ECOPOTENTIAL (2015-2019)

Consiglio Nazionale delle Ricerche

www.ecopotential-project.eu

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

ECOPOTENTIAL

LTER

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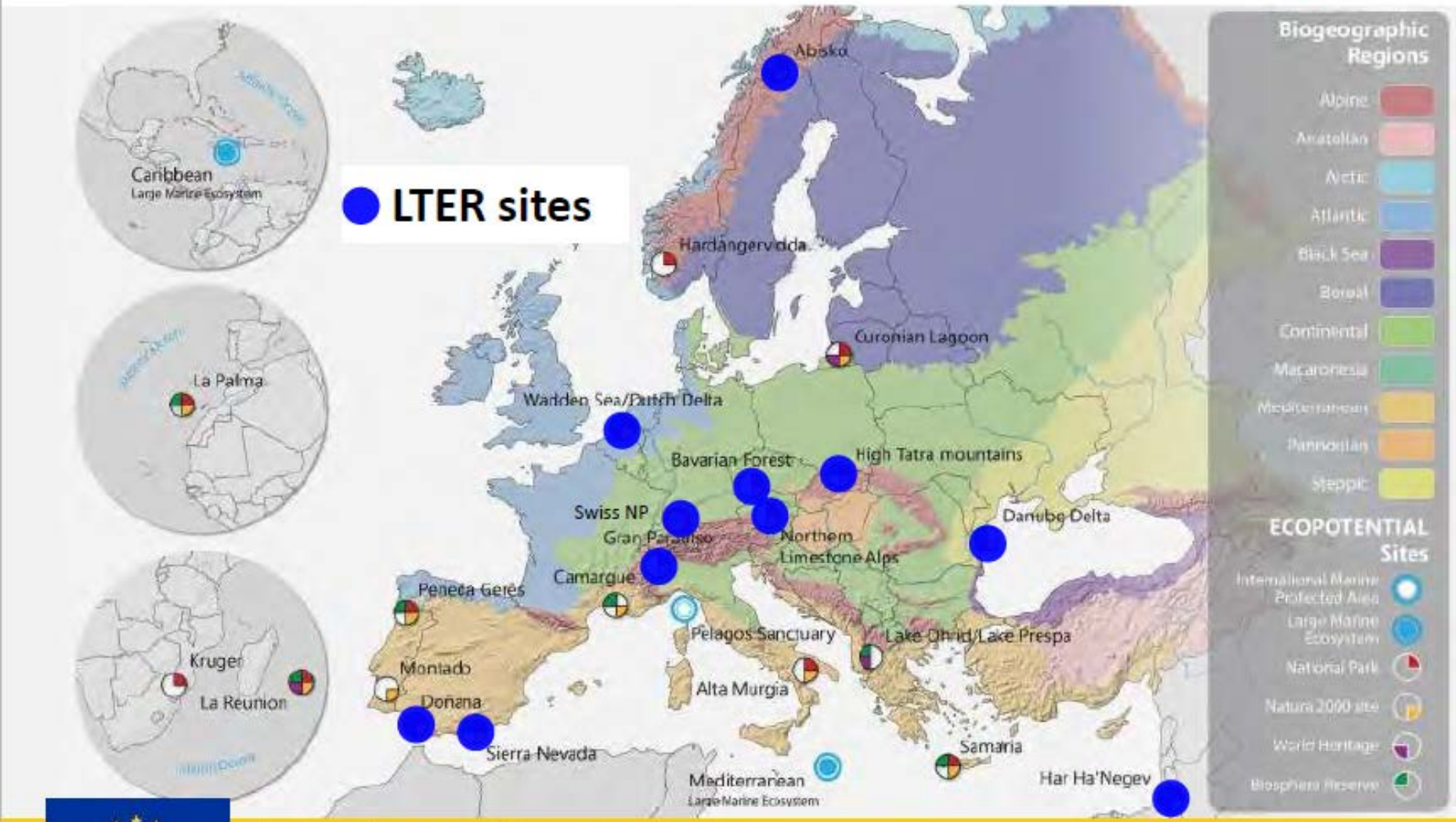
Working in partnership with **Protected Areas in Europe and beyond**



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ECOPOTENTIAL: EO for natural ecosystems

1. How is your project contributing to the achievement of SDGs on health, climate action and the **preservation of terrestrial and maritime ecosystems (SDG 15)**?

✓ ECOPOTENTIAL contributes through the production and dissemination of new knowledge by pursuing the following operational objectives:

- ***Monitoring of:*** essential variables, ecosystems extent, ecosystems functioning, and changes through the *Earth Observation Data for EcoSystem Monitoring (EODESM)* system
- ***Modelling****:* Macro-systems Ecology and scenario analysis for future protections
- ***Fostering the transition from the web of data to the web of knowledge:*** Models and services are fed into the Virtual Laboratory (VL) platform
- ***Developing a community of practices.*** It involves researchers, PA managers, and policy makers – **Dissemination of results** has a key role

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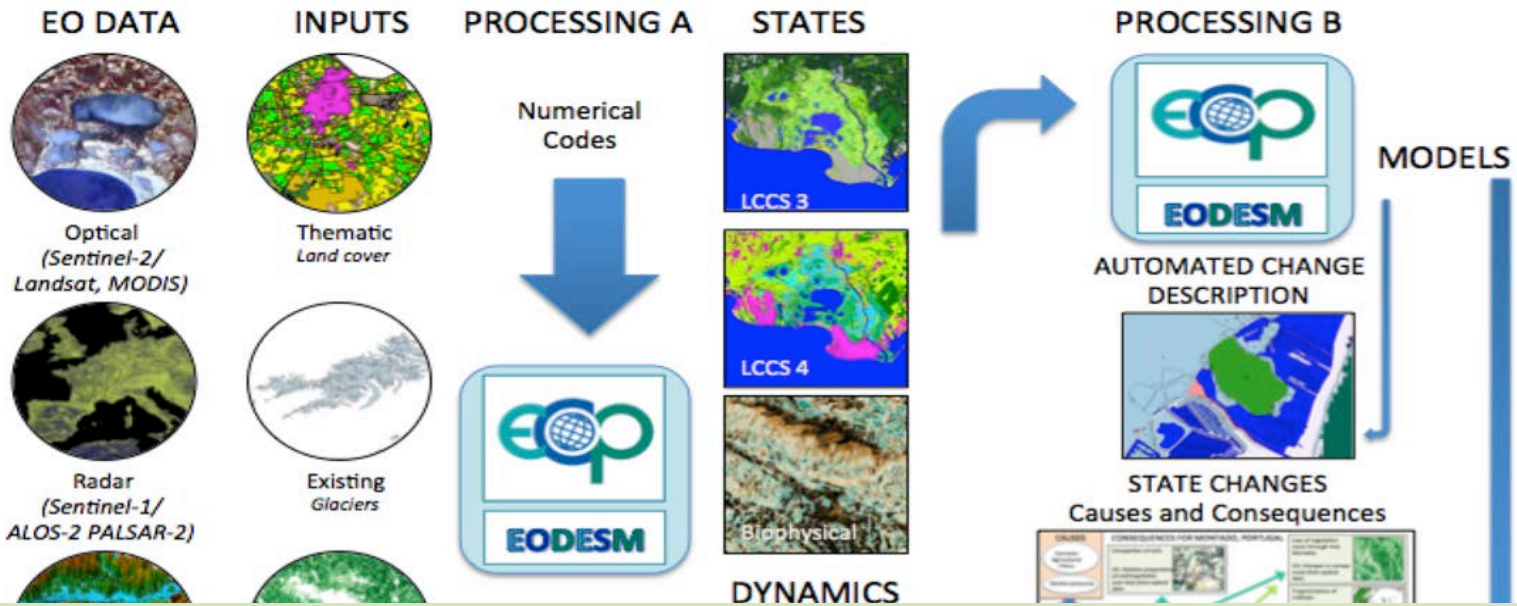
Monitoring: EODESM system

a unified framework for EO data analysis



The Earth Observation Data for Ecosystem Monitoring (EODESM)

- Food and Agriculture Organisation (FAO) Land Cover Classification System (LCCS2) hierarchical structure
- Python open source software
- KEA files provide raster attributes, including additional environmental variables.

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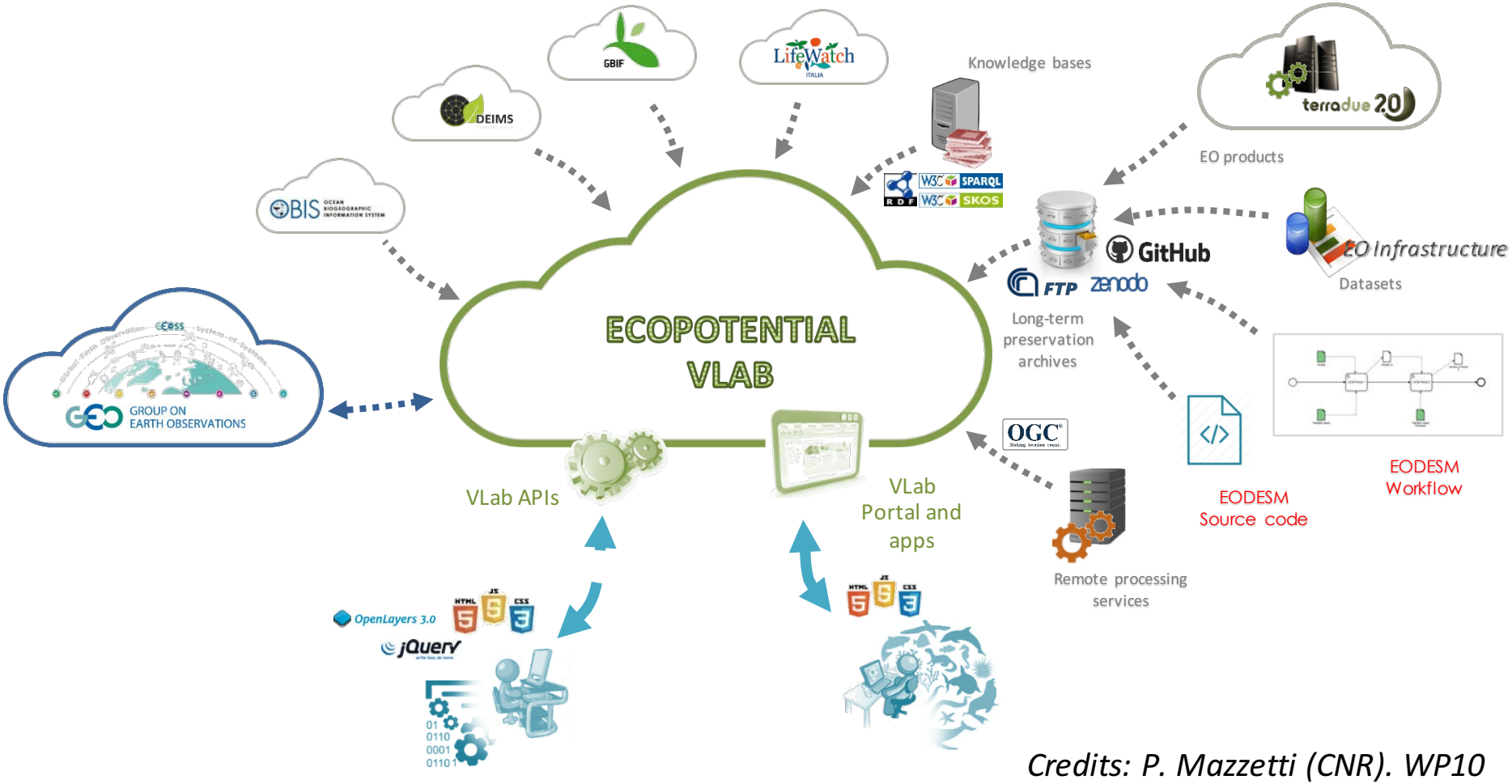
Virtual Laboratory (VL)

The VL is a virtual environment to facilitate the activities in the ecosystem community-of-practice for generating knowledge for informed decision-making



Credits: P. Mazzetti (CNR). WP10

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Natural grasslands in Murgia Alta NP

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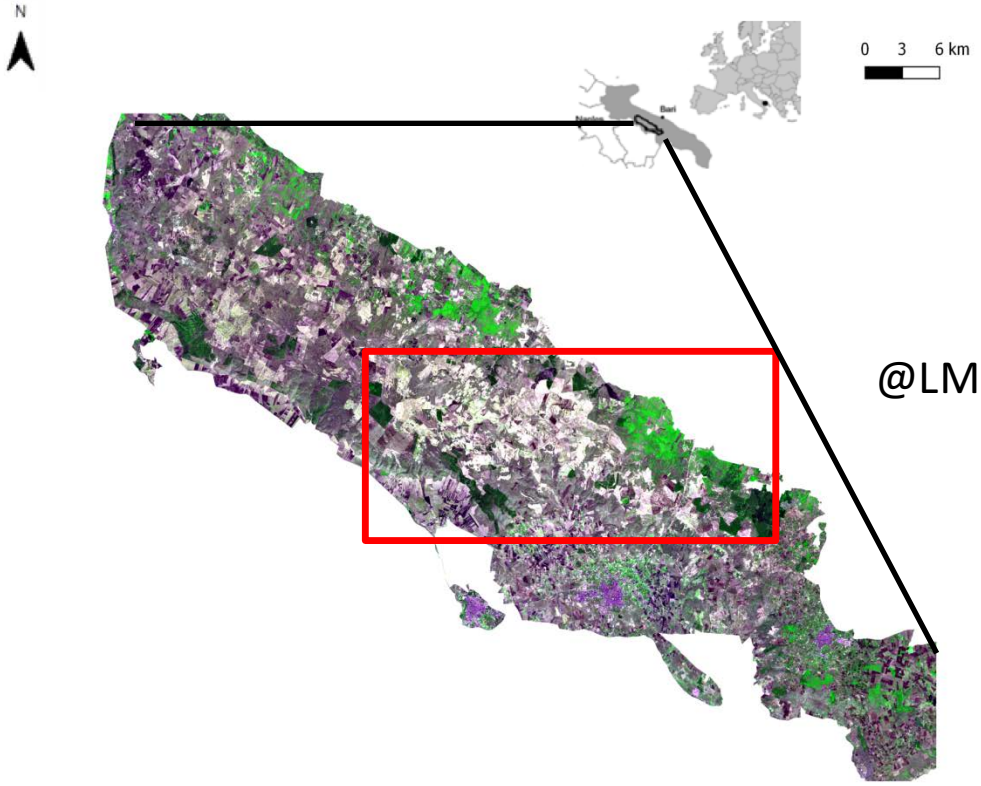
Rock graining and *A. altissima* invasion



Sentinel-2

7 Aug. 2017

RGB: 4-8-2/10 m.

@LM

@LM

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Very High Resolution LC mapping:

Worldview–2 image/RGB: 5-7-2/2 m.

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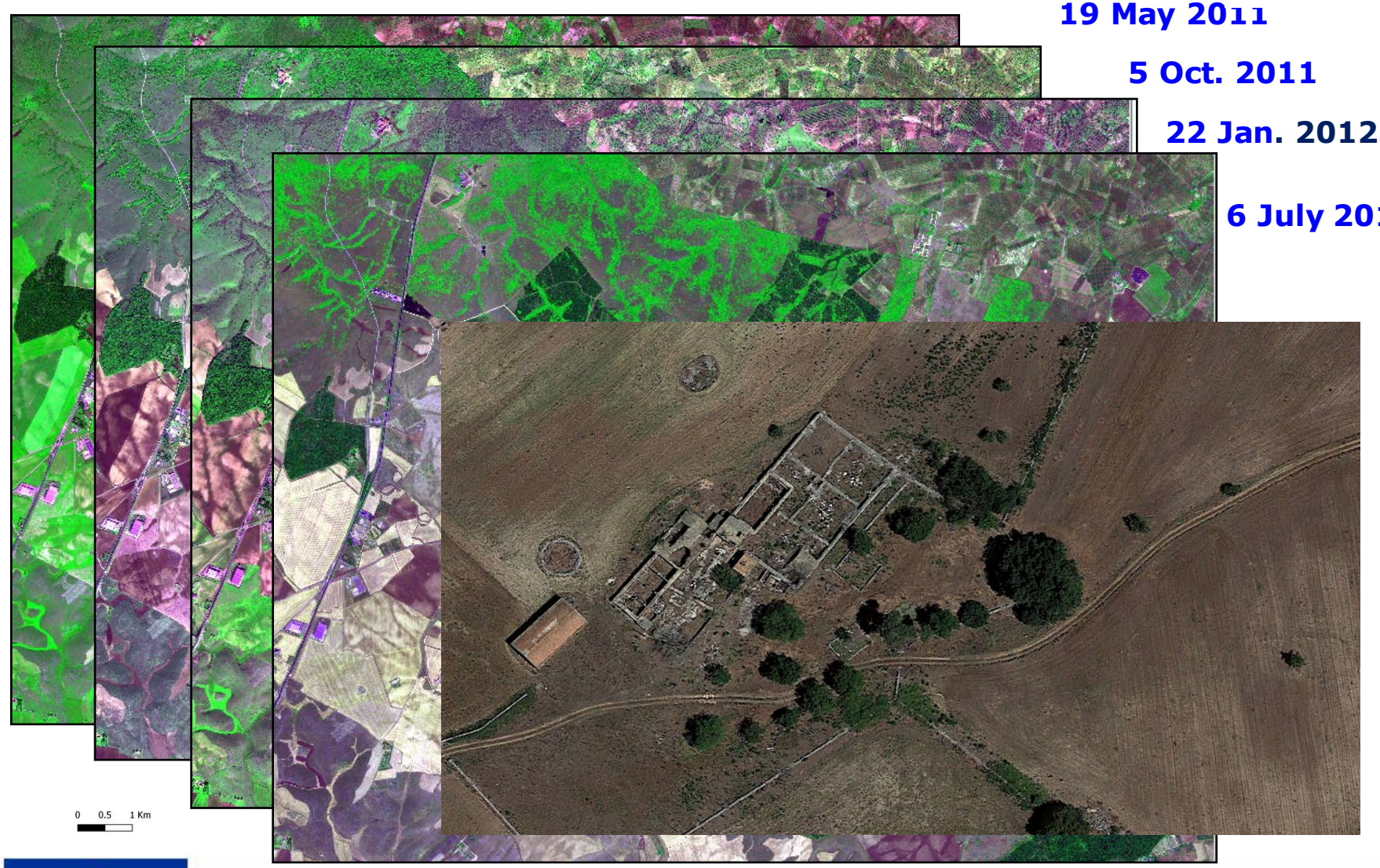

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EODESM: Very High Resolution Land Cover map

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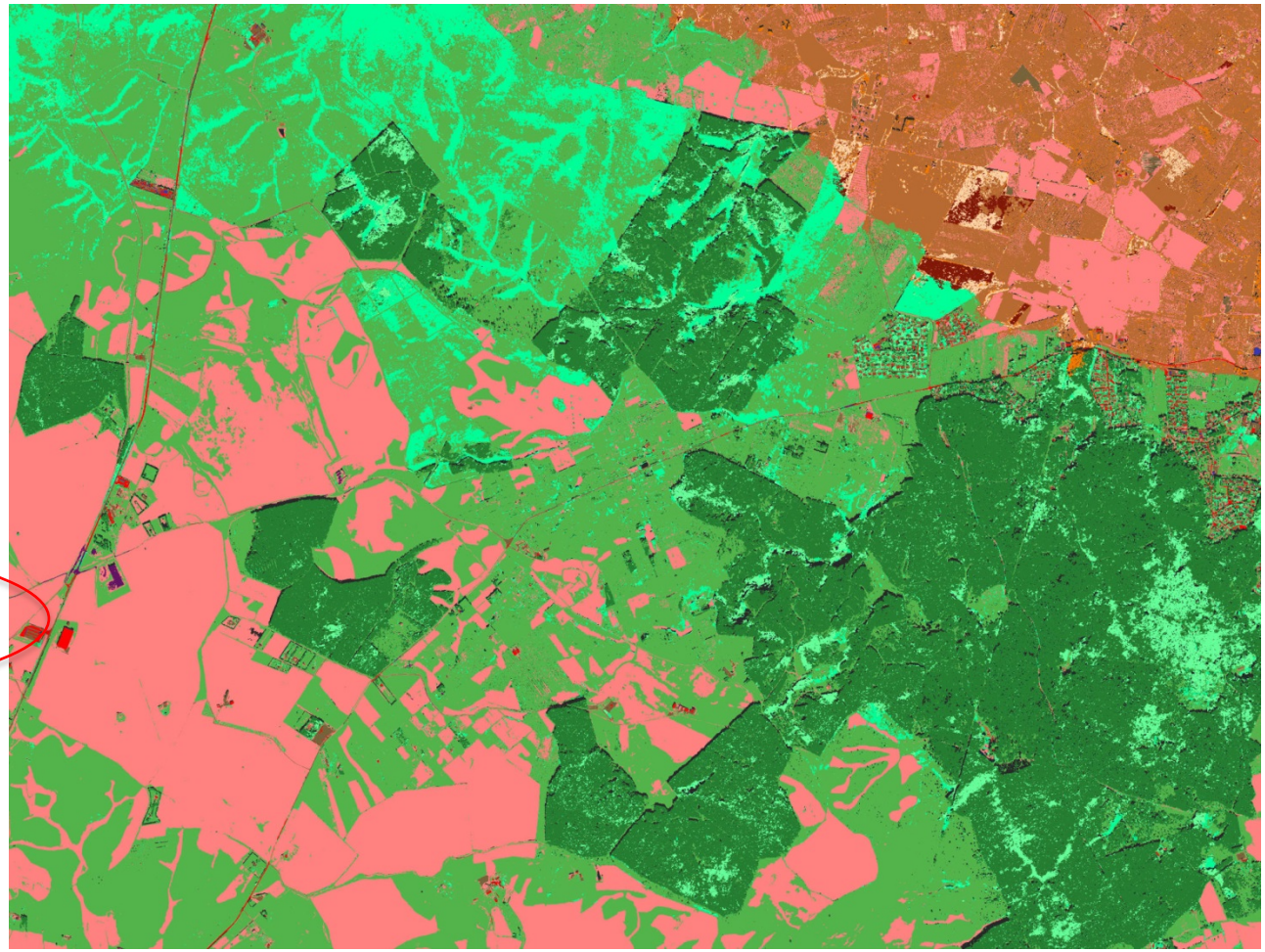
- **Extent of natural grasslands;**
- **Deciduous layer extraction.**



Overall Accuracy = 92.77±0.04%

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Modelling: the spreading of *A. altissima*

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ORIGINAL ARTICLE
Journal Section

Optimal spatio-temporal effort allocation for invasive species removal incorporating a removal handling time and budget

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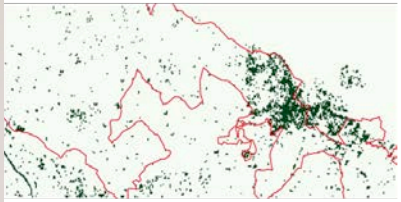
Funding information
This work has been carried out H2020 project 'ECOPOTENTIA Future Ecosystem Benefits Thro Observations', coordinated by C (http://www.ecopotential-proje project has received funding fro European Union's Horizon 2020 and innovation programme und agreement No 641762.
Christopher M. Baker is the reci John Stocker Fellowship from th and Industry Endowment Fund

Presence of Ailanthus



State PDE

$$\frac{\partial u}{\partial t}(\mathbf{x},t) - D\,\Delta u(\mathbf{x},t) = r\,u(\mathbf{x},t)\left(\rho(\mathbf{x}) - \frac{u(\mathbf{x},t)}{k}\right) - \frac{\mu\,u(\mathbf{x},t)\,E(\mathbf{x},t)}{1+\tau\,\mu\,u(\mathbf{x},t)}$$

diffusion — logistic growth — Holling II type harvesting

Symbol	Variable	Ecological meaning	Dimension
u	Plant density	#plant in the unitary area	km^{-2}
E	Effort density	# team in the unitary area	km^{-2}

Objective funtional to be minimized

$$\mathfrak{J}(E) = \alpha \int_0^T e^{-\delta t}\left(\int_\Omega E^2(\mathbf{x},t)\,d\mathbf{x}\right)dt + \beta \int_0^T e^{-\delta t}\left(\int_\Omega \frac{E^3(\mathbf{x},t)}{B^3}d\mathbf{x}\right)dt$$

$$+ \gamma \int_0^T e^{-\delta t}U(t)\,dt + \theta\,e^{-\delta T}U(T), \qquad U(t) = \int_\Omega u(\mathbf{x},t)\,d\mathbf{x}$$

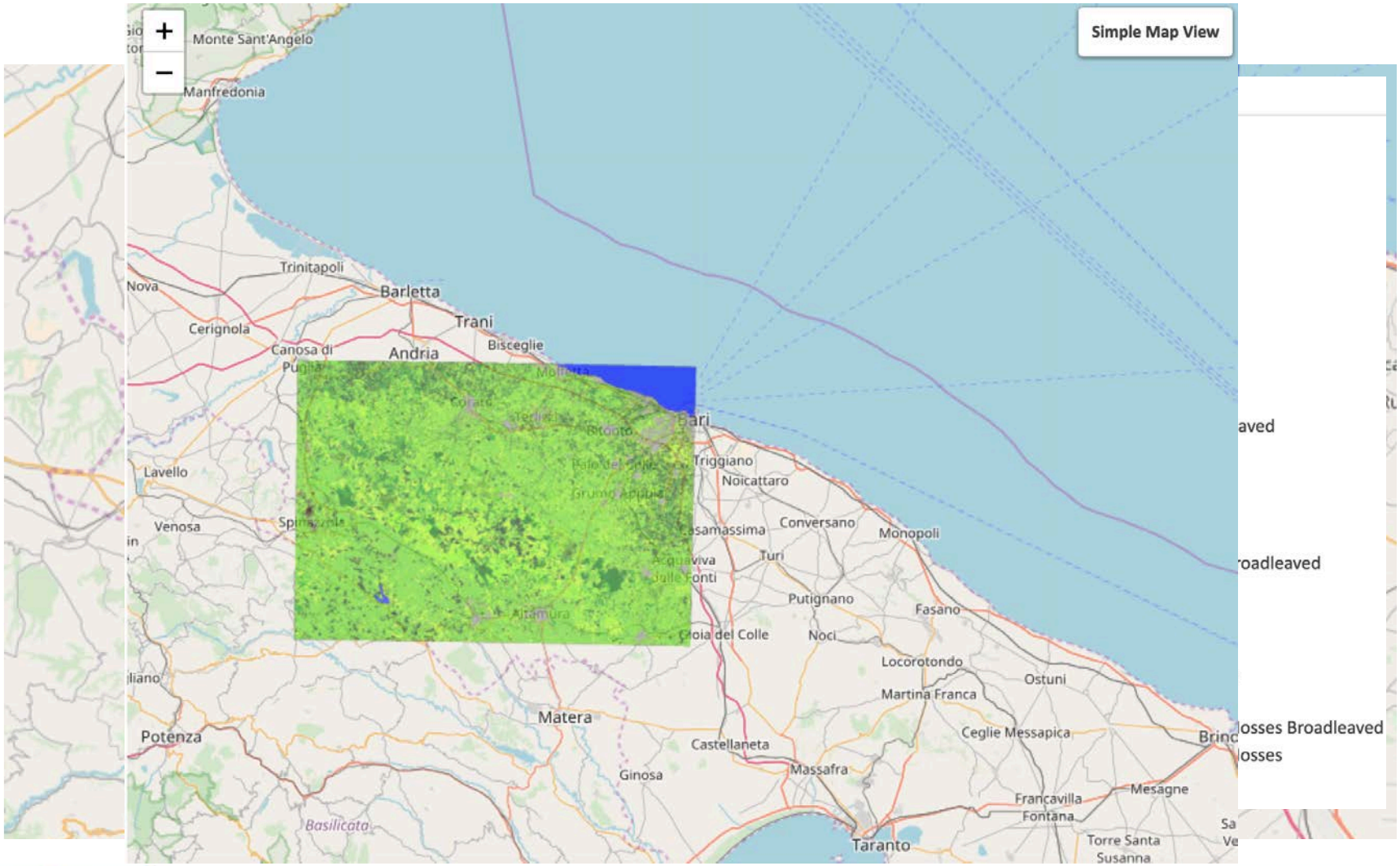
#plant in Ω

Mathematical modelling **for optimal spatio-temporal effort allocation** in the eradication of *A. altissima,* incorporating a removal handling time and budget

SDG 15-Target 15.8. By 2020, introduce measures to prevent the introduction and significantly reduce the impact of invasive alien species on land and water ecosystems and control or eradicate the priority species

Murgia Alta: High Resolution LC map (FAO-LCCS)

Generated by the VL



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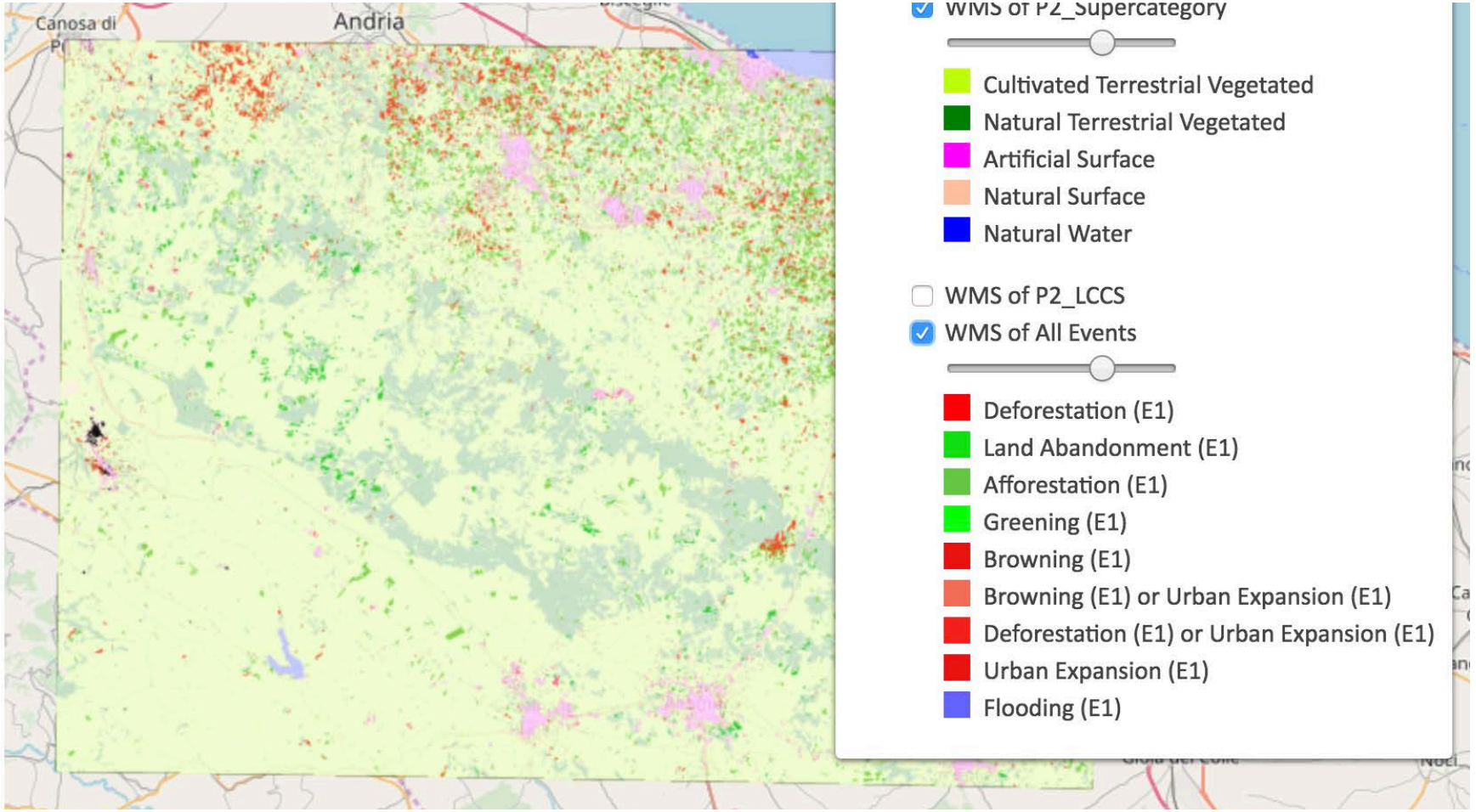
Murgia Alta: change map

Generated by the Virtual Lab



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High Resolution Intra-annual time series analys

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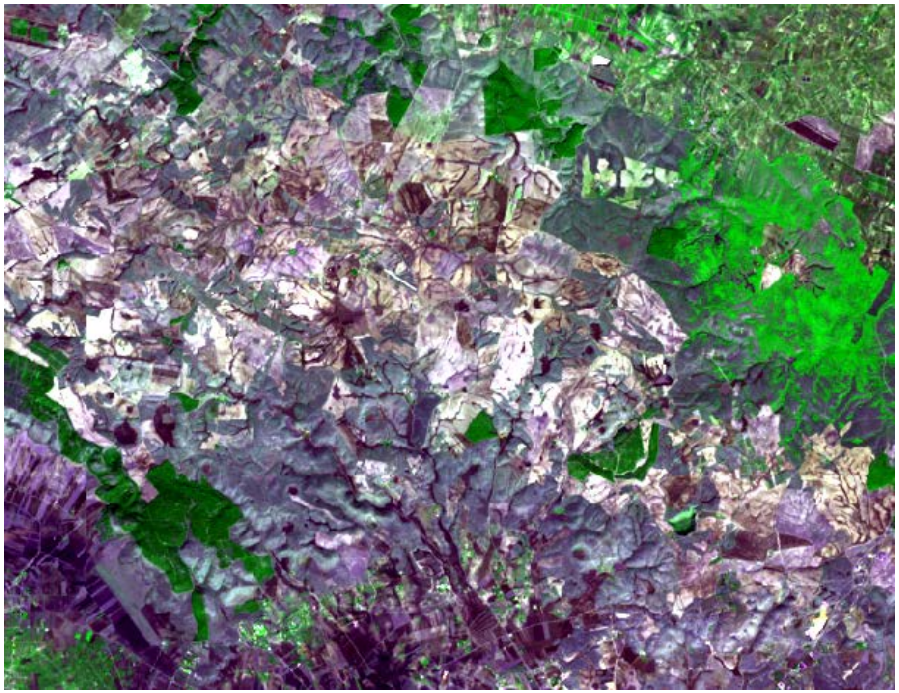
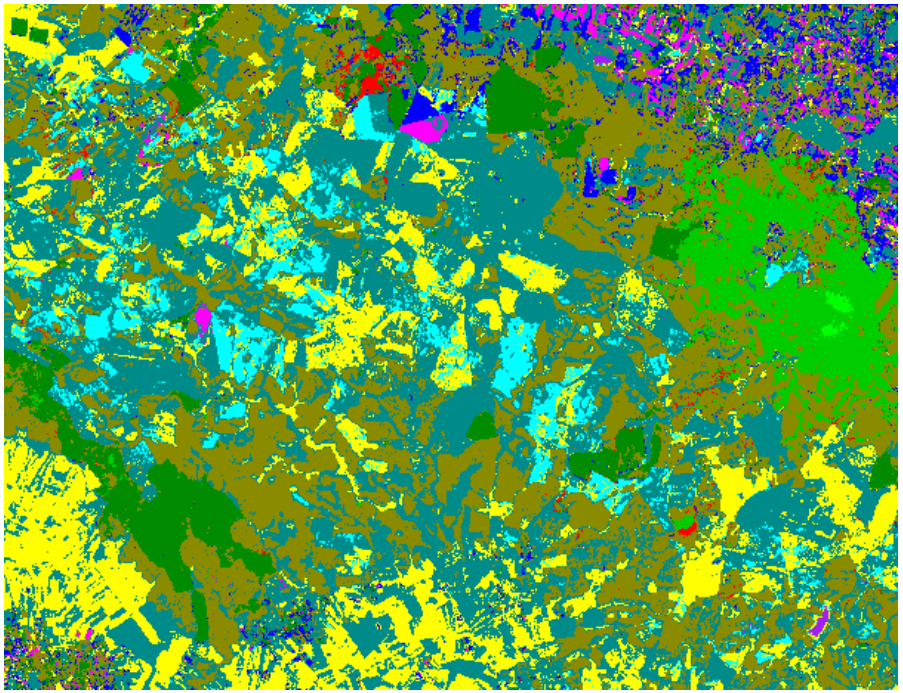
Intra-annual supervised classification of 27 Landsat scenes (2013)



Landsat 8, level 2 –10 Oct. 2013



Output classified map; OA=90.16%±0.65

- UNCLASSIFIED
- BROADLEAVED DECIDUOUS
- BROADLEAVED EVERGREEN
- NEEDLELEAVED EVERGREEN
- GRASSLAND
- CROPS TYPE1
- CROPS TYPE2
- CROPS TYPE3
- CROPS TYPE4
- CROPS TYPE5
- EXTRACTION SITES
- BURNED AREAS

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N 0 2.5 5 km

Breaks for Additive Seasonal Trends (BFAST)

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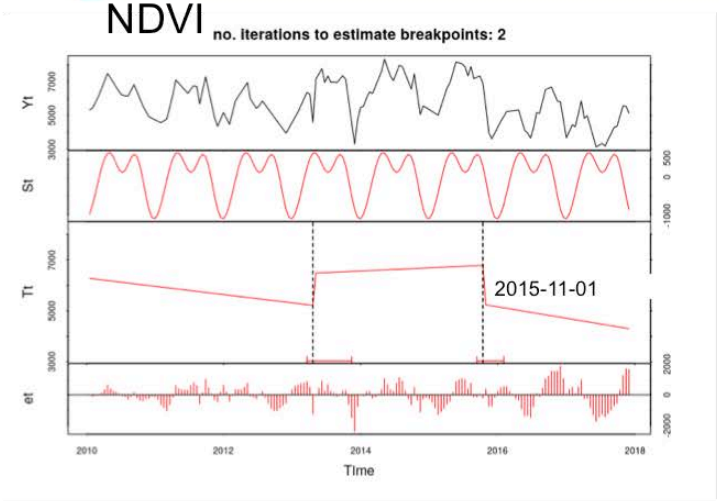
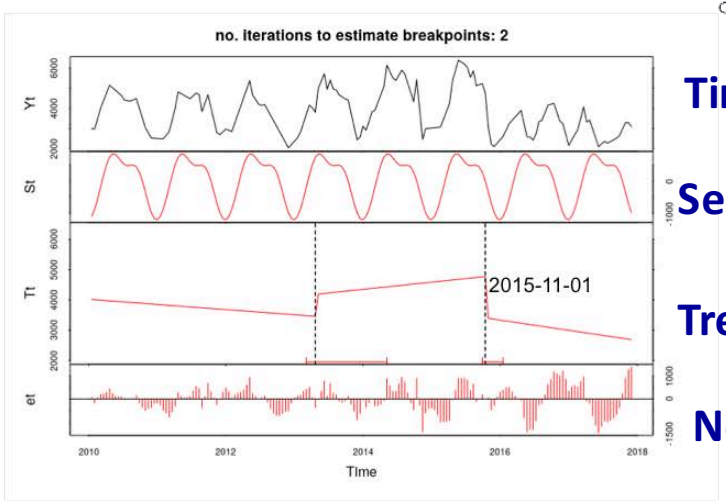
NDVI



SAVI



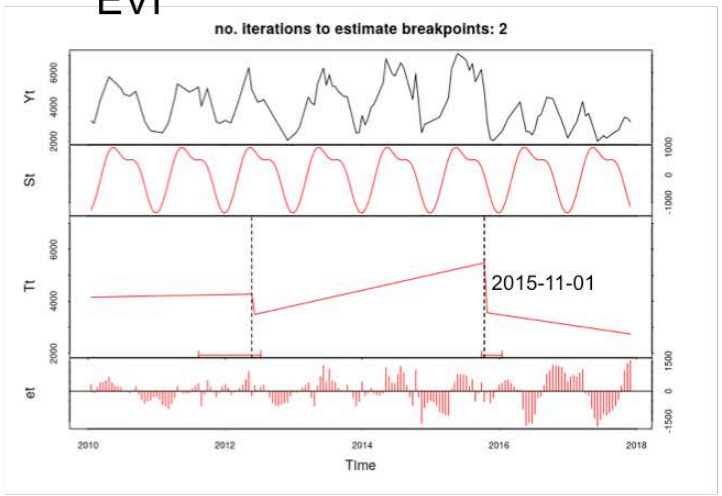
Time series

Seasonality

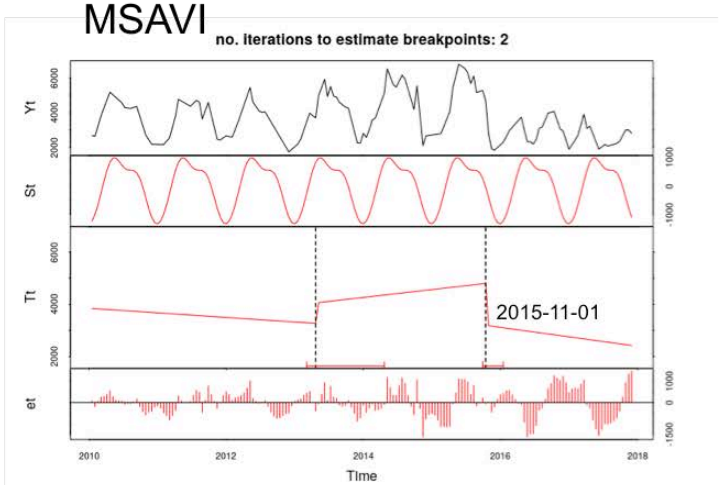
Trend

Noise

EVI



MSAVI



Inter-annual (2010-2018) analysis to monitor the effectiveness of eradication efforts

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Current Virtual Lab Status

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Achievements

- Dataset discovery and access supported through GEO DAB technology
  - Functionalities accessible through the user interface and through RESTful API
  - In-situ (LTER DEIMS, OBIS, GBIF) and EO (data and products) available
- Documentation available for developers
- Portal based on GEOSS Portal Mirror (ESA)
- Demonstrated at the GEO XIV Week (Washington, October 2017)
- Training event for ECOPOTENTIAL users (developers) held on 25th January and 2nd February 2018

Supported workflows

- EODESM scenario (CNR and UNSW)
- Despeckling module (CERTH)
- 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)
- Water quality (DELTARES)

Credits: P. Mazzetti (CNR)

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From the web of data to the web of knowledge

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The ECOPOTENTIAL Virtual Laboratory (VL) is a virtual environment supporting the activities of the ecosystem community-of-practice

From Science to Society

Integration with global efforts for science-based decision-making

From Ecosystem Community to policy-makers

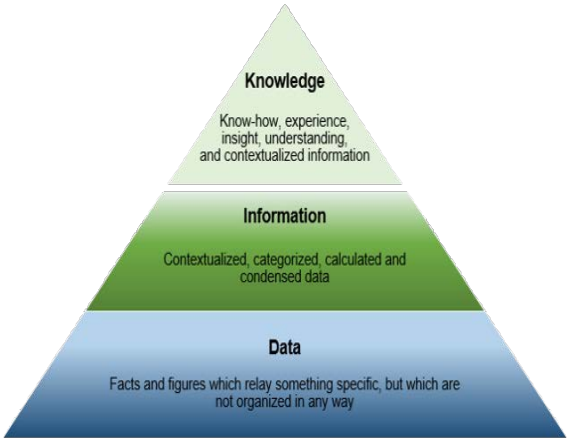
Generated knowledge targeted to policy-makers (e.g. PA managers)

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



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ECOPOTENTIAL: EO for natural ecosystems

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2. What are the implications resulting from your projects for policy development on sustainable development?

- ✓ **Informed decisions making**: the project provides quantitative evidence of ecosystem degradation and biodiversity loss through the **EODESM and the Virtual Laboratory (openly available services)**

- ✓ Such services can be used:
  - **to compare trends** in the status and functioning of ecosystem in different PA;
  - **to evaluate the impact that climate change and anthropic pressures** may have within and outside PA in support to the **extension of protection measures (future projections)**
  - **to evaluate the impact of existing and new policies.**

- ✓ Project findings can support the selection of adequate **Nature Based** solutions, useful for **SDG 11**

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3. What is needed to convince governments that Earth observations are the key for sustainable development?

- ✓ **Developing *communities of practice*** by providing not only data but added value products (services) and models
- ✓ **Providing evidence** that Earth Observations can be used to monitoring ecosystem functioning and resilience across political borders (e.g., Curonian Lagoon).
- ✓ **Demonstrating cost effectiveness** of regular monitoring of large and often not easily accessible areas (e.g. Mountains, tiger reserve in India, Africa).
- ✓ **Providing VHR data** for regular monitoring in protected areas (LTER sites), useful **for local decision making**, at lower costs or for free: new markets are in down- stream services from data

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4. Based on your project's operations, successes, and failures to date, **what are the main challenges that you have encountered**, or foresee, in relation to monitoring and reporting of the SDGs?

- ✓ **Regular collection of in-situ and ancillary data** as well as their harmonization in national data bases, according to specific requirement,s both for providing down stream services and validation. Citizen science tools may support.
- ✓ **Educational (cultural) efforts** for ecosystem services understanding and their value for human health.

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5. Any particular issue related to inter-operability with other accessible datasets worldwide, as well as cross-checking of data with realities on the ground, especially in third countries?

- ✓ ECOPOTENTIAL has been planned to produce interoperable data accessible through the GEOSS GCI platform since the beginning (VL).
- ✓ It is strongly connected with the ILTER network and the LifeWatch infrastructure, however there are gaps due to different data sampling strategies. *Models could contribute to address such issue.*
- ✓ Lack of in-situ data networks for validation (e.g., see wind measurements)
- ✓ UN support (UNEP, UNESCO, FAO..) will be crucial to overcome the gaps of **data in third countries**.

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6. What actions is your project taking to support decision-making in Europe and, particularly, at local levels of government?

✓ **Dissemination - exploitation of results – creation of a Community of Practice**

- **340** presentations at conferences and workshops; **79 free open access** peer reviewed publications (other forthcoming), website, newsletters, videos, summer schools, interviews, leaflets and a Book

✓ **Engagement with local users and decision makers**

- **Local meetings with end users and questionnaires:** 27 Protected Areas visited– 2 devoted workshops and training courses involving local managers

✓ **Data and results MADE AVAILABLE to final users and policy makers:**

- *Web app* for visualization and download of all data sets elaborated in the project. It adopts GEO standard for metadata
- *Mobile app* for gathering ground truth LC/LU to validate EODESM outputs
- *Training of apps* in the field, forthcoming (summer 2018)

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6. What actions is your project taking to support decision-making in Euro[illegible] particularly, at local levels of government?

D1.6	Recommendations for the activities of GEO/GEOSS and GEOGNOME
D12.10	Instructional video(s) for PA management using EO data/tools.
D8.4	Asessment of future ecosystem and ecosystem services
D9.3	Overview of potential impacts of drivers of changes on the PAs
D11.3	Policy recommendations mainstreamed into the GEO/GEOSS
D6.3	Online monitoring data services for ecosystem indicators
D7.3	Toolbox for decision support
D12.12	Science-policy briefing at the European Parliament
D2.3	EO-driven Essential Variables and general Implications
D8.5	Guidelines for large scale monitoring ecosystems
D1.9	Final GEO conference
D9.4	Roadmap for current and future novel PAs
D12.14	Short documentary film

Research activities generate new knowledge and products useful for informed decision making and evaluation of the policies adopted

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6. What actions is your project taking to support decision-making in Europe and, particularly, at local levels of government? towards European Institutions

- ✓ **Community of Practice**, at international level:
  - ECOPOTENTIAL involve European institutions in the Community of Practice
  - ECOPOTENTIAL strongly contributes to the GEO ECO initiative: methodologies will be extended to other PA and further gaps identified

- ✓ A **photo exhibition at the European Parliament (January 2018),** Committee of the Regions and now at the DG Environment and one dedicated workshop in Bruxelles to communicate the projects results to European institutions

- ✓ **Dissemination: POLICY BRIEFING at the European Parliament** is foreseen for autumn 2018.

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7 Do you **see knowledge gaps for developing methodologies and techniques related to the SDGs** that may engage the global research community in the future to come?

- ✓ New techniques for the integration of data of different nature and from different sources (including web, citizen science, **socio-economics**) to evaluate and reduce the **uncertainty** associated to models, data and knowledge in support to **informed decision making**
- ✓ Better understanding of **long term ecosystem dynamics** and fluxes (e.g., water, energy, carbon). The eLTER research infrastructure may be crucial to understand complex conceptual issues through multi-source EO
- ✓ New research on the *Critical Zone* concept for understanding fluxes/processes among soil, vegetation and atmosphere to produce indictors useful for SDGs monitoring
- ✓ *Nature based* solutions for ecosystem restoration towards SDGs 15 - 11

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Thank you for your attention!

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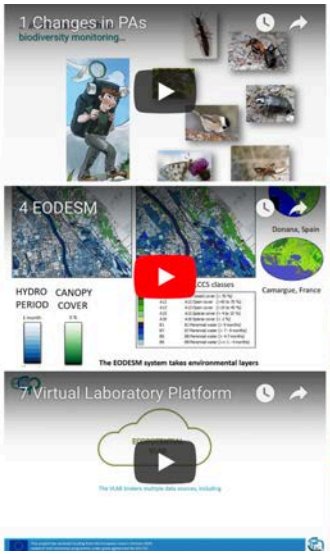
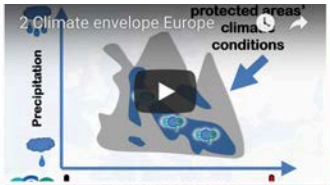
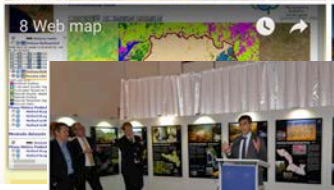
Deliverables







No.	Title	Month	WP	Resp. Partner
D12.1	Science school (1)	3	12	7 - UBT
D1.3	Data management plan	6	1	1 - CNR
D11.1	Research outputs as needed by stakeholders	11	11	5 - UFZ
D2.1	Review of existing EVs	12	2	34 - MLU
D10.1	Design of the ECOPOTENTIAL Virtual Laboratory	12	10	1 - CNR
D11.2	Synthesis study on integration of EO data/tools in decision making	12	11	42 - UNEP
D12.5	Science school (2)	15	12	7 - UBT
D5.1	Final list of data delivered by PAs	15	5	12 - UB
D4.1	EO data preprocessing and fusion modules	16	4	31 - DELTARES
D4.2	EO biophysical parameters, land use and habitats extraction modules	22	4	1 - CNR
D2.2	EO-driven Essential Variables	24	2	34 - MLU
D1.4	Mid-term report on ethical issues	24	1	1 - CNR
D6.1	Methods in EO-based modeling	24	6	17 - EPFL
D12.7	Science school (3)	27	12	7 - UBT
D5.2	Metadata for preexisting Datasets	28	5	16 - FORTH
D4.3	EO change detection Modules	28	4	43 - UNSW
D4.5	Time series EOFs (map and analysis)	30	4	22 - ISPRA
D5.3	Framework for user oriented quality evaluation routines	30	5	13 - ICETA
D5.4	Data sets on the historic evolution of the ecosystems	30	5	1 - CNR
D7.1	Assessment of status and evolution of ecosystem service indicators	30	7	10 - UNIVLEEDS
D8.1	High resolution (1-10 km) climate, land use and ocean change scenarios	30	8	1 - CNR

Video

Photos

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