GEO Community Activity on Essential Variables – GEO-EVs

1. *Executive Summary* (1 page)

Full title of the Community Activity: GEO Community Activity on Essential Variables
Short title or acronym: GEO-EVs
Proposed category: Community Activity
Overview:

The concept of Essential Variables (EVs) is increasingly used in Earth observation communities to identify those variables that have a high impact, high feasibility and relative low cost of implementation. The community of GCOS was the first to develop a full set of Essential Climate Variables (ECV). Other examples of communities applying the same concept are oceans (EOV-BluePlanet), biosphere (EBV-GEOBON), water cycle (GEOGLOWS), etc. ConnectinGEO illustrated that EVs can be a useful approach to several indicators for monitor SDGs. ERA-PLANET GEO-Essential proposes a need to review and extend the current EV framework and a priority assignment in designing, deploying and maintaining EV in connection with the responsible observation networks. At the same time, EVs should be promoted among all SBAs in GEO. The GEO-EVs Community Activity aims to be a panel of experts to discuss about the current status of the EVs, exchange knowledge, experiences and methodologies in EVs definition, analyse the usefulness of some of them in creating SDG indicators and the gaps to be solved in communities in the near future. This Community Activity does not have the intention to interfere in the on-going communities already working on the definition of the EVs, but to become a common point to share expertise and to have a single voice inside GEO regarding EVs.

Planned Activities:

- Meta-coordination in the elaboration of EVs among SBAs. Reduce the overlapping already between existing between and future EVs. Shared knowledge and processes for EVs definition.
- Gap analysis of EVs and observation networks.
- Convergence of the definition of EVs across SBAs.
- Expanding EVs to all relevant themes in Earth Observation.
- Relationship between EVs and SDGs. Further analyse the approximation of SDGs indicator's retrieval based on the use of EVs as a proxy.

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2. *Purpose (1 page)*

Sustainable development that preserves the capacity of the environment to sustain well-being of present and future generations can only be achieved through transformational pathways departing from the current unsustainable routes. Informed governance can lead to policies supporting best practices for sustainable development (Griggs et al., 2013; Griggs et al., 2014). Reaching the Sustainable Development Goals (SDGs), as adopted by the United Nations in 2015, should be

constrained within stable and functioning life-support systems that define a safe operating space for humanity (Rockstrom et al., 2009; Steffen et al., 2015). Raworth (2012) is further defining a safe and just space by integrating the social boundaries. This means addressing biophysical and social targets in ways that incorporate synergies and tradeoffs. Griggs (Griggs et al. 2014; Griggs et al. 2013) also recommends working with quantifiable targets at multiple geographical scales and across sectors. For now, the Inter-Agency Expert Group on SDG Indicators provided a first set of indicators for consideration by the United Nations Statistical Commission. The International Council for Science (ICSU, 2015; Lu et al., 2015) has defined five priorities for science to measure progress towards the SDGs: i) design a set of practical indices; ii) set up a monitoring program for these indices; iii) evaluate the performance towards achieving the targets; iv) improve the observational infrastructures; and v) standardize the sources and quality of data. An additional recommendation is that the SDGs indicators are aligned with those of existing international agreements (e.g. UNFCCC for climate, CBD Aichi targets for biodiversity (Brooks et al., 2015)). Indeed, the temptation is great, when defining SDGs or other integrated environmental indicators, to reinvent the wheel instead of using existing initiatives and data available –for instance through the Group on Earth observations (GEO) and its Global Earth Observation System of Systems (GEOSS) (GEO, 2017).

In this context, Essential Variables (EVs) are used in Earth observation to identify variables that correspond to high impact on the Earth system and should be a priority for monitoring. EVs assume that there is a limited number of variables that are essential to characterize the state in a system without losing significant information on its past and future trends. The identification of these variables should help supporting adequate observing systems in the context of restricted budgets. EVs are also thought to improve the definition and maintenance of workflows from raw data to final end users' products. Indeed, EVs are being used by different communities to define the smallest number of variables describing a system allowing defining indicators for policy purposes. The review of the set of EVs, conducted by ConnectinGEO (www.connectingeo.net (ConnectinGEO, 2016a, b, c)) in several GEO communities, revealed that there exist different maturity levels and a considerable overlap between the EVs identified by the different communities considered. The community working on the Global Climate Observing System (GCOS) was the first to develop a full set of EVs, i.e. the Essential Climate Variables (ECV) (Bojinski et al., 2014; Hollmann et al., 2013; Szczypta et al., 2014). Presently, significant efforts are being made to define and monitor EVs in the areas of biodiversity and ecosystems (Pereira et al., 2013; Scholes et al., 2012), water (Lawford, 2014), oceans (Constable et al., 2016; Hayes et al., 2015) and more recently on SDGs themselves (Reyers et al., 2017). Some of the later efforts are still incomplete. In addition, there is a need to generalize and complete the definition of EVs the rest of Earth thematic areas to have a full description of the status and trends of the Earth System.

This Community Activity does not have the intention to interfere in the on-going communities already working on the definition of the EVs, but to become a common point to exchange procedures, experiences and challenges, know overlapping and gaps, and to have a single voice inside GEO.

3. Background and Previous Achievements (1/2 page)

This Community Activity comes from the previous work already done by GCOS, GEOBON and GEOWLOWS, among others, regarding EVs and the knowledge gathered in the H2020 ConnectinGEO project on their status particularly in the GEO community. Within ConnectinGEO a gap analysis in European EO in-situ data was performed under the umbrella of SDGs and EVs and among GEO SBAs.

Now, this work continues under the ERA-PLANET GEOEssential project (H2020-SC5-15-2015), active from 2016 to 2021 collecting all this work and evolving the approach between EVs, SDGs, communities and framework policies (Lehmann et al. 2019).

The first step on that work started with the workshop "*Towards a sustainability process for GEOSS Essential Variables (EVs)*" held in Bari on June 11-12, 2015. The workshop covered the status of EV discussions in the SBAs Agriculture, Biodiversity, Climate (and specifically Atmospheric composition, Carbon Cycle, and Greenhouse Gases), Disasters, Ecosystems, Energy, Health, Water (and River discharge), and Weather, and in the thematic areas Citizen Science, Human Settlements, Oceans (and Marine Ecosystems), and Solid Earth Science (including volcanology). From that workshop, we learnt that in most SBAs and thematic areas, the development of sets of EVs is a community processes leading to an agreement on what is essential for the goals of that community. While there are many differences across the communities in the details of the criteria, methodologies, and processes used to develop sets of EVs, there is also a considerable common core across the communities, particularly those with a more advanced discussion. Concerning inter-community differences of criteria, in particular, the feasibility to measure the EVs in terms of cost, effort, and impact plays a different role in different communities. There is some level of overlap between the EVs determined by different communities (e.g., Climate and Water), and there is a potential to develop an integrated set of EVs common to several or all SBAs, which then could be complemented with SBA specific EVs (Figure 1).

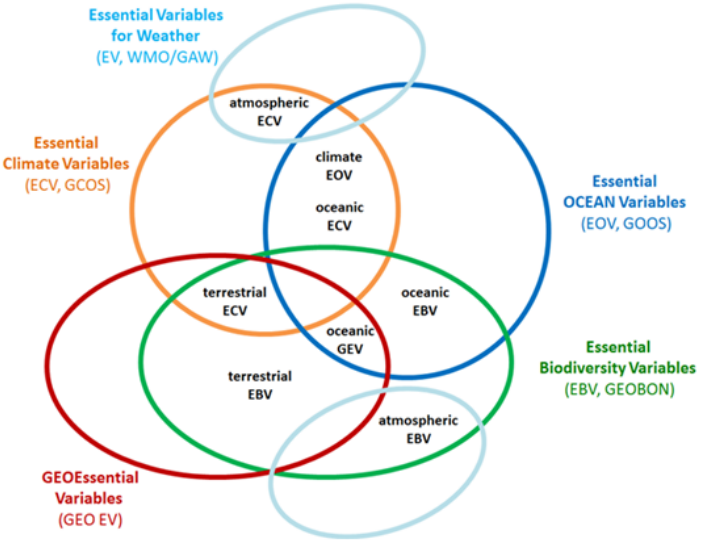

Figure 1. Conceptual overlap of all projects for defining Essential Variables (figure from (Lausch et al., 2018))

4. *Key Activities (1 page)*

- Become a central point where to exchange experiences, methodologies and knowledge regarding the development of EVs in several GEO communities → Constitute a group with representatives from all domains with a collaborative platform to easy share knowledge. Regular telecons will be set up and collocated meetings will be planned within GEO meetings.
- Monitoring the evolution of the EV definition in different domains. Detect gaps and overlaps → All EVs will be plotted in the dynamic ENEON graph allowing to detect overlapping and gaps (http://www.eneon.org/graph-ev-sdg/index.htm).
- Recommendations to consolidate the EV in the themes that has not completed a consolidated list of EVs → Best practice and recommendation documents will be shared among the community.

- Generate a roadmap to generalize and complete the definition of EVs to other EO communities to have a full description of the status and trends of the Earth System → This roadmap will be based on the knowledge of the process on defining EVs.
- Ensure that all the relevant SDG indicators are covered by the existence of future EVs framework and other policy frameworks and GEO engagement priorities → Interlinkages between EVs and SDGs will be plotted in the dynamic ENEON graph allowing to detect overlapping and gaps (http://www.eneon.org/graph-ev-sdg/index.htm).
- Collecting the definitions of the spatial and temporal resolutions of EVs for different scopes → Definitions will be considered in best practice and recommendation documents shared among the community.

These are the expected outputs of this Community Activity:

- Monitoring the evolution of the EV definition in different domains. Detect gaps and overlaps.
- Recommendations to consolidate the EV in the SBAs that has not completed a consolidated list of EVs
- Generate a roadmap to generalize and complete the definition of EVs to other EO communities to have a full description of the status and trends of the Earth System. This roadmap is based on the knowledge of the process on defining EV's.
- Ensure that all the relevant SDG indicators are covered by the existence of future EVs framework and other policy frameworks and GEO engagement priorities.
- Collecting the definitions of the spatial and temporal resolutions of EVs for different scopes.
- Serve as a forum to exchange experiences, best practices, and knowledge about EVs.

5. Relationship to GEO Engagement Priorities and to other Work Programme Activities (1/2 page)

Related GEO Flagships:

- GEO Biodiversity Observation Network (**GEOBON**) → developers of the EBVs.
- GEO Global Agricultural Monitoring (**GEOGLAM**) → in relation to the future EVs on Agriculture.
- Global Forest Observation Initiative (**GFOI**) → possible relation with the EBVs.

Related GEO Initiatives:

- **Earth Observations in Service of the 2030 Agenda for Sustainable Development** → in relation to the connection between EVs and SDG indicators.
- **EuroGEOSS** → in relation with several EVs.
- **GEO Carbon** and GHG Initiative → in relation to ECVs.
- Geo Global Ecosystem Initiative (**GEOECO**) → in relation to EBVs.
- Geo Global Network for Observation and Information in Mountain Environments (**GEO-GNOME**) → in relation to EBVs.
- GEO Global Water Sustainability (**GEOGLOWS**) → in relation to the future EVs on Water.
- GEO Vision for Energy (**GEO-VENER**) → in relation to the future EVs on Energy.
- **GEOSS-EVOLVE** → in relation with several EVs.
- Oceans and Society (**Blue Planet**) → in relation to the Ocean EVs.
- Other **regional GEOSS** initiatives such as AFRIGEOSS, AMERIGEOSS and AOGEOSS → in relation with several EVs.

Related Foundational Tasks:

- **GEOSS In-Situ Earth Observation Resources** → in relation with the monitoring networks for several EVs.
- **GEOSS Satellite Earth Observation Resources** → in relation with the remote sensing products that can deliver several EVs.

Related Community Activities:
- Access to climate data in GEOSS
- Airnow International: Expanding Networks and Integrating Methods for Air Quality and Health Data → in relation to the future EVs on Health.
- Copernicus Atmospheric Monitoring Service (CAMS) → in relation to ECVs.
- Copernicus Climate Change Service (C3S) in relation with several EVs.
- Earth Observations and Citizen Science
- Earth Observations for Health (EO4HEALTH) → in relation to the future EVs on Health.
- Earth Observations for the Water-Energy-Food (W-E-F) Nexus
- Earth2Observe → in relation to the future EVs on Water.
- Geodata for Agriculture and Water (G4AW) → in relation to the future EVs on Water and EVs on Agriculture.
- Global Agricultural Drought Monitoring → in relation to the future EVs on Agriculture.
- Global Ecosystems and Environment Observation Analysis Report Cooperation (GEOARC) → EBVs?
- Global Marine Ecosystem Monitoring (GMEM) → in relation to EBVs
- In-Situ Observations and Practices for the Water Cycle → in relation to the future EVs on Water.
- Land Cover and Land Cover Change → in relation with several EVs; in particular with the ECVs.
- Socio-Economic Benefits of Earth Observations → in relation with several EVs.

6. Governance (1/2 page)

A very simple governing structure is proposed with two chair persons and an advisory committee. The two co-chairs are responsible for the management of the activity (e.g. organizing regular meetings with the Advisory Board and with the Stakeholders) and to organize the execution of the decisions that the Advisory Board recommends by consensus. The Advisory Board is composed of selected experts on EVs coming from the different EV initiatives.

Regular communications about the Community Activity will be organized where stakeholders will be invited. Main opportunities will be the GEO meetings and the GEO Essential plenary meetings. Following the advice of the board, regular telecons will be organized to monitor the progress of the internal tasks and towards the expected outcomes. If necessary, dedicated telecons or face-to-face meeting will be organized to make progress toward a particular outcome.

7. Data Policy (1/2 page)

- Adherence to GEOSS Data Sharing Principles and Data Management Principles.
- Use of the GEOSS Mirror on EVs (under development from the GEOEssential Project).

Annexes (additional annexes may be added as required)

I. Acronyms and abbreviations

CBD: Convention on Biological Diversity
ENEON: European Observatory of Earth Observation Networks
EV: Essential Variable
EBV: Essential Biodiversity Variable
ECV: Essential Climate Variable
EOV: Essential Ocean Variable
EV: Essential Variable
EWV: Essential Water Variable
GCOS: Global Climate Observing System
ICT: Information and Communication Technology
SBA: Societal Benefit Areas
SDG: Sustainable Development Goals
UNFCCC: United Nations Framework Convention on Climate Change

II. List of key scientific references describing the basis for the work of the Community Activity

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III. Brief CV of Project Leader(s)

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- MSc, Biology, University of Geneva, 1992
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- 2001-2006: Scientific collaborator, Swiss Center for Mapping Fauna, University of Neuchâtel
- 1999-2001: First Assistant, Fellowship from Academic Society of Geneva, Aquatic Biology, University of Geneva
- 1998: Postdoc, SNF fellowship, Landcare Research, Hamilton, New Zealand
- 1993-1997: Assistant, PhD candidate, Aquatic Biology, University of Geneva

4-Insitutional responsibilities

- From August 2017: Vice-director of the Institute for Environmental Sciences at the University of Geneva.

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- BSc, Physics, Universitat Autonoma de Barcelona, 1992

3-Employment history

- Since 1995: Researcher at CREAF
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