of new technologies for the analysis of animal behaviours.

The description of a service is required to make it understandable and attractive to users. The way a service provider describes a service is standardized through a service metadata model. All services process the specific input product, the ARGOS positions of animals, and generate added value information which has also to be described. Even if ARGOS positions can be considered as the main inputs, the EO4wildlife platform is designed to accept other tracking data.

Services can also use additional products, such as Sentinel Earth Observations, bathymetry or whatever biological or physical data. These additional products are called auxiliary data in this document. To be complete, the service description requires also the description of these associated auxiliary data. The product description has to be done by the product provider who gets the best skills to describe the auxiliary data he is in charge of. To make homogenous the product description, a product metadata model is also defined in the EO4wildlife system. The delivery times of the product description and of the service descriptions are not correlated. Nevertheless, the administrator will ensure the consistency of the descriptions.

Once the definition of a service is complete, the service provider can develop it, and test it on its own before the upload of the service in the EO4wildlife system.

All services are validated by the EO4wildlife administrator to ensure the quality of the EO4wildlife system.

Thus 'Description and upload' use cases are the preliminary steps required before a user can go ahead in the use of the EO4wildlife system.

The user can then discover the services and the associated auxiliary data, and brings new intelligence by defining a new service as a combination of existing services and creates a new workflow of services. The user can run several times a service to fine-tune the expected result. The 'Discover, run and display' use case describes in details how can be realized this possibility.

The functional modelling of the system is decomposed in 3 main parts:

1. First we have the integration of products and services in the EO4wildlife system, which contains 3 use cases:
 - The description of a product: that means the creation of the metadata product
 - The description of a service: that means the creation of the metadata service
 - The upload of a service in the EO4wildlife platform
2. Then we have the main functions of the platform concerning all users: discovery, service run and display:
 - Discover product : the search of a product in the catalogue of products
 - Discover service : the search of a service in the catalogue of services
 - Run Service : define and run of a service, or a set of services
 - Display and on-line tools: the display of products and service outputs
3. Finally we have the administrative functions of the EO4wildlife system:
 - Validate or invalidate the product or service metadata
 - Test and uploaded service
 - Invalidate a service
 - Manage the users : create/modify/delete

We consider the possibility for the user to register to the EO4wildlife system through a registration form out of the scope of system since it is not a valuable function for EO4wildlife business model. Be aware that it could be of interest for an operational implementation of the EO4wildlife system.

2.2.2 Nomenclature

2.2.2.1 Use case Nomenclature

The following nomenclature, **UC-XXX-NNN** is used in the use cases description:

- **UC** means Use Case
- **XXX** is the abbreviation of the use case name
- **NNN** is optional and is a scenario identifier for the use case: BIRD for birds, FISH for fishes, TURT for turtles, AFB for marine protected areas

The use cases and their abbreviation are:

- DiscProd for Discover Product
- DiscServ for Discover Service
- RunServ for Run Service
- Display for Display and on-line tools
- DescProd for Describe Product
- DescServ for Describe Service
- UpServ for Upload Service
- ValMeta for Validate Product or Service Metadata
- InvMeta for Invalidate Product or Service Metadata

- TestServ for Test the uploaded Service
- InvServ for Invalidate a Service
- ManUser for Manage the Users

2.2.2.2 Requirement nomenclature

The requirements will have the following nomenclature: **sss-ttt-xxx-yyyy/V**

- **sss** = System, EO4, for EO4WildLife System
- **ttt**: Type of the requirement
 - INT: Interface
 - FCT: Functional
 - IMP: Design / Implementation
 - PRF: Performance
 - DFM: Availability/Reliability/Maintainability
 - SEC: Safety
 - OPE: operational
- **xxx**: the use case abbreviation, or GEN If the requirement is general with the system
- **yyyy**: number with 4 digits which is allocated to a requirement when created and never modified nor used for any other requirement.
- **V**: mode requirement verification method: (**T** = Test, **A** = Analysis or **I** = Inspection)
 - **Test**: a test of validation makes it possible to check the requirement
 - For the requirements which cannot be checked by a test:
 - **Inspection**: activity of control per examination, observation or audit (example: the data access path is customizable)
 - **Analysis**: activity which requires a study to validate the respect of the requirement. For example calculation of performance.

2.2.3 General requirements

EO4-FCT-GEN-0010/T

The user has to be connected to the EO4wildlife system with credentials before any interaction with it.

EO4-FCT-GEN-0020/T

There are 4 user profiles in the EO4wildlife system: user, product provider, service provider and administrator. Each one has access authorization as mentioned in the use cases.

The administrator has access to all functionalities.

The product provider has access to the user rights, plus specific rights for product provider

The service provider has access to the user rights, plus specific rights for service provider

EO4-FCT-GEN-0030/T

During the description of a product or a service, the user can save temporarily its form, and complete it later in another session.

EO4-FCT-GEN-0040/T

In case of an error on a field (bad format, mandatory field missing, etc), an error message is displayed and the error field is marked in red

2.2.4 Description and upload Use cases

The following use cases allow the users to describe a product and a service and to upload a service in the EO4wildlife system. The description is stored as metadata for the product or service. This metadata is then used by the discovery function.

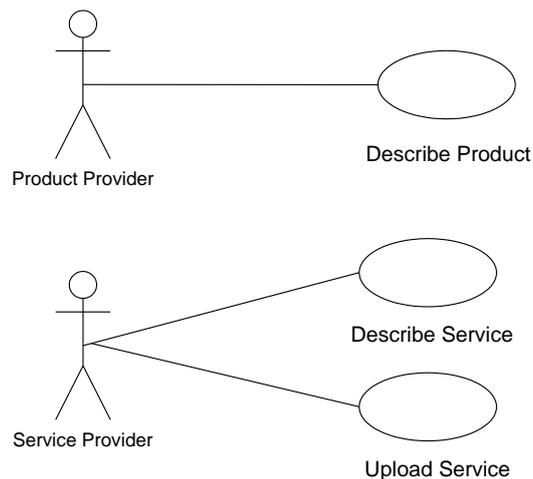


Figure 3: Description and Upload Use case diagram

2.2.4.1 Use case Describe Product: UC-DescProd

Summary: this use case describes the way to make a product description available in the EO4wildlife system through a metadata model.

Trigger: The product provider activates this use case on demand through the EO4wildlife user interface.

Actor: product provider

Description:

There are two possibilities to generate a product description. The first one is to create it from scratch:

The product provider selects the 'product description' option, then the 'create' option

The system displays the different fields of the EO4wildlife metadata product model. The following information are required to describe a product in the EO4wildlife system: (all fields are mandatory)

- Product ID: this is the EO4wildlife unique identifier
- Product name: this is the product name the end user is familiar with
- Overview: brief description of the product
- Full description: full description of the product
- Product Provider Identifier: Organization and Name
- Category: a predefined list allows the user to select 'Ocean, Atmosphere or Sea Ice'
- Download URL: access point to extract the product. The user can validate it by selection of a 'validate' button.

- Display URL: access point to display the product, when available. The user can validate it by selection of a 'validate' button.
- GetDescription: access point to get the dataset description, when available. The user can validate it by selection of a 'validate' button. If the response is successful, the system asks the product provider if he wants to import automatically the description: variables, time coverage, temporal resolution, geographical coverage, spatial resolution. If the product provider services do not expose such a service, the product provider has to complete manually the product description.
- Product level: L2, L3, L4, ..
- The projection, when needed.
- The updating frequency and time if any
- GetSize: access point to get the estimated size of an extraction. If such an URL does not exist, the product provider enters a default typical size for an extraction.
- Credentials: login and password to extract product (when required)

The product provider has also to upload a quicklook

The product provider validates the creation and the product metadata is pushed into the product catalogue.

The second option is to retrieve the product description from an existing catalogue. In such case:

The product provider selects the 'harvest' option,

The product provider enters the catalogue URL to harvest and the product identifier for the product, with credentials when required

The product provider validates the request to the external catalogue and gets the available information in the form which includes all the fields of the creation from scratch described just above.

The product provider completes the missing information when not available in the external catalogue

The product provider validates the information and the product metadata is pushed by the system into the product catalogue

The system generates automatically a creation date/time of the metadata. The update date/time of the metadata is equal to the creation date/time the first time. The metadata product status is set to 'To validate' (see Metadata State Diagram chapter 2.3.1). It is not accessible by the product discovery.

When a product is updated according to a predefined frequency and time, the system updates automatically the time coverage of the product in the metadata.

Variations

The product provider can modify the product metadata: all fields can be modified. The metadata returns to the state "to validate" and the modification date is updated in such case. The update is possible if the product provider has the required access rights (either the creator of the metadata, or a product provider of same organization).

The product provider cannot delete a metadata product since he cannot be aware of all the services that are processing the product. But he can turn it to 'invalid'.

Requirements

EO4-FCT-DescProd-0050/T

The product provider can describe a new product in the EO4wildlife system, according to the EO4wildlife metadata product model

EO4-FCT-DescProd-0060/T

There are 2 options for the metadata product creation: creation from scratch (entry fields manually), or creation from an existing catalogue (harvest from an external catalogue and complete the creation manually)

EO4-FCT-DescProd-0070/T

Once the metadata product is created, the system set it to the “to validate” state.

EO4-FCT-DescProd-0080/T

The product provider (creator, or same organization) can modify the metadata product.

EO4-FCT-DescProd-0090/T

The product provider can turn the metadata state to ‘invalid’.

EO4-FCT-DescProd-0100/T

The system updates automatically the time coverage information when the product is regularly updated.

2.2.4.2 Use case Describe Service UC-DescServ

Summary: this use case describes the way to make a service description available in the EO4wildlife system through a service metadata model.

Trigger: The service provider activates this use case on demand through the EO4wildlife user interface.

Actor: service provider

Description:

The service provider selects the ‘service description’ option, then the ‘create’ option

The system displays the different fields of the EO4wildlife service metadata model. The following information are required to describe a service in the EO4wildlife system: (all fields are mandatory)

- Service ID: this is the EO4wildlife unique identifier
- Service name: this is the service name the end user is familiar with
- Input product: ARGOS or in situ locations (CSV or XML file, or URL for extraction)
- Parameters: Any value required to process the input product (threshold values for a filter, interpolation step or selection of the ARGOS location class to consider for a track computation for instance),
- Available output products and associated formats:
 - File: CSV, netcdf, KML, PDF report

- URL: HTTP/WMS, HTTP/WFS, HTTP/WCS to visualize the result,
- Auxiliary data: identifier of any additional product with a list of:
 - Protocol used to access the service
 - URL access when dynamic auxiliary data have to be loaded by the service
 - Login/password to access the product
 - If an auxiliary data is static, as a configuration file, it could be just mentioned in the description of the service.
 - A 'fit to data' option allow the download of auxiliary data according to the geographical and temporal coverage computed from the inputs
 - A 'predefined' option informs the user on the geographical and temporal coverage predefined by the service provider.
- Overview : The service provider describes briefly the service steps, inputs and outputs,
- Full description: the service provider details the steps of the process and the auxiliary data
- Category: predefined values from the catalogue (turtle, birds, marine mammals, fish, protected areas)
- Type of service: track processing, filter, behaviour monitoring, thematic.
- Required Resources
 - Physical resources required to run the service: memory, disk, OS, software
- Operational service level : on demand, on line, replicated
 - On demand: when a user runs the service
 - On line: the service is deployed to be accessible quickly
 - Replicated: a high level of availability is required
- Target : EO4wildlife platform or server URL (Scientist server) where is deployed the service
- Nominal duration in seconds: this information provides the nominal elapsed time for a typical amount of input.
- Service Provider Identifier: Organization and Name
- The log level: INFO, WARNING, ERROR

Once the user validates the creation, the system generates automatically a creation date/time of the metadata. The update date/time of the metadata is equal to the creation date/time. The service metadata status is set to 'To validate' (See Metadata State Diagram chapter 2.3.1). The service metadata is saved in the service catalogue. It is not accessible by the service discovery.

The service provider uploads the service in an independent way in the EO4wildlife system (described in "upload service" use case).

Variations

The service provider can modify the service metadata: all fields can be modified. The service metadata returns to the state "to validate" and the modification date is updated. The update is possible if the service provider has the access rights to do so (either the creator of the metadata, or a service provider of a same organization).

The service provider cannot delete a metadata service but can turn it to 'invalid' if he detects any issue in the service execution.

Requirements

EO4-FCT-DescServ-0110/T

The service provider can describe a new service in the EO4wildlife system, according to the EO4wildlife service metadata model.

EO4-FCT-DescServ-0120/T

Once the service metadata created, its state is "to validate".

EO4-FCT-DescServ-0130/T

The service provider (creator, or same organization) can modify the service metadata.

EO4-FCT-DescServ-0140/T

The service provider cannot delete the service metadata but can turn it to 'invalid'.

EO4-OPE-DescServ-0150/A

Services level agreements are defined according to the service level:

- On demand : 99% of runs are successful
- On line : 95% availability over one month
- Replicated : 99% availability over one month

2.2.4.3 Use case Upload Service UC-UplServ

Summary: this use case describes the way to upload a service in the EO4wildlife system.

Trigger: the service can be uploaded independently of its description. Generally, the service is described first (use case UC-DescServ), and then uploaded. But it is also possible to upload it first (for example for testing purposes), and then to describe it.

Actor: service provider

Description:

The service provider describes the deployment plan of the service in the EO4wildlife system, provides the service implementation (software delivery package).

Then, the system deploys automatically the uploaded service.

If the upload is run without error, the service switches to the "uploaded" state. (see Service deployment State Diagram chapter 0).

The service provider also describes a test case and uploads the input product to test with and the expected outputs products so that the administrator can run the service and validate it (see Test the uploaded service UC-TstServ).

Requirements

EO4-FCT-UplServ-0160/T

The service provider can upload a new service in the EO4wildlife: if the upload is run without error, the service switches to the "uploaded" state.

2.2.5 Discover, run and display use cases

Any user (user, service provider, product provider, administrator) has access to the ‘discover, run and display’ use cases.

The user browses the catalogue via the discover functions. He can consult a product or a service via the display function.

He can run a service in the catalogue but can also create and run its own service defined by a combination of a set of services. He can then access not only to the final outputs but also to intermediate results or auxiliary data implied in the service with the display function. He can also use on-line tools to improve the quality of the display or post-process the results.

The use cases are shown in the following picture.

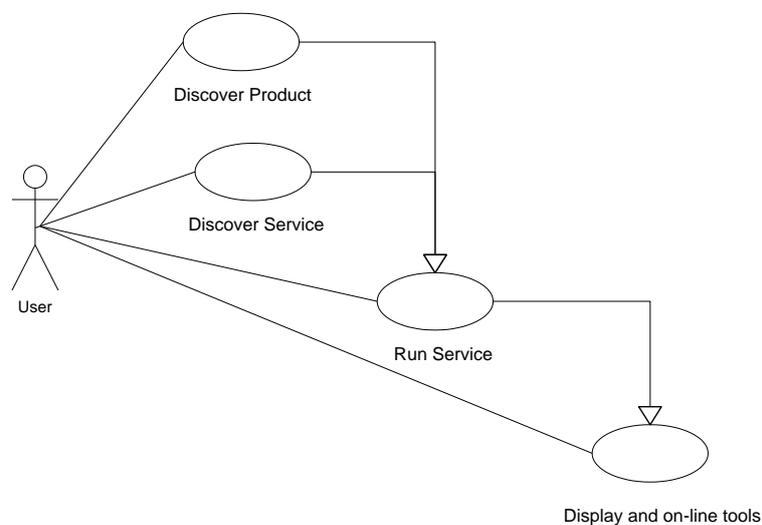


Figure 4: Discover, run and display Use case diagram

2.2.5.1 Use case Discover Product UC-DiscProd

Summary: this use case describes the way to discover a product in the EO4wildlife system catalogue.

Trigger: The user activates this use case on demand through the EO4wildlife user interface

Actor: Any actor

Description:

The user can enter one or several criteria to request the product catalogue:

- Product type: ocean, atmosphere, sea ice
- Variable: physical or biological identifier
- Temporal resolution: frequency at which are computed the product instances
- Geographical resolution: product grid resolution
- Product level: L2, L3, L4, etc
- Period: begin and end dates
- Geographical area: min/max longitude, min/max latitude

Only the validated products are displayed in the results of the search query. The search results consist in the display of the search criteria and number of matching products, and for each matching product:

- The product name
- A brief description of the product
- The time coverage
- A quick look of the product if available
- The Display option to display the product
- The download option to access the product
- A “More Info” option gives access to the full description of the product

A sort function by time coverage or by product name is available.

The system will provide a single extraction interface which is in charge of the extraction management. The user can then save the extracted product locally or in the platform with a duration of retention.

The user can visualize the product: see “Display and on-line tool” use case.

Requirements

EO4-FCT-DiscProd-0170/T

Any user of the EO4wildlife system can discover products by selection of search criteria: product type, variable, temporal resolution, geographical resolution, product level, period, geographical area. The results of the search query are display in a friendly way to allow sorts by name, time coverage.

EO4-FCT-DiscProd-0180/T

Only the validated products of the catalogue are available to the users

EO4-FCT-DiscProd-0190/T

After the discovery, the user can extract part of the data product and display it.

EO4-FCT-DiscProd-0200/T

The extracted data should be less than 1 Gb.

2.2.5.2 Use Case Discover Service UC-DiscServ

Summary: this use case describes the way to discover a service in the EO4wildlife system.

Trigger: The user activates this use case on demand through the EO4wildlife user interface

Actor: user

Description:

Only the validated services are available to the users.

The user can enter one or several fields:

- Category: turtle, birds, marine mammals, fish, protected marine area
- Service type: track processing, filter, behaviour monitoring, thematic
- Service Provider: body in charge of the delivery of the service: IT Innovation, CLS, ATOS, ...

- Output Protocol/Formats : wms, wfs, ftp, netcdf, pdf

The results are displayed in a list with the search criteria and the number of matching services.

For each service are displayed:

- The service ID and name
- The description of the service
- The target to access the service: EO4wildlife platform or server URL
- A “More Info” button to access to the detailed description of the service

The user can select one or several service he would like to run: see “run service” use case and save them into a cart or as a bookmark.

Requirements

EO4-FCT-DiscServ-0210/T

Any user of the EO4wildlife system can discover service by choosing one or several selection criteria: category, type, provider, output protocol

EO4-FCT-DiscServ-0220/T

Only the validated services of the catalogue are available to the users

EO4-FCT-DiscServ-0230/T

The user can save a service in a cart or in a bookmark.

2.2.5.3 Use Case Run Service UC-RunServ

Summary: this use case describes the way to run a service in the EO4wildlife system

Trigger: The user activates this use case on demand through the EO4wildlife user interface

During the “product and services discovery” use cases, the user has already identified the services of interest he would like to run putting them into his cart.

Actor: user

Description:

If the user discovered the right service to run and put it in his cart, he just has to run the service by selecting from the cart.

Otherwise the user can also create a workflow for a selection of services in his cart. The user orders the selected services according to the process he defines. At each step of this workflow definition, the user enters the parameters required by the current selected service. The system checks that the output of a current step is compliant as an input of the following steps, otherwise an error message is displayed.

Once all the steps of the workflow are validated, the user can save it as a new service, so as to reuse the workflow definition for any new run. The user can **add this new service to his list of bookmarks**.

The user can also select the service to run from his bookmarks. In such case, the system asks him if he wants to update the parameters. If yes, all the parameters are displayed for any update. If no, the current values of the parameters are used in the run.

Then, the user runs the service for an instance of the input ARGOS data product. The time of interest is computed by the system as the time period made of the timestamp of the first ARGOS location and the

latest one. The area of interest is processed automatically by the system as a rectangular area including all the ARGOS locations.

Then the system checks the availability of auxiliary data. If several instances of the same auxiliary data (radar scenes or optical images for instance) are available for the run within the time of interest and the area of interest, the system displays them to the user and the user has to select the one to process with. If any auxiliary data is missing, no matching between the criteria of interest (AOI, TOI) and the available auxiliary data, the user is not entitled to go further in the workflow execution and the missing auxiliary data are listed. If any product or service is no more valid in the catalogue, a specific error message is also displayed. When everything is ready, the user confirms the execution of the run. A typical execution time is displayed to the user as the sum of the nominal durations of the involved services.

Once executed, the user can **save the results of the run with a run identifier**. He can easily adjust any parameter and process a new run for the input data.

When all the required auxiliary data are selected, the user selects the 'run workflow' button to start the execution. At the end of the execution, the user receives a mail describing the status of execution for each step of the workflow and including the way to access to the steps outputs he selected (WMS, PDF report...). When several auxiliary data are used during the process, the EO4wildlife platform allows the user to select and display them in distinct layers. If the user wants to display several auxiliary data at the same time, he can use transparency options (see "display and on-line tools" use case).

A **history of all executions** is available so that the user can quickly visualize the different runs he made and results he got.

Typical steps of a workflow definition can be thematic or global.

Here below is a list of global steps that can be of interest for scientists :

- Filter ARGOS product:
 - By ARGOS location class,
 - By speed from previous point
 - By distance from previous point,
 - By change of direction
 - Landmask to select or unselect position on land
 - Daily best locations
 - Clean and transform process
- Track processing:
 - Kalman filtering
 - Spline filtering
 - Interpolate missing positions using different algorithms
- Distance to
 - Compute the distance to the shore
 - Compute the distance to area (e.g the colony/breeding area or a thermal front)
- Behaviour monitoring:
 - Compute speed, angle and distance between successive locations

The thematic steps of interest are:

- Calculate density maps:
 - Number of animal, (tracked vs extrapolation to wider population)

- Number of animal days, in a specified time period (e.g. days hours, weeks, months)
- Average of animal per area
- Kernel analysis: area of greatest use
- Number of marine mammals in an image
- Fusion-Cross correlation:
 - Calculate time within physical parameter window (temperature, depth, chlor-a, barometric level...)
- Behaviour monitoring:
 - Behaviour per location
 - Behaviour changes
 - Home range,
 - Habitat
 - Delta between travel direction and current direction
 - Calculate time spent per cell/AOI
 - Minimum displacement rate
 - Movement monitoring / alarm trigger
- Compute fish location algorithm
- Optical image processing
- Find images for an area of interest with a compliant sea state (TBC)

A detailed list of the services to implement is given in Appendix A at the end of the document.

Scenario

Any thematic platform can call for a service of the EO4wildlife system.

Requirements

EO4-FCT-RunServ-0240/T

The user can run a service, providing parameters, input and a selection of auxiliary products

EO4-FCT-RunServ-0250/T

The user can create a service as a workflow, which is an ordered combination of services, providing parameters required for each service. This new service can be saved in his bookmark.

EO4-FCT-RunServ-0260/T

The EO4WildLife system checks the validity of the workflow:

- The output of a step has to be compliant with the input of the following step
- All required parameters and auxiliary data should be available
- All auxiliary data and service steps should be declared as valid in the catalogue.

EO4-FCT-RunServ-0270/T

Typical steps of a workflow definition can be thematic or global.

EO4-FCT-RunServ-0280/T

The user can run a workflow (instance ready to run) and see its current execution status: a complete status of execution is available for the user. The user can access to the step outputs and the auxiliary data involved in the process

EO4-FCT-RunServ-0290/T

The user can save the run results with a run identifier.

EO4-FCT-RunServ-0300/T

The user can easily reuse a workflow definition and execute new runs changing inputs products or parameters.

EO4-FCT-RunServ-0310/T

The user can visualize a history of all the runs he made

EO4-FCT-RunServ-0320/T

Any thematic platform can call for a service of the EO4wildlife system

EO4-PRF-RunServ-0330/T

A run can be executed for 100 millions of input positions.

2.2.5.4 Use Case Display and on-line tools UC-Display

Summary: this use case describes the way the user can display the process outputs and use additional on-line tools to be able to prepare the next service definitions or new runs to perform.

Trigger:

The display function is available after the discovery of product (use case “Discover product”, or after the run of service (use case “run Service”).

In the case of a service run, the user has received a mail with links to access to the display of the inputs, outputs and auxiliary data of the run. He can also look for a run in the history of runs, select one of them to display the mail content of the run to access to the associated results.

Actor: user

Description:

The outputs of the service can be displayed in a web interface. The user selects the results to display. He can ask a display in distinct tabs, or in a single tab with an overlay of layers.

For each layer, additional tools can be used to perform the following actions:

- Select a colour map for the display
- Adjust automatically the min-max value of the colour map to the displayed data
- Use a linear or logarithm scale in the colour map
- Define the transparency level

- Select a location and retrieve the physical value for the layer on this location
- Draw a transect polyline when 3D data are displayed, and get the associated transect
- Draw polylines when 2D data are displayed and get the associated curve
- Define a mask with a min max value definition. All mismatching data will be made transparent

The ARGOS input product can be displayed as a track for an animal. The user has the possibility to select a maximal duration of the display of the track, for instance, display the track only for the last 24 hours. When tracks for several individuals are included in the input, the user can select the individual or a set of individuals to display. The user can ask for an animation of the individuals' tracks along a time bar and can define the track duration to optimize the displayed information. For instance, if a position at a one hour rate over one month is provided for 10 individuals, only the last 6 hours of each track are displayed for all animals during the animation.

When the location errors of the positions are provided, the user can activate the display of the elliptic error along the track. The user can also apply filters on the track and see the filtered track.

The user can also ask for an extraction of the displayed data:

- along the complete or a part of a track
- in the area defined by the elliptic errors around the track
- over an area he creates as a rectangle

For the extraction of data, the user has to define the expected spatial resolution. The system will interpolate if necessary the values. The export can generate:

- a netCDF grid with a variable per layer. During the extraction, an interpolation will be performed when the input data is at a lower resolution
- a CSV export of each variable
- A KML/KMZ output of each variable
- A PNG/JPEG output of each variable
- A PDF report including all the results

The user can also apply thematic tools to:

Determine convergence zones/frontal zones for the displayed layer

Determine front for the displayed layer

Filter the input locations on line thanks to the different track processing services

Then the user can also use generic tools to:

Measure the distance between 2 locations, or to an area

Generate an area from a pattern created thanks to a wizard tool and compute a surface of this area

Requirements

EO4-FCT-Display-0340/T

The user can visualize products, auxiliary data and service outputs in a web interface. He can ask a display in distinct tabs, or in a single tab with an overlay of layers.

EO4-FCT-Display-0350/T

For each layer, the user can be configure the display selecting a specific colour map, a linear or logarithmic scale, a transparency level, assign the dynamic of the colour map to the min-max displayed values.

EO4-FCT-Display-0360/T

The user can apply a mask on data to make transparent all data out of a min-max interval

EO4-FCT-Display-0370/T

The system can display data values on a location, along the track, along a polyline, along a transect for 3D data

EO4-FCT-Display-0380/T

The user can display the track of a mobile or set of mobiles, he can apply filters on the track, he can ask for an animation of the mobiles.

EO4-FCT-Display-0390/T

When the location error of the positions are provided, the user can activate the display of the elliptic error along the track

EO4-FCT-Display-0400/T

The user can ask for an extraction of data values along the track, by definition of the polyline track, or within the elliptic error along the track, or by definition of an area.

EO4-FCT-Display-0410/T

The user can generate a report of a complete or a part of the displayed data in different formats: netCDF, CSV, KML/KMZ, PNG/JPEG, PDF, shapefile

EO4-FCT-Display-0420/T

Generic tools are used to compute the distance between two points or to an area.

EO4-FCT-Display-0430/T

More specific tools allow the user to identify areas of interest such as fronts and convergences

2.2.6 Administration use cases

The following diagram shows the functionalities accessible only to administrators.

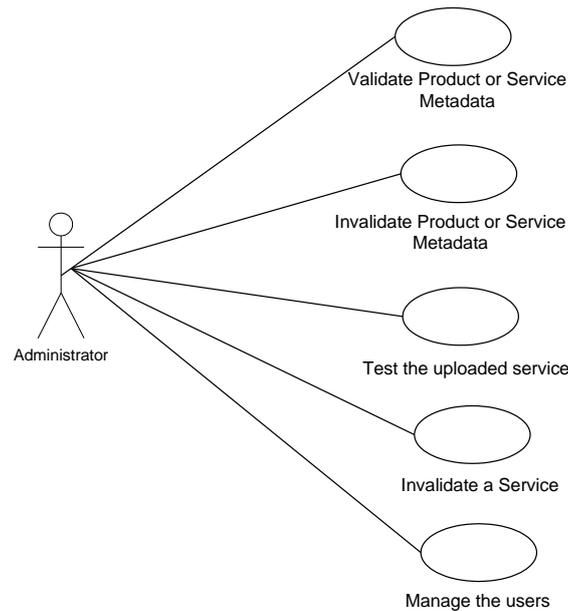


Figure 5: Administration Use case diagram

The administrator has all the rights on the EO4wildlife system. He has to validate product or service metadata before their publication in the catalogue. He has to test the uploaded service, which becomes validated and thus accessible in the catalogue. He is the only actor who can invalidate metadata and service. He manages the users and their profile.

2.2.6.1 Use case Validate Product or Service metadata UC-ValMeta

Summary: this use case describes the way to validate a product or service metadata in the EO4wildlife system.

Trigger: The EO4wildlife system administrator activates this use case on demand through the EO4wildlife user interface. The metadata has been created by the product or service provider (use case “describe product” and “describe service”). The metadata is in the state “to validate”.

The administrator can also validate a metadata which is in a state “invalid” (see metadata state diagram chapter 2.3.1)

Actor: administrator

Description:

The EO4wildlife system displays the list of metadata to validate. The administrator can access to the content of the metadata. If everything is ok for him, he validates the metadata, which switches to the state “validated”. If not, he does not validate and the metadata returns to the state “in progress”.

If the metadata is validated, it is then automatically added to the EO4wildlife catalogue and available to any user.

Requirements

EO4-FCT-ValMeta-0440/T

Only the administrator can validate the product or service metadata: it is then available to any users.

EO4-FCT-ValMeta-0450/T

The administrator will check the use of shared vocabularies, like skos vocabularies, and conventions, like COARDS-CF to insure the coherence in descriptions.

2.2.6.2 Use case Invalidate Product or Service metadata UC-InvMeta

Summary: this use case describes the way to invalidate a product or service metadata in the EO4wildlife system.

Trigger: The EO4wildlife system administrator activates this use case on demand through the EO4wildlife user interface. The metadata has been validated (use case “validate product or service metadata”). The administrator has the possibility to invalidate it for example if a critical issue was raised and not yet fixed in a service.

The metadata state diagram is described in chapter 2.3.1.

Actor: administrator

Description:

The administrator has access to the list of all metadata validated of the EO4wildlife system. He can select one and invalidate it. The metadata switches to the state “invalid”. The product or service is then not accessible by others users.

Requirements**EO4-FCT-InvMeta-0460/T**

Only the administrator can invalidate a product or service metadata: it is then not available to others users.

2.2.6.3 Use case Test the uploaded service UC-TstServ

Summary: this use case describes the way to test a service uploaded by a service provider.

Trigger: The EO4wildlife system administrator activates this use case on demand through the EO4wildlife user interface. The service provider has uploaded a service in the EO4wildlife system (use case upload service)

The administrator can also validate a service which has been invalidated (in the state “invalid”)

See service deployment state diagram in chapter 0.

Actor: administrator

Description:

The administrator access to the service and input products: he can run the service and compare results with results provided by the service provider. If the execution is OK and if the service metadata is also validated, the service is ready and available in the catalogue service to be run by users.

Requirements**EO4-FCT-InvMeta-0470/T**

The administrator test a service uploaded in the EO4wildlife system. Once the test is OK, and the service metadata is validated, the service is ready for run.

2.2.6.4 Use case Manage the users UC-ManUser

Summary: this use case describes the way to create/modify/delete a user of the EO4wildlife system.

Trigger: The EO4wildlife system administrator activates this use case on demand through the EO4wildlife user interface.

Actor: administrator

Description:

The user has

- An identifier and a name
- An organization : company, or association
- A profile : user or service provider or product provider or administrator
- A unique login/password

The administrator can create a user.

He can modify one of the attributes of a user: for example he can change the profile of a user. A user can become a service provider for example.

He can delete a user.

Requirements

EO4-FCT-manUser-0480/T

The administrator manages (create/modify/delete) the users in the EO4wildlife platform. A user has an identifier, a name, an organization, a profile (ID, Name, Organization, Profile, login/Password)

2.3 Metadata and Service State diagram

2.3.1 Metadata state diagram

The following figure presents the state diagram of a metadata, whether for a product or service.

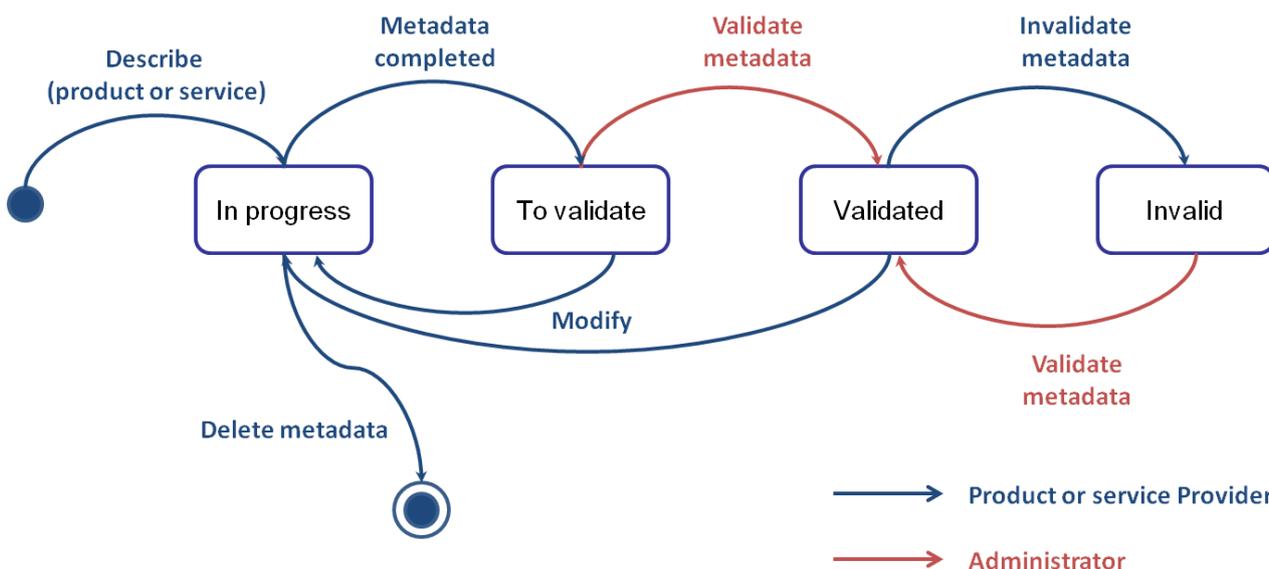


Figure 6: Metadata state diagram

The transitions authorized for product or service provider are in blue, the transitions only accessible to the administrator are red. Notice that administrator has also access to the Product or Service Provider transitions.

When a product or service provider begins to describe a product or service, the metadata is in the “In progress” state, and remains in this state while it is not completed: all fields have to be fulfilled, with correct format. Then the metadata pass into the state “to validate”: only the administrator can validate the metadata.

Once validated, the metadata is accessible through the catalogue by all users.

The administrator or the product/service provider can invalidate the metadata, but it is better to keep the metadata for historical reasons. The metadata pass into the state “Invalid” and is not visible by the users except the administrator, who can modify it and validate it again.

When the metadata is modified, it comes back to the “in progress” state, and has to be validated again to be available to all users.

A definitive delete is only possible during the metadata is in progress.

2.3.2 Service deployment state diagram

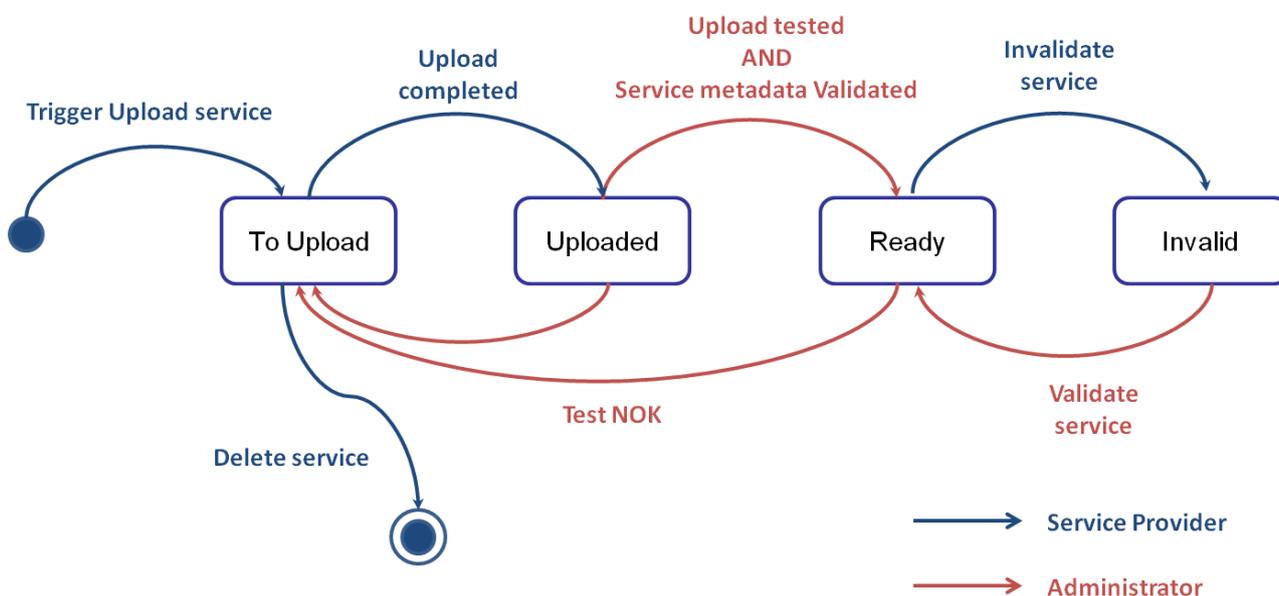


Figure 7: Service deployment state diagram

When the service provider ask to upload a service, the service is in the “to upload” state. Then the service pass into the state “uploaded”.

The administrator has to test it by running it. The service is ready for run once the metadata is validated by the administrator and once the service run is OK.

The administrator or the service provider can invalidate a service, which pass into the state “Invalid” and is not visible by the users except the administrator, who can modify it and validate it again.

If the test is not OK, the service comes back to the “to upload” state, and has to be uploaded and tested again to be available to all users.

A definitive delete is only possible during the service is “to upload”.

2.4 Traceability matrix

Scenarios coverage is linked to user requirements in the matrix below.

Dynamic management (alerts) is not considered yet.

| Identifier | Description | Scenario Requirement |
|-------------------------|---|----------------------------|
| EO4-FCT-GEN-0010/T | The user has to be connected to the EO4wildlife system with credentials before any interaction with it. | |
| EO4-FCT-GEN-0020/T | There are 4 user profiles in the EO4wildlife system: user, product provider, service provider and administrator. Each one has access authorization as mentioned in the use cases. | |
| EO4-FCT-GEN-0030/T | During the description of a product or a service, the user can save temporarily its form, and complete it later in another session. | |
| EO4-FCT-GEN-0040/T | In case of an error on a field (bad format, mandatory field missing, etc.), an error message is displayed and the error field is marked in red | |
| EO4-FCT-DescProd-0050/T | The product provider can describe a new product in the EO4wildlife system, according to the EO4WildLife metadata product model. | B4, M1, M2, M3, M4, F2 |
| EO4-FCT-descProd-0060/T | There are 2 options for the metadata product creation: creation from scratch (entry fields manually), or creation from an existing catalogue (harvest from an external catalogue and complete the creation manually). | |
| EO4-FCT-DescProd-0070/T | Once the metadata product is created, the system set it to the "to validate" state. | |
| EO4-FCT-DescProd-0080/T | The product provider (creator, or same organization) can modify the metadata product. | |
| EO4-FCT-DescProd-0090/T | The product provider can turn the metadata state to 'invalid'. | |
| EO4-FCT-DescProd-0100/T | The system updates automatically the time coverage information when the product is regularly updated. | |
| EO4-FCT-DescServ-0110/T | The service provider can describe a new service in the EO4wildlife system, according to the EO4WildLife service metadata model. | B4, M1, M2, M3, M4, F1, F3 |
| EO4-FCT-DescServ-0120/T | Once the service metadata created, its state is "to validate". | |
| EO4-FCT-DescServ-0130/T | The service provider (creator, or same organization) can modify the service metadata. | |
| EO4-FCT-DescServ-0140/T | The service provider cannot delete the service metadata but can turn it to 'invalid'. | |
| EO4-OPE-DescServ-0150/A | Services level agreements are defined according to the service level: On demand : 99% of runs are successful On line : 95% availability over one month Replicated : 99% availability over one month | |
| EO4-FCT-UpServ-0160/T | The service provider can upload a new service in the EO4wildlife: if the upload is run without error, the service switches to the "uploaded" state. | F1 |

| | | |
|--------------------------------|--|-------------------------------------|
| EO4-FCT-DiscProd-0170/T | Any user of the EO4wildlife system can discover products by selection of search criteria: product type, variable, temporal resolution, geographical resolution, product level, period, geographical area. The results of the search query are display in a friendly way to allow sorts by name, time coverage. | |
| EO4-FCT-DiscProd-0180/T | Only the validated products of the catalogue are available to the users | |
| EO4-FCT-DiscProd-0190/T | After the discovery, the user can extract part of the data product and display it. | |
| EO4-FCT-DiscProd-0200/T | The extracted data should be less than 1 GB. | |
| EO4-FCT-DiscServ-0210/T | Any user of the EO4wildlife system can discover service by choosing one or several selection criteria: category, type, provider, output protocol | |
| EO4-FCT-DiscServ-0220/T | Only the validated services of the catalogue are available to the users | |
| EO4-FCT-DiscServ-0230/T | The user can save a service in a cart or in a bookmark. | |
| EO4-FCT-RunServ-0240/T | The user can run a service, providing parameters, input and a selection of auxiliary products | F1, F3 |
| EO4-FCT-RunServ-0250/T | The user can create a service as a workflow, which is an ordered combination of services, providing parameters required for each service. This new service can be saved in his bookmark. | B6, M5 |
| EO4-FCT-RunServ-0260/T | The EO4wildlife system checks the validity of the workflow: The output of a step has to be compliant with the input of the following step All required parameters and auxiliary data should be available All auxiliary data and service steps should be valid. | |
| EO4-FCT-RunServ-0270/T | Typical steps of a workflow definition can be thematic or global. | B1, B2, B3, B8,T1,T2,T6,F4,F5,F6 |
| EO4-FCT-RunServ-0280/T | The user can run a workflow (instance ready to run): a complete status of execution is sent to the user. The user can access to the step outputs and the auxiliary data involved in the process | |
| EO4-FCT-RunServ-0290/T | The user can save the run results with a run identifier. | |
| EO4-FCT-RunServ-0300/T | The user can easily reuse a workflow definition and execute new runs changing inputs products or parameters. | |
| EO4-FCT-RunServ-0310/T | The user can visualize a history of all the runs he made | |
| EO4-FCT-RunServ-0320/T | Any thematic platform can call for a service of the EO4wildlife system | B5, T4 |
| EO4-PRF-RunServ-0330/T | A run can be executed for 100 millions of input positions (TBC). | B7, T5 |
| EO4-FCT-Display-0340/T | The user can visualize products, auxiliary data and service outputs in a web interface. He can ask a display in distinct tabs, or in a single tab with an overlay of layers. | |
| EO4-FCT-Display-0350/T | For each layer, the user can configure the display selecting a specific colour map, a linear or logarithmic scale, a transparency level, assign the dynamic of the colour map to the min-max displayed values. | |
| EO4-FCT-Display-0360/T | The user can apply a mask on data to make transparent all data out of a min-max interval | |
| EO4-FCT-Display-0370/T | The system can display data values on a location, along the track, along a polyline, along a transect for 3D data | |

| | | |
|-------------------------------|--|--|
| EO4-FCT-Display-0380/T | The user can display the track of an individual or set of individuals, he can apply filters on the track, he can ask for an animation of the individual. | |
| EO4-FCT-Display-0390/T | When the location error of the positions are provided, the user can activate the display of the elliptic error along the track | |
| EO4-FCT-Display-0400/T | The user can ask for an extraction of data values along the track, by definition of a polyline, within the elliptic error or by definition of an area. | |
| EO4-FCT-Display-0410/T | The user can generate a report of a complete or a part of the displayed data in different formats: netCDF, CSV, KML/KMZ, PNG/JPEG, PDF | |
| EO4-FCT-Display-0420/T | Generic tools are used to compute the distance between two points or to an area. | |
| EO4-FCT-Display-0430/T | More specific tools allow the user to identify areas of interest such as fronts and convergences | |
| EO4-FCT-ValMeta-0440/T | Only the administrator can validate the product or service metadata: it is then available to any users. | |
| EO4-FCT-ValMeta-0450/T | The administrator will check the use of shared vocabularies, like skos, and conventions | |
| EO4-FCT-InvMeta-0460/T | Only the administrator can invalidate a product or service metadata: it is then not available to others users. | |
| EO4-FCT-InvMeta-0470/T | The administrator test a service uploaded in the EO4wildlife system. Once the test is OK, and the service metadata is validated, the service is ready for run. | |
| EO4-FCT-manUser-0480/T | The administrator manages (create/modify/delete) the users in the EO4wildlife platform. A user has an identifier, a name, an organization, a profile (ID, Name, Organization, Profile, login/Password) | |

Table 8: Traceability matrix

References

- [1] Maxwell SM, Breed GA, Nickel BA, Makanga-Bahouna J, Pemo-Makaya E, Parnell RJ, Formia A, Ngouessono S, Godley BJ, Costa DP, Witt MJ, Coyne MS (2011) Using satellite tracking to optimize protection of long-lived marine species: olive ridley sea turtle conservation in central Africa. *PLoSOne* 6:e19905
- [2] Worton B.J, 1989, Kernel methods for estimating the utilization distribution in home range studies, *Ecology*, Vol 70, 164-168
- [3] Bullard, F. 1999. Estimating the home range of an animal: a Brownian bridge approach. Johns Hopkins University. Master thesis
- [4] Horne, J.S., Garton, E.O., Krone, S.M. and Lewis, J.S. 2007. Analyzing animal movements using Brownian bridges. *Ecology*, 88, 2354-2353
- [5] Benhamou, S. and Cornelis, D. 2010. Incorporating movement behavior and barriers to improve kernel home range space use estimates. *Journal of Wildlife Management*, 74, 1353-1360
- [6] Benhamou, S. 2011. Dynamic approach to space and habitat use based on biased random bridges. *PLOS ONE*, 6, 1-8
- [7] Keating, K. and Cherry, S. 2009. Modeling utilization distributions in space and time *Ecology*, 90, 1971-1980
- [8] Kenward, R., Clarke, R., Hodder, K. and Walls, S. 2001. Density and linkage estimators of home range: nearest neighbor clustering defines multinuclear cores. *Ecology*, 82, 1905-1920
- [9] Getz, W., Fortmann-Roe, S., Cross, P., Lyons, A., Ryan, S. and Wilmers, C. 2007. LoCoH: Nonparametric Kernel Methods for Constructing Home Ranges and Utilization Distributions. *PloS one*, 2, e207
- [10] Anne Haugommard, Fanny Martin; White paper EO4wildlife; Interactions between external platforms and EO4wildlife platform, 2016.
- [11] Roberts et al divide transects into segments

Annex 1: EO data description

| product name | granularity | frequency | resolution | catalogue/URL |
|--|--------------|-----------|---------------|---|
| Absolute Dynamic Topography (aka Sea Surface Height above geoid) | daily | quarterly | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| Absolute Dynamic Topography (aka Sea Surface Height above geoid) | daily | daily | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| Bathymetry ETOPO1 | - | - | 1' | https://www.ngdc.noaa.gov/mgg/global/global.html |
| Global Ocean, Ocean Colour Chlorophyll (Optimal Interpolation) | daily | daily | 4 km | http://marine.copernicus.eu/web/69-interactive-catalogue.php |
| Global Ocean, Ocean Colour Chlorophyll (Optimal Interpolation) | daily | annual | 4 km | http://marine.copernicus.eu/web/69-interactive-catalogue.php |
| Net Primary Production | daily | quarterly | 4 km | http://motu.cls.fr/cls-gateway-servlet/Motu?action=productdo |
| "Filaments" (convergence/divergence) | 3-daily | annual | 0.04° | http://www.aviso.altimetry.fr/en/data/products/value-added-p |
| currents (geostrophic) from Sea Level Anomalies | daily | quarterly | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| currents (geostrophic) from Sea Level Anomalies | daily | daily | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| currents (geostrophic) from Absolute Dynamic Topography | daily | quarterly | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| currents (geostrophic) from Absolute Dynamic Topography | daily | daily | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| Global Ocean OSTIA Sea Surface Temperature and Sea Ice Analysis | daily | daily | 0.05° | http://marine.copernicus.eu/web/69-interactive-catalogue.php |
| Global Ocean OSTIA Sea Surface Temperature and Sea Ice Reprocessed (1985-2007) | daily | | 0.05° | http://marine.copernicus.eu/web/69-interactive-catalogue.php |
| Global Ocean Wind L4 Delayed Time 6 hourly Observations | monthly | - | | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| Global Ocean Wind L4 Near real Time 6 hourly Observations | 6-hourly | daily | 0.25° | http://marine.copernicus.eu/web/69-interactive-catalogue.php |
| Global Ocean Wind L4 Near real Time 6 hourly Observations | 6-hourly | daily | 0.25° | http://marine.copernicus.eu/web/69-interactive-catalogue.php |
| Sea Level Anomalies (aka Sea Surface Height above a mean sea surface) | daily | | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| Sea Level Anomalies (aka Sea Surface Height above a mean sea surface) | daily | ~4 months | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| 10 metre U wind component+10 metre V wind component+Mean sea level pressure | 6-hourly | daily | 0.083°x0.083° | http://motu.cls.fr/cls-archive-gateway-servlet/Motu?action=pr |
| Wave components | 6-hourly | daily | 0.083°x0.083° | http://motu.cls.fr/cls-archive-gateway-servlet/Motu?action=pr |
| | | | | |
| | | | | |
| Ocean Temperature at depth | daily/hourly | daily | 0.083°x0.083° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| Ocean Temperature at depth | daily | daily | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |
| Ocean Temperature at depth | daily | annually | 0.25°x0.25° | http://marine.copernicus.eu/services-portfolio/access-to-produ |

Table 9: List and details of most requested EO data

Annex 2: Detailed list of services to implement

EO4-FCT-RunServ-0490/T

The EO4wildlife platform allows the download of auxiliary data from CMEMS.

EO4-FCT-RunServ-0500/T

The EO4wildlife platform allows the download of auxiliary data from AVISO+.

EO4-FCT-RunServ-0510/T

The EO4wildlife platform allows the download of auxiliary data from the CLS datastore.

EO4-FCT-RunServ-0520/T

The EO4wildlife platform implements a service to extract environmental data along animal tracks.

EO4-FCT-RunServ-0530/T

The EO4wildlife platform services allow the activation and display of logs at INFO, WARNING or ERROR level.

EO4-FCT-RunServ-0540/T

The EO4wildlife platform implements a track reprojection service.

EO4-FCT-RunServ-0550/T

The EO4wildlife platform implements a track splitting bird Service

EO4-FCT-RunServ-0560/T

The EO4wildlife platform implements a track gridding service.

EO4-FCT-RunServ-0570/T

The EO4wildlife platform implements a speed filter service.

EO4-FCT-RunServ-0580/T

The EO4wildlife platform implements a turning filter service.

EO4-FCT-RunServ-0590/T

The EO4wildlife platform implements a position quality filter service.

EO4-FCT-RunServ-0600/T

The EO4wildlife platform implements a regular location filter service.

EO4-FCT-RunServ-0610/T

The EO4wildlife platform implements a redundancy filter service.

EO4-FCT-RunServ-0620/T

The EO4wildlife platform implements a track splitting discontinuous service.

EO4-FCT-RunServ-0630/T

The EO4wildlife platform implements a track gridding service.

EO4-FCT-RunServ-0640/T

The EO4wildlife platform implements a track sampling service.

This service allows to export filtered data with associated user defined EO data. It should export the tracks as CSV so that each location has the EO data associated with it.

EO4-FCT-RunServ-0650/T

The EO4wildlife platform implements a track circular sampling service.

EO4-FCT-RunServ-0660/T

The EO4wildlife platform implements a pelagic fish scenario service.

EO4-FCT-RunServ-0670/T

The EO4wildlife platform implements a sea birds service.

EO4-FCT-RunServ-0680/T

The EO4wildlife platform implements a sea turtles service.

EO4-FCT-RunServ-0690/T

The EO4wildlife platform implements a sea state discovery service. (TBC)

EO4-FCT-RunServ-0700/T

The EO4wildlife platform implements a marine mammal count service.

EO4-FCT-RunServ-0710/T

The EO4wildlife platform implements a convergence, zone fronts identification service.

EO4-FCT-RunServ-0720/T

The EO4wildlife platform implements a distance to the nearest sea surface temperature front service.

E04-FCT-RunServ-0730/T

The EO4wildlife platform implements a distance to nearest canyon service.

E04-FCT-RunServ-0740/T

The EO4wildlife platform implements a distance to shore service.

E04-FCT-RunServ-0750/T

The EO4wildlife platform implements a distance to the nearest seamount service.

E04-FCT-RunServ-0760/T

The EO4wildlife platform implements a compute min/max/mean of EO data service.

E04-FCT-RunServ-0770/T

The EO4wildlife platform implements a divide transects track service.

E04-FCT-RunServ-0780/T

The EO4wildlife platform implements a model of sighting rates service.

Smoothed functions relating sea state (calculated from EO data) to sighting rate generated for each species (when enough data) to adjust survey effort within each sea state category by an appropriate correction factor

E04-FCT-RunServ-0790/T

The EO4wildlife platform implements a Generalized Additive Model service.

E04-FCT-RunServ-0800/T

The EO4wildlife platform implements a Generalized Linear Model service.

E04-FCT-RunServ-0805/T

The input of services can be pre-defined CSV or EO4wildlife XML files. (TBC)

E04-FCT-Display-0810/T

The user can display the time at METOC conditions.

E04-FCT-Display-0820/T

The user can display the time at depth for sensor data

E04-FCT-Display-0830/T

The user can display speed with time along track

E04-FCT-Display-0840/T

The user can display the parameters and dataset identifiers when displaying outputs of a service.