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D1.6 Recommendations for the activities of GEO/GEOSS and GEOGNOME

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Abstract	A few recommendations for the improvement of the effectiveness of the GEO activities have been developed and are described in this document, focussing especially on intellectual property rights and the open-access science model, on the capacity building on the use of EO, on the use of concept of ecosystem services and on the establishment of Essential Variables, and on the dialogue among scientists, users and policy makers on the definition of indicators and conservation policies. The document also briefly resumes the participation of ECOPOTENTIAL to the activities of GEO.
Keywords	Recommendations, Open Science, GEO/GEOSS

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1. Executive summary

The ECOPOTENTIAL project as a whole has a strong link with GEO and GEOSS activities. Its work plan includes several actions directly or indirectly contributing to the development of GEO and GEOSS. Moreover, the GEO 2017-2019 Work Programme cites ECOPOTENTIAL as a major contributor to the GEO Global Ecosystem Initiative (GEO ECO). ECOPOTENTIAL contributes also to the GEO Initiatives GEO GNOME and EUROGEOSS. Possible contributions to the new Land Degradation Neutrality Initiative have been discussed in the general meeting of the Initiative that took place in Kyoto on the second of November.

Many of the project's work packages contribute to reach GEO's aims and in particular WP1 (Coordination and Management), WP4 (Earth Observation Data Generation and Harmonization), WP5 (In Situ Monitoring Data) and WP10 (ECOPOTENTIAL Virtual Laboratory Platform).

In particular, the ECOPOTENTIAL Work Package 10 on "ECOPOTENTIAL Virtual Laboratory Platform" is specifically dedicated to the design, implementation and operation of the ECOPOTENTIAL VLAB, a virtual environment directly contributing to the GEOSS Common Infrastructure (GCI) and GEO EVOLVE tasks by making ECOPOTENTIAL data, products and workflows freely available in GEOSS, and supporting the activities of GEO ECO (providing one of the main results for the "Ecosystem models and e-laboratories" activity) and of the ecosystem Community of Practice.

The activities developed in WP 10, aiming to implement the Virtual Laboratory, are described in the deliverable D10.4, and have been presented at the last two GEO Plenary meetings in Washington (2017) and Kyoto (2018).

ECOPOTENTIAL partners have directly taken part to the last three GEO General meetings in St. Petersburg (2016), Washington DC (2017) and Kyoto (2018) either with projects' side events or taking part to other side events as invited speakers; the project has presented its contributions in the EU and Italian GEO statements.

From this participation, a few recommendations for the improvement of the effectiveness of the GEO activities have been developed and are described in this document, focussing especially on intellectual property rights, on the exploitation of open data by big companies, on the open-access science model, on the capacity building on the use of EO, on the use of concept of ecosystem services and on the establishment of Essential Variables and on the dialogue among scientists, users and policy makers on the definition of indicators and conservation policies.

2. Introduction

The ECOPOTENTIAL project focuses its activities and pilot actions on a targeted set of internationally recognised protected areas (PAs) in Europe, European Territories and beyond, including mountain, arid and semi-arid, and coastal and marine ecosystems.

PAs such as those considered in ECOPOTENTIAL provide essential ecosystem services but are exposed to a variety of pressures, which can change their very nature. ECOPOTENTIAL sites represent UNESCO World Natural Heritage Sites, Biosphere Reserves, National Parks and important Natura 2000 sites. Additionally, two Large Marine Ecosystems (LME) in the Mediterranean and the Caribbean are included. Many of the study sites exhibit a variety of protection categories. Besides the broad cover of the legal status of outstanding PAs, many of the selected sites are directly linked to Long Term Ecological Research (LTER) sites (http://www.lter-europe.net/).

A strategical asset of the project is the tight relationship between the research community and the managers and the technical staff of the protected areas and one of the main results of the project is a comprehensive picture of the state of the art regarding the role that EO data play in the daily management in a selection of PAs inside and outside Europe.

It has been evidenced that, while at national scale and beyond the interaction between decision-makers and the scientific community is facilitated by existing infrastructures, funding schemes, consultancy organizations, at a more local scale the extent at which the decision are informed by up-to-date knowledge is very diverse throughout Europe and sometimes even in the same country. This fact has a clear impact on the use of EO data, products and tools in planning actions for nature conservation.

Although there is a common trend to favour global studies that perform assessments about ecosystems and ecosystem services at coarse resolution and large time and spatial scales, in order to design policies which are capable to embed entire countries or continents, the daily business of protected areas is to face challenges at small temporal and spatial scale, demanding for fine-tuned solutions to very specific problems.

Nevertheless, according to the *2016 Protected Planet* report by IUCN, terrestrial PAs cover about 15% of the Earth's land and 10% of territorial waters. The report highlights two critical aspects of a by the way encouraging tendency of enlarging the number and size of PAs: 1) crucial biodiversity areas are being left out, with the underrepresentation of some key species and habitats and 2) inadequate management is limiting the effectiveness of protected areas.

As for the second aspects, much can be done by fostering a major and better use of the knowledge and the tools generated by the EO scientific community. The experience done in ECOPOTENTIAL, as well as in other EU projects focusing on protected areas, suggests that a regular communication and a continued collaboration among scientists and PA managers ensures an improvement of the quality and effectiveness of nature conservation actions, as evidenced by the co-design of the ECOPOTENTIAL Storylines which address concrete challenges blending remote sensing, in-situ data, modelling activities and practical conservation concerns.

Aim of this deliverable is to use the experience gained in ECOPOTENTIAL to provide advice to GEO, addressing in particular the following areas of actions of GEO:

- Data collection, sharing and use;
- Defining user-driven data needs, and in particular discovering data gaps and defining priority areas where data are needed;
- Matching data providers and users;
- Granting sustainability of data storage and long-term availability of time series of data.

The last point (long-term sustainability) is a delicate issue as (1) GEO has no specific resources for this, and (2) projects such as ECOPOTENTIAL have a finite life span and cannot guarantee long-term sustainability. Funded projects (as ECOPOTENTIAL) bound to contribute and to provide data to GEO are able to give an effective

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contribution to GEO' s mission. On the other side, the limited time and space span, and the limited coordination with parallel or forthcoming projects in terms of standards in data collection, are at risk of making the data provided scarcely useful for long time and geographically wide studies.

Given the situation, the question to solve is how to move from case studies providing data limited in time and space to data for broader use.

Specific issues are:

- Only big and long-term funded projects (e.g. Copernicus) can provide reliably updated, long lasting data.
- On the other side, to make such data useful, the design of their collection needs to be user-driven.
- The building of permanent bodies that represent groups of users (such as Communities of Practice) is a fundamental step to guarantee that users are involved in the design of the data collection and storage.

Regarding how to enlarge the use of data provided through GEO, another important aspect is the capacity of GEO to reach data users. GEO should actively promote its actions, outreach towards final users and enforce their capacities as data users. Actions aimed to foster the use and the share of open data should be directed towards:

- Universities and students (summer schools, grants)
- Local administrations
- Research centres
- Environmental agencies

In the following, we list the contributions of ECOPOTENTIAL to GEO and elaborate further on the points raised above, providing specific recommendations to GEO. The contributions of ECOPOTENTIAL to the GEO activities are summarized in Appendices 1 and 2.

3. ECOPOTENTIAL recommendations to GEO

The ECOPOTENTIAL project activities, and the knowledge gained in the interaction with users (mainly technical and management staff from protected areas and policy makers) lead us to formulating a set of general recommendations for addressing the following issues:

1. The notion of **open data and open information**, widely discussed in GEO, supported by EU and NSF, is still only partially implemented in everyday research activities. In particular, older data from individual research groups, especially for what concerns in-situ data, are still difficult to obtain and sometimes even to identify.
   ***Recommendation*:** GEO should not stop raising awareness on the benefits of open data. Only a community-driven awareness can help completing the transition to an open data vision and scientific inquiry. Researchers involved in GEO should actively promote the notion of open data in their institutions and networks. We should not think that the problem has been solved.

2. **Intellectual Property Rights** (IPR). Despite the growing importance of organizations and projects working in the field of open data (e.g. Creative Commons, OpenAire) and the EU policy on open data pilots for funded projects, the lack of information about how IPR of open data work is still an impediment to the adherence of the scientific community to the open data policy. Moreover, access to open data is still difficult because of the difficulties to implement the FAIR principles. There is the need to raise awareness on the use and benefits of open and shared data in the scientific community, as well as to raise awareness on the way to protect intellectual property of shared and open data (guidelines).
   ***Recommendation*:** GEO could form a working group of experts in IPR in order to discuss and disseminate guidelines on a) protection of IPR of open data; b) the issue of possible digital divide on the use of open data; c) open access publications: roadmap to address the issue of the "open access business" (publishers who make a business model out of open access publishing – the issue of Impact Factor), and the issue of the now predominant "paywall business" model (Scientific communities who have to pay the publishers to access the knowledge that they generate). GEO could link with other initiatives aimed to enforce the awareness of open science and open data (such as OpenAire or the new PlanS (https://www.coalition-s.org/) and foster a debate within the scientific community on the existing open access / open data models, in order to state the point of view of the community of producers and users of open data and open science).

3. A possible drawback of open data is that **big-data companies could exploit open data** produced by publicly funded research activities for making profits by using their monopolistic position and their powerful means in terms of investments on data infrastructures, and even enforcing them by the exploitation of open data, without contributing to the community that cares for data collection and management. While there is a will of the EU to help the establishment of high-tech industry in the field of remote sensing (and digital data in general), there is now a concern on the fact that big data companies may be exploiting the collection of open data for making big profits and enforce their monopoly – see the business model of Amazon which is now selling services for the provision of Copernicus Sentinel data. This also highlights the question of appropriate access and support for SMEs. There is a danger that if GEO is to attract funding from major industrial players as has been mooted, then this will become a case of "he who pays the piper calls the tune". This could have a very detrimental impact on the private sector capabilities and risks undermining the impact of public investments.

   Recommendation: GEO can promote a working group of experts (also involving other institutions, also MEPs) on this issue and write a white book addressed to policy makers (e.g. the EU parliament and the EU commission). GEO could also set its own fairness rules on the use of data shared through the GEOSS portal. Suggestions can come from the report to the EU commission of 2013 about the need that the EU should avoid the monopoly of data: "Assessment of the achievement of GEO…A European Perspective" – page 56: "*However, there are concerns that certain conditions may do no more than re-enforce very large, internet companies. It is already the case that, even in Europe, the public Copernicus Programme is making the data and information available to the public sector without measures in place that would to make this available to*

industry; one solution being discussed is to use Google as a global data distributer. Whilst this may be an easy and effective solution, in the longer term there are concerns to avoid dependence on a monopoly supplier. European policy makers and industry together need to take steps to avoid this imbalance in the market. GEO may provide a lever to help achieve this."

4. Sharing and communication # 1 (structured language). One of the main obstacles encountered in the dialogue between the scientific community and PA staff is the **confusing terminology generated by a variety of existing frameworks** such as the DPSIR framework, the frameworks based on strengths, weaknesses, opportunities and threats (SWOT) analysis, the WCPA/IUCN framework for assessment and monitoring of PAs and so on. Same problem occurs internally to the scientific community regarding the use of different taxonomies for habitats, ecosystem, ecosystem services and so on. The existence of different mapping standards, or pressure assessment frameworks makes it difficult to compare different studies, to perform joint experiments across different regions, to establish a clear and unambiguous communication channel with the stakeholders. Although it might be unfeasible to reduce such a complexity by adopting a unique standard, an attempt has to be made to build tools that lead back to a common language the galaxy of frameworks on driver-impact-threats.

   ***Recommendation*:** GEO could offer tools to make experiments repeatable and results comparable and to assist in the disambiguation of the knowledge communication.

5. Sharing and communication # 2 (metadata). ECOPOTENTIAL produced a significant number of dataset collected/processed/generated from both in-situ and remote sensing observations. An intense capacity building activity has been planned to support a proper description and documentation of the data and their quality through well-defined metadata. **The lack or the incompleteness of metadata is the most common factor that makes the data difficult to share and to re-use**. Storing or linking petabytes of data of limited re-usability is a real danger of any data infrastructure. Although this specific issue has been already pointed out several times in the past, still much has to be done. Some specific and fine-tuned recommendations come from the Deliverable *D5.6 Harmonized delivery of the data* which suggests the adoption of standards, conventions for naming, formats and structures of the datasets according to the FAIR principles which provide principles to ensure the findability (F), accessibility (A), interoperability (I) and re-usability (R) of data.

   ***Recommendation*:** capacity building actions for improving the findability and usability of data are of greatest importance to ensure the long-term sustainability of GEOSS. Those actions have to be planned not only for the stakeholders but also for the scientific community to raise the awareness of the importance of complementing the data with an appropriate and standardized description.

6. In ECOPOTENTIAL, we have witnessed a large demand, by part of users such as the technical and management staff of protected areas, of **capacity building in the use of Remote Sensing products**, data analysis tools and models, etc. In ECOPOTENTIAL, we organized training courses and material which was widely distributed. An ecosystem Community of Practice has been started.

   ***Recommendation*:** GEO can advocate the need for advancing capacities in EO data handling in universities, in public administrations, among practitioners, etc. and ask for financed projects aimed to enhance such capacities in the users' communities. **In particular, GEO could** enhance capacity building on the use of Remote Sensing products, by organizing training sessions, webinars, on-site courses, and the development of an attitude towards data analysis and modelling. Close contacts with EU Research Infrastructures such as LifeWatch ERIC can help along these lines.

7. **In-situ data collection and sharing of the measured parameters is highly inhomogeneous** across protected areas and European ecosystems. Sometimes, local research groups and parks have problems even in maintaining the collection of long time series of environmental (biotic and abiotic) data and the elaboration of

indicators. In addition, many research sites do not have standard ways to store and make available the in-situ data and metadata and are not aware of the best practices on how to implement the FAIR principles . It is crucial to identify ways to support the continuation of such efforts.

Recommendation: GEO could encourage and support work on:

- Capacity building on the application of the FAIR principles to in-situ data collections.
- Leveraging the role of the research infrastructures aimed to collect and share data, as ILTER and CZEN and, in Europe, eLTER and LifeWatch ERIC.
- Leveraging the role of other long-term organizations as environmental agencies and institutions aimed to manage protected areas as bodies able to collect, preserve and share long and complete time series of data – involve them in the GEO process.
- A specific help in this sense can come from European infrastructures and networks such as eLTER, currently on the ESFRI roadmap.

8. Most data are collected and analyzed in the framework of specific projects, which have a finite (and often relatively short) lifetime. In such conditions, once the funding is finished, there is no guarantee for a **long-term sustainability of the data sets**, of the information, and of the archives and web sites.

Recommendation: GEO could actively engage in ensuring the long-term sustainability of data sets, analysis methods, models, information and knowledge, through the support to global networks (such as ILTER and CZEN), the links with continental-scale initiatives such as LifeWatch ERIC, eLTER, CZO, and others, and the active inclusion of "endangered data sets" in the GEOSS portals.

9. The concept of **Ecosystem Services** is very useful for communicating the benefits that ecosystems offer to the society. Along these lines, ecosystem services have been used as a keyword for the dialogue between scientists, conservationists and policy makers. In some cases, the need for optimizing ecosystem services has also guided conservation and management measures. However, if taken purely for their economic value, ecosystem services can also become detrimental to the conservation of natural ecosystems. In particular, direct contact with protected area staff has revealed a limited use of ecosystem service notions in practical management decisions, and even a certain level of suspicion of the potentially negative impact that these concepts could have on nature conservation.

Recommendation: GEO could stimulate an open discussion between scientists, policy makers, users, economic actors and technical staff working at local site scale on the benefits and dangers of the ecosystem service concept, on the monetization of natural capital, and on the possibility of using ecosystem service approaches in day-by-day management and conservation of the ecosystems and environments of protected areas.

10. **Essential Variables** have become a common terminology as well as a powerful approach to the standardization of observations. They are also an essential tool for defining indicators in the dialogue with conservation managers and policy makers at continental level, to define priorities in allocating monitoring resources as well as to collect comparable data facilitating monitoring and research at larger scale than the single PA. However, the number of the variables considered to be "essential" is constantly growing, owing to the complexity of the natural systems and the processes operating in the environment. In addition, Essential Variables are often defined in scientific circles, sometimes without direct contact with the final users (for example, the staff of protected areas working on very specific conservation issues). As such, there may be a *hiatus* between the global or continental-scale needs for standardization and performance indicators, and the practical management and conservation needs at the local site scale. Direct contact with field personnel has often revealed the difficulty of including also measurements of Essential Variables on top of the many duties already faced by the staff working in protected areas.

Recommendation: GEO could stimulate a broad discussion on the role and definition of Essential Variables, with specific reference to Essential Variables for Ecosystems, with the aim of obtaining useful, practical, simplified and shared indications, avoiding individual communities to take their own path without contact with each other or with the final users.

11. The **dialogue between scientists and technical and management staff working at site scale** is not always simple. In ECOPOTENTIAL, we have analysed the perception of the main threats to ecosystems and relevance of ecosystem services among researchers and protected areas staff, finding a very different outcome from the two communities. Only the close collaboration between the two communities during the second part of ECOPOTENTIAL has led to some convergence of the views. Interestingly, it was the scientists that changed most of their positions, suggesting that some of the scientists may have had a previously limited experience on the practical issues faced by protected areas. (see: *Deliverable No: D9.1* "*Essential Environmental and Socio-Economic Variables for future and current Protected Areas*")

Recommendation: GEO could encourage involvement of final users in the definition of the relevant research themes, supporting the co-design of strategies and methodologies through direct contact and discussions. Along these lines, it is important to avoid both the predominance of the scientific community views over the concrete user needs (users seen as passive customers), as well as the "a-la-carte" and acritical response of scientists to the challenges expressed by users who often do not have full knowledge of the potentialities and limitations of current scientific knowledge.

1. At the policy level, it emerges from ECOPOTENTIAL studies (e.g. Deliverable 9.3 *"Overview of potential impacts of drivers of changes on the PAs"*) that the **involvement of the scientific and management community in decision-making processes concerning nature conservation is not structural at PAs scale**. This may affect the use and the willingness to use EO data and products to support the management actions.

Recommendation**:** One of the crucial GEO's aims is to provide data for informing knowledge-based policy actions, e.g. providing data for the indicators – and sub indicators – for SDGs. The information on the status and changes of ecosystems as a consequence of global changes is of particular relevance for protected areas. GEO could thus foster the science-policy dialogue, favouring the involvement of local actors and users such as, in the case of ECOPOTENTIAL, the staff and managers of protected areas and the conservation groups. Sometimes, continental-scale policies are designed by scientists that can have limited contact with the everyday needs of conservation and management. It would be beneficial to promote a regulation framework with an active engagement of the scientific community in all decision-making bodies dealing with nature conservation, at PA scale, even if only acting as guidelines or voluntary schemes. GEO, through GEO ECO, could leverage the communication between the scientific community and the policy makers on protected areas at the highest level e.g. through dedicated working sessions at the GEO meetings (EUROGEOSS or other thematic meetings).

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5. Appendix 1: Participation of ECOPOTENTIAL in GEO Boards, Tasks and Meetings

WHAT IS THE GROUP ON EARTH OBSERVATION?

GEO is a partnership of 104 Member governments and the European Commission; and 127 Participating Organizations comprised of international bodies with a mandate in and/or use of Earth observations.

GEO convenes expertise from across different disciplines to coordinate their activities and promote broad and open data polices. The GEO Workplan 2017-2025 brings together experts to ensure global collaboration, identify gaps and reduce duplication in the areas of Biodiversity and Ecosystem Sustainability; Disaster Resilience; Energy and Mineral Resources Management; Food Security; Infrastructure & Transportation Management; Public Health Surveillance; Sustainable Urban Development; and Water Resources Management.

Together, the GEO community is creating a Global Earth Observation System of Systems (GEOSS) to better integrate observing systems and share data by connecting existing infrastructures using common standards. There are more than 400 million data resources in GEOSS that span all GEO's thematic areas.

GEO's mission is implemented through the *GEO 2016-2025 Strategic Plan: implementing GEOSS*, by the GEO Workprogramme 2017-2019. The Work Programme consists of GEO Community Activities, GEO Initiatives, GEO Flagships and GEO Foundational tasks, collectively known as the GEO Implementation Mechanisms.

The GEO Plenary is the main body of designated representatives of the Members and Participating Organizations of the Group on Earth Observations (GEO), with Members holding decision-making authority. It is the GEO's primary decision-making body.

The GEO Plenary establishes Working Groups to address aspects of GEOSS implementation and provide a mechanism for members of the GEO community to engage full in the work of GEO. Working groups provide high-level review, advice, recommendations and support in the ongoing development and implementation of the *GEO 2016-2025 Strategic Plan: implementing GEOSS.* Working groups also actively promote the implementation of GEOSS activities described in the annual Work Plan.

All the information regarding GEO's mission and governance can be found at http://earthobservations.org and in particular in this webpage: http://earthobservations.org/geoss_wp.php that provides access to the Strategic Plan, the Workprogramme and the implementation bodies webpages.

PARTICIPATION OF ECOPOTENTIAL IN GEO TASKS AND BOARDS

The contribution to GEO and GEOSS is one of the main objectives of the H2020 ECOPOTENTIAL (Improving Future Ecosystem Benefits through Earth Observations) project.

The contribution of ECOPOTENTIAL research to GEO and GEOSS objectives is implemented through the activities of several projects' workpackages, and in particular:

- WP1: Creation of a Community of Practice and contribution to the GEO ECO and GEO GNOME Initiatives, as well as to the regional EUROGEOSS Initiative;
- WP4 and WP5: provision of open Remote Sensing and In Situ data and metadata to be made available through GEOSS;
- WP10: Creation of the Virtual Laboratory platform fully interoperable with the GEOSS Common Infrastructure and contribution to the related tasks.

Members of ECOPOTENTIAL are taking active parts in GEO activities as members of GEO Boards and GEO Tasks working groups.

- Antonello Provenzale from CNR-IGG, coordinator of ECOPOTENTIAL, is:
  - Leader of the GEO Global Ecosystem Initiative (GEO ECO) Initiative;
- Stefano Nativi from CNR-IIA, leader of ECOPOTENTIAL WP10, is:
  - Alternate member of the GEO Programme Board representing Italy
  - Co-leader of the Knowledge Base tool development activity in the User Needs and Gap Analysis Foundational Task
  - Contributor of the GEOSS Common Infrastructure (GCI) Operations Foundational Task, leading the GEO Discovery Access Broker (DAB) activity;
  - Contributor of the GEOSS-EVOLVE Foundational Task, co-leading the GEOSS Architecture and Evolution activity
- Joan Masó from CREAF (WP4 leader and WP10), is:
  - Alternate member of the GEO Programme Board representing Spain
  - Contributor of the GEOSS In-Situ Earth Observation Resources Foundational Task representing ENEON
- Ivette Serral from CREAF (WP4) is:
  - Contributor of the GEOSS In-Situ Earth Observation Resources Foundational Task representing ENEON
- Elisa Palazzi from CNR-ISAC (WP8), is:
  - Co-leader of the Geo Global Network for Observation and Information in Mountain Environments (GEO-GNOME)
- Mattia Santoro from CNR-IIA (WP10) is:
  - Contributor of the GEOSS Common Infrastructure (GCI) Operations Foundational Task.
  - Contributor of the GEOSS-EVOLVE Foundational Task
  - Contact person for the GEO DAB technical support team to GEO Secretariat for the registration and brokering of new data systems in GEOSS.
- Gregory Giuliani from UNIGE (WP10) is:
  - Contributor of the Capacity Building Coordination Foundational Task
  - Contributing member of the GEOSS Common Infrastructure (GCI) Operations Foundational Task.
- Palma Blonda (CNR), Mariasilvia Giamberini (CNR), Gregory Giuliani (UNIGE), Carmela Marangi (CNR), Joan Maso (CREAF), Paolo Mazzetti (CNR), Elisa Palazzi (CNR), Antonello Provenzale (CNR), Stefano Nativi (CNR and JRC), Mattia Santoro (CNR), Ivette Serral (CREAF), are permanent members of their respective GEO national delegations.

PARTICIPATION OF ECOPOTENTIAL AT GEO WORKSHOP AND MEETINGS

ECOPOTENTIAL has been variously presented at GEO general meetings and EUROGEOSS workshops, as follows:

11-12 June 2015 – Workshop: Towards a sustainability process for GEOSS Essential Variables - Bari, Italy

Antonello Provenzale	ECOPOTENTIAL: improving ecosystems benefits through Earth observation	Provenzale_Bari_EV_2015.pptx

15 - 16 June 2015 - 9th GEO European Projects Workshop - Copenhagen, Denmark

Antonello Provenzale	ECOPOTENTIAL: improving ecosystems benefits through Earth observation

11-12 November 2015 - GEO-XII Plenary meeting, Mexico City

Ioannis Manakos (CERTH)	POSTER: H2020 Project ECOPOTENTIAL: improving ecosystems benefits through Earth observation - U Commission Booth

20-21 Jan 2016 - EC GEO European Projects Special Biodiversity Workshop, Bruxelles, Belgium

Antonello Provenzale (CNR)	ECOPOTENTIAL: improving ecosystems benefits through Earth observation
Stefano Nativi, Paolo Mazzetti	ECOPOTENTIAL: Data portals, community portals, platforms, and GEOSS/GCI

May 31-June 2nd 2016 - 10th GEO European Projects Workshop 2016: Fostering Open Earth Observation for Europe - Berlin, Germany

Antonello Provenzale	ECOPOTENTIAL: improving ecosystems benefits through Earth observation

June 2017: European GEO Workshop – EGW 2017 - Helsinki, Finland

Elisa Palazzi (CNR)	Elevation Dependent Warming and the need for a network of monitoring stations: the role of GEO GNOME
Mariasilvia Giamberini - CNR	Geosphere-Biosphere Interactions in Mountain Protected Areas: the ECOPOTENTIAL View
Joan Maso - CREAF	Protected Areas from Space: the ECOPOTENTIAL View
Francisco Bonnet Garcia - University of Grenada	Blending Remote Sensing and Earth Observation at Sierra Nevada National Park, Spain
Antonello Provenzale - CNR	Geosphere-biosphere interactions and ecosystem changes from space: the ECOPOTENTIAL view

October 2017 - GEO Plenary meeting 2017 – Washington D.C., USA

ECOPOTENTIAL partners taking part at the GEO Plenary meeting as members of national delegations:

- Palma Blonda, CNR
- Mariasilvia Giamberini, CNR
- Gregory Giuliani, UNIGE
- Carmela Marangi, CNR
- Joan Maso, CREAF

- Paolo Mazzetti, CNR
- Stefano Nativi, CNR
- Elisa Palazzi, CNR
- Mattia Santoro, CNR
- Ivette Serral, CREAF
- Marc Zebisch, EURAC

Side Events:

Organisation of the side event: Earth Observation for achieving and monitoring mountain-related SDGs: ECOPOTENTIAL, GEO-GNOME and GEO-ECO, chaired by Matthias Jurek, UNEP.

ECOPOTENTIAL presentations and posters:

PRESENTER	**TITLE**
Ioannis Manakos - CERTH	Overview of ECOPOTENTIAL project (Side Event: EO for achieving & monitoring mountain-related SDGs: ECOPOTENTIAL, GEO-GNOME & GEO-ECO)
Elisa Palazzi (CNR)	GNOME and GEO-ECO (Side Event: EO for achieving & monitoring mountain-related SDGs: ECOPOTENTIAL, GEO-GNOME & GEO-ECO)
Palma Blonda (CNR-IIA), Paolo Mazzetti (CNR-IIA)	From Data to Knowledge: Biodiversity and Ecosystem - the Ecopotential scenario (Side event: GEO in ACTION)
Marc Zebisch - EURAC	European Mountains - EO for environmental monitoring in mountains – opportunities and challenges (Side Event: EO for achieving & monitoring mountain-related SDGs: ECOPOTENTIAL, GEO-GNOME & GEO-ECO)
Max Craglia, JRC	EUROGEOSS Protected Areas pilot
Joan Maso - CREAF	EUROGEOSS
Joan Maso - CREAF	ECOPOTENTIAL presentation at the side event “GEO in ACTION” (GCI for Biodiversity” 2/2 Ecopotential)
G. Colangeli (ESA)	live demonstration of the ECOPOTENTIAL use-case in the ESA booth in the exhibition area
S. Giamberini, C. Marangi et al. (CNR)	Presentation of the ECOPOTENTIAL project at the EUROGEOSS Stand (2 posters, live talks)

Sept 2018 – EUROGEOSS WORKSHOP – GENEVA – SWITZERLAND

Oral presentations

PRESENTER	TITLE
Carl Beierkuhnlein (UBT)	Representing ECOPOTENTIAL at the EUROGEOSS event and round table
Francesco Cozzoli	ECOPOTENTIAL4SCHOOLS: an international game experience with students
Mariasilvia Giamberini (CNR-IGG)	ECOPOTENTIAL: Using Earth Observations to Protect Natural Landscapes
Richard Lucas (University of South Wales)	The Earth Observation Data for Ecosystem Monitoring (EODESM)
Ioannis Manakos (CERTH)	Validation activities for global and continental land cover products within SCERIN project (session: #Validation of satellite data)
Ioannis Manakos - CERTH	Earth Observation online services for land features' estimation
Carmela Marangi (CNR-AC)	ECOPOTENTIAL: Integration of Earth Observation in ecological modeling
Paolo Mazzetti (CNR-IIA)	Virtual laboratory and Knowledge base development (session: #Hands on Essential Variables)

Organisation and chairing of the session: # SDG15 Life on land – Chair: Ghada El Serafy

PRESENTER	TITLE
Duccio Rocchini (University of Trento)	Theories and algorithms for solving the `biodiversity from space' conundrum
Palma Blonda (CNR-IIA)	ECOPOTENTIAL contribution to the achievement of SDG15
Richard Lucas (UNSW Sydney)	Application of the Earth Observation Data for Ecosystem Monitoring for Change Detection

Posters and videos

- ECOPOTENTIAL – Improving Future Ecosystems' Benefits through Earth Observation (Video)
- The Ecopotential Virtual Laboratory (Video)
- ECOPOTENTIAL - Protected Areas and Earth Observation Carl Beierkuhnlein (Poster).

October 2018 - GEO Plenary meeting 2018 Kyoto - Japan

ECOPOTENTIAL partners taking part at the GEO Plenary meeting as members of national delegations:

- Palma Blonda, CNR
- Mariasilvia Giamberini, CNR

- Gregory Giuliani, UNIGE
- Carmela Marangi, CNR
- Joan Maso, CREAF
- Paolo Mazzetti, CNR
- Stefano Nativi, CNR
- Elisa Palazzi, CNR
- Mattia Santoro, CNR
- Ivette Serral, CREAF

Side event: Detecting and Analysing Changes and Future Scenarios

in Protected Areas: from ECOPOTENTIAL to GEO ECO – Geo Week 2018 – Monday Oct 29th

Being a major contributor to the GEO ECO, GEO GNOME and EuroGEOSS initiatives, ECOPOTENTIAL organised a side event at the XV GEO week, with the aim of presenting and discussing some of the major findings contributing to such GEO initiatives and useful for reporting on SDG 15.

The event has addressed the questions about how ECOPOTENTIAL achievements can contribute to:

- ✓ Understand the effects of climate change on ecosystems;
- ✓ Define and monitor resilience indicators and Essential Variables;
- ✓ Data cube exploitation: linking the past (time series analysis) to future scenario modelling;
- ✓ Provide insights for nature based solutions;
- ✓ Support Sustainable Development Goals (SDG15 and others);

The **programme** was the following:

Part 1 - Chair P. Blonda (CNR)

1. *Preliminaries*
   - Side event objective and proposed discussion themes (Palma Blonda - CNR) [5 min]
   - The ECOPOTENTIAL project goals (Carmela Marangi - CNR) [5 min]
   - GEO ECO: motivation (Joan Masò - CREAF) [5 min]

2. *EO change detection*
   - Ecosystem change detection: why and how through EODESM and FAO-LCCS. The present (Palma Blonda - CNR) [5 min]
   - From land cover to land use for ecosystem monitoring through FAO-LCML. The future (A. Di Gregorio-FAO Consultant) [15 min]
   - EV change detection for biodiversity monitoring (Letitia Navarro – GEOBON) [10 min]

Part 2 - Chair: S. Giamberini (CNR)

3. *Products for GEO ECO*
   - From EODESM to the Virtual Lab (Paolo Mazzetti and Mattia Santoro - CNR + video) [10 min]
   - Ecosystems mapping (Roger Sayre - USGS) [10 min]
   - EO products for ecosystem modelling at regional scale (Carmela Marangi - CNR) [10 min]
   - Past and future snow cover changes in the Alps and driving mechanisms (Elisa Palazzi - CNR) [5 min]
   - Snow cover evolution using the Swiss Data Cube in Gran Paradiso (Gregory Giuliani-UnepGRID) [10 min]
5. *Perspectives*
   - After ECOPOTENTIAL: what comes next (Silvia Giamberini - CNR) [5 min]
   - What else for contributing to SDG15 (Douglas Cripe- Geosec) [10 min]

6. Final Discussion [10 min] – lead by Palma Blonda (CNR) and Joan Masò (CREAF)

The presentations specifically reporting about ECOPOTENTIAL achievements and perspectives, in the ECOPOTENTIAL side event and in other events, are the ones listed below:

PRESENTER	**TITLE**
Carmela Marangi - CNR	The ECOPOTENTIAL project goals (ECOPOTENTIAL Side event)
Palma Blonda - CNR	Ecosystem change detection: why and how through EODESM and FAO-LCCS. The present (ECOPOTENTIAL Side event)
Paolo Mazzetti and Mattia Santoro - CNR	From EODESM to the Virtual Lab (ECOPOTENTIAL Side event)
Carmela Marangi - CNR	EO products for ecosystem modelling at regional scale (ECOPOTENTIAL Side event)
Elisa Palazzi - CNR	Past and future snow cover changes in the Alps and driving mechanisms (ECOPOTENTIAL Side event)
Silvia Giamberini - CNR	After ECOPOTENTIAL: what comes next (ECOPOTENTIAL Side event)
Silvia Giamberini - CNR	Presentation of the ECOPOTENTIAL statement on the improvements needed in GEO actions for the use of In Situ data at the side event “towards integrated in situ ecosystem observations”
Paolo Mazzetti (CNR) and Joan Maso (CREAF)	Virtual Laboratory and Interoperability (ERA PLANET side event)
Moses Cho and Abel Ramoelo (CSIR)	Assessing the Spatial-temporal dynamics of savanna ecosystem condition and services in and around the Kruger National Park - KNP, South Africa (side event: EU Africa cooperation in Earth Observation)
S. Giamberini, C. Marangi et al. (CNR)	Presentation of the ECOPOTENTIAL project at the EUROGEOSS Stand (2 posters, live talks)

This strong participation of people involved in ECOPOTENTIAL allows a clear alignment of ECOPOTENTIAL objectives and outcomes to GEO and GEOSS requirements. On the other side, they allowed a contribution by ECOPOTENTIAL to GEO and GEOSS.

Co-funded by the European Union

6. Appendix 2: Contributions to GEO Tasks and Initiatives

CONTRIBUTION TO THE GEO GLOBAL ECOSYSTEM INITIATIVE (GEO ECO)

The GEO ECO initiative recognizes that "Knowledge-based conservation, management and restoration policies are urgently needed in order to ensure delivery of ecosystem benefits in the face of increasing anthropogenic pressures", and that "Fundamental to all these is effective monitoring, understanding and modelling of the state and trends in ecosystem functions and services". To this aim, GEO ECO identifies seven major activities for the period 2017-2019. Five of them see the direct contribution of ECOPOTENTIAL research. Namely:

- Remote sensing observations for Protected Areas;
- Long-Term ecological data from *in-situ* measurements;
- Ecosystem models and e-laboratories;
- Future ecosystem scenarios and related uncertainties;
- Characterization of geosphere-biosphere interactions.

In detail, ECOPOTENTIAL contributes to such activities in GEO ECO by:

- Providing and making available an array of remote sensing products for the project Protected Areas in Europe and beyond, through the Virtual Laboratory (WP4 and WP10);
- Providing access to the long-term ecological data from *in-situ* measurements in the project Protected Areas through the DEIMS repository (WP5 and WP10);
- Making freely accessible an array of ecological models through the Virtual Laboratory (WP6 and WP10);
- Elaborate future projections for ecosystems and related uncertainties (WP8) as well as future requirements for protected areas (WP9);
- Achieve the GEO ECO user engagement objectives through the training and dissemination activities (WP1, WP10, WP12);
- Characterising the geosphere-biosphere interactions as a component of the research activities on the state and evolution of ecosystem functions and services, in selected protected areas within the project.

ECOPOTENTIAL is also, at present, the major financial contributor to the initiative.

CONTRIBUTION TO GEO GNOME

The Group on Earth Observations "Global Network for Observations and Information in Mountain Environments" (GEO-GNOME) is a GEO Initiative in the current 2017-2019 Work Programme that seeks to connect and facilitate access to diverse sources of mountain EO data and other kinds of information regarding drivers, conditions, and trends in biophysical and socio-economic processes that induce changes at different scales. GEO-GNOME treats mountains as complex socioecological systems, where dynamic interactions occur. To this end, the ability to integrate biophysical and socioeconomic data and information is its overarching purpose. In this framework, GEO-GNOME and ECOPOTENTIAL are strongly interlinked, possibly benefiting one from each other.

The "mountain component" of ECOPOTENTIAL, in particular, making available mountain data from EO as well as climate model projections devised for mountains, can strongly support GEO-GNOME and its objective to identify all mountain observation/information data and create a common platform to easily access them, following GEO standards and directives and exploiting GEO infrastructures/facilities. At the same time, GEO-GNOME outcomes can be of use for ECOPOTENTIAL researchers and users. **For example, in 2017, GEO-GNOME launched an online visualization tool for spatial delineation of mountains according to different definitions (Sayre et al 2018) which can be of use for the ECOPOTENTIAL community, including both researchers and practitioners.**

In 2017 GEO-GNOME underwent a profound revision of its original work plan to redefine time frames and align tasks with resources. This led to a reconfiguration of objectives, tasks, and contributors. The real and effective mutual interaction between GEO-GNOME and ECOPOTENTIAL is just being redrawn and will take place in the coming year and beyond. The GEO-GNOME co-leads (CNR in Italy and the Mountain Research Initiative in Switzerland), in collaboration with the Institute for Earth Observation at EURAC Research, Italy (also partner of ECOPOTENTIAL) convened the ''GEO-GNOME Status and Scoping Workshop,'' on 23–25 May 2018, in Bern, Switzerland (Adler et al., 2018). Among the participants were also some ECOPOTENTIAL researchers contributing to the discussion on how to reinforce collaborations and common actions between ECOPOTENTIAL and the GEO Initiative, exploiting common tools such as the Global Mountain Explorer (Sayre at al., 2018, https://rmgsc.cr.usgs.gov/gme/), and brainstorming about gaps and needs in mountain science.

A clear contribution of ECOPOTENTIAL to GEO-GNOME is mainly on two topics: **(1) EO infrastructures and information, demand for and supply of data from a user perspective;** and **(2) science of mountain observation data and processes**. ECOPOTENTIAL has already achieved outstanding results in (1) owing to the user perspective which underlines the entire ECOPOTENTIAL approach. For item (2), the workshop held in Bern has surely represented a very good example of science brainstorming between the ECOPOTENTIAL and GEO-GNOME researchers, especially on the need to define essential climate variable for mountains and setting up a transect of in-situ stations along altitudinal gradients which will constitute a standard way of observing change in mountains, also serving as a template approach to combine other mountain-relevant non-climate parameters and variables.

CONTRIBUTION TO THE EUROGEOSS INITIATIVE

EuroGEOSS is the European component of the Global Earth Observation System of Systems (GEOSS) with a focus on coordination and scaling-up user-driven applications being developed in Europe. This GEO regional initiative aims to improve user uptake of Earth Observation data and Improve forecasting capabilities for sound decision-making by governments for Europe's benefit.

ECOPOTENTIAL can contribute to the development and activities envisaged for EUROGEOSS programme by providing pilot cases from the research work done in the various European protected areas, and in particular by:

- Providing case studies for the development of user-oriented services, developed at the stage of pre-operational services within the project, thus providing multidisciplinary pilot cases that may be scaled-up at European level;
- Contribute to promote further incubation and scaling-up of the most promising user-oriented services;
- Through its outreach initiatives (e.g. the newsletter, the website, the final project conferences, the participation to public events directed to decision makers), to accelerate GEOSS adoption and engagement across Europe from regional to local scales and to showcase the benefits of GEOSS to European citizens, science and business, also promoting the GEO vision to support decision making by Earth observation;
- Contribute to link EUROGEOSS to the other GEO tasks and initiatives contributed by ECOPOTENTIAL;
- Demonstrate the effective use of European Earth observation resources.

In fact, the research activities developed in collaboration with Protected Areas have been planned using a co-design approach, based on the analysis of the most important ecosystem services and of the ecological challenges to be faced, so to identify the data and the research needs in order to face such challenges. The process has been entirely user-driven and the data collected and processed have been chosen in order to address such challenges.
The analysis of the EO applications successfully used in the project will help to identify those with the highest potential to respond to European needs in knowledge-based nature conservation policies.

POSSIBLE CONTRIBUTION TO THE NEW "LAND DEGRADATION NEUTRALITY INITIATIVE"

The new "Land Degradation Neutrality initiative" (LDN) has been launched at the last GEO Plenary meeting with a dedicated side-event. The aim of the initiative is to support the quantitative assessments and corresponding mapping of degraded lands, as required by the Sustainable Development Goals (SDGs), in particular the SDG indicator 15.3.1 ("proportion of land that is degraded over total land area"), as well as by the adoption of Land Degradation Neutrality (LDN) targets under the auspices of the United Nations Convention to Combat Desertification (UNCCD).

One of the aims will be "the establishment of federated collaborative platforms with high computing capacities and big data analytics tools (e.g., EO data cubes) that would allow countries to easily select, access, process, analyse, interpret and quality control large datasets associated with EO and geospatial information, while at the same time ensuring national ownership".

ECOPOTENTIAL may contribute to the LDN initiative:

- Providing a "pilot case" in one or more selected protected areas, where the application of the LDN principles can be monitored inside and outside the protected areas boundaries.
- Proving outreach and capacity building on the use of the EODESM software, developed in the framework of the project, which enables to classify land cover through Remote Sensing data using the FAO LCCS2 - taxonomy classification system, analyse changes in land cover and validate the LC classification using a dedicated web application available for android cell phones.
- Providing knowledge and facilitating networking on the aspects related to the carbon cycle and budget in soils (LTER network, Critical Zone Observatories).

CONTRIBUTION TO THE "IN SITU EARTH OBSERVATION RESOURCES" TASK

In ECOPOTENTIAL, Protected areas have used both Remote Sensing and In Situ data for their research work, often combined, and an entire WP has been devoted to provide access to existing relevant in-situ monitoring data related to the project's protected areas.

In this frame, ECOPOTENTIAL contributes to the Subtask C.II "Biodiversity and ecosystems", which are, namely: (from: http://earthobservations.org/activity.php?id=134)

a. Reporting on experiences in in-situ observation site documentation in DEIMS and comparative examination of requirements/applicability in GEO and ILTER.
b. Towards an integrated observation approach of biotic and abiotic system components: Attempt to integrate the concepts of Ecological Integrity and Essential Biodiversity Variables as a reference for ecosystem observation.
c. Review and suggest research and development fostering linkage between in-situ and satellite observations on ecosystem structure and functions, and evaluation of their services. "Super-site" concept may be considered.

CONTRIBUTION TO THE GEOSS COMMON INFRASTRUCTURE (GCI) OPERATIONS

The SC5-16-2014 call for "Making Earth Observation and Monitoring Data usable for ecosystem modelling and services" specifically asked for the undertaking of "pilot actions in selected protected areas to further developing the Global Earth Observation System of Systems (GEOSS)" (European Commission 2013). The call also expected impact in terms of "new prototype products and ecosystem services, based on improved access to (notably via GEOSS) and long-term storage of ecosystem Earth Observation data and information" and more generally achieving "strong European support and leadership within the GEO Ecosystem tasks" (GEO ECO).

In the ECOPOTENTIAL project "open and interoperable access to data and knowledge is assured by a GEO Ecosystem Virtual Laboratory Platform, fully integrated in GEOSS", making the ECOPOTENTIAL Virtual Laboratory and related applications a major way for implementing the GEO and GEOSS contribution by ECOPOTENTIAL.

The ECOPOTENTIAL Work Package 10 on "*ECOPOTENTIAL Virtual Laboratory Platform*" is specifically dedicated to the design, implementation and operation of the ECOPOTENTIAL VLAB (European Commission 2015). Task 10.4 on "*Coordination and interoperability with the GEO/GEOSS GCI and other significant initiatives*" assures that "A specific attention will be paid to GEO for the integration of the ECOPOTENTIAL capacities in GEOSS. A sustained interaction with the GEO governance, in particular with the GEOSS Infrastructure Implementation Board will assure the alignment of the ECOPOTENTIAL platform with the GEOSS targets, requirements and architecture."

The ECOPOTENTIAL VLAB provides the technical platform for addressing a general requirement of the SC5-16-2014 call: "recovering existing data, supporting new measurements and observations, synthesis and interpretation of data for making all information and knowledge available to scientists, policy makers, citizens and other concerned stakeholders to provide a full picture of the state and temporal evolution of ecosystems in existing internationally recognised protected areas" (Nativi, Mazzetti, and Santoro 2016).

This makes the VLAB a valuable contribution to GEO and GEOSS, not limited to the Ecosystem Tasks, but more generally to all the GEO Tasks aiming at knowledge generation and support to informed policy-making, in particular, referring to the United Nations Sustainable Development Goals (SDG).

In particular, ECOPOTENTIAL WP10 contributes to the GEOSS Common Infrastructure (GCI) Operations Task, whose general objective is to "Operate and maintain a user driven GEOSS Common Infrastructure (GCI) to discover and access GEOSS resources (e.g. datasets and services)", as the Virtual Laboratory is designed in order to "better respond to user needs" through an enhanced user interface, and to improve user experience making the portal intuitive and easy to use (see D10.4).
Moreover, the GEOSS Common Infrastructure (GCI) Operations Task activities for the 2017-2019 period include the development of Pilots/Applications to "Create a set of significant User-driven Pilots utilizing the resources available in the GCI to demonstrate its usability, effectiveness and importance for users and decision making". **The ECOPOTENTIAL VLAB, and the workflows ported on it, especially those specifically dedicated to support informed policy-making, clearly show usability, effectiveness and importance of GEOSS.** For example, the EODESM model, accessible through the ECOPOTENTIAL Virtual Laboratory, allows evaluating land cover changes in Protected Areas based on a well-known taxonomy (Food and Agricultural Organisation's Land Cover Classification System - LCCS2 - taxonomy).

CONTRIBUTION TO THE "GEO EVOLVE" TASK

The activities in ECOPOTENTIAL WP10 provide a clear contribution to the main objectives of the GEO EVOLVE task:

1. To advance and evolve the GEOSS architecture based on the architectural principles described in the GEO Strategic Plan 2016-25, the analysis of the evolving landscape for technology and production/ consumption of Earth Observation (EO) data products and services, and the **specific user requirements coming from the GEO Flagships and Initiatives**;
2. To conduct research and development activities, in collaboration with public, private, and voluntary sectors, **to develop and test new functionalities**, solutions, and components, including those needed to advance the GCI, to support the GEO Strategic Plan objectives and user needs;
3. To prepare documentation and training materials needed to support the transition from development to operations of the new components and solutions identified.

As a major contribution to the GEO ECO Initiative, **the requirements collected by ECOPOTENTIAL and addressed by the VLAB, are an important contribution to the analysis of "the specific user requirements coming from the GEO Flagships and Initiatives"**. Indeed, ECOPOTENTIAL WP9 "Requirements of future protected areas", WP11 "EO

supported policy development and integration" and WP12 "Capacity building and knowledge exchange", collect requirements from different stakeholders and for different objectives. In a co-design approach, their input contribute to the elicitation of system requirements for the implementation of the ECOPOTENTIAL VLAB.

Moreover, ECOPOTENTIAL is a research and development activity **developing and testing new functionalities with particular reference to workflows and knowledge bases support**. Contribution to User Needs and Gap Analysis

The User Needs and Gap Analysis task aims at establishing "a comprehensive overview of user needs […]. Of particular interest are those information needs that are linked to indicators supporting the advocacy and monitoring of the Sustainable Development Goals (SDGs)".

The ECOPOTENTIAL VLAB provides an example of how dedicated tools can support such objectives. Workflows for informed policy-makers are typically scientific business processes to generate indicators from EO and in-situ data and products. Specific indicators can be used to assess and monitor the status towards SDG targets and goals. Therefore, **a VLAB based on the ECOPOTENTIAL experience can help GEOSS to document the transition from data to information (e.g. Essential variables) and knowledge (indices, indicators) and to identify observation gaps**. Indeed, specific models for the generation of indicators for the assessment of SDG Goals and Targets could be ported in the VLAB and run with GEOSS data for monitoring indicators, or running "what-if" scenarios.

CONTRIBUTION TO ADVANCING GEOSS DATA SHARING PRINCIPLES

The "Advancing GEOSS Data Sharing Principles "Foundational task aims at "promoting free, full, open and timely access to Earth observation datasets, products and services". In particular, one of the specific objectives of the task is to "address legal interoperability of datasets across various SBAs, through recommended mechanisms to share data as part of GEOSS DataCORE or compatible open licenses". The Data-CORE (Data Collection of Open Resources for Everyone) is a distributed pool of documented datasets with full, open and unrestricted access at no more than the cost of reproduction and distribution.

The ECOPOTENTIAL project participates in the Pilot on Open Research Data in Horizon 2020 which requires that "users can normally access, mine, exploit, reproduce and disseminate openly accessible research data free of charge" (European Commission Directorate-General for Research & Innovation 2017). This is implemented assuring that **the ECOPOTENTIAL Virtual Laboratory Platform will be fully interoperable with the GCI and the GEOSS Web Portal and its resources will contribute to the GEOSS Data Core** (European Commission 2015).

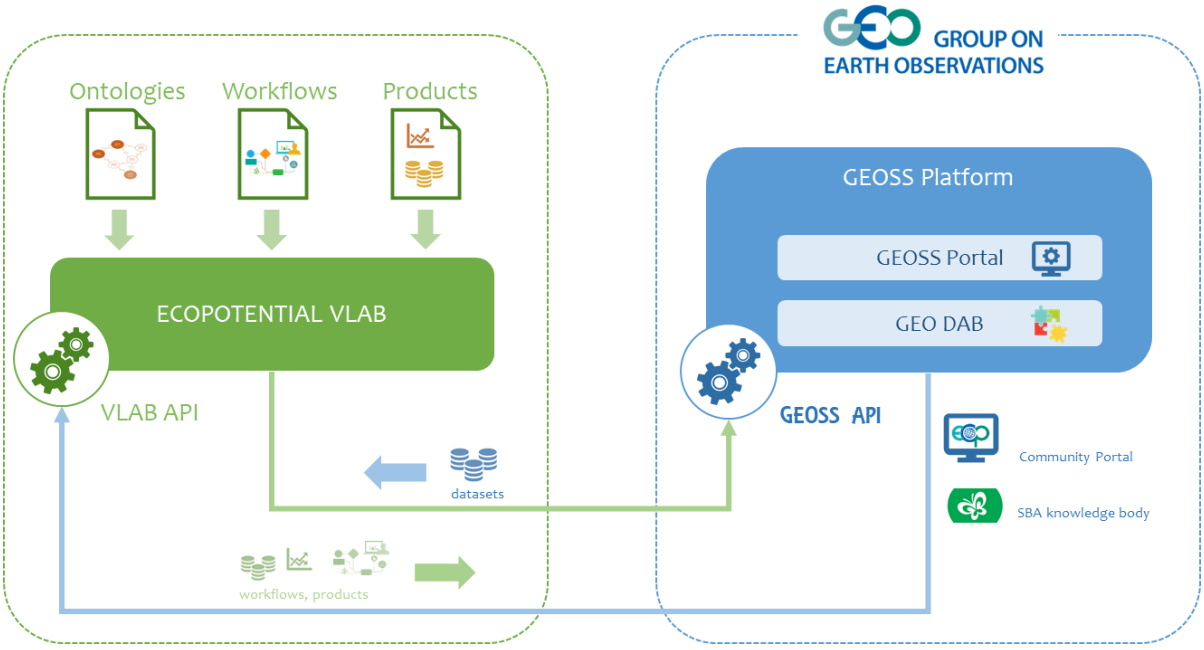

Figure 1 - Interoperability between the ECOPOTENTIAL VLAB and the GEOSS Platform

The design of the ECOPOTENTIAL VLAB defines how it will be interoperable with the GEOSS Platform (Figure 1). The interoperability is implemented through APIs for discovery and access of resources. **The ECOPOTENTIAL VLAB APIs expose resources accessed by the VLAB (data, products, workflows) making them accessible by the GEOSS Platform** to build Community Portals and SBA knowledge bodies.