Improving future ecosystem benefits through earth observations in the SCERIN:
the ECOPOTENTIAL approach

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Sustainable ecosystem services and human well-being are strongly interconnected.

Anthropogenic pressures cause threats to ecosystem integrity, functions and processes, potentially leading to loss of essential ecosystem services.

For these reasons, there is now an urgent requirement to monitor in real time the 'where', 'why' and 'how' of the changes.

Core project activities are

i) the exploitation of Earth Observation data from existing archives and new missions,

ii) the utilization of latest advancements in data mining and image processing,

iii) the adjustment of process-based models to assimilate the aforementioned data, maximizing performance,

iv) the incorporation of cross-scale interactions in the processing concept, and

v) the combination and alignment of the ecosystem functions with the beneficiaries needs.

ECOPOTENTIAL will

- assess climate change impacts combined with land cover and land use change scenarios,

- will consider ecosystem services including supply and demand, and

- will provide platforms for cyber infrastructures and data interoperability,

- while taking into consideration policy developments,

- benefitting from citizen science activities, and

- implementing capacity building and outreach activities.

To address this challenge, the EU H2020 ECOPOTENTIAL project includes a strong trans-disciplinary team of experts and stakeholders from 47 directly-involved renowned Institutions across Europe and beyond.
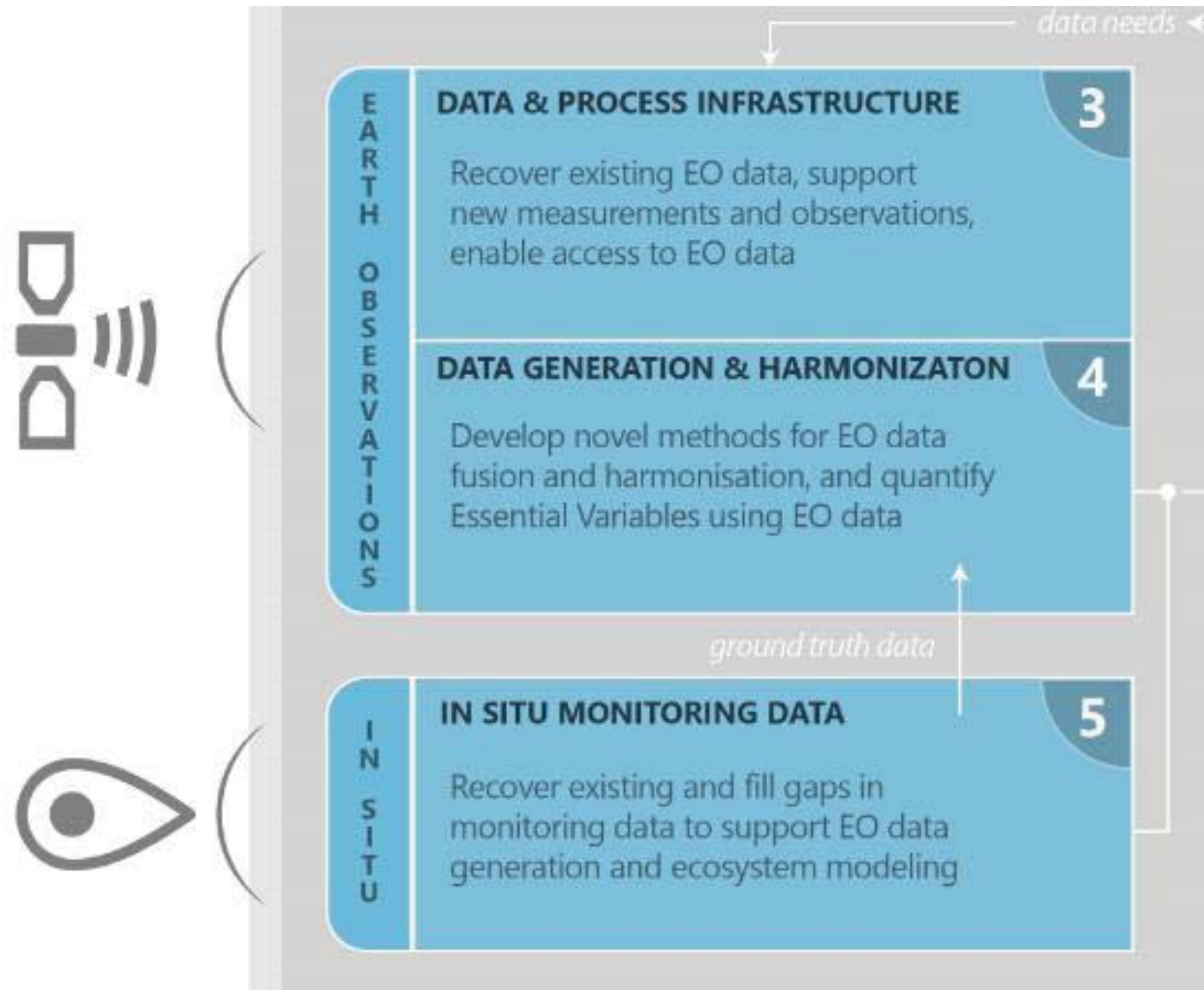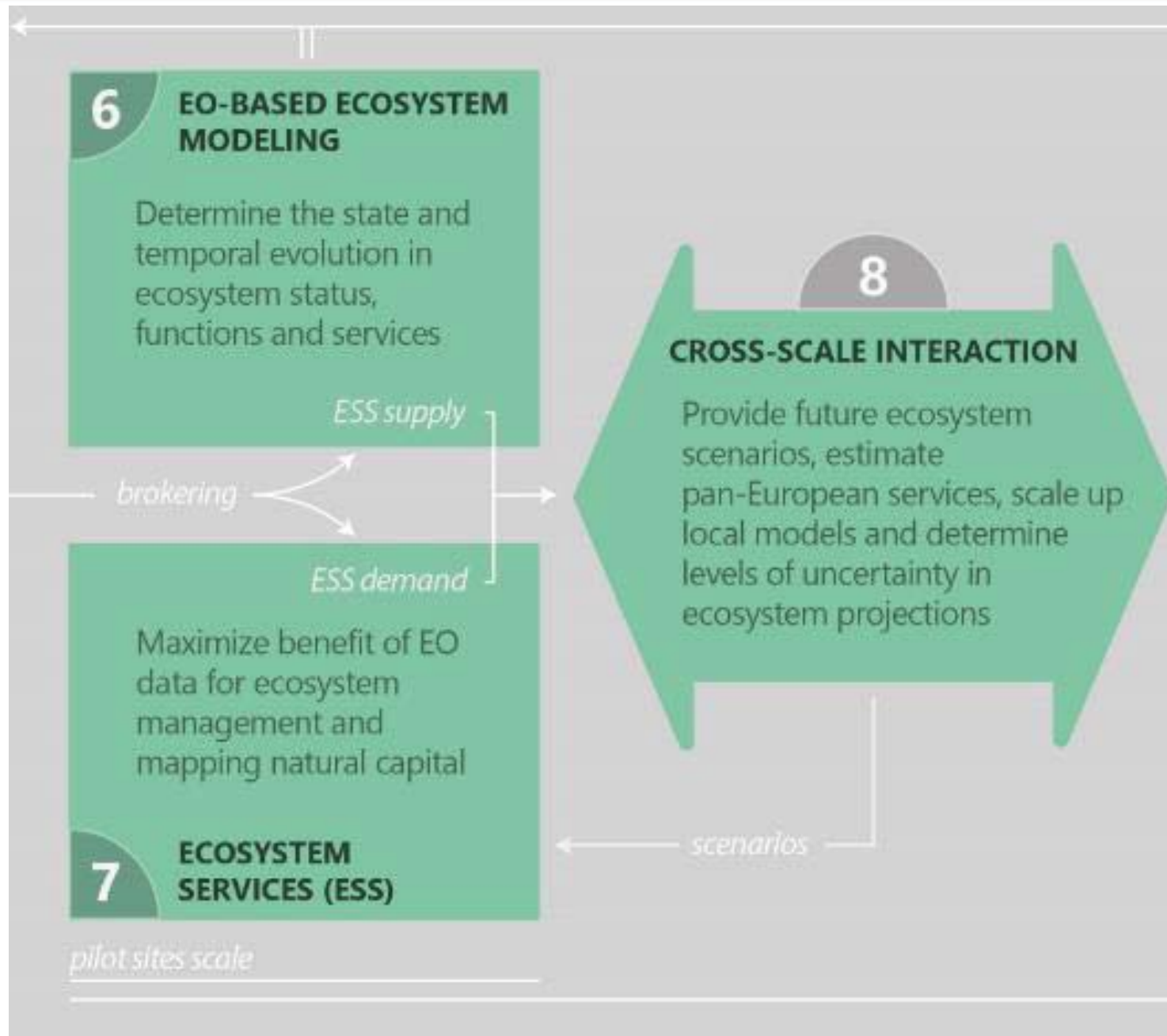
REQUIREMENTS OF FUTURE PROTECTED AREAS 9

Determine what information indicates the quality status of protected areas and can support the definition of future Protected Areas

pan-European scale

ECOPOTENTAL VIRTUAL LABORATORY PLATFORM 10

Make all information and knowledge available to scientists, policy makers, citizens and other concerned stakeholders , in collaboration with GEO/GEOSS

EO SUPPORTED POLICY DEVELOPMENT & INTEGRATION **11**

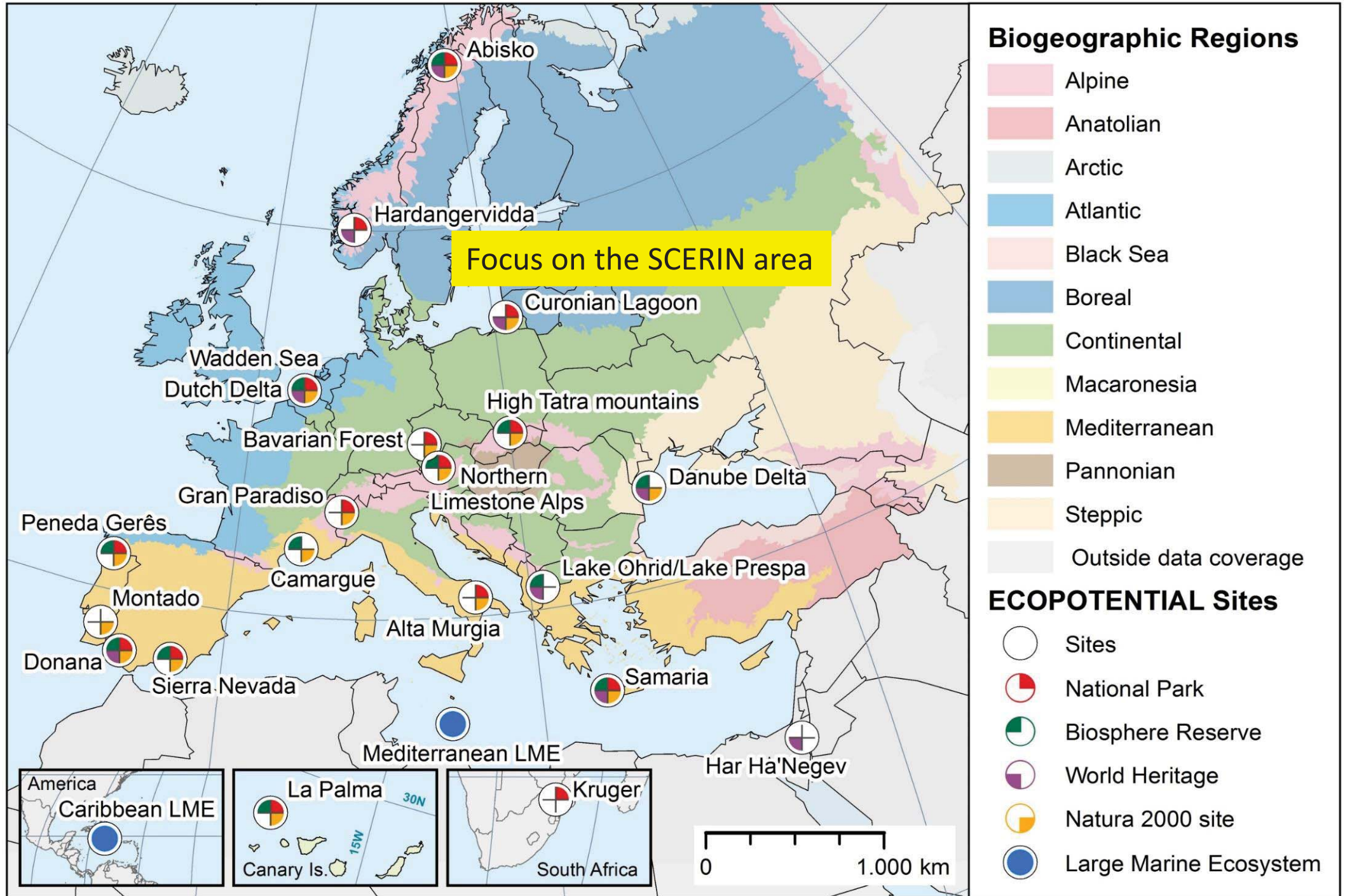Strengthen the use of EO data and tools for improved decision making

CAPACITY BUILDING & KNOWLEDGE EXCHANGE **12**

Enable and enhance participation of all players in environmental decision making

Disseminate results developed during the project, and contribute to the research requirements for the Copernicus operational services

Protected Areas in the SCERIN area

Focus on the SCERIN area

Biogeographic Regions

- Alpine
- Anatolian
- Arctic
- Atlantic
- Black Sea
- Boreal
- Continental
- Macaronesia
- Mediterranean
- Pannonian
- Steppic
- Outside data coverage

ECOPOTENTIAL Sites

- Sites
- National Park
- Biosphere Reserve
- World Heritage
- Natura 2000 site
- Large Marine Ecosystem

Site labels: Abisko, Hardangervidda, Curonian Lagoon, Wadden Sea, Dutch Delta, Bavarian Forest, High Tatra mountains, Northern Limestone Alps, Danube Delta, Gran Paradiso, Peneda Gerês, Camargue, Montado, Lake Ohrid/Lake Prespa, Alta Murgia, Donana, Sierra Nevada, Samaria, Mediterranean LME, Har Hà'Negev, America Caribbean LME, La Palma, Canary Is., Kruger, South Africa

0   1.000 km

Ecosystems & Sites

Mountain ecosystems at 9 European countries:

Coastal ecosystems at 5 European countries:

Sierra Nevada	North Limestone	Lake Ohrid/Prespa	Danube Delta	Dutch Delta	Curonian Lagoon
Bavarian Forest	Abisko	Peneda-Gerês	Donana	Camargue	
Gran Paradiso	High Tatra	Hardangervidda		Mediterranean Sea	Caribbean Sea
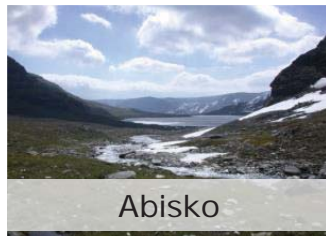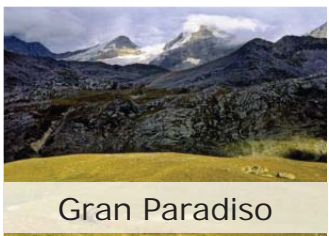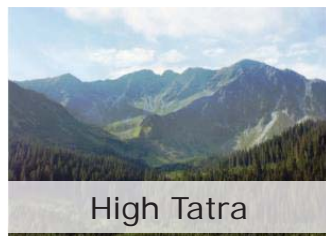
Marine ecosystems at the Mediterranean & the Caribbean seas:

Arid/Semi-Arid ecosystems around the Mediterranean & South Africa:

Har HaNegev	Samaria	Kruger	Alta Murgia	Montado
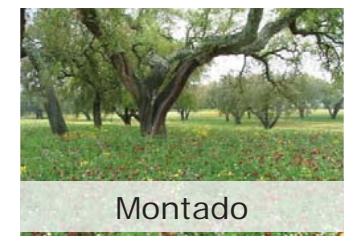
Provisioning: fish captures, water (for drinking), reed harvesting as fodder, row materials (reed, wood, sand), honey, hunting (as wild food), forestry (especially willow and poplar), agriculture (mainly eco and bio certified production)

Regulation and maintenance: mechanical filtration done by plants, filtration done by mussels, biogeochemical cycles occurring in aquatic ecosystems, dilution in lakes, rivers, sea and sediments, transport and storage of sediment by Danube river and delta's lakes and wetlands, pollination by insects; seed dispersal by insects, birds and other animals, important reproduction area for fish and bird populations, gas emissions as result of decomposition processes, carbon sequestration.

Cultural services: leisure and ecotourism, spiritual value (different religious beliefs), human ethno-cultural diversity, bird watching, boating, sport fishing/hunting, research and monitoring activities.

Contact and credit:

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The impact of aquatic ecosystems provisioning services on tourism

Example gaps and research questions:
- What is the impact of multiple drivers (land use, climate change, suspended solids, pollution, and eutrophication) on ecosystem services?

- Valuation and mapping of ecosystem services on the basis of transdisciplinary research and stakeholder involvement.

- How the climate change would influence the dynamics of water level, wetland extent and biological diversity in the Danube Delta?

- What are the effects of floodplain ecosystem restoration on the Danube Delta ecosystem services?

Similar cases at the SCERIN area ?
Possible support provision by the ECOPOTENTIAL

Nationally designated areas
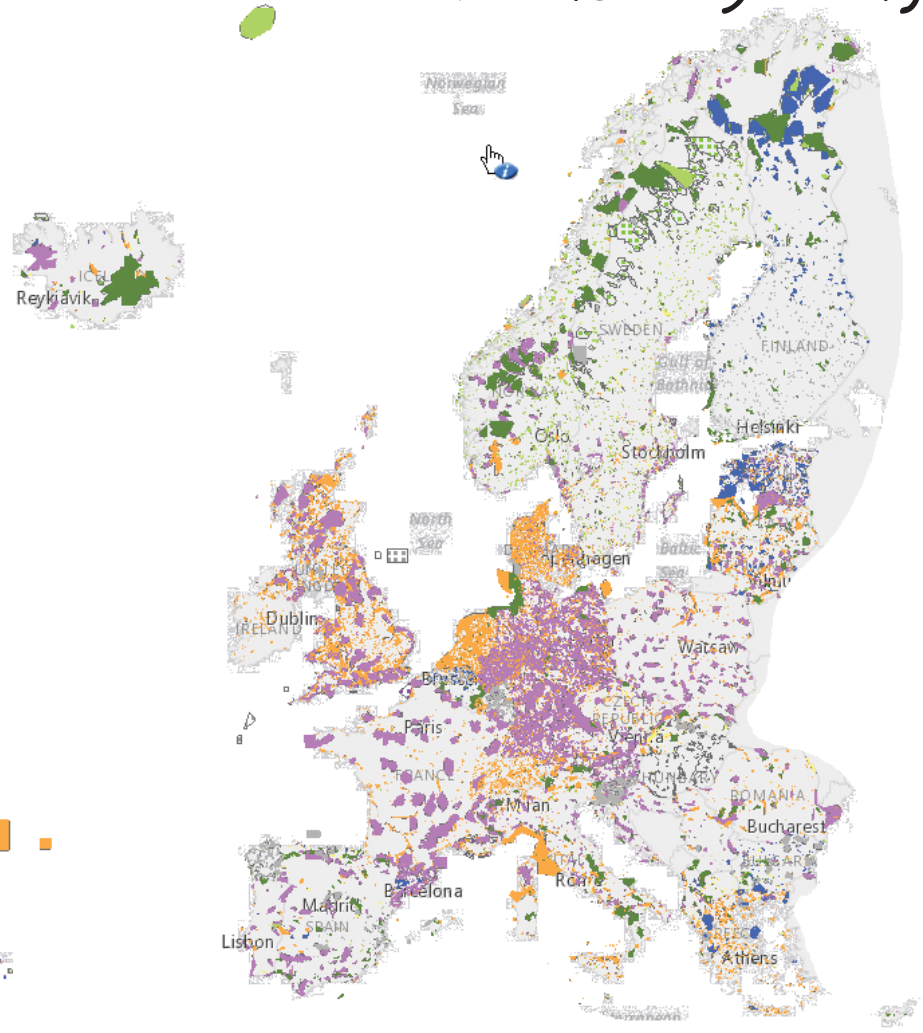
CDDA – IUCN categories:

- Strict Nature Reserve (I)
- National Park (II)
- Natural Monuments (III)
- Habitat/ Species Managements Area (IV)
- Other
- Protected Landscape/ Seasca[e(V)
- Managed Resource Protected Areas (VI)

Credit: European Environmental Agency (EEA)

Natura 2000 Network Viewer

EO LC products for ecosystem monitoring
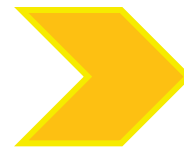
International acknowledgement of the role of LC products for ecosystem monitoring

Aichi Targets: following the Strategic Plan for Biodiversity by the United Nations (UN), Convention on Biological Diversity (CBD)

Strategic Goals

CBD headline indicators

	Strategic Goals	CBD headline indicators
A	4. Sustainability	(4) Pressure practices, (5) Pressures various
B	5. Habitat loss	(1) Extent, (4) Pressures practices, (5) Pressures Various
B	7. Agriculture, forest and aquaculture	(4) Pressures practices
B	8. Pollution	(5) Pressures various
B	9. Alien species	(2) Species, (5) Pressures various
C	11. Protected areas	(11) Protected areas
C	12. Threatened species	(2) Species
C	13. Genetic diversity	
D	14. Ecosystem services	(6) Services, (11) Protected areas
D	15. Climate change resilience	(6) Services, (11) Protected areas
E	17. National BD Strategies & Action Plans	
E	18. Indigenous knowledge	
E	19. Knowledge Sharing	

Land Cover products contribute to 13 out of 20 targets, as acknowledged by

Z. Petrou, *I. Manakos*, T. Stathaki, "*Remote sensing for biodiversity monitoring: A review of methods for biodiversity indicator extraction and assessment of progress towards international targets*", 2015, Biodiversity and Conservation, 24(10), 2333-2363.

- Terrestrial mapping

- Ecosystem degradation and deforestation

- Ecosystem fragmentation and connectivity

- Agriculture and Forestry monitoring

- Species (plant, animal) distribution estimation

- Detection of pressures from climate change and pollution

- Food, raw material, and water provisioning services

- Assessment of carbon stocks

- Estimation of biotic stresses

European Nature Information System (EUNIS)

EUNIS is a comprehensive pan-European system to facilitate the harmonized description and collection of data across Europe through the use of criteria for habitat identification. It is hierarchical and covers all types of habitat types from natural to artificial, from terrestrial to freshwater and marine.

Mapping and Assessment of Ecosystems and their Services (MAES)

MAES aims to demonstrate the effectiveness of mapping and assessment of ecosystems and their services in planning and land management. Ecosystems are mapped by interpreting available land cover (LC) data on the basis of the European habitat classification (EUNIS).

Links to **General Habitat Categories** and **Annex I** ones are established within EU projects

Links to **LCCS of FAO**, as well:

V. Kosmidou, Z. Petrou, R.G.H. Bunce, C.A. Mucher, R.H.G. Jongman, M.M. Bogers, R.M. Lucas, V. Tomaselli, P. Blonda, E. Padoa-Schioppa, I. Manakos, M. Petrou, "Harmonization of the Land Cover Classification System (LCCS) with the General Habitat Categories (GHC) classification system", 2014, Ecol. Indic. 36, 290–300.
M. Adamo, C. Tarantino, V. Tomaselli, V. Kosmidou, Z. Petrou, I. Manakos, R.M. Lucas, C.A. Mucher, G. Veronico, C. Marangi, V. De Pasquale, P. Blonda, "Expert knowledge for translating land cover/use maps to General Habitat Categories (GHC)", 2014, Landscape Ecol., 29(6), 1045-1067.
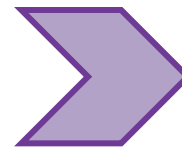
Towards integrated service platforms
(examples from on going research activities)

Earth Observation Data for Habitat Monitoring - EODHaM

1ˢᵗ-stage preliminary *spectral* classification

2ⁿᵈ-stage *context-sensitive* classification

3ʳᵈ-stage GHC classification and Annex 1 Habitat map production

Preliminary classification maps

Spectral indices

In-situ data including environmental attributes/qualifiers

In-situ data including environmental attributes/qualifiers

LC maps

LCC maps

Biodiversity indicators

GHC maps

GHCC maps

Annex 1 Habitat maps

RS data

Uncertainty information

LC/LU class specific description by semantic nets

GHC class specific description by semantic nets

Landscape Pattern Analysis

R. Lucas, P. Blonda, P. Bunting, G. Jones, J. Inglada, M. Arias, V. Kosmidou, Z. Petrou, I. Manakos, M. Adamo, R. Charnock, C. Tarantino, C. A. Mücher, R. Jongman, H. Kramer, D. Arvor, J. P. Honrado, P. Mairota, "The Earth Observation Data for Habitat Monitoring (EODHAM) System", 2015, International Journal of Applied Earth Observation and Geoinformation 37, 17–28.

- ➢ The Food and Agriculture Organization Land Cover Classification System (FAO_LCCS) is adopted as the classification scheme

- ➢ An object oriented approach is adopted within e-Cognition and then translated to open source code along with image pre-processing, segmentation and feature extraction software

- ➢ The system adopts deductive learning schemes (i.e., it based on expert knowledge elicitation to fill the gap between domains)

- ➢ Ontologies and semantic networks are used:
  - ➢ *Domain ontologies* for Land Cover and Land Use (LC/LU) and Habitat class description and LC/LU to Habitats translation;
  - ➢ *Task ontologies* for data processing tools description;
  - ➢ *Unified Modeling Language* UML language used

- ➢ Uncertainty handling through the Dempster-Shafer theory principles

Earth Observation Data for Ecosystem Monitoring

Previous EODHaM system
- Segmentation and attribution
- Rule-based classification using indices and image bands
- Translation to GHCs and Annex 1

Updated EODHaM system*
① Refinement of existing rule-based approaches
② Integration of existing land cover/habitat maps
③ Incorporation of external classifications (e.g., random forests, K means)
④ Introduction of sub-pixel proportions
⑤ Change detection (LCCS L3/L4 and indices)
⑥ Categorisation of processes of change (e.g., deforestation, agricultural expansion, woody shrub decline)
⑦ Inclusion of a scoring system that relates change events to impacts on ecosystem services.
⑧ Application of an accuracy assessment procedure (TBD).

*Credit: Richard Lucas and Anthea Mitchell
University of New South Wales, Sydney, Australia

ECOPOTENTIAL's Virtual Laboratory Platform*

Enable the discovery, access, and use of

- open (EO and in-situ monitoring) data, metadata, scientific models and results, semantic engines, and analytics' provision;
- ecosystem models and upscaling methods;
- the necessary knowledge to analyse ecosystems services;
- climate and land-use change scenarios, and definition of the requirements for future protected areas;
- specific applications and portals for different users (e.g. experts, activists, decisions makers), enabling multidisciplinary applications.

All services are empowered by a set of transparent brokering services provided by the platform, as defined in the GEO/GEOSS framework and compliant with the GEOSS Common Infrastructure (GCI) and the GEO Portal (http:// www.geoportal.org/).

*Credit: Stefano Nativi, CNR

Towards integrated networking platforms

First joint Workshop of the EARSeL Special Interest Group on Land Use & Land Cover and the

Berlin, March 2014

http://www.earsel.org/SIG/LULC/index.php

Timely and thematically coupled with ESA's Living Planet Symposium

Advancing horizons for land cover services entering the big data era

Second joint Workshop of the EARSeL Special Interest Group on Land Use & Land Cover and the NASA LCLUC Program

The Workshop is organized around four representative sessions, covering the latest advances; trending activities and future challenges in land-cover services in the big data era. The four sessions are:

1. Harmonization of Sentinel-2 and Landsat products
2. Mapping Land Cover and Land Use with cross-scale and cross-sensors approaches
3. Challenges of Land Cover and Land Use Monitoring with Dense Time Series of EO Data
4. EO benefits for ecosystem services and human wellbeing

Free open access publication following the normal review procedure at Special Issues of the **European Journal of Remote Sensing or the EARSeL ePreoceedings Journal**

ECOPOTENTIAL: the biggest science platform on the topic for collaboration in Europe today

47 prestigious partners across Europe and beyond, across disciplines,
work together for the next 3 years on
'Improving Future Ecosystem Benefits through Earth Observation'

**Meet us / Join us @
http://ecopotential-project.eu/**

Curonian Lagoon

High Tatra mountains

Northern
Limestone Alps

Danube Delta

Lake Ohrid/Lake Prespa

Samaria

With my thanks and appreciation to **Garik, Petya, Jana and GOFC-GOLD, START, and ECOPOTENTIAL** for providing us this opportunity

At your disposal for questions/ clarifications

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