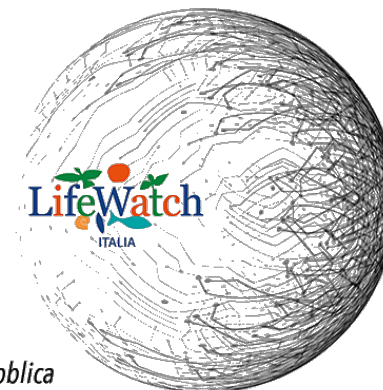


Conferenza Annuale di LifeWatch Italia
Roma, 25-27 giugno 2018



in collaborazione con il Segretariato Generale della Presidenza della Repubblica



THE ECOPOTENTIAL VIRTUAL LABORATORY

P. MAZZETTI, M. SANTORO, R. LUCAS, P. BLONDA, S. NATIVI

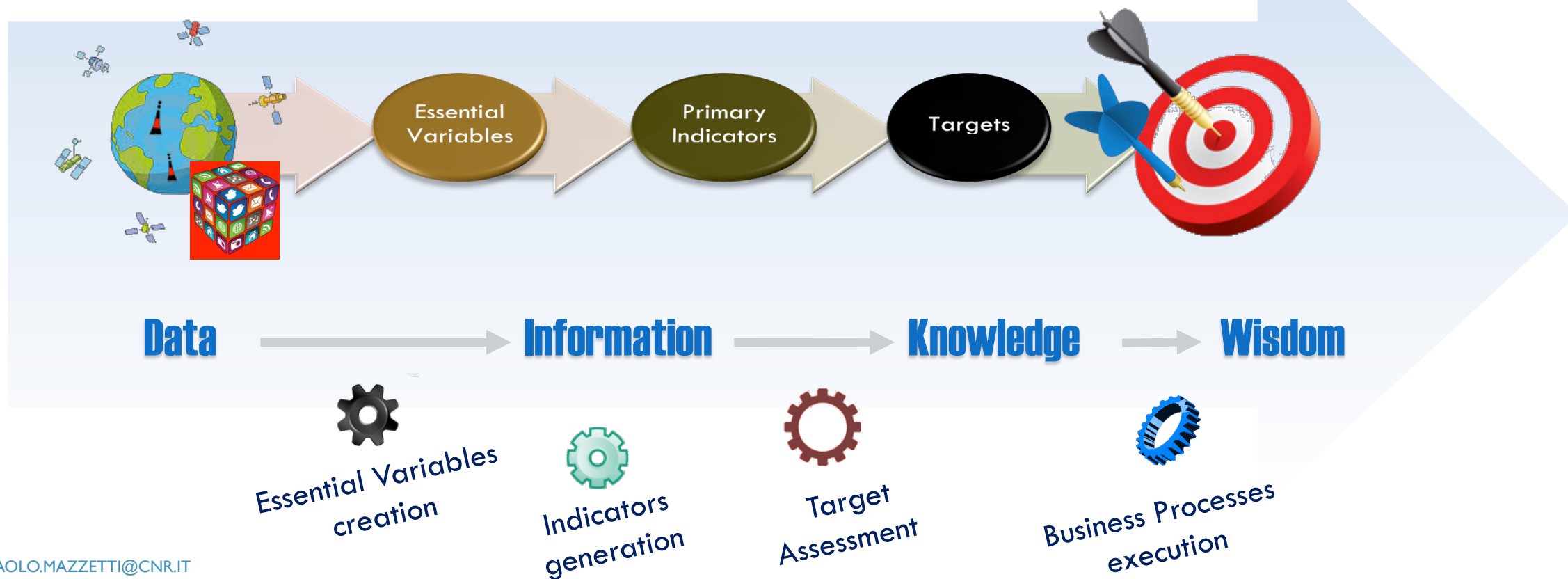
SPECIAL THANKS TO:

- IOANNIS MANAKOS (CERTH)

RATIONALE: FROM DATA TO KNOWLEDGE

EO & Socio-
economic Data

Policy Goals (UN SDG,
International treaties, ...)



ECOPOTENTIAL

- **ECOPOTENTIAL** aims at creating a unified framework for ecosystem studies and management of protected areas (PA).
 - Focus on internationally recognized PAs in Europe and beyond in a wide range of biogeographic regions
 - Best use of Earth Observation (EO) and monitoring data through new EO ecosystem data services
 - Support of modelling approaches including information from EO data
 - Open and interoperable access to data and knowledge through a GEO Ecosystem Virtual Laboratory Platform, fully integrated in GEOSS.

ECOPOTENTIAL

Improving Future Ecosystem Benefits through Earth Observations

- **Funding programme:** EC H2020
- **H2020 Topic:** Societal Challenges - Climate action, environment, resource efficiency and raw materials
- **Call topic:** Making Earth Observation and Monitoring Data usable for ecosystem modelling and Services
- **Duration:** 2015-06-01 / 2019-05-31
- **Number of partners:** 47
- **Estimated cost:** 15,993,931.25 EUR





THE ECOPOTENTIAL VIRTUAL LABORATORY

- The ECOPOTENTIAL Virtual Laboratory is a *knowledge generation platform supporting the activities of the ecosystem science Community of Practice*

From Science to Policy

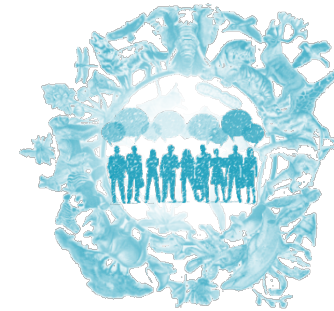
*Generated knowledge targeted to policy-makers (e.g. PA managers)
Integration with global efforts for Science-Based Environmental Policy*

From Data to Knowledge

Generation of Essential Variables, Indicators and Indices from data

From Open Data to Open Science

Sharing of knowledge (ontologies), procedures (scientific business process), algorithms (source code) for reusability, reproducibility, etc.



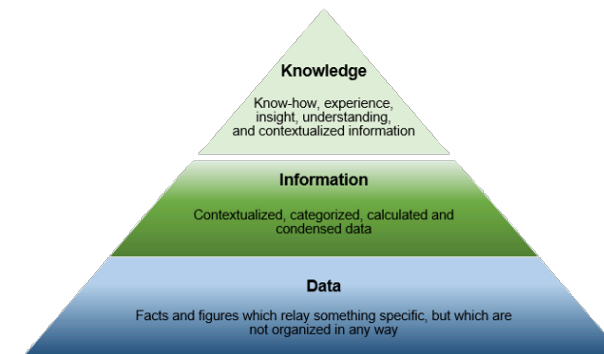
6.6 By 2020, protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes



14.2 By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans

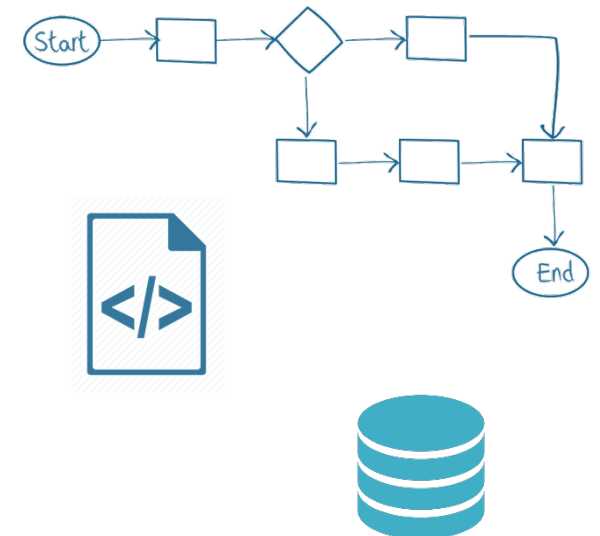


Goal 15. Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss



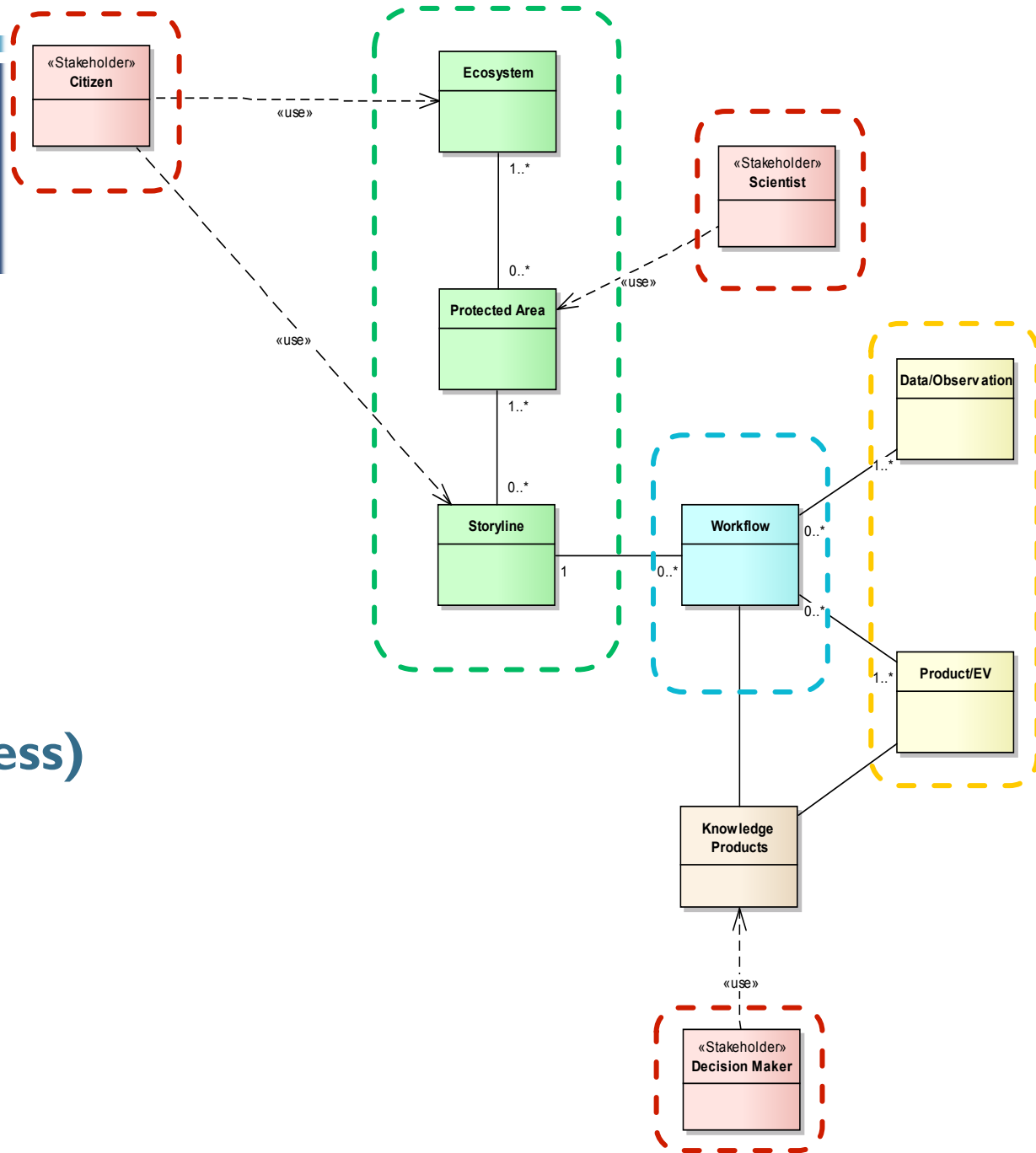
THE ECOPOTENTIAL VIRTUAL LABORATORY

- Main functionalities:
 - Handling of different kind of resources: datasets, algorithms, workflows, ...
 - publishing, harmonized discovery, access and visualization
 - Running workflows implementing scientific business processes
 - Interaction through GUI (Portal) and APIs

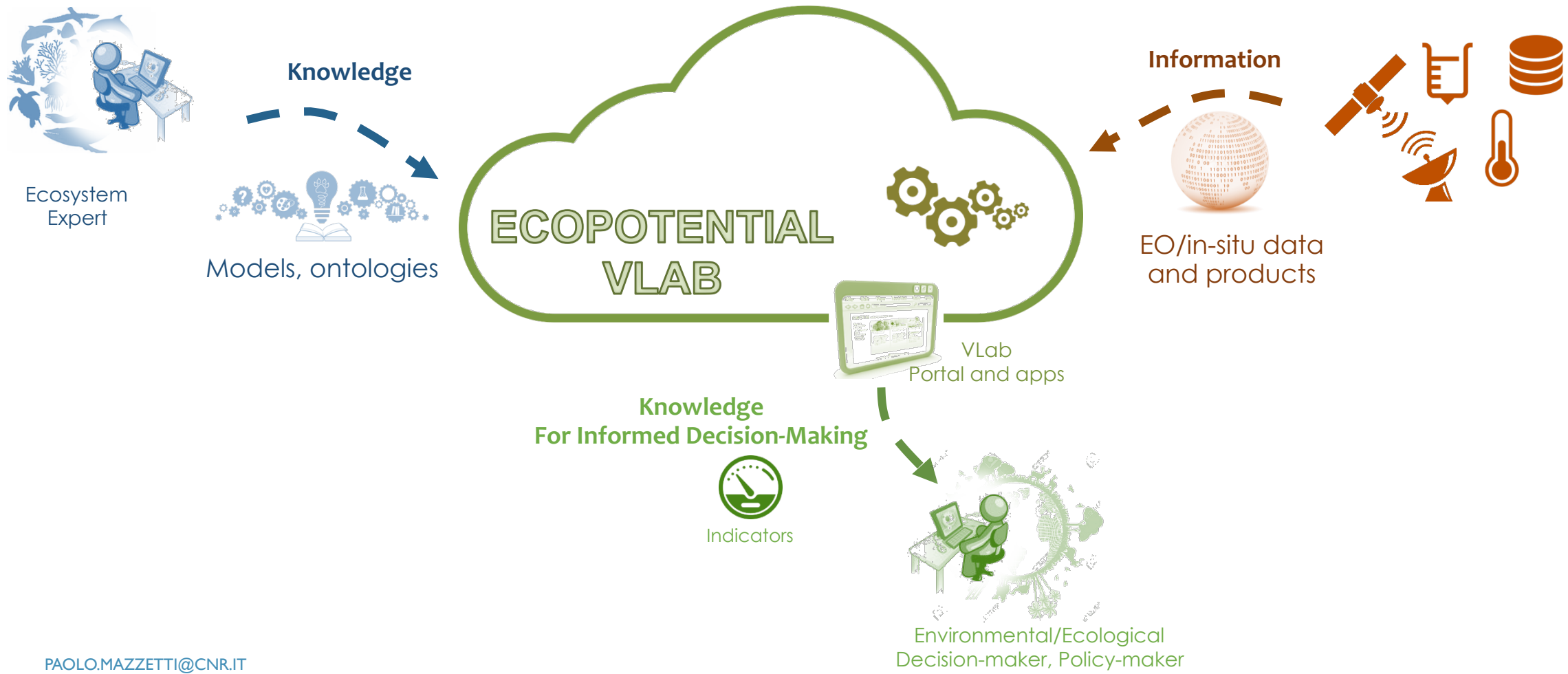


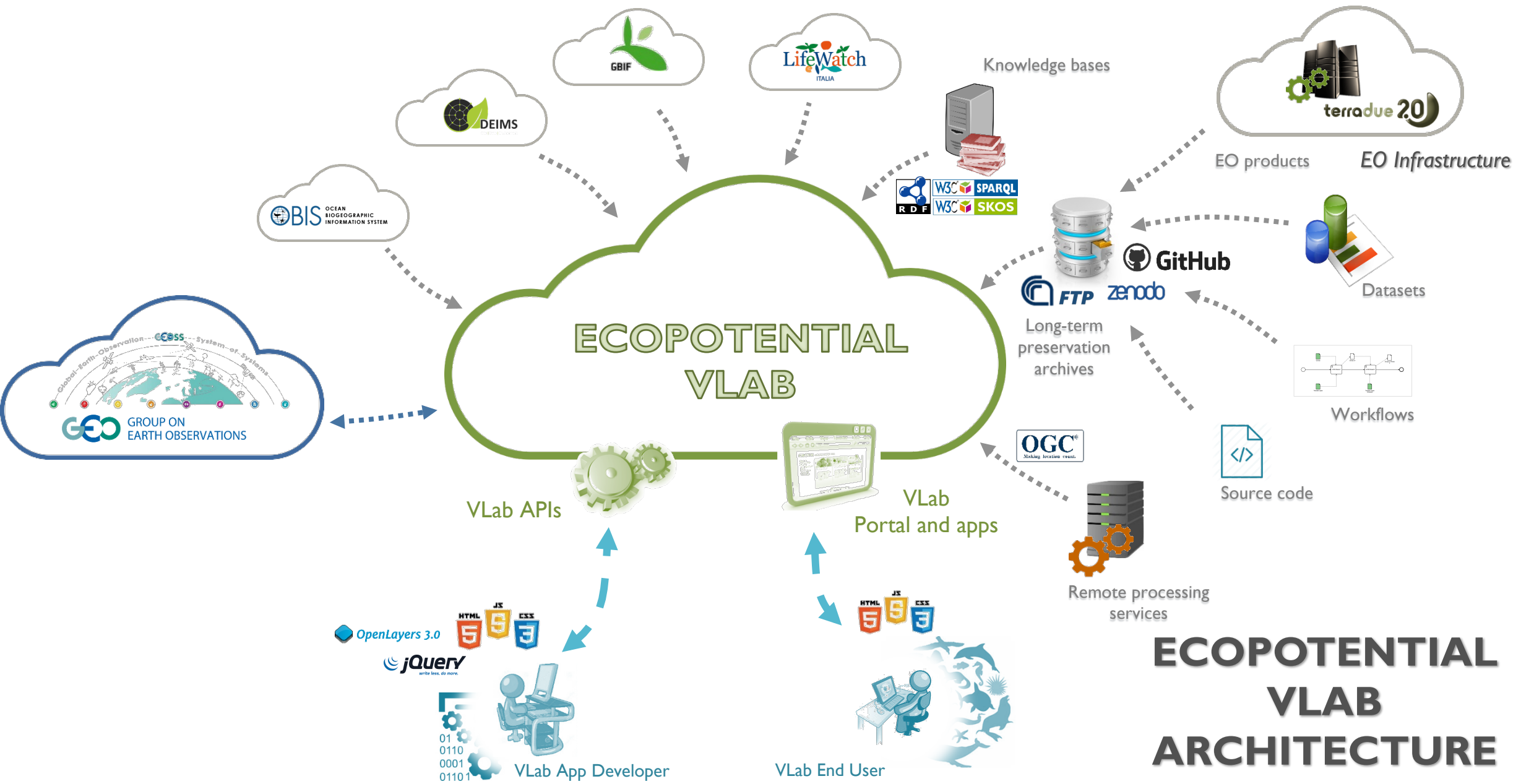
THE ECOPOTENTIAL ONTOLOGY

- Main concepts:
 - Ecosystem
 - Protected Area
 - Storyline (scenario)
 - Workflow (scientific business process)
 - Data/Observation
 - Product / Essential Variable
 - Users

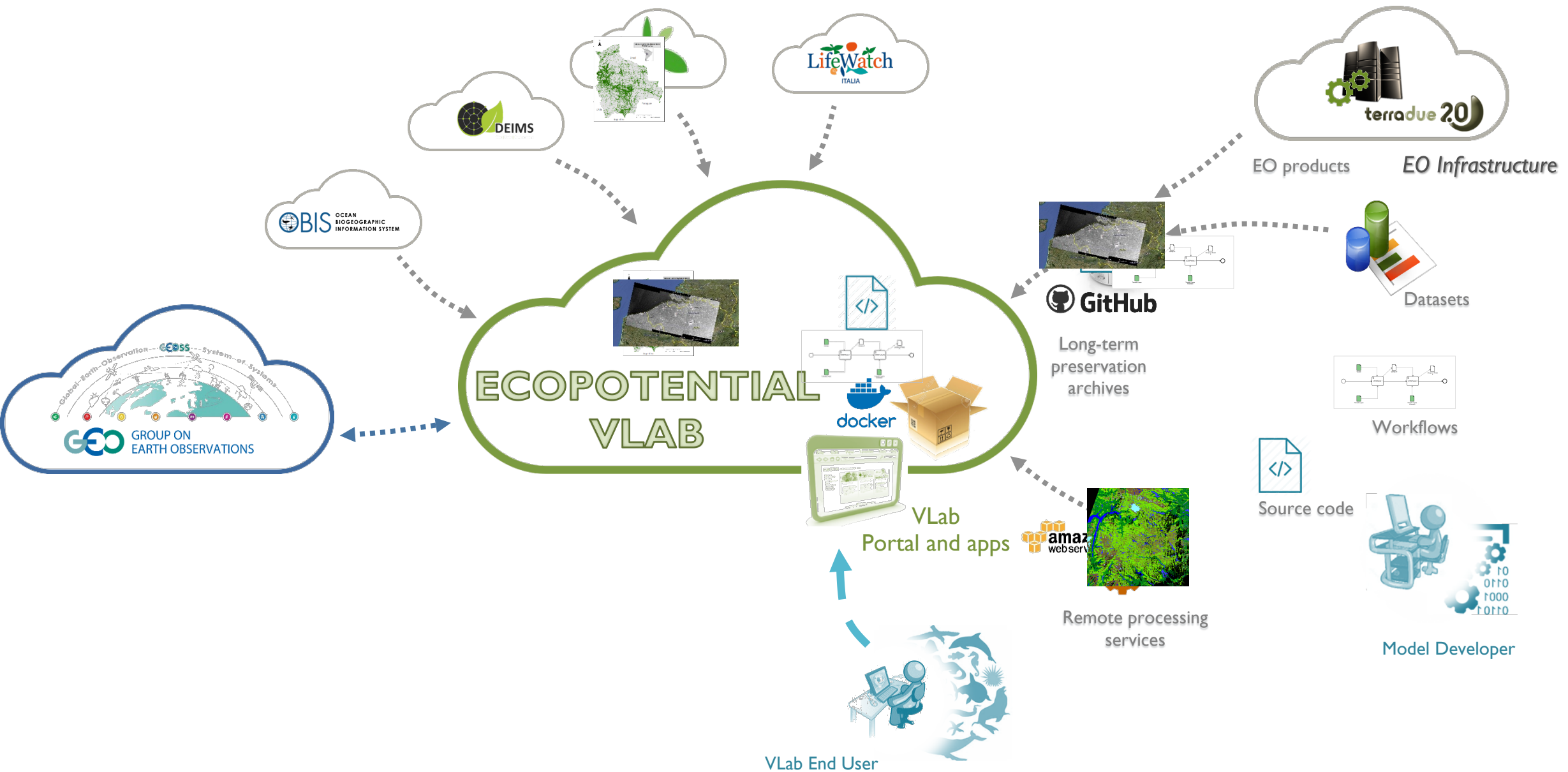


THE ECOPOTENTIAL VLAB CONCEPT





ECOPOENTIAL VLAB ARCHITECTURE



MAIN REQUIREMENTS

- Lowering entry barriers for end-users
 - Decision-makers should be able to easily run scientific models for the generation of indicators
- Lowering entry barriers for modelists
 - Modelists should be able to easily make their scientific models available to end-users
- Lowering entry barriers for application developers
 - App developers should be able to easily develop desktop and mobile applications for end-users

Select an Ecosystem

Arid/semi-arid

Arid and semi-arid ecosystems represent life under extreme conditions. They are water-limited ecosystems especially vulnerable to impacts associated with global change. In addition, they exhibit unique pathways of ecosystem functions and specialized ecosystem services. In water-limited ecosystems, temporal variability is particularly important.



Coastal/Marine

Coastal and marine ecosystems are essential components of the Earth's global ecosystem and are critical in sustaining biodiversity. The health of oceans and coasts is being negatively affected by the impact of human activities, leading to a loss of biodiversity, decreased abundance of species, damage to habitats and loss of ecological functions and ultimately, ecosystem services. Coastal areas, in particular, are particularly important for the migration and refuge of species with complex habitat requirements.



Mountains

Mountain ecosystems, rich in endemic and endangered species, are directly linked to downstream regions through ecosystem goods and services including food and energy production, recreational services and options for tourism. Mountain ecosystems are "sentinels of change" with respect to climate change and human pressures, and they show several altitudinal zones and ecosystems. In Europe, the spatial heterogeneity of mountains (cloudiness, shade, etc.) creates methodological challenges for Earth Observations.



1 - 4

Mediterranean Sea Large Marine Ecosystem



Camargue



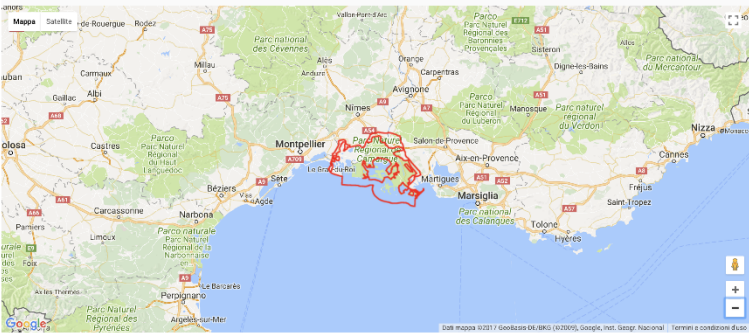
Caribbean LME



Curonian Lagoon



Camargue in detail



Storylines associated with Camargue

Wetlands Camargue

Lead by: IAV
 Conserving dynamic wetlands under combined global, regional and local stressors - The case of Camargue. Hydrology is a prime factor influencing wetland functions, biodiversity and services (Coops and Hosper, 2002; Janssen et al., 2005). In semi-permanent and brackish environments, seasonal variations in water levels are particularly crucial for the maintenance of emerged and submerged macrophytes and their associated fauna (Bolduc and Alton, 2004; Osland et al., 2011).

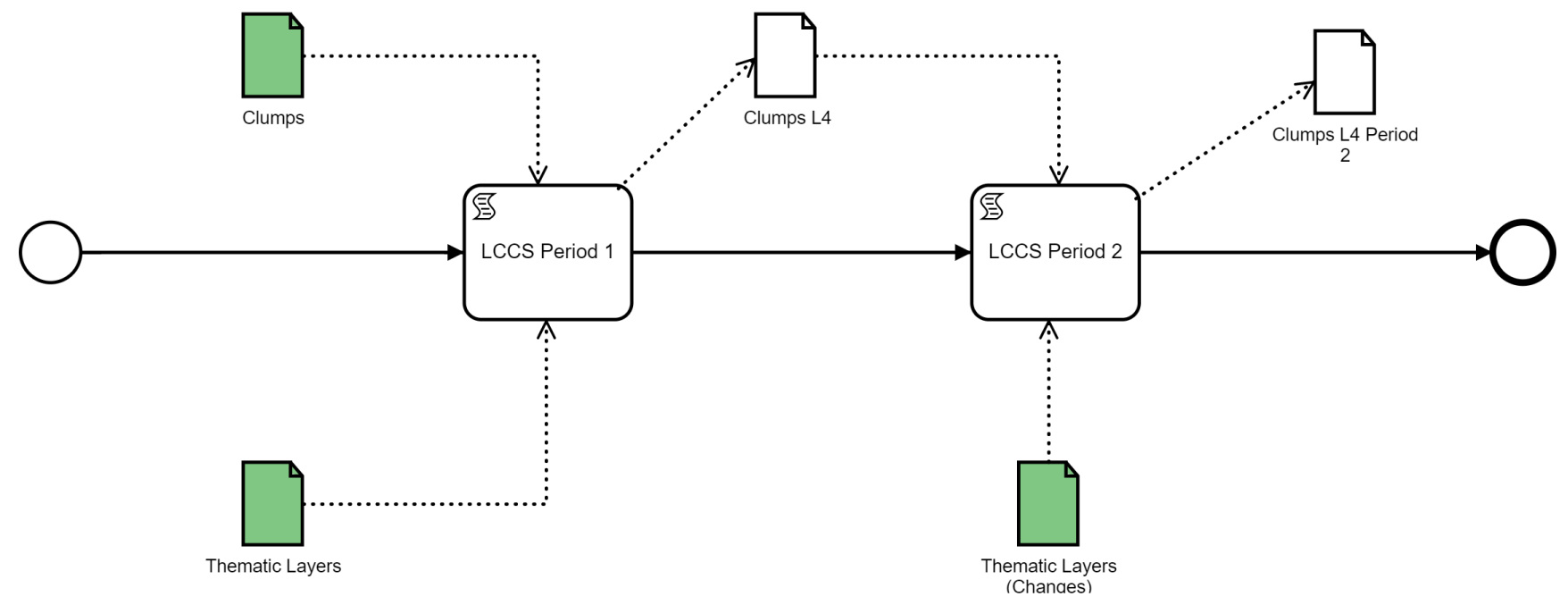
Ecosystems

Protected Areas

Storylines (scenarios)

Workflow (scientific business process)

BPMN Diagram





EARTH OBSERVATION DATA FOR ECOSYSTEM MONITORING (EODESM)

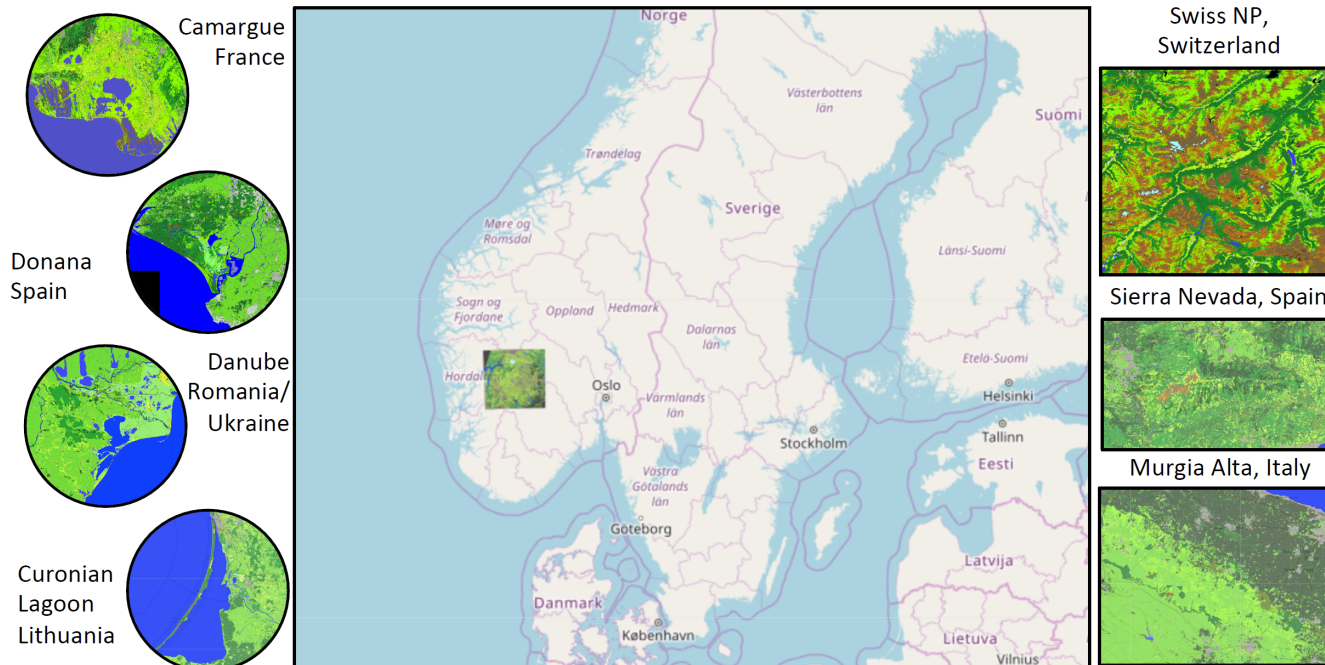
- The EODESM system classifies land covers according to the Food and Agricultural Organisation's (FAO's) **Land Cover Classification System (LCCS2)** taxonomy.
- The EODESM system can use, as input, any remote sensing or other spatial datasets and at any scale
- Highly detailed and relevant classifications are generated for protected areas and surrounds
- The system is designed for use by a wide range of users and is entirely open source and freely available.



UNSW SYDNEY



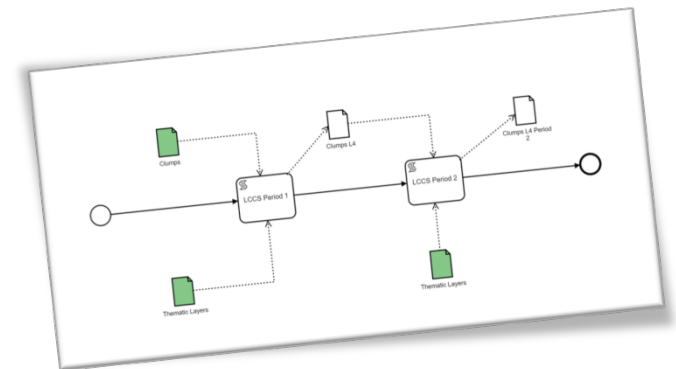
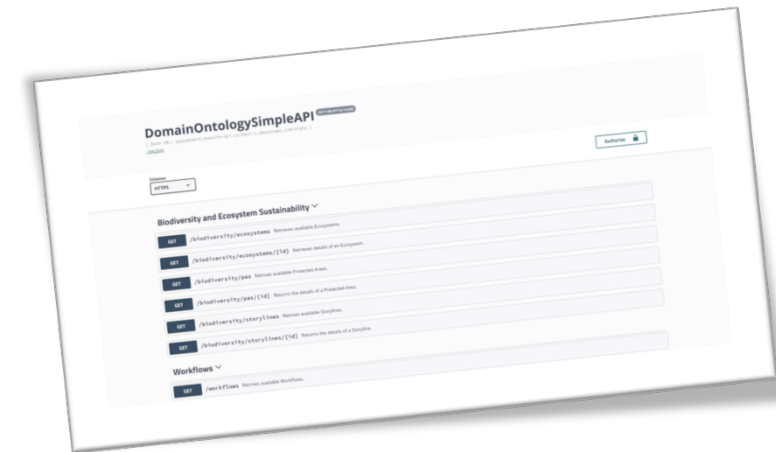
1872 PRIFYSGOL ABERYSTWYTH UNIVERSITY



CAPACITY FOR EUROPEAN CLASSIFICATION OF LAND COVER AND LAND COVER CHANGE WITHIN THE VIRTUAL LABORATORY: OUTPUTS OF THE EODESM MODEL

LOWERING ENTRY BARRIERS FOR MODEL DEVELOPERS

- Source code retrieved by GitHub repository
 - Always up-to-date
- Support of Docker packaging as the only constraint
 - Support of multiple software frameworks: Python, R, etc.
 - Github ECOPOTENTIAL conventions
- Leveraging datasets harmonization by an internal data broker (DAB)
- Access through RESTful API for system integration and app development
- The workflow has an abstract (high-level) representation in BPMN
 - Targeting end-users not code developers





GEOSS INTEGRATION



Ontologies



Workflows



Products



ECOPOTENTIAL VLAB



GEOSS Platform

GEOSS Portal



GEO DAB



VLAB API

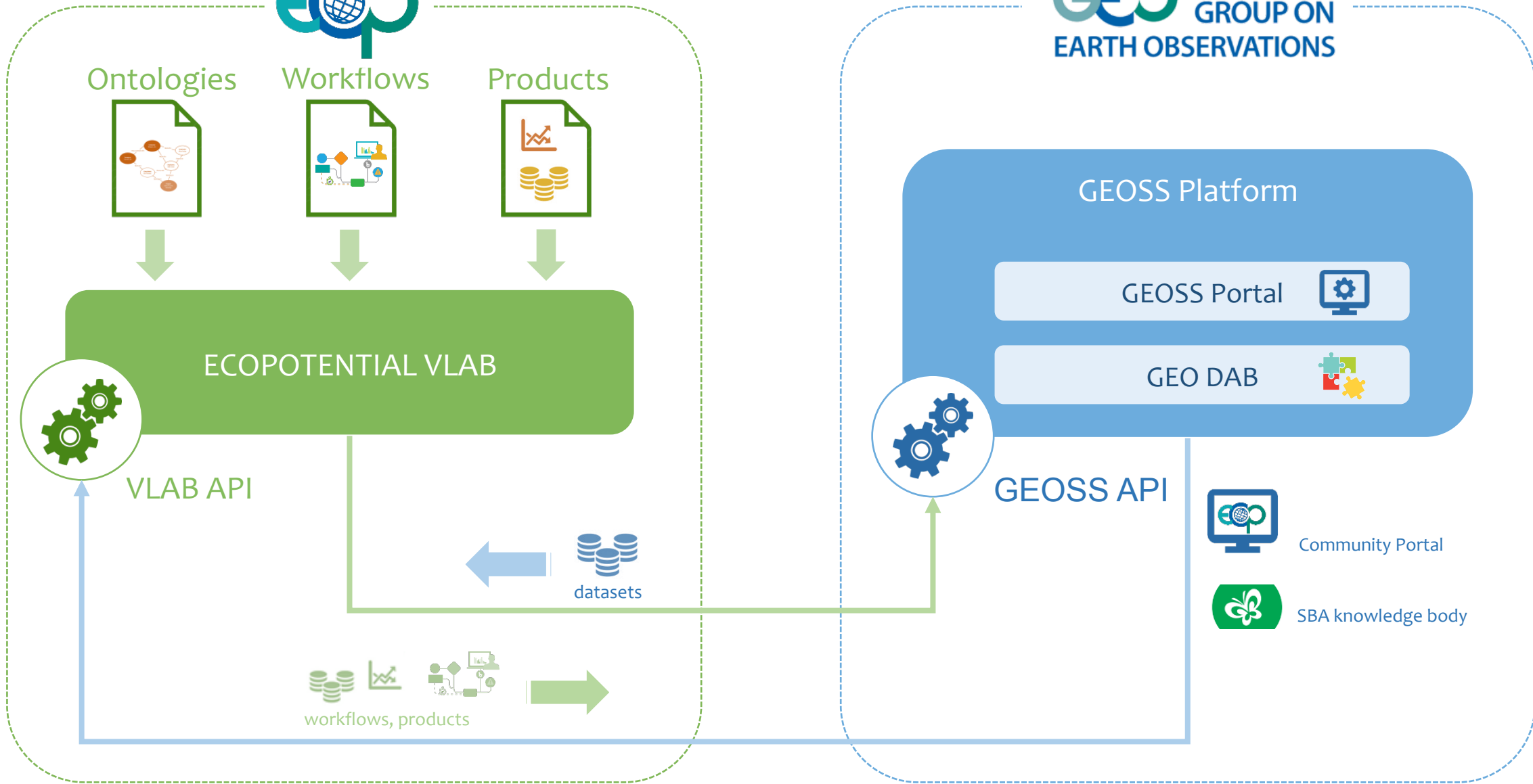
GEOSS API

datasets

workflows, products

Community Portal

SBA knowledge body





USER INTERFACE FOR MODELISTS

V
BETA

ECO-POTENTIAL DOMAIN
WORKFLOWS
MODEL UPLOAD
Developed by

V

ECO-POTENTIAL DOMA

Select an E

Arid/semi-ar

Arid and semi-aric represent life unde They are water- lii especially vulnera associated with gl addition, they exh of ecosystem func ecosystem servic ecosystem systems, temp particularly import

All stable

- Earth Observation Data for Ecosystem Monitoring (EODESM)**
- Simple S2A to PNG
- Hydroperiod Estimation (HydroMap)
- Inland free water surface derivation from Sentinel-2 satellite imagery (WaterMasks)
- Landscape fragmentation measures calculation (LandMetrics)
- Sentinel-1 data speckle noise suppression (SpeckleRemoval)

Earth Observation Data for Ecosystem Monitoring (EODESM)

Description

The EODESM system classifies land covers according to the Food and Agricultural Organisation's (FAO's) Land Cover Classification System (LCCS2) taxonomy. The EODESM system can use, as input, any remote sensing or other spatial datasets (including modelled output) and at any scale of choosing. The system is designed for use by a wide range of users and is entirely open source and freely available. This document provides a simple summary allowing users to access and easily use the EODESM system.

Developed by

Name: Richard Lucas
Organization: UNSW

Diagram

Clumps
Clumps description

Thematic Layers Extend the default list

[ADD THEMATIC LAYERS](#)

Thematic Layers (Changes) Extend the default list

[ADD THEMATIC LAYERS \(CHANGES\)](#)



GEOSS COMMUNITY PORTAL





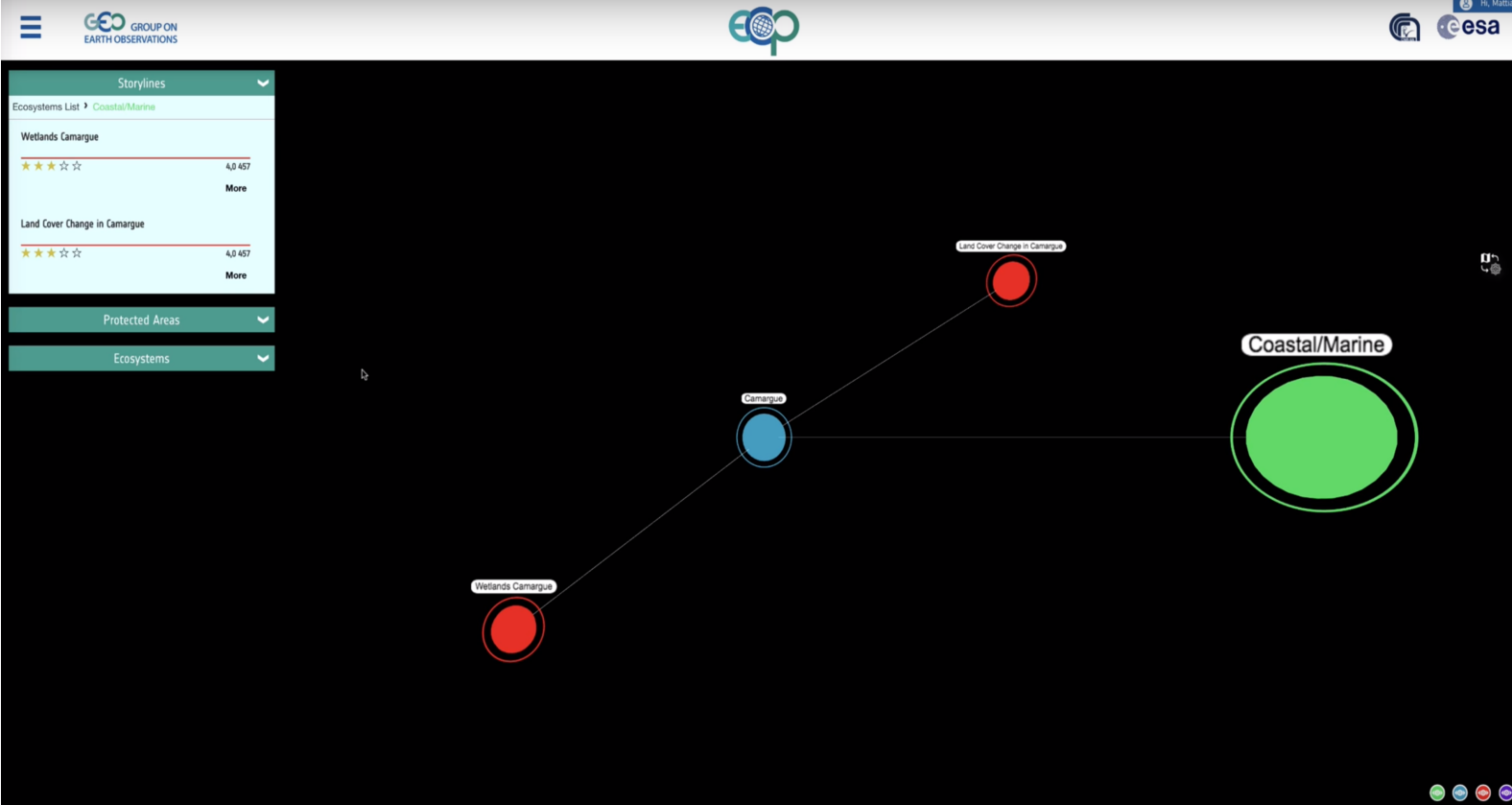
GEOSS Mirrors



GEOSS Widgets



GEOSS Views



The screenshot displays the GEOSS Community Portal interface. The top navigation bar includes the 'GROUP ON EARTH OBSERVATIONS' logo and the 'esa' logo. A sidebar on the left lists 'Storylines' with two entries: 'Wetlands Camargue' (4,0457) and 'Land Cover Change in Camargue' (4,0457). Below the sidebar, a map shows a network of nodes: 'Wetlands Camargue' (red), 'Camargue' (blue), 'Land Cover Change in Camargue' (red), and 'Coastal/Marine' (green). The 'Coastal/Marine' node is highlighted with a larger green circle.

<https://youtu.be/m8IFGaDabo4>



MODELS AVAILABLE IN THE ECOPOTENTIAL VLAB

Model	Model developers
EODESM (Earth Observation Data for Ecosystem Monitoring)	UNSW/Aberystwyth University
COINS (COntrol of INvasive Species)	CNR-IAC
INSTAR	UGR
Inland free water surface derivation from Sentinel-2 satellite imagery (WaterMasks)	CERTH
Hydroperiod Estimation (HydroMap)	CERTH
Landscape fragmentation measures calculation (LandMetrics)	CERTH
Estimation of phenology metrics (PhenologyMetrics)	CERTH
BFAST: detection of changes in NDVI approximated phenological cycles (PhenologyChanges)	CERTH
Sentinel-1 data speckle noise suppression (SpeckleRemoval)	CERTH
Mountain metapopulation	EPFL
MOHID	IST
Iris-SDM	ICETA
DELFT3D FLOW & GEM	DELTAIRES

CURRENT STATUS

Achievements

- Dataset discovery and access supported through GEO DAB technology
 - Functionalities accessible through the user interface and through RESTful API
 - In-situ and EO data and products available
- Documentation available for developers
- Portal based on GEOSS Portal Mirror technology (ESA)
- Live demo at the GEO XIV Week (Washington, October 2017)
- Training event for ECOPOTENTIAL users (developers) held on February 2018

Supported workflows

- Despeckling module (CERTH))
- EODESM scenario (CNR and UNSW)
- Phylogenetic Diversity Estimation (CNR)
- MOHID Land (IST)
- Metapopulation presence of a focus species (EPFL)
- INSTAR (UGR)
- Optimal allocation of resources for the harvesting of an invasive species (CNR-IAC)
- Water quality (DELTARES)

CURRENT STATUS

- Dataset discovery and access supported through GEO DAB technology
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- Portal based on GEOSS Portal Mirror technology (ESA)
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CONCLUSIONS

- ECOPOTENTIAL is developing a Virtual Laboratory to facilitate activities in the ecosystem science community of practice
- The VLAB will be adopted and enhanced in other initiatives and projects including ERA-PLANET GEOEssential
- The VLAB adopts widespread and mature technologies to provide harmonized low-level functionalities (Cloud IaaS/PaaS, Docker container, DAB mediator)
- The VLAB adds advanced functionalities tailored to ecosystem science community-of-practice: ECOPOTENTIAL ontology, execution of scientific business processes, etc.
- The VLAB is aligned with major international activities on resource sharing for science and environmental policy (namely GEO)

Thank you for your attention!

<http://www.ecopotential-project.eu>

ECOPOTENTIAL VLAB: <http://vlab.geodab.eu/>

ECOPOTENTIAL VLAB Documentation: <http://confluence.geodab.eu/>



The ECOPOTENTIAL project has received funding from the *European Union's Horizon 2020 research and innovation programme* under grant agreement No 641762