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Deliverable D6.3

Gap analysis final report including prioritization

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Acronyms

BUT1 Bottom-Up Thread 1

BUT2 Bottom-Up Thread 2

BUT3 Bottom-Up Thread 3

CGT ConnectinGEO Gap Table

ConnectinGEO Coordinating an Observation Network of Networks EnCompassing saTellite and IN-situ to fill the Gaps in European Observations

DAB Discovery and Access Broker

DRR Disaster Risk Reduction

ENEON European Network of Earth Observation Networks

EO Earth Observation

EV Essential Variable

ECV Essential Climate Variable

FWEN Food-Water-Energy Nexus

GBA goal-based approach

GEO Group on Earth Observations

MSCA Marie Sklodowska-Curie Actions

SDG Sustainable Development Goal

SEE-IN KB Socio-Economic and Environmental Information Needs Knowledge Base

SSI Surface Solar Irradiance

TDT1 Top-Down Thread 1

TDT2 Top-Down Thread 2

WWW World-Wide Web

Executive Summary

This document is the final report of Work Package (WP) 6 of the ConnectinGEO project. WP 6 focused on the development of the ConnectinGEO approach to gap analysis and prioritization and the production of a prioritized list of gaps. The initial approach is described in Deliverable 6.1 and more detailed in Deliverable 6.2. Deliverable 6.2 also provides a detailed preliminary review of the gaps identified in the project. Here we focus on prioritization and report the outcome of the analysis and present a prioritized list of gaps. For the sake of completeness, this summary also includes the main findings and recommendations of Deliverable 6.2.

Gap analyses have been attempted in many Earth Observation (EO) communities both within and outside of the Group on Earth Observations (GEO). For a review of these attempts see D6.2. In general, gap analyses require information on what is needed on the one side, and on what is available to meet these needs on the other side. An important concept in linking societal knowledge and information needs to observational requirements is that of Essential Variables (EVs). Several EO communities have developed set of theme-specific EVs using an expert-based approach (EBA), which starts from thematic expertise of EO feasibility and eventually links the resulting EVs to societal impacts. Deliverable 2.2 provides an overview of the existing and developing set of EVs. ConnectinGEO added a complementary goal-based approach (GBA, see Deliverable 2.1), which starts at a set of agreed-upon societal goals and identifies the EVs required in support of implementing the goals and monitoring process towards these goals.

Based on these previous efforts, ConnectinGEO developed a threaded approach to gap analysis with five threads:

- **Top-Down Thread 1 (TDT1)**: Identification of a collection of observation requirements and specifications from generic goals for sustainability of the global civilization.
- **Top-Down Thread 2 (TDT2)**: Review of documents from international programs and community assessments of socio-economic benefits of Earth observations.
- **Bottom-Up Thread 1 (BUT1)**: Consultation process in the current EO networks, consisting of collaboration platforms, surveys and discussions at workshops.
- **Bottom-Up Thread 2 (BUT2)**: A careful analysis of the observations and measurements that are currently in GEOSS DAB.
- **Bottom-Up Thread 3 (BUT3)**: The realization of a series of real industry-driven challenges to assess the problems and gaps emerging during the creation of business opportunities.

In doing so, ConnectinGEO built on previous efforts and used the gap typology developed by GAIA-CLIM with minor modifications.

ConnectinGEO applied these threads to produced a list of gaps, which is compiled in the ConnectinGEO Gap Table (CGT). The CGT is available at http://twiki.connectingeo.net/foswiki/bin/view/ConnectinGEOIntranet/GapAnalysisTable?cover=print. The CGT is open to publish gap information and give feedback. It has the advantage of being easily accessible for partners to publish their results. However, it has the disadvantage of limited functionality. Therefore, the results have been included in the Socio-Economic and Environmental Information Needs Knowledge Base (SEE-IN KB) available at http://www.seeinkb.net, which allows for more information to be associated to each gaps and facilitates the tracking of the development of reviewing and addressing the gap over time.

The total number of gaps identified in the ConnectinGEO project is 235, of which most resulted from thread TDT2. The seven gaps directly resulting from the goal-based approach applied to the SDGs are indicated by the prefix "SDG-GP".

A review of the 235 gaps was carried out to determine priorities. Prioritization was based on two approaches:

- **Priority Parameter:** Feasibility together with the potential impacts a gap would have, the estimated costs and the required time frame for closing the gaps were used to compute a priority parameter that gives an indication of the how feasibility and impact relate to costs and the time needed to implement a solution.

- **Expert Assessment:** A group of experts were asked to select ten gaps that they considered to have highest priority.

Computing the priority parameter was unfortunately not possible for many gaps because estimates of all four required variables were not quantified for all gaps. In total, for 54 gaps the priority parameter p could computed based on this approach. The gaps with highest p value is CGT-174 ("Lack of continuity and uniform temporal sampling in time series," $p = 16$; page 25). The remedy recommended in the gap instance is to implement data fusion techniques to generated regular interpolated samples. Four gaps have a p value of 12: For CGT-175 ("Lack of tidal, ocean currents and water elevation prediction services," $p = 12$; page 25), the proposed remedy is to implement a forecast system based on recent data. For CGT-176 ("Lack of tools for Big Data analysis: merge timeseries, proper map and statistics visual representation," $p = 12$; page 60), it is recommended to develop the tools for big data analysis and visualization. For SDG-GP-2 ("Insufficient accounting for environmental variables in SDG indicators," $p = 12$; page 64), the remedy is integration of socio-economic and environmental data, and this is addressed in a recommendation below. For SDG-GP-6 ("Skills required for matching providers and policy makers.," $p = 12$; page 27), the develop of educational programs that focus on inter-sectoral skills would be the remedy, and this is also addressed in a recommendation below.

The expert assessment resulted in a total of 60 gaps being prioritized by a group of nine experts. One gap was identified by five experts as having high priority, i.e, CGT-023 ("LIDAR global dataset", page 30). For this gap no remedy was indicated by the author. Two gaps got four votes, i.e., Gap CGT-92 ("Lack of sufficient spatial coverage for many climatic applications, specially in the Southern hemisphere", page 31) and CGT-219 ("No European in-situ cross-domain coordination initiative", page 31. For CGT-92, a remedy would be to extend spatially the number of mooring sites with current meters at least for key dynamic areas (e.g., main energetic currents, Aghulas retroflection, Malvinas confluence) particularly in the Southern ocean. For CGT-219, the remedy is expected to be implemented through the European Network of Earth Observation Networks (ENEON). Another four gaps were selected by three experts and twelve gaps got two votes (see Table 5).

In the **TDT1**, focus was on the Sustainable Development Goals (SDGs) as the primary societal goal set. There are two main areas where EO provides a substantial contribution to the quest of reaching the SDGs by 2030, namely the monitoring of progress and the development of actions for the implementation. The SDG indicator framework used for the monitoring requires EOs for the quantification of a number of the more than 240 indicators. Many of the indicators were found to require socio-economic data (Gap SDG-GP-1, see page 64). As a remedy for this gap, there is an urgent need to integrate socio-economic and environmental data such that the integrated data base can be used to aggregate indicators and to support model simulations for policy development (for which the need is identified in Gap SDG-GP-2, see page 64). However, the strategy for exploiting these opportunities does not exist.

Data Integration: *It is recommended that a strategy be developed for the integration of socio-economic and environmental data and a platform be developed for this integration.*

It was also found that many indicators depend on EVs characterizing the built environment (Gap SDG-GP-7, see page 65). A number of these SDG-related EVs have already been included in the list of SDG provided in Section 6.4. The remedy for this gap is seen in the development of a research program to extract as much as possible information on the built environment from traditional EO as well as through crowd sourcing and citizen scientists.

Data on Built Environment: *It is recommended that a methodology be developed for the extraction of information on the built environment from a combination of traditional EO, crowd sourcing, and citizen science efforts.*

Only a minority of indicators depend on variables that can be extracted directly from EOs. This is found to be due to the current indicator frame work being strongly result focused with little emphasis on monitoring the actual systemic processes that can lead to achieving the targets. A preliminary review of several targets shows that adding system-relevant indicators would provide valuable monitoring that could be used to monitor the impacts of policies and other actions prior to achieving the results.

Indicator Assessment: *It is recommended that a thorough analysis of all targets be conducted to identify additional process-focused indicators that could be proposed to the Inter-Agency and Expert Group (IAEG) responsible for the revision of the SDG Indicator framework.*

Understanding the linkage of the SDGs and associated Targets to sustainability (Gap SDG-GP-3, see page 68) and

the interconnection between the different goals and targets (Gap SDG-GP-4, see page 69) requires research that depends to a large extent on EOs. Policy development requires tools to assess the future policy impacts. Understanding of interdependencies between goals is currently limited and tools for policy developments are lacking. Taking a nexus approach provides a methodology to assess the interdependencies.

SDG Interdependencies: *It is recommended that a comprehensive assessment of interdependencies between different SDGs and the associated targets be conducted to ensure that synergies are exploited and detrimental interactions are avoided.*

Implementation of the SDGs is hampered by the lack of methodologies and tools to create and validate transformation knowledge (Gap SDG-GP-0, see page 68), required to develop policies and actions that can divert the current system trajectory such that progress towards the SDGs and associated targets is made. In the context of the developing field of sustainability science, there is an urgent need to develop tools that can be used to create transition knowledge and to develop epistemic concepts for the validation of this knowledge (Gap SDG-GP-5, see page 69). For the former, complex system-of-system (SoS) models can provide a means for scenario-based simulations. For the latter, so-called "real world laboratories" (RWLs) are an emerging approach. In both cases, a collaboration between EO communities, science communities and those developing and implementing policies for the SDGs is a necessity.

Policy Development: *It is recommended that tools for scenario-based creation of transition knowledge and policy impact assessments be developed in support of policy development. Of particular interest are tools that can answer "What if" questions and support scenario-based simulations.*

Policy Validation: *It is recommended that a concept of "Real-World Laboratory" be developed, including the required traditional and emerging EO elements, for the validation of policies developed and implemented to achieve progress towards specific SDG targets.*

In the **TDT2**, a large number of documents were reviewed. The review resulted in 145 gaps added to the CGT. In many cases, theme-specific EVs could be identified, but the link to specific observational requirements is often lacking.

Observational Requirements: *It is recommended that best practices for the process leading from the identification of EVs to the specification of observational requirements be developed and promoted.*

In the **BUT1**, the main source for the identification of gaps was a survey conducted in EO and user communities. Most of the issues identified by the participants were in the field of data coverage and data access, as well as obstacles hampering data exploitation. In terms of unmet needs, the participants indicated direct data download in harmonized formats and portals offering both discovery and access to data as common issues. Other common needs referred to higher spatial and temporal resolutions of datasets.

In the **BUT2**, the comparison of an Observation Inventory (OI) established with the help of the DAB and additional enrichment tools to a set of generic observational requirements showed that most of the entries in the OI did not meet the requirements for spatial and temporal resolutions. However, no specific gaps were added to the CGT.

In the **BUT3**, five specific industry-driven challenges were addressed. Common to all challenges was the need for improved data access and the harmonization of semantics and the lack of collaboration across stakeholders, disciplines, and societal sectors.

Data access: *It is recommended that efforts to improve data access, particularly direct data access through discovery portals, be continued as a core focus of GEOSS.*

Semantic Harmonization: *It is recommended that efforts to harmonize data-related semantics be significantly elevated to improve data discovery, integration, and usability.*

Cross-Domain and Cross-Sector Collaboration: *It is recommended that additional efforts be made to increase collaboration between stakeholders in different disciplines and societal sectors using complex issues such as the Food-Water-Energy Nexus and the interdependency of SDGs as a catalyst to trigger the collaboration, and building upon efforts such as ENEON.*

The "Industry energy challenge" demonstrated that building a platform can increase data access and use and bring stakeholders together. However, extra efforts were found to be necessary to identify, convince, access and connect private sector data. It was indicated that ENEON could play a role here.

The "In-situ data compatible to satellite mission challenge" built on results from several European projects and identified a number of functional gaps of generic type in in-situ data. Among them were insufficient geographical and temporal coverage required to meet the needs of Cal/Val applications and the lack of complete uncertainty and covariance matrices required for error propagation and comparisons. The lack of metadata harmonization and supportive data policies were identified as obstacles to data access and exchange. Data documentation is found to be often incomplete limiting traceability and data governance. Moreover, parameters are often missing or cannot be extracted from the monitored EVs.

In-Situ Observations: *It is recommended that an elaborate effort be made to improve the documentation, coverage, access, and quality of in-situ data with particular focus on the needs of satellite-based observations. It should be assess to what extent ENEON could play a role in this effort.*

The "In-situ integration into the CGI challenge" addressed the lack of interoperability for discovery, access and use of data from new systems with the GCI.

The "Private sector challenge "European EO Product of the year"" addressed the lack of involvement of the private sector in GEO activities. A competition for the "product of the year" award was utilized to stimulate increased involvement. It was noticed that the participants in this competition in general did not make use of the GCI to discover or access data.

The "Interdisciplinary cooperation on the food-water-energy nexus (FWEN)" challenge focused on a review of documents related to the FWEN. Main issues identified include a lack of collaborations across relevant disciplines and across the societal sectors. The study also revealed that GEOSS has limited capabilities to support theme-based approaches and that there is a missing link between relevant stakeholder communities in industry and science. Importantly, there is a lack of coordination mechanisms to establish links between different networks providing data in support of addressing the FWEN. The nexus approach is found to be very valuable to address complex issues and could be a model for other complex challenges. Using recommendations made for the FWEN, generic recommendations for the implementation of the SDGs from a nexus point of view can be developed.

Nexus Indicators: *It is recommended that a nexus approach be used to address SDG interdependencies and to develop nexus-based indicators that account for the complexity of the interdependencies.*

Nexus Tool Box: *It is recommended that appropriate data and information systems and diagnostic tool boxes be developed that support a nexus approach to interdependencies between SDGs.*

The statistics of the gaps collected in the CGT show that most gaps are associated with the Climate theme followed by the Ocean theme. This uneven distribution indicates that the two communities in the fields were more active than other communities. Most of the identified gaps resulted from TDT2, which shows that a review of documents prepared by major international communities is an important source for the identification of gaps.

The lack of coordination between, and collaboration of, stakeholders across disciplinary and sectoral boundaries is recognized as a major obstacle for the full exploitation of traditional and emerging EOs. There is a significant lack of policy frameworks that explicitly address the coordination required by complex nexus issues as exemplified by the FWEN. In many cases, complex issues are not addressed from a nexus point of view but rather segmented and distributed of several governmental departments, with little collaboration across departmental boundaries.

ENEON has made an effort to map the landscape of the EO networks and research infrastructures in Europe. Equally important is to map the landscape of societal stakeholders and users who depend on knowledge created on the basis of EOs. It is anticipated that the GEO Foundational Task on User Needs and Gap Analysis can contribute to this mapping effort.

Mapping Societal Landscape: *It is recommended that the societal landscape of beneficiaries, users, and applications depending on EO-based knowledge be mapped as a basis for matching users to providers.*

There is a need to develop capacity and skilled experts for bringing together providers and users (match-making). This is expressed in Gap SDG-GP-6 ("Skills required for matching providers and policy makers," see page 65). While there are funding programs that aim at regional mobility (in space) there appears to be a lack of programs that facilitate mobility across disciplinary and sectoral boundaries.

Mobility: *It is recommended that mobility funding programs such as the Marie Sklodowska-Curie Individual Fellowships emphasize mobility across disciplinary and sectoral boundaries with the goal to increase skills in*

matching providers and users.

Finally, it was the intent to propose the gap analysis and prioritization approach developed in ConnectinGEO to GEO. A step in this direction is the integration of the approach into the SEE-IN KB, which provides a basis for the GEO Fundamental Task on Unser Needs and Gap Analysis.

GEO Gap Analysis and Prioritization: *It is recommended that the ConnectinGEO approach to gap analysis and prioritization is further developed by the GEO Foundational Task on User Needs and Gap Analysis and used as a standard approach to detect and prioritize gaps in the GEO communities.*

1 Introduction

1.1 Scope of the Deliverable

One of the objectives of the *Coordinating an Observation Network of Networks EnCompassing saTellite and IN-situ to fill the Gaps in European Observations (ConnectinGEO)* project is to provide a prioritized list of gaps relevant to GEO and to provide recommendations to funding agencies concerning options to address these gaps. This list is presented in the present project Deliverable. Prioritizing of the 235 gaps identified in the project has been based on two approaches discussed below.

The approach to gap analysis developed in the ConnectinGEO project is described in Deliverable 6.1, which defines five threads for the gap analysis and specifies the format of the resulting *ConnectinGEO Gap Table (CGT)*. These threads have been used in several ConnectinGEO Work Packages. The preliminary results of the gap analysis are discussed in Deliverable 6.2. The results of the gap analysis are compiled in the CGT, which is available at http://-twiki.connectingeo.net/foswiki/bin/view/ConnectinGEOIntranet/GapAnalysisTable?cover=print. The results are also available in the *Socio-Economic and Environmental Information Needs Knowledge Base (SEE-IN KB)*, where further analyses can be conducted. The SEE-IN KB is accessible at http://www.seeinkb.net.

In the present deliverable, we discuss several approaches to prioritization of gaps. Two different methods were used to extract a low number of gaps of high priority from the set of 235 gaps identified in the project. It turns out that each approach has its own strengths and weaknesses, and the resulting prioritizations show significant deviations between the two approaches. It is clear that more work needs to be done to develop a more robust methodology for prioritization.

1.2 Structure of the Document

In the next section, the findings of gap analysis and prioritization are reported and discussed. This section is an updated version of a similar section in Deliverable 6.2. The subsequent sections provide details on the result of gap analysis, as well as the approach to, and results of, prioritization. The statistics of the 235 gaps are discussed briefly in Section 3, including the distribution of gaps across threads, themes, *Essential Variables (EVs)*, and gap types. Section 4 discusses the results of two approaches to prioritization, i.e., one that uses feasibility, impact, cost and time frame to compute a priority parameter (Section 4.1), and one that uses input from experts to identify high-priority gaps (Section 4.2). In Section 2.4, opportunities for companies to address some of the gaps are highlighted. Section 5 provides the prioritized lists of gaps based on two approaches. Section 5.1 list those gaps that have a high priority parameter value based on feasibility, impact, cost and time frame. The gap instances identified by experts to have high priority are grouped based on the number of experts identifying them as high priority gaps. Group 1 includes the six gaps with three or more votes (Section 5.2), group 2 the 12 gaps with 2 votes (Section 5.3), and group 3 those identified by one expert (Section 6.1). After each gap, all instances are listed to which this gap instance is linked to, including the gap analysis thread, one or more themes, one or more EVs, reviews, recommendations, and traces.

Section 6 compiles instances other relevant groups including several gaps mentioned in the document, gap analysis threads, themes, EVs, reviews, recommendations, and traces. Here we also in other gaps mentioned in this document are listed in group 4 (Section 6.1).

Finally, Section 7 lists the controlled vocabularies used for several of the attributes of gap instances, including gap type, feasibility, impact, costs, time frame, gap status, and priority.

2 Summary of Findings

This section combines the findings reported in Deliverable 6.2 with the new findings resulting from the prioritization. This provides a complete picture of the findings of WP 6 in the ConnectinGEO project.

The ConnectinGEO approach to gap analysis and prioritization of gaps has been shown to be capable of identifying and prioritizing gaps in different categories ranging from data resolution, extent, quality, management, documentation, access, and sharing to conceptual and organizational aspects. The list of gaps identified in the project reflects expected biases towards selected themes and groups of EVs resulting from a broader participation of experts in these themes. However, a number of gaps emerged that are prevalent across domains. Taking into account the bias towards certain domains, the prioritized lists of gaps can inform the discussion of where to focus efforts to improve *Earth Observation (EO)* activities and the availability of information derived from EOs.

The ConnectinGEO approach is applicable to all themes and disciplines and it is expected that a broader application of the approach will lead to improved and more comprehensive lists of prioritized gaps. The approach for gap analysis and prioritization of gaps developed in the project will be proposed to *Group on Earth Observations (GEO)* as a template for gap analysis and prioritization. The GEO Foundational Task on User Needs and Gap Analysis is expected to build upon the outcomes of the ConnectinGEO Project. Therefore, the approach developed in the project and the results obtained have been implemented in the SEE-IN KB, which is utilized by the GEO Foundational Task.

2.1 Relevance of Gaps

In all threads, two common gaps were identified that can significantly limit the exploitation of EOs and the realization of the societal benefits:

- The lack of access to data and harmonization of data semantics are two common gaps identified in most threads.
- The lack of collaboration between stakeholders across disciplines and societal sectors is a gap that appears in almost all thread.

Particularly for complex issues such as the FWEN, there is a lack of collaborations across disciplines and domains relevant to the issue. GEOSS has limited capabilities to support a theme-based approaches to data and product discovery. Particularly for in-situ observations, there are currently no coordination mechanism to establish links between different observing networks to address a complex issue.

For the SDGs, three primary issues were identified:

- Understanding and monitoring progress towards the SDG targets requires comprehensive information on the built environment and the embedded social fabric. The question to what extent such information can be extracted from EOs, potentially in combination with Big Data analyses, citizen science data, and crowdsourcing needs to be addressed.
- There is an urgent need to integrate socio-economic and environmental data such that the integrated data base can be used to aggregate indicators and to support model simulations for policy development. However, the strategy for exploiting these opportunities does not exist.
- The complexity and interdependency of the SDGs requires new tools to generate the transformation knowledge required for the implementation of the SDGs. Of importance are modeling tools that can answer "What if" questions and support scenario-based simulations. The integration of a comprehensive data base with modeling tools such as agent-based and equation-based models in a GeoDesign approach can provide important parts of such a toolbox.

At regional and global levels, additional independent monitoring capabilities are needed to meet the knowledge needs associated with complex issues such as the FWEN and the relevant SDGs. This includes in-situ observations

as well as new approaches, such as Big Data, crowd-sourcing and citizen science. A central knowledge platform could address multiple needs including those associated with the SDGs including the interdependencies between them. Such a knowledge platform also would provide a basis to take a nexus approach to complex issues linking several goals together.

Concerning the SDG indicators, is has to be emphasized that the current indicator framework focuses on final results and not on the systemic properties that are relevant to these results. Most of the indicators are focused on socio-economic aspects while environmental aspects and their impacts on the social fabric are underrepresented. As currently defined, the indicators provide limited report cards and target outcomes for simulations required for policy development, but they do not inform the simulation tools urgently needed to support policy development. Importantly, a validation of the indicators with respect to their relevance to the goals and targets is needed.

For the indicators, information needs to be aggregated to national and global scales and accumulated over several years. For implementation of the targets and for addressing complex issues and interdependencies, disaggregated data are required. It is challenging to bring these two types of together, and it needs to be studied whether the knowledge platform can help to address this challenge.

In addition to data needs for the quantification of the indicators, there is a need to increase modeling capabilities to create the transformation knowledge for the implementation of the targets. Systems have to be identified or developed that can combine modeling and observations in a way best suited to meet the needs of the SDG implementation taking into account the complexity arising from the interdependencies between the goals.

There is a significant lack of policy frameworks that explicitly address the coordination required by complex issues such as the FWEN. In many cases, complex issues are not addressed from a nexus point of view but rather segmented and distributed of several governmental departments, with little collaboration across departmental boundaries. If the process of implementing the SDGs would take a nexus-focused approach, it could be instrumental in supporting transformative changes at different levels. To achieve this, local communities and stakeholder groups have to be involved in steps towards implementation and monitoring of progress, as well as the processes of developing meaningful indicators. The FWEN could be a model case providing guidance on how to achieve the relevant SDGs of a nexus.

For the EO communities, an important question is how to provide information that could support the governments in their quest for the SDGs. While the provision of data for the quantification of indicators is an important contribution, of equal importance is the support of policy development for SDG implementation. For that, an environment needs to be created that enables the integration of EOs, models and simulation tools for the assessment of policy options.

2.2 Prioritized Gap List

We determined two prioritized gap lists based on the two approaches discussed in Section 4. Although the two approaches resulted in two different lists, these lists are of value for the prioritization of resources to address the many gaps identified in the project.

For most of the prioritized gaps, remedies have been identified and included in the instances. These remedies can be found in the gap listings.

Using feasibility, impact, cost and time frame to compute a priority parameter p was possible for a limited number of gaps, because the required four variables were often not available. Thus, other gaps might have scored high if the variables had been quantified. Gap CGT-174 ("Lack of continuity and uniform temporal sampling in time series," see page 25) resulted in the highest p value of $p = 16$. In many cases, this gap can easily be addressed by changing operational practice and increasing awareness. Changes of sampling rates and coordination of sampling across networks could address most of the problems.

Four gaps had parameter values $p = 12$. Gap CGT-175 ("Lack of tidal, ocean currents and water elevation prediction services," see page 25) could be addressed by sharing of available models and setting up operational services. Gap CGT-176 ("Lack of tools for Big Data analysis: merge time series, proper map and statistics visual representation," see page 60) refers more to the analysis of big data amounts than the original meaning of the term, which includes the extraction of information from huge amount of data available on the *World-Wide Web (WWW)*.

Solutions could be easily implemented through improved data management and the adding of tools to the data. For both CGT-175 and CGT-176, implementing operational processes and creating awareness are recommended remedies.

Gap SDG-GP-2 ("Insufficient accounting for environmental variables in SDG indicators," see page 64) requires a through review of the SDG indicators, and GEO could use its convening power to organize a process involving relevant scientific communities to address this problem. Gap SDG-GP-6 ("Skills required for matching providers and policy makers," see page 65) relates to the lack of matching between users and providers. As already pointed out in D6.2, this gap could easily be addressed by existing educational and professional programs by emphasizing cross-sectoral mobility.

As detailed in Section 4.2, the experts participating in the prioritizing of gaps expressed concerns about being able to assess the priority of gaps outside of their own domain. Although there appears to be a bias of experts to prioritize gaps in their own discipline, the resulting list of gaps shows a small number of gaps that received a high priority from three or more out of the nine experts.

Based on expert assessments, gap CGT-23 ("LIDAR global dataset," see page 30) reached the highest ranking. This gap aims at the estimation of biomass globally and with a good resolution as a basis for understanding carbon sequestration in forestry on a global scale.

Two gaps were listed by four experts. Gap CGT-92 ("Lack of sufficient spatial coverage for many climatic applications, specially in the Southern hemisphere," see page 31) emphasizes the need for observations of *Essential Climate Variables (ECVs)* with sufficient spatial coverage including the Southern hemisphere, where data coverage is often incomplete. Gap CGT-219 ("No European in-situ cross-domain coordination initiative," see page 31) relates to the insufficient coordination of observations across domains that would lead to a much better exploitation of data and responsiveness to information needs. *European Network of Earth Observation Networks (ENEON)* is making an attempt to address this gap.

Four gaps were identified by three experts as high priority gaps. Gap CGT-43 ("Scarcity of accurate in situ measurements in most of the world. Large networks measuring radiation, such as GAW, BSRN have a limited coverage. National meteo networks are by definition limited and in addition, many of them do not measure radiation, except sunshine duration," see page 32) addresses the need for more complete in-situ networks. This is a gap that the GEO Foundational Task on GEOSS in-situ resources will have to consider in more detail. Gap CGT-45 ("Scarcity of accurate in situ measurements in coastal areas for marine renewable energies. Bathymetry, type of floor, tides, swell, currents," see page 33) also address a need for more in-situ observations. It is mentioned here that these observations would serve many other purposes in addition to marine renewable resources, for examples, improved storm surge modeling and predictions. Currently, companies must invest in very costly campaigns for collecting data on local bathymetry, type of floor, swell etc. These campaigns must last approx. 1 year and are very expensive, especially outside of Europe. Gap CGT-185 ("Ice sheet, Ice sheet mass change - requires knowledge of basal melt, surface melt, accumulation, velocity, calving rate," see page 33) identifies a gap that hampers many climate impact assessments, in particular, a better understanding of how much the ice sheets are contributing to present-day sea level rise and which processes are involved in this contribution. Gap CGT-222 ("Missing high resolution data for terrestrial ecosystems structure and terrestrial ecosystems function," see page 34) has many implications ranging for the understanding of the loss in biodiversity to the accounting for ecosystem services in economic considerations.

This discussion of the prioritized gaps shows that despite the concerns expressed by the participating experts the gaps that emerged with highest priority appear to be agreeable as gaps that need attention and investments in remedies.

2.3 Relevance for ENEON

The need for cross-discipline and cross-sectoral coordination on regional level has been emphasized by the work of the GEO Foundational Task GD-09 (Plag & Masó, 2016). The need for coordination on European level is reflected in gap CGT-219 ("No European in-situ cross-domain coordination initiative"). Several other gaps underlined the need for improved interactions and communication between the providers and users. ConnectinGEO has made an effort to map the landscape of the EO networks and relevant research infrastructure and coordination mechanisms

in Europe (see Deliverable 6.2). With the establishment of ENEON, a new coordination component has been added, which could participate in the matchmaking between societal users and the European EO communities.

As emphasized in D6.2, while ConnectinGEO has developed both the coordination mechanism and the map of the landscape for the provider side, there is a lack of these elements on the user side. It would be important that GEO in its effort to map users and user requirements would focus on mapping the user landscape and identifies coordination mechanisms that could provide an entry point for matchmaking. It is also recommended to develop use cases that require matching and coordination across disciplinary and sectoral boundaries to demonstrate the validity of the approach sketched in. The FWEN could be an excellent starting point for such a use case.

A particular gap identified is the lack of experts that have the acquaintance with, and understanding of, both sides of the matchmaking. This impacts in particular the use of EO for the implementation and monitoring of SDGs. The lack of mobility between societal sectors and the lack of educational efforts to create this mobility are reasons for the limited number of experts that can work and communicate across societal sector boundaries. This is reflected in gap SDG-GP-6 ("Skills required for matching providers and policy makers," see 65).

The existing mobility programs, such as *Marie Sklodowska-Curie Actions (MSCA)*, aim mainly at geographical and inter-cultural mobility. There is a lack of programs that would encourage mobility across disciplinary and sectoral boundaries. It is recommended that the European Commission makes an effort to extend existing mobility programs to also facility mobility across disciplinary and sectoral boundaries.

2.4 Gaps and Business Opportunities

This section assesses the detected gaps from the point of view of SMEs and companies interests. It identifies a short list of topics where companies could focus, that will help in covering some of the gaps and at the same time create business opportunities.

An important part of the gaps detected refers to the lack of the absence of measures, lack of spatial resolution or lack of temporal resolution. Companies should work towards operationalizing novel in-situ sensors that are based on miniaturized devices and microelectronics advances that might reduce the cost of versus the previous sensors deployed. This will favor opportunities for new measurements or more dense deployments of sensors. Automatic sensors that are connected to centralized databases can increase the temporal resolution. A set of tailored-made novel in-situ observation methods could enable companies to modernize and optimize processes.

The possibility of building and commercializing novel in-situ constitutes an opportunity for companies specialized in sensors that can be easily deployed on the field. To make that possible, companies need to guarantee a good level of accuracy and precise quantification of uncertainties (many gaps detected mention concerns about the lack of uncertainty measurement or unacceptable uncertainty levels).

The lack of standardization of data and interoperability of procedures creates another opportunity for companies (see Gaps CGT-70 on page 66, CGT-200 on page 67 and CGT-201 on page 62). Users have concerns about being lock to a particular tool or technology and want to prevent data silos. Companies should work with standard bodies, such as IEEE and OGC, to agree on a common set of standards for in-situ observations and protocols to retrieve them. The implementations of these standards could bring a competitive advantage to the companies implementing them.

From EARSC recent study on MAEOS, the market for EO services is changing rapidly. Up to now it has largely been driven by bespoke services; one product, one customer. The advent of many new data sources, an operational Copernicus system, cloud services, and better and faster processing capabilities are making possible the delivery of real on-line services, where all transactions are online and one product can be subscribed to by many customers.These issues have been also addressed in the gap analysis with the lack of computer resources (Gap CGT-176, page 60) and fast networks to address big data analytics (Gaps CGT-173, page 67 and CGT-206, page 63). Create the necessary distributed computer infrastructure in Europe has been detected as a priority for the new European Digital Economy and the EC has decided to enhance access to the Copernicus data and information through the DIAS call (Copernicus Data and Information Access Service) which will enable improved access to Copernicus data and informationand will address a common need for ICT services to make data available next to computing resources that allow value extraction and inter alia be offered on a commercial basis.

The infrastructure should be accompanied by the necessary software to analyze and visualize the results of the analysis and companies will contribute to create a distributed computational infrastructure and to provide products and services to analyze EO big-data. In that sense, no easy access to and high costs of EO measurements can prevent SMEs to exploit this resources (Gap CGT-44, 46).

Access to geological information is essential for every government, in order to assess the countrys mineral potential. It is also a cornerstone for attracting new investors to the countrys mining sector. If the lack of EO-based mineral resources datasets (Gap CGT-18, page 66) is solved, this could open an opportunity for companies that can use these datasets to detect ideal places for exploitation of them. Straightforward and comprehensive access to geological and mineral information is a key element in promoting and developing the mineral resources sector where consultancy companies should look at what is currently possible to do with EO and incorporate data products that can increase their capabilities and reliability of their reports. Other companies should look at EO data as another source of information for designing natural resources exploitation campaigns.

Industry should have a proven business case to contribute to the *Sustainable Development Goals (SDGs)*. Mining and raw material extraction could contribute to many of the SDGs and need to address environmental degradation, displacement of populations, and risk of many health problems. The EO industry might help the mining industry to go through the different phases of the processes including exploration, production, and eventually mine closure. Those SDGs directly impacted include SDG6 (Clean Water and Sanitation), SDG7 (Affordable and Clean Energy), SDG8 (Decent Work and Economic Growth), SDG9 (Industry, Innovation, and Infrastructure), SDG13 (Climate Action) and SDG15 (Life on Land).

Disasters risk reduction (Gap CGT-38, page 46) and emergency events assessment and mitigation (Gap CGT-20, page 35) are other applications of EO data. Companies should provide civil protection expert systems based on EO data (combined with other sources, i.e. socio-economic data) for dealing with all phases of disaster events. Monitoring for Intelligence and Early Warning, Border security and Crisis situation are some examples for the main security needs. Analysis of potential threats and continuous monitoring for objects and events which could act as a trigger for incoming crises is required.

The necessary data to determine the best place to deploy renewable energy power plants and the data that helps to estimate its energy production potential (Gap CGT-45, page 33) is crucial for the renewable energy sector. Disruptions to the energy sector from extreme events often occur over large geographic areas and have huge economic impacts. Therefore, improvements in measurements related to weather and climate, are virtually certain to provide direct benefits to the energy sector.

Many countries have introduced increasing percentages of renewables in their energy balances future objectives and competing energy companies collect weather and climate data that they view as sensitive proprietary information. Increased availability of these data would likely improve forecast skill and facilitate integration of a wide variety of energy resources. Policies to encourage the sharing of data, while still protecting the business interests of private-sector companies, have considerable potential to benefit the energy sector by creating business opportunities in the sector

The LiDAR Market size is expected to reach USD 1.1 billion by 2023, according to a new research report by Global Market Insights, Inc. The industry is characterized by key notable players offering advanced, diverse and cost-effective solutions which in cooperation with space agencies could investigate a mission on global LIDAR coverage (Gap CGT-23, page 30). This gap has been identified by several experts as a high-priority gaps (see Section 5.2). For example, rising the need of accurate elevation data for roads and construction projects for validating initial quantity estimates would support the civil engineering demand, among other sectors. Multi viewpoint data collection, greater degree of efficiency, and increasing number of projects on a global scale will positively impact revenue across various industry applications.

3 Gap Statistics

A total of 235 gaps have been identified and added to CGT. Here we comment on the distribution of gaps over gap types, themes, threads, and EVs.

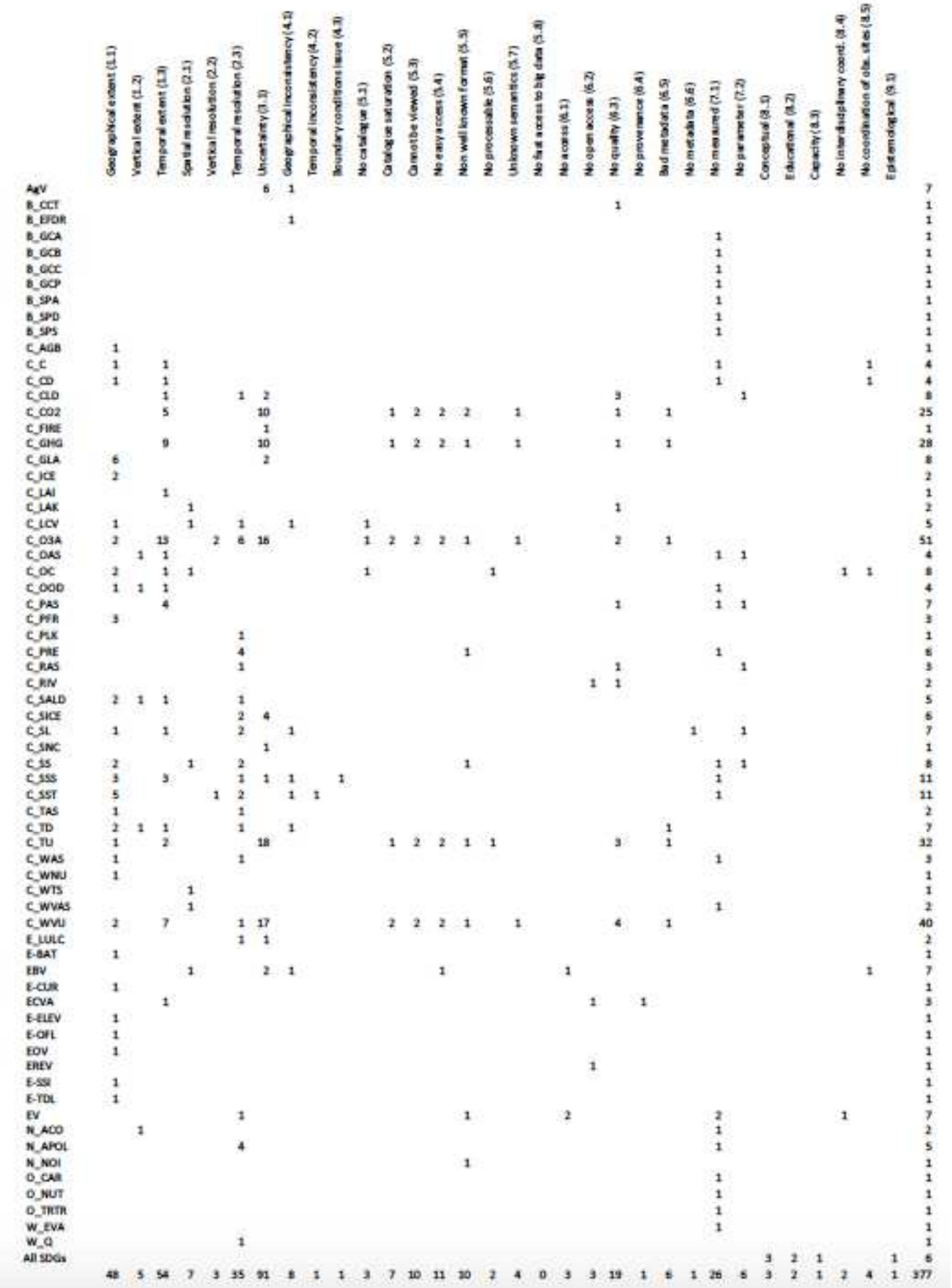
Figure 1 shows the distribution of the gaps in a matrix of EVs and gap types. Note that the total in the lower right corner of this figure does not correspond to the number of gaps due to the fact that several gaps are relevant for more than one EV. In most cases, the gaps are evenly distributed over the EVs and gaps types with a few notable exceptions. The EVs C_TU (Temperature, Atmosphere upper-air) and C_WVU (Water Vapor, Atmosphere upper-air) have 18 and 17 gaps, respectively, related to uncertainties. C_O2 ("Carbon dioxide", Atmosphere composition") and C_GHG ("Methan, and other long-lived greenhouse gases") have ten gaps each related to uncertainties. The EV C_O3A (Ozone and aerosol, Atmosphere composition) has sixteen gaps related to uncertainties and in addition thirteen gaps that relate to the temporal extent, i.e., the length of observations.

Table 1 summarizes the gap distribution over gap type. 91 gaps address the lack of uncertainty information or inaccurate uncertainties, and this is the gap type with the large number of gaps. The spatial and temporal extent are other data characteristics that score many gaps. In total, 102 gaps address these two gap types. In 35 cases, the gaps address temporal resolution of the data. There are still some concerns about data access issues and these are reflected in 31 gaps. 26 gaps reflect concerns about EVs that are not measured, mainly in the biodiversity theme and to a lesser amount in the ocean and atmospheric composition themes. The lack of quality measures is also a concern with 18 gaps addressing this gap type.

Most gaps (in total 112) are related to the theme "Climate" (Table 2, left), which also explains why several ECV scored high numbers of gaps. In 63 cases, gaps were associated with multiple themes. The themes of "Biodiversity" and "Ocean" are associated with 13 and 12 gaps, respectively, while all other themes are only associated with a small number of gaps. The theme "Health" did not appear explicitly in any of the gaps. This is only due to the fact that the health community was not involved in identifying the gaps.

Most of the gaps were identified in thread TDT2, i.e., based on review of literature with focus on documents produced by international programs. This thread accounts for 145 of the 235 gaps. The consultation process of BUT1 contributed 44 gaps and the goal-based approach applied in TDT1 yielded 37 gaps. However, these numbers do not provide an assessment of the threads. They reflect more the level of activities associated with the individual threads and the ability to engaged additional outside resources for the gap analysis.

Individual EVs that scored high numbers of gaps (Table 3) include C_O3A ("Ozone and aerosol," Atmosphere composition), C_WVU ("Water vapour," atmosphere upper air), C_TU ("Temperature," atmosphere upper air), and C_GHG "Methan, and other long-lived greenhouse gases").



	Geographical extent (1.1)	Vertical extent (1.2)	Temporal extent (1.3)	Spatial resolution (2.1)	Vertical resolution (2.2)	Temporal resolution (2.3)	Uncertainty (3.1)	Geographical inconsistency (4.1)	Temporal inconsistency (4.2)	Boundary conditions issue (4.3)	No catalogue (5.1)	Catalogue saturation (5.2)	Cannot be viewed (5.3)	No easy access (5.4)	Non well known format (5.5)	No processable (5.6)	Unknown semantics (5.7)	No real access to big data (5.8)	No access (6.1)	No open access (6.2)	No quality (6.3)	No provenance (6.4)	Bad metadata (6.5)	No metadata (6.6)	No measured (7.1)	No parameter (7.2)	Conceptual (8.1)	Educational (8.2)	Capacity (8.3)	No interdisciplinary coord. (8.4)	No coordination of obs. sites (8.5)	Epistemological (9.1)	
AgV							6	1																									7
B_CCT																					1												1
B_EFDR								1																									1
B_GCA																									1								1
B_GCB																									1								1
B_GCC																									1								1
B_GCP																									1								1
B_SPA																									1								1
B_SPD																									1								1
B_SPS																									1								1
C_AGB	1																																1
C_C	1		1																						1						1		4
C_CD	1		1																						1						1		4
C_CLD			1			1	2														3					1							8
C_CO2			5				10					1	2	2	2		1				1		1										25
C_FIRE							1																										1
C_GHG			9				10					1	2	2	1		1				1		1										28
C_GLA	6						2																										8
C_ICE	2																																2
C_LAI			1																														1
C_LAK				1																	1												2
C_LCV	1			1		1		1			1																						5
C_O3A	2		13		2	6	16				1	2	2	2	1		1				2		1										51
C_OAS		1	1																						1	1							4
C_OC	2		1	1							1					1															1	1		8
C_OOD	1	1	1																						1								4
C_PAS			4																		1				1	1							7
C_PFR	3																																3
C_PLK						1																											1
C_PRE						4									1										1								6
C_RAS						1															1					1							3
C_RIV																				1	1												2
C_SALD	2	1	1			1																											5
C_SICE						2	4																										6
C_SL	1		1			2		1																1		1							7
C_SNC							1																										1
C_SS	2			1		2									1										1	1							8
C_SSS	3		3			1	1	1		1															1								11
C_SST	5				1	2		1	1																1								11
C_TAS	1					1																											2
C_TD	2	1	1			1		1															1										7
C_TU	1		2				18					1	2	2	1	1					3		1										32
C_WAS	1					1																			1								3
C_WNU	1																																1
C_WTS				1																													1
C_WVAS				1																					1								2
C_WVU	2		7			1	17					2	2	2	1		1				4		1										40
E_LULC						1	1																										2
E-BAT	1																																1
EBV				1			2	1						1					1												1		7
E-CUR	1																																1
ECVA			1																	1		1											3
E-ELEV	1																																1
E-OFL	1																																1
EOV	1																																1
EREV																				1													1
E-SSI	1																																1
E-TDL	1																																1
EV						1									1				2						2					1			7
N_ACO		1																							1								2
N_APOL						4																			1								5
N_NOI															1																		1
O_CAR																									1								1
O_NUT																									1								1
O_TRTR																									1								1
W_EVA																									1								1
W_Q						1																											1
All SDGs																											3	2	1			1	6
	48	5	54	7	3	35	91	8	1	1	3	7	10	11	10	2	4	0	3	3	19	1	6	1	26	6	3	2	1	2	4	1	377

Figure 1. Distribution of gaps over gap types.

Table 1. Distribution of gaps over gap type.

Gap Type	No of Gaps
Geographical extent (1.1)	48
Vertical extent (1.2)	5
Temporal extent (1.3)	54
Spatial resolution (2.1)	7
Vertical resolution (2.2)	3
Temporal resolution (2.3)	35
Uncertainty (3.1)	91
Geographical inconsistency (4.1)	8
Temporal inconsistency (4.2)	1
Boundary conditions issue (4.3)	1
No catalogue (5.1)	3
Catalogue saturation (5.2)	7
Cannot be viewed (5.3)	10
No easy access (5.4)	11
Non well known format (5.5)	10
No processable (5.6)	2
Unknown semantics (5.7)	4
No fast access to big data (5.8)	0

Gap Type	No of Gaps
No access (6.1)	3
No open access (6.2)	3
No quality (6.3)	19
No provenance (6.4)	1
Bad metadata (6.5)	6
No metadata (6.6)	1
No measured (7.1)	26
No parameter (7.2)	6
Conceptual (8.1)	3
Educational (8.2)	2
Capacity (8.3)	1
No interdisciplinary coord. (8.4)	2
No coordination of obs. sites (8.5)	4
Epistemological (9.1)	1

Table 2. Distribution of gaps over themes (left) and threads (right).

Theme	No. Gaps
Climate	112
Ocean	12
Water	4
Biodiversity	13
Disaster	6
Energy	5
Health	0
Agriculture	7
Human Settlements	1
Multiple	63
All themes	6
SDGs	8

Thread	Code	No. Gaps
Thread 1	TDT1	37
Thread 2	TDT2	145
Thread 3	BUT1	44
Thread 4	BUT2	0
Thread 5	BUT3	9

Table 3. Distribution of gaps over EVs.

EV	No. Gaps
All EBV	7
B_GCC	1
B_GCA	1
B_GCP	1
B_GCB	1
B_SPD	1
B_SPA	1
B_SPS	1
B_CCT	1
B_EFNP	1
B_EFDR	1
ECVA	3
C_TAS	2
C_WAS	3
C_WVAS	3
C_PAS	1
C_RAS	3
N_APOL	5
N_ACO	2
C_TU	35
C_WNU	1
C_WVU	43
C_CLD	8
C_CO2	28
C_GHG	31
C_O3A	57
C_PRE	5
C_SST	11
C_SSS	11
C_SL	7
C_SS	8
C_SICE	6
C_C	4
C_OC	10
C_OAS	5

EV	No. Gaps
C_PLK	1
C_TD	8
C_SALD	5
C_CD	4
C_OOD	4
C_RIV	2
C_WTS	1
C_LAK	2
C_SNC	1
C_GLA	8
C_ICE	2
C_PFR	3
C_LCV	5
C_LAI	1
C_AGB	1
C_FIRE	1
EOV	1
O_NUT	1
O_CAR	1
O_TRTR	1
AgV	7
EREV	1
E-SSI	1
E_LULC	2
E-ELEV	1
E-TDL	1
E-CUR	1
E-BAT	1
E-OFL	1
W_EVA	1
W_Q	1
EV	7
N_NOI	1
SDG-ALL	7
HS_ALL	1

4 Prioritizing Gaps

Prioritization is a process that has to involve community deliberations leading to a consensus of what to prioritize. However, the deliberations can be informed by ranking schemes. Moreover, the deliberations can utilize crowd-sourcing within the relevant communities to ensure that a broad basis is engaged in the prioritizing process.

Two approaches to prioritization were utilized in the project:

- **Priority Parameter:** Feasibility together with the potential impacts a gap would have, the estimated costs and the required time frame for closing the gaps were used to compute a priority parameter that gives an indication of the how feasibility and impact relate to costs and the time needed to implement a solution.
- **Expert Assessment:** A group of experts were asked to select ten gaps that they considered to have highest priority.

These two approaches and the results of applying them are discussed in detail below in Sections 4.1 and 4.2. A third approach to prioritizing was the option of those identifying and publishing gaps in the CGT assigning a priority to each gap. However, the priorities assigned by the authors appear to be biased by personal judgments and therefore these priorities were not considered further.

In Section 6.2 of Deliverable 6.2, we introduced a gap rank based on the number of links between a gap and other instances of users, applications, research needs, etc. This rank provides valuable information if the gap is sufficiently and comprehensively linked to other instances. The current population in the SEE-IN KB does not allow yet the estimation of rank numbers. Therefore, considering the ranks derived from this approach has to await a more fully populated SEE-IN KB.

4.1 Ranking Gaps

In principle, priority can be considered to be a product of feasibility and impact divided by the product of costs and time frame, i.e., gaps with a high feasibility of the solution, a high impact if closed, low costs and short time frames for the solution should have high priority. Thus,

$$p = \frac{f \cdot i}{c \cdot t}, \tag{1}$$

with p priority, f feasibility, i impact, c costs, and t time frame. The challenge is in estimating the values of the variables f, c, i, and t. In most cases, expert estimates have to be used.

For estimating i, the knowledge of user needs can be very helpful. Based on the relevance of a gap to user needs, the potential impact of closing the gaps can be estimated. The SEE-IN KN provides an opportunity to compute a ranking based on the number of applications and users a gap is linked to. In Section 4.1 below more details on an approach to ranking are provided.

Unfortunately, for many gaps not all of these required four variables were quantified. In total, 54 gaps could be assigned a priority rank based on this approach. The gaps with highest ranks are CGT-174 ($p = 16$; "Lack of continuity and uniform temporal sampling in time series," page 25), CGT-175 ($p = 12$; "Lack of tidal, ocean currents and water elevation prediction services," page 25), CGT-176 ($p = 12$; "Lack of tools for Big Data analysis: merge time series, proper map and statistics visual representation," page 60), SDG-GP-2 ($p = 12$; "Insufficient accounting for environmental variables in SDG indicators,"page 64), and SDG-GP-6 ($p = 12$; "Skills required for matching providers and policy makers," page 65). For the other ranks, see Table 4.

4.2 Expert-Based Ranking

In order to gain experience with expert-based prioritizing of gaps, we invited experts in several fields and asked them to review the gaps collected in the CGT. They were asked to select ten gaps each that had highest priority for them. Nine experts provided responses, including their list of high-priority gaps. The resulting ranking based on the number of "votes" a gap received is compiled in Table 5.

Although the base for this experiment was with nine experts responding to the invitation very small, the results showed a strong bias of experts to prioritize gaps in their own discipline. Most of the experts expressed their bias to their own field and had concerns that they would not be able to assess the priority of gaps in other fields. However, an effort was made by most of them to overcome this bias as far as possible and focus on more generic gap types.

One expert noted that many gaps relate to insufficient coverage (spatial, or temporal) or insufficient extent (spatial, temporal) and commented that before addressing these gaps, it would be important to seriously study what resolution is needed for which application. This need is reflected in Gap CGT-110 "Need for a scientific approach for the assessment of gaps in the existing networks measuring ECVs" (see page 58). This gap needs to be addressed with high priority to avoid unnecessary oversampling.

It was also commented that some gaps may be very difficult to remedy, because of political and organizational barriers or because of very high costs. This means that they cannot be solved by a classical research project as the result of a call in a work program. This does not mean, however, that these gaps should not consider them.

Experts also pointed out the it is very difficult to provide a ranking between gaps in different domains. For example, are biodiversity issues more or less important than atmospheric uncertainties or oceanic questions?

Based on expert assessments, gap CGT-23 ("LIDAR global dataset," see page 30) reached the highest ranking. This gap aims at the estimation of biomass globally and with a good resolution as a basis for understanding carbon sequestration in forestry on a global scale.

Two gaps were listed by four experts. Gap CGT-92 ("Lack of sufficient spatial coverage for many climatic applications, specially in the Southern hemisphere," see page 31) emphasizes the need for observations of ECVs

Table 4. Ranking based on feasibility, impact, costs, and time frame.

Gap	Rank
CGT-174	16.00
CGT-175	12.00
CGT-176	12.00
SDG-GP-2	12.00
SDG-GP-6	12.00
CGT-180	8.00
CGT-35	6.00
CGT-178	6.00
CGT-183	6.00
CGT-219	6.00
CGT-220	6.00
CGT-43	5.33
CGT-108	4.50
CGT-179	4.00
CGT-194	4.00
CGT-195	4.00
CGT-193	3.00
CGT-197	3.00
CGT-216	3.00
CGT-177	2.25
CGT-186	2.25
CGT-188	2.25
CGT-198	2.25
SDG-GP-4	2.25
SDG-GP-5	2.25
CGT-3	2.00
CGT-47	2.00
CGT-49	2.00
CGT-59	2.00
CGT-92	2.00
CGT-181	2.00
CGT-222	2.00
SGD-GP-0	2.00
CGT-45	1.77
CGT-84	1.77
CGT-94	1.50
CGT-184	1.50
CGT-221	1.50
CGT-233	1.50
CGT-50	1.33
CGT-52	1.33
CGT-58	1.33
CGT-71	1.33
CGT-88	1.33
CGT-89	1.33
CGT-185	1.33
SDG-GP-3	1.33
SDG-GP-7	1.33
CGT-46	1.00
CGT-57	1.00
CGT-189	1.00
CGT-223	1.00
CGT-23	0.50

with sufficient spatial coverage including the Southern hemisphere, where data coverage is often incomplete. Gap CGT-219 ("No European in-situ cross-domain coordination initiative," see page 31) relates to the insufficient coordination of observations across domains that would lead to a much better exploitation of data and responsiveness to information needs. ENEON is making an attempt to address this gap.

Four gaps were identified by three experts as high priority gaps. Gap CGT-43 ("Scarcity of accurate in situ measurements in most of the world. Large networks measuring radiation, such as GAW, BSRN have a limited coverage. National meteo networks are by definition limited and in addition, many of them do not measure radiation, except sunshine duration," see page 32) addresses the need for more complete in-situ networks. This is a gap that the GEO Foundational Task on GEOSS in-situ resources will have to consider in more detail. Gap CGT-45 ("Scarcity of accurate in situ measurements in coastal areas for marine renewable energies. Bathymetry, type of floor, tides, swell, currents," see page 33) also address a need for more in-situ observations. It is mentioned here that these observations would serve many other purposes in addition to marine renewable resources, for examples, improved storm surge modeling and predictions. Gap CGT-185 ("Ice sheet, Ice sheet mass change - requires knowledge of basal melt, surface melt, accumulation, velocity, calving rate," see page 33) identifies a gap that hampers many climate impact assessments, in particular, a better understanding of how much the ice sheets are contributing to present-day sea level rise and which processes are involved in this contribution. Gap CGT-222 ("Missing high resolution data for terrestrial ecosystems structure and terrestrial ecosystems function," see page 34) has many implications ranging for the understanding of the loss in biodiversity to the accounting for ecosystem services in economic considerations.

Table 5. Prioritization of gaps based on expert assessments.

Gap No.	Type	Votes
CGT-23	1.1	5
CGT-92	1.1	4
CGT-219	8.4	4
CGT-43	1.1	3
CGT-45	1.1	3
CGT-185	1.1	3
CGT-222	2.1	3
CGT-10	2.3	2
CGT-17	4.1	2
CGT-20	6.1	2
CGT-84	1.2	2
CGT-94	7.1	2
CGT-95	8.5	2
CGT-108	5.1	2
CGT-205	2.3	2
CGT-216	2.3	2
CGT-220	8.4	2
CGT-223	4.1	2
CGT-226	3.1	2
CGT-3	2.3	1
CGT-8	2.3	1
CGT-9	2.3	1
CGT-11	2.3	1
CGT-14	2.3	1
CGT-19	6.3	1
CGT-26	1.1	1
CGT-27	1.1	1
CGT-35	8.5	1
CGT-38	7.1	1
CGT-44	6.2	1
CGT-46	2.3	1
CGT-47	4.1	1
CGT-50	7.1	1
CGT-59	4.1	1
CGT-71	2.1	1
CGT-72	1.1	1
CGT-79	5.1	1
CGT-80	8.4	1
CGT-87	1.1	1
CGT-88	1.1	1
CGT-89	1.3	1
CGT-93	1.3	1
CGT-106	3.1	1
CGT-107	6.3	1
CGT-110	6.3	1
CGT-128	2.2	1
CGT-138	1.3	1
CGT-142	1.3	1
CGT-176	5.2	1
CGT-180	1.1	1
CGT-184	1.1	1
CGT-193	3.1	1
CGT-201	2.3	1
CGT-206	5.5	1
CGT-208	2.1	1
SDG-GP-1	8.1	1
SDG-GP-2	8.1	1
SDG-GP-6	8.2	1
SDG-GP-7	7.1	1

5 Prioritized List of Gaps

This section presents the prioritized lists of gaps resulting from the two approaches to prioritization discussed in the previous Section 4. First we list the gap instances that have priority parameters p with a value exceeding 10. In Section 5.2 we list those gaps that received the high priority assessment from 3 or more of the participating nine experts. Section 5.3 list the twelve gaps that were listed by two experts as having high priority. For the sake of completeness, in Section 5.4, we include the gaps that were considered of high priority by one expert.

5.1 High-Priority Based on Feasibility, Impact, Cost, and Timeframe

Gap "CGT-174"

NAME	CGT-174
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Lack of continuity and uniform temporal sampling in time series.
OBSERVED	RS (1)
PURPOSE	Temporal series
REMEDY	Implement data fussion techniques to generated regular interpolated samples.
FEASIBILITY	Very high (4)|
IMPACT	Very high (4)|
COST	Low (1)|
PRIORITY	Low (5)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Solved (6)

Gap "CGT-174" is linked (Left) to EssentialVariable E-ELEV (see page 96)

Gap "CGT-174" is linked (Right) to GapAnalysisThread GAT-CG-BUT3 (see page 72)

Gap "CGT-174" is linked (Left) to Theme"Disasters" (see page 73)

Gap "CGT-174" is linked (Left) to Trace_168 (see page 108)

Gap "CGT-174" is linked (Left) to Review"Operational" (see page 115)

Gap "CGT-174" is linked (Left) to Recommendation"Operational" (see page 115)

Gap "CGT-175"

NAME	CGT-175
GAPTYPE	Temporal extent (1.3)
DESCRIPTION	Lack of tidal, ocean currents and water elevation prediction services
OBSERVED	RS (1)
PURPOSE	Tidal monitoring
REMEDY	Implement a forecast system based on recent data
FEASIBILITY	Very high (4)|
IMPACT	High (3)|
COST	Low (1)|
PRIORITY	Low (5)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Solved (6)

Gap "CGT-175" is linked (Left) to EssentialVariable C_SL (see page 86)

Gap "CGT-175" is linked (Right) to GapAnalysisThread GAT-CG-BUT3 (see page 72)

Gap “CGT-175” is linked (Left) to Theme“Oceans” (see page 72)

Gap “CGT-175” is linked (Left) to Trace_168 (see page 108)

Gap “CGT-175” is linked (Left) to Review“Operational” (see page 115)

Gap “CGT-175” is linked (Left) to Recommendation“Operational” (see page 115)

Gap “CGT-176”

NAME	CGT-176
GAPTYPE	Catalogue saturation (5.2)
DESCRIPTION	Lack of tools for Big Data analysis: merge timeseries, proper map and statistics visual representation
OBSERVED	RS (1)
PURPOSE	Big data
REMEDY	Develope the right tools for big data analysis and visualization
FEASIBILITY	Very high (4)|
IMPACT	High (3)|
COST	Low (1)|
PRIORITY	Low (5)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Solved (6)

Gap “CGT-176” is linked (Right) to GapAnalysisThread GAT-CG-BUT3 (see page 72)

Gap “CGT-176” is linked (Left) to Theme“All Themes” (see page 73)

Gap “CGT-176” is linked (Left) to Trace_168 (see page 108)

Gap “CGT-176” is linked (Left) to Review“Operational” (see page 115)

Gap “CGT-176” is linked (Left) to Recommendation“Operational” (see page 115)

Gap “SDG-GP-2”

NAME	SDG-GP-2
GAPTYPE	Conceptual
DESCRIPTION	Insufficient accounting for environmental variables in SDG indicators
OBSERVED	n/a
PURPOSE	Integrating the environment into the monitoring framework: Monitoring progress towards many targets would benefit from additional or modified indicators that integrate more information on the environment.
REMEDY	Integration of socio-economic and environmental data.
FEASIBILITY	Very High (4)
IMPACT	High (3)|
COST	Low (1)|
PRIORITY	High (3)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Accepted (3)

Gap “SDG-GP-2” is linked (Left) to Theme“SDGS” (see page 74)

Gap “SDG-GP-2” is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap “SDG-GP-2” is linked (Right) to EssentialVariable SDG-ALL (see page 98)

Gap "SDG-GP-6"

NAME	SDG-GP-6
GAPTYPE	Educational
DESCRIPTION	Skills required for matching providers and policy makers.
OBSERVED	n/a
PURPOSE	Developing policies and actions for the implementation of SDGs: the matching of providers who can provide products and tools supporting policy developments for the implementation and the monitoring of SDGs with those engaged in the implementation and monitoring of SDGs is not happening sufficiently because of a lack of people with matching skills. Educational efforts need to be made to address this gap.
REMEDY	Develop educational programs that focus on inter-sectoral skills.
FEASIBILITY	Very High (4)
IMPACT	High (3)|
COST	Low (1)|
PRIORITY	High (3)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Accepted (3)

Gap "SDG-GP-6" is linked (Left) to Theme"SDGS" (see page 74)

Gap "SDG-GP-6" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "SDG-GP-6" is linked (Right) to EssentialVariable SDG-ALL (see page 98)

Gap "CGT-180"

NAME	CGT-180
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Glacier, Glacier dammed lakes - near continuous global mapping needed
OBSERVED	Both (3)
PURPOSE	due to accelerating melt rates of many mountain glaciers, glacier lakes are an increasing hazard since many are in remote locations and hard to monitor
REMEDY	traditionally accomplished with visible imagery, but possible also with high resolution SAR
FEASIBILITY	Very high (4)|only a matter scheduling acquisitions and implementing automated change detection algorithms
IMPACT	Very high (4)|recently entire villages in Nepal were wiped out by GLOFs
COST	Medium (2)|depends on source, some data are free, some carry cost
PRIORITY	Very high (2)|the number of dangerous lakes is growning and existing monitoring programs are inadequate
TIMEFRAME	Short term (1)|
GAPSTATUS	Detected (1)

Gap "CGT-180" is linked (Left) to EssentialVariable C_GLA (see page 89)

Gap "CGT-180" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "CGT-180" is linked (Left) to Theme"Disasters" (see page 73)

Gap "CGT-180" is linked (Left) to Trace_172 (see page 108)

Gap "CGT-35"

NAME	CGT-35
GAPTYPE	No coordination of obs. sites (8.5)
DESCRIPTION	No overseeing authority ensuring EO-based biodiversity observations are in line with user needs
OBSERVED	TBD (4)
PURPOSE	Designating leadership and institutional oversight
FEASIBILITY	Very high (4)|
IMPACT	High (3)|
COST	Low (1)|
PRIORITY	Very high (2)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Detected (1)

Gap "CGT-35" is linked (Left) to EssentialVariable EBV (see page 80)

Gap "CGT-35" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-35" is linked (Left) to Theme"Biodiversity" (see page 73)

Gap "CGT-35" is linked (Left) to Trace_33 (see page 100)

Gap "CGT-35" is linked (Left) to Review"EBV Challenge" (see page 112)

Gap "CGT-178"

NAME	CGT-178
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Glacier, Facies, snowline - can be estimated from imagery, approximates equlibrium line
OBSERVED	RS (1)
PURPOSE	facies are the visible expression of the processes determining surface mass balance
REMEDY	facies can be determined from radar and visible imagery with adequate resolution
FEASIBILITY	Very high (4)|only a matter scheduling acquisitions at end of ablation season for all the world's glaciers
IMPACT	High (3)|Most glaciers are losing mass which is impacting water resources and sea level rise
COST	Medium (2)|depends on source, some data are free, some carry cost
PRIORITY	High (3)|also requires people and/or algorithms to interpret the data
TIMEFRAME	Short term (1)|
GAPSTATUS	Detected (1)

Gap "CGT-178" is linked (Left) to EssentialVariable C_GLA (see page 89)

Gap "CGT-178" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "CGT-178" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-178" is linked (Left) to Trace_172 (see page 108)

Gap "CGT-183"

NAME	CGT-183
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Glacier, Glacier topography - inadequate resolution in most places
OBSERVED	RS (1)
PURPOSE	changes in mass balance are reflected in surface topography
REMEDY	various remote sensing methods using lidar, SAR and stereoscopy of visible imagery can be used.
FEASIBILITY	Very high (4)|only a matter scheduling (and paying for in the case of TerraSAR -X) acquisitions
IMPACT	High (3)|Most glaciers are losing mass which is impacting water resources and sea level rise
COST	Medium (2)|
PRIORITY	High (3)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Detected (1)

Gap "CGT-183" is linked (Left) to EssentialVariable C_GLA (see page 89)

Gap "CGT-183" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "CGT-183" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-183" is linked (Left) to Trace_172 (see page 108)

Gap "CGT-219"

NAME	CGT-219
GAPTYPE	No interdisciplinary coord. (8.4)
DESCRIPTION	No European in-situ cross-domain coordination initiative
OBSERVED	In-Situ (2)
PURPOSE	Have a single initiative where network can discuss integration and translate their demands to funding agencies
REMEDY	The European Network of Earth Observation Networks
FEASIBILITY	High (3)|Already created
IMPACT	Very high (4)|
COST	Low (1)|
PRIORITY	Very high (2)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Detected (1)

Gap "CGT-219" is linked (Left) to EssentialVariable EV (see page 98)

Gap "CGT-219" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-219" is linked (Left) to Theme"All Themes" (see page 73)

Gap "CGT-219" is linked (Left) to Trace_208 (see page 108)

Gap "CGT-220"

NAME	CGT-220
GAPTYPE	No interdisciplinary coord. (8.4)
DESCRIPTION	No Global in-situ cross-domain coordination initiative
OBSERVED	In-Situ (2)
PURPOSE	Have a single initiative to ensure completeness and data sharing in GEOSS
REMEDY	A GEOSS fundational task
FEASIBILITY	High (3)|Already created
IMPACT	Very high (4)|
COST	Low (1)|
PRIORITY	Very high (2)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Detected (1)

Gap "CGT-220" is linked (Left) to EssentialVariable EV (see page 98)

Gap "CGT-220" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-220" is linked (Left) to Theme"All Themes" (see page 73)

Gap "CGT-220" is linked (Left) to Trace_209 (see page 109)

5.2 High Priority Based on Expert Assessments

In this section, we present the seven gaps that were selected by three or more experts as high-priority gaps.

Gap "CGT-23"

NAME	CGT-23
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	LIDAR global dataset
OBSERVED	TBD (4)
PURPOSE	Estimate biomass globally and with a good resolution. Carbon sequestration global estimation in forestry
FEASIBILITY	Medium (2)|If a satellite borne is done
IMPACT	High (3)|
COST	Very high (4)|
PRIORITY	High (3)|
TIMEFRAME	Long term (3)|Requires research
GAPSTATUS	Detected (1)

Gap "CGT-23" is linked (Left) to EssentialVariable C_AGB (see page 90)

Gap "CGT-23" is linked (Left) to EssentialVariable B_EFNP (see page 82)

Gap "CGT-23" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-23" is linked (Left) to Theme"Biodiversity" (see page 73)

Gap "CGT-23" is linked (Left) to Trace_22 (see page 100)

Gap "CGT-92"

NAME	CGT-92
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Lack of sufficient spatial coverage for many climatic applications, specially in the Southern hemisphere.
OBSERVED	In-Situ (2)
PURPOSE	Currents are essential to determine the transport of mass, energy and many other properties (nutrients, O2, sediments, etc.) from basin to global scales. They are necessary to determine absolute velocity fields complementing the geostrophic field from temperature and salinity measurements. Direct measurements of lateral and bottom boundary currents ara important to resolve Ekman transport of properties to constraint large-scale and basin ocean currents, from small to climate scales. Important for model validation.
REMEDY	To extent spatially the number of mooring sites with currentmeters at least for key dynamic areas (e.g. main energetic currents, Aghulas retroflection, Malvinas confluence) particularly in the Southern ocean.
FEASIBILITY	High (3)|Technology is ready but feasibility in this case is more related to the capacity, mainly in terms of efforts and costs, of national agencies to maintain mooring sites.
IMPACT	Very high (4)|Variability of currents in the Southern ocean is a key aspect to understand changes in the climate system.
COST	Medium (2)|Of course cost depend on the number of sites to be covered and maintained.
PRIORITY	Very high (2)|Necessary to better characterize and understand the variability of several ocean variables
TIMEFRAME	TBD (99)|New mooring sites should be maintained to get long time series to resolve interanual and decadal variability.
GAPSTATUS	Detected (1)

Gap "CGT-92" is linked (Left) to EssentialVariable C_CD (see page 88)

Gap "CGT-92" is linked (Left) to EssentialVariable C_C (see page 87)

Gap "CGT-92" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-92" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-92" is linked (Left) to Trace_87 (see page 104)

Gap "CGT-92" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-92" is linked (Left) to Trace_79 (see page 103)

Gap "CGT-219"

NAME	CGT-219
GAPTYPE	No interdisciplinary coord. (8.4)
DESCRIPTION	No European in-situ cross-domain coordination initiative
OBSERVED	In-Situ (2)
PURPOSE	Have a single initiative where network can discuss integration and translate their demands to funding agencies
REMEDY	The European Network of Earth Observation Networks
FEASIBILITY	High (3)|Already created
IMPACT	Very high (4)|
COST	Low (1)|
PRIORITY	Very high (2)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Detected (1)

Gap “CGT-219” is linked (Left) to EssentialVariable EV (see page 98)

Gap “CGT-219” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-219” is linked (Left) to Theme“All Themes” (see page 73)

Gap “CGT-219” is linked (Left) to Trace_208 (see page 108)

Gap “CGT-43”

NAME	CGT-43
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Scarcity of accurate in situ measurements in most of the world. Large networks measuring radiation, such as GAW, BSRN have a limited coverage. National meteo networks are by definition limited and in addition, many of them do not measure radiation, except sunshine duration.
OBSERVED	In-Situ (2)
PURPOSE	Various. Ranges from establishing a bankable report for investment seeking to validation / calibration of Copernicus products and others
REMEDY	Meta-Network: Opportunities exist to get access to in-situ measurements coming from numerous PV plant operators all over Europe. PV plant operators do hold in-situ measurements for their daily work. An extra effort is needed to identify, convince, access and connect their data. As a result one could create a Meta-Network of private providers using open, standard and interoperable technologies. This Meta-Network would complement existing well known meteo networks (GAW, BSRN).
FEASIBILITY	Very high (4)|No instrument to develop, no specific installation. It is a matter of networking
IMPACT	Very high (4)|Such data are needed right from the start to develop projects in solar energy. Such data would be used routinely for the validation of Copernicus radiation products
COST	Low (1)|It can be done with existing sensors. Costs are those for networking and operating a platform implementing the meta-network for interoperability of various small networks
PRIORITY	Crucial (1)|Crucial for the development of projects in Africa or Asia where data may exist but are yet unknown and unavailable. Crucial also for the development of Copernicus products in solar energy as validation in areas outside Europe will help the uptake of these products by companies as it increases their confidence in products
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap “CGT-43” is linked (Left) to EssentialVariable E-SSI (see page 95)

Gap “CGT-43” is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap “CGT-43” is linked (Left) to Theme“Energy” (see page 73)

Gap “CGT-43” is linked (Left) to Trace_42 (see page 100)

Gap "CGT-45"

NAME	CGT-45
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Scarcity of accurate in situ measurements in coastal areas for marine renewable energies. Bathymetry, type of floor, tides, swell, currents.
OBSERVED	Both (3)
PURPOSE	Various. Ranges from establishing a bankable report for investment seeking to validation / calibration of Copernicus products and others
REMEDY	For bathymetry and type of floor, exploit SAR images or images in visible-NIR range together with computer models. For the other variables, see the gaps 64 to 72
FEASIBILITY	Very high (4)|Images exist, models exist
IMPACT	Very high (4)|Such data are needed right from the start to develop projects in marine energy.
COST	High (3)|Computer resources needed. Validation campaigns needed
PRIORITY	Crucial (1)|Crucial for the development of projects in marine energy
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-45" is linked (Left) to EssentialVariable E-BAT (see page 96)

Gap "CGT-45" is linked (Left) to EssentialVariable E-TDL (see page 96)

Gap "CGT-45" is linked (Left) to EssentialVariable E-CUR (see page 96)

Gap "CGT-45" is linked (Left) to EssentialVariable E-OFL (see page 96)

Gap "CGT-45" is linked (Right) to GapAnalysisThread GAT-CG-BUT3 (see page 72)

Gap "CGT-45" is linked (Left) to Theme"Energy" (see page 73)

Gap "CGT-45" is linked (Left) to Trace_44 (see page 101)

Gap "CGT-45" is linked (Left) to Review"Gap related to other gaps" (see page 113)

Gap "CGT-45" is linked (Left) to Recommendation"Bathymetry" (see page 115)

Gap "CGT-185"

NAME	CGT-185
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Ice sheet, Ice sheet mass change - requires knowledge of basal melt, surface melt, accumulation, velocity, calving rate
OBSERVED	RS (1)
PURPOSE	ice sheets are continental-scale masses of glacier ice with outlets mostly terminating at the ocean, and thus loose mass by calving, and in the case of floating ice shelves, through basal melting
REMEDY	all of the measurements describe in gap #177-184
FEASIBILITY	High (3)|various satellite and aircraft missions needed to carry out the measureents
IMPACT	Very high (4)|potential for global scale human disaster of unimaginable proportions
COST	High (3)|
PRIORITY	Very high (2)|
TIMEFRAME	Long term (3)|
GAPSTATUS	Detected (1)

Gap "CGT-185" is linked (Left) to EssentialVariable C_ICE (see page 90)

Gap "CGT-185" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "CGT-185" is linked (Left) to Theme"Climate" (see page 72)

Gap “CGT-185” is linked (Left) to Trace_172 (see page 108)

Gap “CGT-222”

NAME	CGT-222
GAPTYPE	Spatial resolution (2.1)
DESCRIPTION	Missing high resolution data for terrestrial ecosystems structure and terrestrial ecosystems function
OBSERVED	RS (1)
PURPOSE	There are products are more corse resolution but not at this resolutions. Sentinel 2 based high level products can potentially deliver some EBV
REMEDY	Create services and methodologies to calculate high level products
FEASIBILITY	Medium (2)|Requires reserach and innovation to mature the algoritms
IMPACT	Medium (2)|
COST	Medium (2)|
PRIORITY	High (3)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Detected (1)

Gap “CGT-222” is linked (Left) to EssentialVariable EBV (see page 80)

Gap “CGT-222” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-222” is linked (Left) to Theme“Climate” (see page 72)

Gap “CGT-222” is linked (Left) to Trace_211 (see page 109)

5.3 Other High Priority Gaps

This section presents the twelve gaps selected by two experts as high-priority gaps.

Gap “CGT-10”

NAME	CGT-10
GAPTYPE	Temporal resolution (2.3)
DESCRIPTION	Monitoring hourly/daily gas particle ratio (NH3/NH4, HNO3/NO3) and monthly Ammonia in emission areas (NH3)
OBSERVED	RS (1)
PURPOSE	Acidification and eutrophication: Observations contributes to the assessment of nitrogen chemistry, influence by local emissions and dry deposition fluxes.
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap “CGT-10” is linked (Left) to EssentialVariable C_PRE (see page 86)

Gap “CGT-10” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-10” is linked (Left) to Theme“Climate” (see page 72)

Gap “CGT-10” is linked (Left) to Trace_4 (see page 99)

Gap "CGT-17"

NAME	CGT-17
GAPTYPE	Geographical inconsistency (4.1)
DESCRIPTION	Develop high-resolution global land-cover and land-cover change data sets, based on international community consensus and including a robust accuracy assessment.
OBSERVED	Both (3)
PURPOSE	Reduce inconsistencies between land cover products
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-17" is linked (Left) to EssentialVariable E_LULC (see page 96)

Gap "CGT-17" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-17" is linked (Left) to Theme"Energy" (see page 73)

Gap "CGT-17" is linked (Left) to Trace_16 (see page 99)

Gap "CGT-20"

NAME	CGT-20
GAPTYPE	No access (6.1)
DESCRIPTION	There is not timely and reliable access to in-situ data required in emergency events.
OBSERVED	TBD (4)
PURPOSE	Promote timely and reliable access to in situ data required in emergency events
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-20" is linked (Left) to EssentialVariable EV (see page 98)

Gap "CGT-20" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-20" is linked (Left) to Theme"Disasters" (see page 73)

Gap "CGT-20" is linked (Left) to Trace_19 (see page 99)

Gap "CGT-84"

NAME	CGT-84
GAPTYPE	Vertical extent (1.2)
DESCRIPTION	Insufficient vertical coverage of measurements down 2000 m (more of the 50% of the ocean volume is whithin the layer deeper than 2000 m). XBT regular sections are concentrated around the first 750 m and in general below 700 m data are too sparse.
OBSERVED	In-Situ (2)
PURPOSE	To characterize deep water masses, to monitor the ocen heat content and to determine the general structure of the ocean circulation and the conveyor belt. Necessary to determine the water cycle, heat and mass gesotrophic transports and the steric component of the sea level change, and indirectly to understand changes in the marine biology and biogeochemistry. Essential for data assimilation into ocean circulation models.
REMEDY	To deploy a fraction of Argo profilers with the ability to increase the vertical extent downwards.
FEASIBILITY	Very high (4)|Argo technology for CTD recording (conductivity, temperature and pressure) is not a problem. However some aspects concerning the need of pressure-ressistance equipment and energy storage may be problematic in terms of cost.
IMPACT	Very high (4)|The Argo program is a key oceanic observation system with considerable impact on the quality of forecasts and analysis of present ocean models. In 10 years (2006-2016) the Argo program has collected more data than in the previous century (1900-2000).
COST	High (3)|Deployment of deep profilers implies a significant increase of costs. Already comercial deep floats increases a factor of 10 with respect the current Argo floats.
PRIORITY	TBD (0)|In addition to temperature and salinity this gap affects several EOV variables (e.g. nutrients, oxygen, pH, CO2 associated variables, etc.). Immediate impact would be on detecting trends in deep ocean waters properties (e.g. overturning circulation, ocean acidification), a better estimation of the steric contribution to sea level and improvements in ocean forecasting.
TIMEFRAME	TBD (99)|If enough funds are allocated the solution can be implemented quite fast, however the sampling should guarantee at least enough time for climate purposes.
GAPSTATUS	Detected (1)

Gap "CGT-84" is linked (Left) to EssentialVariable C_TD (see page 88)

Gap "CGT-84" is linked (Left) to EssentialVariable C_SALD (see page 88)

Gap "CGT-84" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-84" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-84" is linked (Left) to Trace_79 (see page 103)

Gap "CGT-84" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-84" is linked (Left) to Trace_78 (see page 103)

Gap "CGT-84" is linked (Left) to Review"Merged Gap" (see page 114)

Gap "CGT-94"

NAME	CGT-94
GAPTYPE	No measured (7.1)
DESCRIPTION	Present observing systems are inadequate to directly measure the vertical component of currents.
OBSERVED	In-Situ (2)
PURPOSE	Vertical currents are essential to determine the transport of mass, energy and many other properties (nutrients, O2, sediments, etc.). In particular vertical current are essential to quantify vertical fluxes of nutrients to the photic zone (upwelling sytems).
FEASIBILITY	Medium (2)|
IMPACT	High (3)|
COST	Medium (2)|
PRIORITY	High (3)|
TIMEFRAME	Mid term (2)|Requires reseach
GAPSTATUS	Detected (1)

Gap "CGT-94" is linked (Left) to EssentialVariable C_CD (see page 88)

Gap "CGT-94" is linked (Left) to EssentialVariable C_C (see page 87)

Gap "CGT-94" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-94" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-94" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-95"

NAME	CGT-95
GAPTYPE	No coordination of obs. sites (8.5)
DESCRIPTION	Lack of an international organism coordinating such kind of measurements at global scale.
OBSERVED	In-Situ (2)
PURPOSE	Currents are essential to determine the transport of mass, energy and many other properties (nutrients, O2, sediments, etc.) from basin to global scales. They are necessary to determine absolute velocity fields complementing the geostrophic field from temperature and salinity measurements. Direct measurements of lateral and bottom boundary currents ara important to resolve Ekman transport of properties to constraint large-scale and basin ocean currents, from small to climate scales. Important for model validation.
REMEDY	To promote international cooperation to stablish a coordination organism specific for ocean current measurements.
FEASIBILITY	Very high (4)|Quite feasible if promoted from already existing international organisms (GOOS, WMO, GEO, etc.) Alternatively an initial set-up could arise from specific R+I initiatives (e.g. national research plans or regional alliances) or reserach programs (SVP, GLOBCURRENT,etc)
IMPACT	Very high (4)|To coordinate procedures and best practices to archive, process and deliver such kind of data. It will help to recover much more historical records from field cruises and research experiments presently not much centralised.
COST	TBD (9)|To set up a coordination organism can be ranked as relatively low.
PRIORITY	TBD (0)|The ocean velocity field is as crucial as the other scalars (temperature, salinity) for several themes and SBAs. Stablishing a coordination organism around the ocean velocity variable will accelerate improvements in data quality products, data standardization and data sharing necessary to hold all the information from quite diverse ways to measure it.
TIMEFRAME	TBD (99)|The time necessary to set up and coordinate different initiatives on the frame of several international organism.
GAPSTATUS	Detected (1)

Gap "CGT-95" is linked (Left) to EssentialVariable C_CD (see page 88)

Gap "CGT-95" is linked (Left) to EssentialVariable C_C (see page 87)

Gap "CGT-95" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-95" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-95" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-95" is linked (Left) to Review"Ocean Currents" (see page 115)

Gap "CGT-108"

NAME	CGT-108
GAPTYPE	No catalogue (5.1)
DESCRIPTION	Lack of unified tools showing all the existing observing capabilities for measuring ECVs with respect to satellite spatial coverage
OBSERVED	TBD (4)
FEASIBILITY	High (3)|Demostrated in GAIA Clim
IMPACT	High (3)|
COST	Medium (2)|
PRIORITY	Very high (2)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Detected (1)

Gap “CGT-108” is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap “CGT-108” is linked (Left) to EssentialVariable C_WVU (see page 85)

Gap “CGT-108” is linked (Left) to EssentialVariable C_CO2 (see page 85)

Gap “CGT-108” is linked (Left) to EssentialVariable C_GHG (see page 86)

Gap “CGT-108” is linked (Left) to EssentialVariable C_TU (see page 85)

Gap “CGT-108” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-108” is linked (Left) to Theme“Climate” (see page 72)

Gap “CGT-108” is linked (Left) to Trace_102 (see page 104)

Gap “CGT-205”

NAME	CGT-205
GAPTYPE	Temporal resolution (2.3)
DESCRIPTION	Cloud coverage: Missing data, insufficient temporal resolution
OBSERVED	RS (1)
PURPOSE	energy balance modelling at field level in areas with moderate cloud cover; European Phenological analysis at high spatial resolution
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap “CGT-205” is linked (Left) to EssentialVariable C_CLD (see page 85)

Gap “CGT-205” is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap “CGT-205” is linked (Left) to Theme“Climate” (see page 72)

Gap “CGT-205” is linked (Left) to Trace_191 (see page 108)

Gap “CGT-216”

NAME	CGT-216
GAPTYPE	Temporal resolution (2.3)
DESCRIPTION	Missing Near-/Quasi-Real-Time data on natural hazards
OBSERVED	Both (3)
FEASIBILITY	Low (1)|
IMPACT	Very high (4)|Save many lifes
COST	Very high (4)|Cover all hazards is costly
PRIORITY	Medium (4)|
TIMEFRAME	Long term (3)|
GAPSTATUS	Detected (1)

Gap “CGT-216” is linked (Left) to EssentialVariable EV (see page 98)

Gap “CGT-216” is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap “CGT-216” is linked (Left) to Theme“Disasters” (see page 73)

Gap “CGT-216” is linked (Left) to Trace_191 (see page 108)

Gap "CGT-220"

NAME	CGT-220
GAPTYPE	No interdisciplinary coord. (8.4)
DESCRIPTION	No Global in-situ cross-domain coordination initiative
OBSERVED	In-Situ (2)
PURPOSE	Have a single initiative to ensure completeness and data sharing in GEOSS
REMEDY	A GEOSS fundational task
FEASIBILITY	High (3)|Already created
IMPACT	Very high (4)|
COST	Low (1)|
PRIORITY	Very high (2)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Detected (1)

Gap "CGT-220" is linked (Left) to EssentialVariable EV (see page 98)

Gap "CGT-220" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-220" is linked (Left) to Theme"All Themes" (see page 73)

Gap "CGT-220" is linked (Left) to Trace_209 (see page 109)

Gap "CGT-223"

NAME	CGT-223
GAPTYPE	Geographical inconsistency (4.1)
DESCRIPTION	Forestry Harvest: Spatially explicit information on used/unused forests lacking
OBSERVED	Both (3)
PURPOSE	Allows for tracking trends in afforestation, deforestation and reforestation globally
REMEDY	Data on wilderness or intact forests might provide proxies
FEASIBILITY	Medium (2)|country level stats exist (FAO) and spatial products exist on forests, but managed and unmanaged forests are mixed together - with time series you can get at some of this
IMPACT	Medium (2)|impact is moderate, as this gap prevents us really from knowing how much intact forest we have with direct relation to biodiversity
COST	Medium (2)|costs not negligible but could be borne by many actors - new satellites on board or coming will help
PRIORITY	Crucial (1)|we have good stats at country level - but downscaling needed asap
TIMEFRAME	Mid term (2)|short to medium term - new tech coming will help
GAPSTATUS	Accepted (3)

Gap "CGT-223" is linked (Left) to EssentialVariable B_EFDR (see page 83)

Gap "CGT-223" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "CGT-223" is linked (Left) to Theme"Biodiversity" (see page 73)

Gap "CGT-223" is linked (Left) to Trace_212 (see page 109)

Gap "CGT-223" is linked (Left) to Recommendation"EO Community Action" (see page 116)

Gap "CGT-226"

NAME	CGT-226
GAPTYPE	Uncertainty (3.1)
DESCRIPTION	Crop Harvest
OBSERVED	RS (1)
PURPOSE	GHG management
REMEDY	insitu data needed
FEASIBILITY	Low (1)|many intricacies
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	Crucial (1)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Accepted (3)

Gap "CGT-226" is linked (Left) to EssentialVariable AgV (see page 94)

Gap "CGT-226" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "CGT-226" is linked (Left) to Theme"Agriculture" (see page 73)

Gap "CGT-226" is linked (Left) to Trace_212 (see page 109)

Gap "CGT-226" is linked (Left) to Recommendation"In-Situ Data" (see page 116)

5.4 Other Prioritized Gaps

Here we collect the gap instances that were included in the expert-based assessment of priorities by one expert in their list of high-priority gaps.

Gap "CGT-3"

NAME	CGT-3
GAPTYPE	Temporal resolution (2.3)
DESCRIPTION	Daily/weekly monitoring of heavy metals in precipitation
OBSERVED	RS (1)
PURPOSE	Monitoring of heavy metals in precipitation As, Cd, Ni, Cd, Pb, Cu, Zn
FEASIBILITY	Medium (2)|If a low cost automatic sensor is available
IMPACT	Very high (4)|Human health
COST	Medium (2)|If a low cost automatic sensor is available
PRIORITY	None (6)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Detected (1)

Gap "CGT-3" is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap "CGT-3" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-3" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-3" is linked (Left) to Trace_3 (see page 99)

Gap "CGT-8"

NAME	CGT-8
GAPTYPE	Temporal resolution (2.3)
DESCRIPTION	Monthly monitoring of PM mass in air PM 2.5, PM 10
OBSERVED	RS (1)
PURPOSE	Monthly monitoring
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-8" is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap "CGT-8" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-8" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-8" is linked (Left) to Trace_8 (see page 99)

Gap "CGT-8" is linked (Left) to Review"Mass Concentrations" (see page 111)

Gap "CGT-9"

NAME	CGT-9
GAPTYPE	Temporal resolution (2.3)
DESCRIPTION	Not enough temporal monitoring of Precipitation amount in ecosystem observation sites
OBSERVED	TBD (4)
PURPOSE	Daily and mounthly monitoring
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-9" is linked (Left) to EssentialVariable C_RAS (see page 84)

Gap "CGT-9" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-9" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-11"

NAME	CGT-11
GAPTYPE	Temporal resolution (2.3)
DESCRIPTION	Monitoring hourly NOx, hourly Light hydrocarbons, and hourly Methane (Photochemical oxidants).
OBSERVED	RS (1)
PURPOSE	Observations contributes to the assessment of oxidant precursors
REMEDY	Develop research infrastructures like ACTRIS to support programmes like EMEP and WMO-GAW.
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-11" is linked (Left) to EssentialVariable C_PRE (see page 86)

Gap "CGT-11" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-11" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-11" is linked (Left) to Trace_4 (see page 99)

Gap "CGT-11" is linked (Left) to Review"NOx and VOC concentrations" (see page 111)

Gap "CGT-14"

NAME	CGT-14
GAPTYPE	Temporal resolution (2.3)
DESCRIPTION	Particulate matter: Monitoring daily/weekly: mineral dust in PM10 (Si, Al, Fe, Ca), Elemental and Organic Carbon. Hourly/daily: Aerosol absortion, Aerosol size number distribution (dN/dlogDp), Aerosol scatering. Hourly: Aerosol Optical Depth at 550 nm
OBSERVED	RS (1)
PURPOSE	Observations contributes to the assessment of particulate matter and its source apportionment
REMEDY	Secure funding for observations
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-14" is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap "CGT-14" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-14" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-14" is linked (Left) to Trace_4 (see page 99)

Gap "CGT-14" is linked (Left) to Review"Aerosol Properties" (see page 111)

Gap "CGT-19"

NAME	CGT-19
GAPTYPE	No quality (6.3)
DESCRIPTION	In order to gain an understanding of the physical processes that are related to water vapor, clouds, aerosols and precipitation, a new observation paradigm needs to be established that focuses on the physical processes rather just on the final quantity.
OBSERVED	TBD (4)
PURPOSE	Develop an observation strategy to improve the synergistic understanding between water vapor and clouds, and if feasible, aerosols and precipitation.
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-19" is linked (Left) to EssentialVariable C_WVU (see page 85)

Gap "CGT-19" is linked (Left) to EssentialVariable C_CLD (see page 85)

Gap "CGT-19" is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap "CGT-19" is linked (Left) to EssentialVariable C_RAS (see page 84)

Gap "CGT-19" is linked (Left) to EssentialVariable C_RIV (see page 89)

Gap "CGT-19" is linked (Left) to EssentialVariable C_LAK (see page 89)

Gap "CGT-19" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-19" is linked (Left) to Theme"Water" (see page 73)

Gap "CGT-19" is linked (Left) to Trace_17 (see page 99)

Gap "CGT-26"

NAME	CGT-26
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Absence of in a near real-time operational and timely manner global coverage Sea Surface Temperature (SST) and sea-Ice Surface Temperature (IST)
OBSERVED	RS (1)
PURPOSE	Global coverage Sea Surface Temperature (SST) and sea-Ice Surface Temperature (IST)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-26" is linked (Left) to EssentialVariable C_SST (see page 86)

Gap "CGT-26" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-26" is linked (Left) to Theme"Oceans" (see page 72)

Gap "CGT-26" is linked (Left) to Trace_23 (see page 100)

Gap "CGT-26" is linked (Left) to Review"Spatial Resolution" (see page 112)

Gap "CGT-27"

NAME	CGT-27
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Absence of in a near real-time operational and timely manner a global coverage ocean colour and water quality products
OBSERVED	RS (1)
PURPOSE	Global coverage ocean colour and water quality products
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-27" is linked (Left) to EssentialVariable C_OC (see page 87)

Gap "CGT-27" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-27" is linked (Left) to Theme"Oceans" (see page 72)

Gap "CGT-27" is linked (Left) to Trace_23 (see page 100)

Gap "CGT-27" is linked (Left) to Review"Gap Effects EOV" (see page 112)

Gap "CGT-35"

NAME	CGT-35
GAPTYPE	No coordination of obs. sites (8.5)
DESCRIPTION	No overseeing authority ensuring EO-based biodiversity observations are in line with user needs
OBSERVED	TBD (4)
PURPOSE	Designating leadership and institutional oversight
FEASIBILITY	Very high (4)|
IMPACT	High (3)|
COST	Low (1)|
PRIORITY	Very high (2)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Detected (1)

Gap "CGT-35" is linked (Left) to EssentialVariable EBV (see page 80)

Gap "CGT-35" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-35" is linked (Left) to Theme"Biodiversity" (see page 73)

Gap "CGT-35" is linked (Left) to Trace_33 (see page 100)

Gap "CGT-35" is linked (Left) to Review"EBV Challenge" (see page 112)

Gap "CGT-38"

NAME	CGT-38
GAPTYPE	No measured (7.1)
DESCRIPTION	There is the need to improve the availability of EO data to implement disaster risk reduction and resilience measures, during all disaster risk management phases
OBSERVED	TBD (4)
PURPOSE	To increase the availability and accuracy of risk related information, both satellite EO information combined with other sources of data (in-situ ground observations, socio-economic, model outputs)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-38" is linked (Left) to EssentialVariable EV (see page 98)

Gap "CGT-38" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-38" is linked (Left) to Theme"Disasters" (see page 73)

Gap "CGT-38" is linked (Left) to Trace_37 (see page 100)

Gap "CGT-44"

NAME	CGT-44
GAPTYPE	No open access (6.2)
DESCRIPTION	No easy access by SMEs to meteorological measurements because of costs
OBSERVED	Both (3)
PURPOSE	Various. Ranges from establishing a bankable report for investment seeking to validation / calibration of Copernicus products and others
REMEDY	It is likely a networking activity to demonstrate to governments supporting met-offices that providing easy access at very limited costs to companies will foster the development of renewable energy projects and will support their international commitments in climate and environment
FEASIBILITY	Very high (4)|No instrument to develop, no specific installation. It is a matter of networking
IMPACT	High (3)|Such data are really needed and their availability would help in developing renewable energy. However, it is not crucial as companies have found ways to cope with this gap.
COST	TBD (9)|I cannot say. It is a balance at governmental level
PRIORITY	High (3)|Such data are really needed and their availability would help in developing renewable energy. However, it is not crucial as companies have found ways to cope with this gap.
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-44" is linked (Left) to EssentialVariable EREV (see page 95)

Gap "CGT-44" is linked (Right) to GapAnalysisThread GAT-CG-BUT3 (see page 72)

Gap "CGT-44" is linked (Left) to Theme"Energy" (see page 73)

Gap "CGT-44" is linked (Left) to Trace_43 (see page 100)

Gap "CGT-44" is linked (Left) to Review"Meteo Data" (see page 113)

Gap "CGT-46"

NAME	CGT-46
GAPTYPE	Temporal resolution (2.3)
DESCRIPTION	Satellite observations about Sea Surface Temperature do not cover the diurnal cycle
OBSERVED	RS (1)
PURPOSE	Determine and understanding ocean-atmosphere heat and gas exchanges. In situ measurements necessary to cal/val satellite signals and sensor drift.
REMEDY	To improve the combination of in-situ sensors with presently available infrared observations including geostationary and microwaves and model analysis to better describe the daily cycle. Increasing microwaves constellation would also help. Ocean operational models should be improved to include the dynamics associated with the processes involved (e.g. restratification, convective cooling, Langmuir turbulence, etc.).
FEASIBILITY	High (3)|While increasing the satellite capacity (e.g. AMSR) and optical recurrency at high spatial resolution are quite expensive, ocean models representing the physical processes are ready but not operational.
IMPACT	High (3)|Weather/ocean forecast uncertainties reduced. Improvements on the atmosphere-ocean feedbacks and parametrizations into climate models. Assessment improvements on fisheries operations (species associated to thermal fronts).
COST	High (3)|Improvements can be done with combinations of sensors in place and analysis with models (e.g. GHRSST) however computational costs associated to make operational models resolving such scales are expensive with present computing resources. Benefits and reduction cost could benefit from more in situ observations.
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-46" is linked (Left) to EssentialVariable C_SST (see page 86)

Gap "CGT-46" is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap "CGT-46" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-46" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-46" is linked (Left) to Review"Measurements" (see page 113)

Gap "CGT-47"

NAME	CGT-47
GAPTYPE	Geographical inconsistency (4.1)
DESCRIPTION	Differences among SST products near the coasts.
OBSERVED	RS (1)
PURPOSE	Determine and understanding ocean-atmosphere heat and gas exchanges. In situ measurements necessary to cal/val satellite signals and sensor drift.
REMEDY	Comprehensive review of procedures and dedicated intercomparisons/experiments against independent data should contribute to characterize and harmonize differences.
FEASIBILITY	Very high (4)|As more high resolution infrared and microwave instruments are being launched data uncertainties will be reduced and differences among procedures as well. However processing methodologies can benefit from specifically dedicated experiment/exercises to validate products against independent data.
IMPACT	High (3)|Weather/ocean forecast uncertainties reduced. Improvements on the atmosphere-ocean feedbacks and parametrizations into climate models. Assessment improvements on fisheries operations (species associated to thermal fronts).
COST	Medium (2)|The costs is between Low and Medium in the sense that intercomparison of procedures are ongoing (e.g. GHRSST) but detailed validation with experiments to obtain new high resolution independent data could be promoted.
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-47" is linked (Left) to EssentialVariable C_SST (see page 86)

Gap "CGT-47" is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap "CGT-47" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-47" is linked (Left) to Trace_46 (see page 101)

Gap "CGT-47" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-47" is linked (Left) to Review"Resolution" (see page 113)

Gap "CGT-50"

NAME	CGT-50
GAPTYPE	No measured (7.1)
DESCRIPTION	Lack of in situ surface measurements from Argo buoys in marginal seas and shelf seas (i.e Baltic Sea, North Sea, Barents Sea etc.) ad polar areas
OBSERVED	In-Situ (2)
PURPOSE	Determine and understand ocean-atmosphere heat and gas exchanges. In situ measurements necessary to cal/val satellite signals and sensor drift.
REMEDY	Some technical solutions endowing Argo floats with inertial navigation systems via accelerometers may help to self-adjust the sampling to bathymetric changes provided bathymetric charts are also included . Adopting measures of hardware protection of antenna and instruments or alternatively using sensing ice algorithms and procedures would also be necessary in polar areas to avoid equipment dammages. For shelf seas complementary meaures can be adopted by extending actual coastal buoys networks or by collaboration with owners of offshore platforms (e.g. oil and gas rigs, aquaculture installation, etc.) to supply environmental data.
FEASIBILITY	High (3)|Some technical solutions endowing inertial navigation systems with accelerometers may help to self-adjust the sampling to bathymetric changes. In polar areas some changes in float design would allow to an efficient solution. However as it is usual a compromise between energy consumption and sampling strategy may constraint their performance, so the limiting element is the energy consumption. In polar areas, Argo floats would benefit of improvements in battery storage technologies. To promote collaboration with already existing offshore installations in shelf areas, usually associated to energy production and aquaculture, to deploy fixed instruments and increase the infromation coverage.
IMPACT	Very high (4)|To provide the most complete coverage of all kind of oceanic regions. Specific impact would be the information on polar regions as being in such areas where environmental changes are relevant footprints of the climate change.
COST	High (3)|Specific hardware additions and changes in float design should be implemented increasing the costs. In polar regions maintenance, deployment operations and monitoring needs would increase costs.
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-50" is linked (Left) to EssentialVariable C_SST (see page 86)

Gap "CGT-50" is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap "CGT-50" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-50" is linked (Left) to Trace_49 (see page 101)

Gap "CGT-50" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-50" is linked (Left) to Trace_47 (see page 101)

Gap "CGT-50" is linked (Left) to Review"ARGO in marginal seas" (see page 114)

Gap "CGT-59"

NAME	CGT-59
GAPTYPE	Geographical inconsistency (4.1)
DESCRIPTION	Products differ due to differences of onboard instrument configurations (e.g. real aperture radiometers versus synthetic aperture radiometers). Also different processing strategies produce different high levels products (L3, L4). Biases and non-linear effects at the level of brightness temperature measurements exist between SSS derived from Aquarius and SMOS missions. A similar gap appears in terms of Temporal Inconsistency.
OBSERVED	RS (1)
PURPOSE	SSS is directly essential for climate, monitoring the water cycle changes and to evaluate Evaporation-Precipitation (E-P) fluxes over the ocean from basin to global scales. It is relevant to determine the sea surface density, freshwater transport and coastal ocean dynamics (river discharges). Further, in situ SSS measurements are essential for cal/val satellite signals and sensor drift of new missions.
REMEDY	To improve intercalibration algorithms.
FEASIBILITY	High (3)|To promote joint synergies among mission teams. An increase of independent in situ measurements would benefit the validation and verification of intercalibrations.
IMPACT	Very high (4)|To improve the SSS analysis reducing the uncertainties in geographical analysis and obtain more coherent time series. Near real time SSS data may help to warn up on biofouling maintenance of open ocean moored arrays.
COST	Medium (2)|The increase of in situ near-surface measurements can be ranked as "High" while improvement the intercallibration can be considered as "Low"
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-59" is linked (Left) to EssentialVariable C_SSS (see page 86)

Gap "CGT-59" is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap "CGT-59" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-59" is linked (Left) to Trace_54 (see page 102)

Gap "CGT-59" is linked (Left) to Trace_234 (see page 102)

Gap "CGT-71"

NAME	CGT-71
GAPTYPE	Spatial resolution (2.1)
DESCRIPTION	Lack of enough resolution. Currents derived from SSH lacks of enough resolution to address ocean submesoscale processes.
OBSERVED	RS (1)
PURPOSE	Submesoscale processes may appear as key processes to better understand ocean-atmosphere exchanges and surface transport of properties (momentum, heat, gases). High resolution velocity fields are needed to resolve submesoscale variability with large impact on seaborne commerce, fishing, storm surges, marine ecosystems, ..
REMEDY	At technical level the solution may come from a virtual constellation of altimeters combined with new generation of sensors, platforms and new satellite capabilities (e.g. 2d-altimetry, Doppler radar). However improvements to extract better information from all in situ available instruments should potentially improve present analysis.
FEASIBILITY	High (3)|Improvements by enlarging the present constellation of altimeters is highly feasible in terms of technology. Improvements with new instruments, sensors and platforms is quite mature in terms of concept but need to be tested. Research activities on new procedures to better exploit data are ongoing but still need to be systematically validated.
IMPACT	Very high (4)|Accessing the scales at the submesoscale will help to clarify and to understand the ocean-atmosphere fluxes, tracer advection and transport processes (e.g. pollution events, ecosystem response, ...). At long scales necessary for climate change and at short scales very important for weather forecast.
COST	High (3)|Improvements on satellite constellation and new technologies could be very expensive, while improving information knowledge will be relatively low cost.
PRIORITY	TBD (0)|The impact of improving ocean currents is very high because affects several socio-economic sectors. Tourism, marine trade, marine security and pollution, fisheries, management, etc.
TIMEFRAME	TBD (99)|New generation of altimeters are on-going. However new missions about 2-d altimetry should be promoted and scheduled as soon as possible. Note however that research activities to improve the present exploitation of data to achieve higher resolutions can be addressed in mid term.
GAPSTATUS	Detected (1)

Gap "CGT-71" is linked (Left) to EssentialVariable C_OC (see page 87)

Gap "CGT-71" is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap "CGT-71" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-71" is linked (Left) to Trace_66 (see page 103)

Gap "CGT-71" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-71" is linked (Left) to Trace_65 (see page 102)

Gap "CGT-72"

NAME	CGT-72
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Insufficient spatial coverage of sea surface measurements. In coastal regions VHF radar measurements mainly cover USA coasts and few locations in Europe. In open ocean where coverage is mainly done with drifters (SVP program) fixed morings and ADCP onboard R/V the highest rate are approximately 1 data per 5 box from drifters.
OBSERVED	Both (3)
PURPOSE	To cover the range of space and time variability of coastal currents. Proved impact on forecasting products via data assimilation techniques at least for regional applications
REMEDY	Similarly to GAP number 71 a virtual constellation of altimeters combined with new generation of sensors, platforms and new satellite capabilities (e.g. 2d-altimetry, Doppler radar) should help to improve both resolution and coverage, particularly to solve the land-sea contamination in radar signals. At the same time improvements to better extract the information from all in situ available sources, mainly through improved dynamical models, should be of great help to progressively increase the quality and coverage of resolution interpolated fields. Particularly for coastal areas, extending the deployment of VHF radar infrastructures (e.e, CODAR, WERA) would be a good remedy.
FEASIBILITY	TBD (9)|Improvements by extending the present constellation of altimeters is highly feasible in terms of technology. Improvements with new instruments, sensors and platforms is quite mature in terms of concept but need to be tested. On the other hand research activities on new procedures to better exploit data is an active area of research. Present VHF technologies are mature enough to be systematically deployed. Furthemore, alliances and collaborations with private sectors (e.g. energy and aquaculture) to share platforms for increasing the observational coverage should also contribute efficiently to lower costs (e.g maintenance and communications)
IMPACT	Very high (4)|The impact of improving ocean currents in coastal areas is very high because affects many socio-economic sectors. Tourism, marine trade, marine security, marine pollution, fisheries, management and assessment of coastal ecosystems, sea level rise impacts are, among many others, some specific sectors that would benefit.
COST	High (3)|Improvements on satellite constellation could be very expensive, while improving information knowledge will be relatively low cost. Increasing the coverage of coastal areas with VHF radars scale with the amount of area to be covered, usually sectors of 50 x 50 km squares.
PRIORITY	TBD (0)|Crucial for coastal management. Coastal areas are the places were antropic impact is more evident.
TIMEFRAME	TBD (99)|The coastal area to be covered is huge. Primary focus should be associated with coastal regions with sensible areas related with marine protected areas and fragile ecosystems , oil-gas and related infrastructures, marine security (e.g. straits), etc.
GAPSTATUS	Detected (1)

Gap "CGT-72" is linked (Left) to EssentialVariable C_OC (see page 87)

Gap "CGT-72" is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap "CGT-72" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-72" is linked (Left) to Trace_67 (see page 103)

Gap "CGT-72" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-79"

NAME	CGT-79
GAPTYPE	No catalogue (5.1)
DESCRIPTION	Lack of development and sharing of in situ databases and derived products of sufficient quality to use in cal/val satellite products.
OBSERVED	In-Situ (2)
PURPOSE	Relevant to determine the marine albedo and assess the ocean ecosystem health and productivity and the role of the oceans in the global carbon cycle. Important to manage living marine resources and to quantify the impacts of climate variability and change.
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-79" is linked (Left) to EssentialVariable C_OC (see page 87)

Gap "CGT-79" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-79" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-79" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-80"

NAME	CGT-80
GAPTYPE	No interdisciplinary coord. (8.4)
DESCRIPTION	Limited linkage between ocean colour and ecosystem variables
OBSERVED	RS (1)
PURPOSE	Relevant to determine the marine albedo and assess the ocean ecosystem health and productivity and the role of the oceans in the global carbon cycle. Important to manage living marine resources and to quantify the impacts of climate variability and change.
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-80" is linked (Left) to EssentialVariable C_OC (see page 87)

Gap "CGT-80" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-80" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-80" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-87"

NAME	CGT-87
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Non-uniform distribution of in situ measurements. Argo profilers by design provide data up to 2000 m leaving inaccessible topographically constraint areas (Caribbean Sea, South China Sea,etc.) and for high latitudes if dedicated deployments are not scheduled.
OBSERVED	In-Situ (2)
PURPOSE	To characterize water masses, to monitor the ocen heat content and to determine the general structure of the ocean circulation. Necessary to determine the geostrophic circulation, heat transport and steric sea level and indirectly to understand changes in the marine biology and biogeochemistry.
REMEDY	Probably the most satisfactory way of solve this gap is to reinforce the Argo program.
FEASIBILITY	TBD (9)|Argo technology for CTD recording (conductivity, temperature and pressure) is not a problem. Deploying strategies are in part designed by national agencies for operational needs and some initiatives to analyze the impact have already addressing it (e.g. EAIMS).
IMPACT	Very high (4)|The Argo program is a key oceanic observation system with considerable impact on the quality of forecasts and analysis of present ocean models. In 10 years (2006-2016) the Argo program has collected more data than in the previous century (1900-2000).
COST	Medium (2)|Cost depends on the number of devices needed to have a satisfactory sampling. However promoting studies to evaluate the needs and the impact in order to optimize deployment strategies are relatively cheap.
PRIORITY	TBD (0)|The solution of this gap mainly affects to reduce uncertainties in some specific undersampled regions.
TIMEFRAME	TBD (99)|Once the regions affected by this gap are detected the solution can be planned in relatively short to mid term.
GAPSTATUS	Detected (1)

Gap "CGT-87" is linked (Left) to EssentialVariable C_TD (see page 88)

Gap "CGT-87" is linked (Left) to EssentialVariable C_SALD (see page 88)

Gap "CGT-87" is linked (Left) to EssentialVariable C_SST (see page 86)

Gap "CGT-87" is linked (Left) to EssentialVariable C_SSS (see page 86)

Gap "CGT-87" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-87" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-87" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-87" is linked (Left) to Review"Merged Gap" (see page 114)

Gap "CGT-88"

NAME	CGT-88
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Lack of enough in situ surface and subsurface measurements in shelf seas, marginal seas (e.g. Baltic Sea, North Sea, Barents Sea, Mediterranean Sea, etc.)
OBSERVED	In-Situ (2)
PURPOSE	To characterize water masses, to monitor the ocen heat content and to determine the general structure of the ocean circulation. Necessary to determine the geostrophic circulation, heat transport and steric sea level and indirectly to understand changes in the marine biology and biogeochemistry.
REMEDY	To reinforce coordination mechanisms among national agencies, the scientific community to agree on plans to have a better and uniform coverage based on reducing uncertainties. To promote systematic detailed studies on the number of Argo floats needed to optimize Argo deployment in such regions. Specific research programs devoted to deal with undersampled regions or to allocate additional funds for a more intensive deployment could be promoted. To promote collaboration with already existing offshore installations in shelf areas, usually associated to the energy sector and aquaculture facilities in order to share observational instruments and increase the information coverage.
FEASIBILITY	High (3)|Concerning the Argo technology the technology is ready. For shelf and polar areas, some technical solutions endowing inertial navigation systems with accelerometers may help to self-adjust the sampling to bathymetric changes characteristic of these regions. In polar areas some changes in float design would allow efficient solutions. However as it is usual a compromise between energy consumption and sampling strategy may constraint their performance where the limiting element is the energy consumption. Argo floats would benefit of improvements in battery storage technologies. On the other hand for deep marginal seas (e.g. Mediterranean, Black Sea..) there is no need of such implementations and feasibility is "Very high"
IMPACT	Very high (4)|The Argo program is a key oceanic observation system with considerable impact on the quality of forecasts and analysis of present ocean models. In 10 years (2006-2016) the Argo program has collected more data than in the previous century (1900-2000). To increase measurements in shelf areas has a high impact because constitutes the boundaries of the open ocean and where anthropic pressures and impacts are more evident.
COST	High (3)|Cost depends on the number of devices needed to have a satisfactory sampling. Synergies for instrumenting offshore platforms could be adopted at lower costs.
PRIORITY	TBD (0)|The priority also depend of the region. In some cases the areas are usually covered by networks of coastal buoys and similar (e,g. North Sea). For polar areas and for regional seas adjacent to poorer countries lacking coastal networks priority should be very high to adequately monitor changes.
TIMEFRAME	TBD (99)|The time frame depend on the adopted solution and the kind of region. Thus in polar areas some technological issues are not at all satisfactory. Other strategies non based on Argo can be solved relatively fast.
GAPSTATUS	Detected (1)

Gap "CGT-88" is linked (Left) to EssentialVariable C_TD (see page 88)

Gap "CGT-88" is linked (Left) to EssentialVariable C_SALD (see page 88)

Gap "CGT-88" is linked (Left) to EssentialVariable C_SST (see page 86)

Gap "CGT-88" is linked (Left) to EssentialVariable C_SSS (see page 86)

Gap "CGT-88" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-88" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-88" is linked (Left) to Trace_83 (see page 103)

Gap “CGT-88” is linked (Left) to Trace_45 (see page 101)

Gap “CGT-88” is linked (Left) to Trace_78 (see page 103)

Gap “CGT-88” is linked (Left) to Trace_56 (see page 102)

Gap “CGT-88” is linked (Left) to Review“Affects many Variables” (see page 114)

Gap “CGT-89”

NAME	CGT-89
GAPTYPE	Temporal extent (1.3)
DESCRIPTION	Insufficient temporal coverage. Argo deployment started in 2000 and became fully operative in 2005-2006, so less than the WMO 30 years definition of clima. Note however that regular sections sections and measurements (bathythermographs, CTD and XBT sections) are available since 1980s and before.
OBSERVED	In-Situ (2)
PURPOSE	To characterize water masses, to monitor the ocen heat content and to determine the general structure of the ocean circulation. Necessary to determine the geostrophic circulation, heat transport and steric sea level and indirectly to understand changes in the marine biology and biogeochemistry.
REMEDY	To maintain, or even increase, the investment on Argo floats at least to ensure the 30 years period according to the WMO definition of clima.
FEASIBILITY	Very high (4)|There is almost no technological problems concerning the measurement of in situ SST from Argo. However, of a total of 3887 operational floats in October 2016, the number of countries contributing to the Argo program falls to only 30 being a few national agencies from specific countries (e.g. USA, France, Australia,..) the main contributors. Probably much more efforts could be easily increased if more national agencies are involved. Outside the operational activities of these agencies, research plans and programs could be somehow incentivated the use and deploy of Argo floats as an indirect way to increase the operational number of floats.
IMPACT	Very high (4)|Generically speaking the impact of the Argo program as a multipurpose platform scanning the 3D structure of the ocean is beyond any doubt and affects a great number of communities. In particular for the sea surface temperature, extending the time series will provide a better description of sub-decadal variability of the ocean heat content impacting our present knowledge of ocean warning to sea level rise.
COST	Very high (4)|According to Argo program estimations, the cost of maintainning an array of 300 requires to deply 600 unities per year which is equivalent to $24m per year. (http://www.argo.ucsd.edu/FAQ.html#cost)
PRIORITY	TBD (0)|This gap affects many variables Probably the main measure is to reinforce the Argo program as the most satisfactory way of solve this gap. Note however that for temperature there exist scomplentary in situ sampling comming from regular XBT sections.
TIMEFRAME	TBD (99)|Argo program reached the coverage objectives in 2006 so at least 20 years more would be the time necessary according to WMO definition of clima
GAPSTATUS	Detected (1)

Gap “CGT-89” is linked (Left) to EssentialVariable C_TD (see page 88)

Gap “CGT-89” is linked (Left) to EssentialVariable C_SALD (see page 88)

Gap “CGT-89” is linked (Left) to EssentialVariable C_SSS (see page 86)

Gap “CGT-89” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-89” is linked (Left) to Theme“Multiple” (see page 73)

Gap “CGT-89” is linked (Left) to Trace_84 (see page 103)

Gap “CGT-89” is linked (Left) to Trace_45 (see page 101)

Gap “CGT-89” is linked (Left) to Trace_86 (see page 104)

Gap “CGT-89” is linked (Left) to Review“Merged Gap” (see page 115)

Gap “CGT-93”

NAME	CGT-93
GAPTYPE	Temporal extent (1.3)
DESCRIPTION	Lack of sufficient temporal coverage and extent for many climatic applications, in particular to monitor the meridional overturning circulation.
OBSERVED	In-Situ (2)
PURPOSE	Currents are essential to determine the transport of mass, energy and many other properties (nutrients, O2, sediments, etc.) from basin to global scales. They are necessary to determine absolute velocity fields complementing the geostrophic field from temperature and salinity measurements. Direct measurements of lateral and bottom boundary currents ara important to resolve Ekman transport of properties to constraint large-scale and basin ocean currents, from small to climate scales. Important for model validation.
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap “CGT-93” is linked (Left) to EssentialVariable C_CD (see page 88)

Gap “CGT-93” is linked (Left) to EssentialVariable C_C (see page 87)

Gap “CGT-93” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-93” is linked (Left) to Theme“Multiple” (see page 73)

Gap “CGT-93” is linked (Left) to Trace_79 (see page 103)

Gap “CGT-93” is linked (Left) to Trace_45 (see page 101)

Gap “CGT-93” is linked (Left) to Trace_87 (see page 104)

Gap “CGT-106”

NAME	CGT-106
GAPTYPE	Uncertainty (3.1)
DESCRIPTION	Missing evaluation criteria for assessing existing observing capabilities
OBSERVED	TBD (4)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap “CGT-106” is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap “CGT-106” is linked (Left) to EssentialVariable C_WVU (see page 85)

Gap “CGT-106” is linked (Left) to EssentialVariable C_CO2 (see page 85)

Gap “CGT-106” is linked (Left) to EssentialVariable C_GHG (see page 86)

Gap “CGT-106” is linked (Left) to EssentialVariable C_TU (see page 85)

Gap “CGT-106” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-106” is linked (Left) to Theme“Climate” (see page 72)

Gap “CGT-106” is linked (Left) to Trace_101 (see page 104)

Gap “CGT-107”

NAME	CGT-107
GAPTYPE	No quality (6.3)
DESCRIPTION	Lack of a comprehensive review of current sub-orbital observing capabilities for all the study of ECVs in atmospheric, ocean and land domains
OBSERVED	TBD (4)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap “CGT-107” is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap “CGT-107” is linked (Left) to EssentialVariable C_WVU (see page 85)

Gap “CGT-107” is linked (Left) to EssentialVariable C_CO2 (see page 85)

Gap “CGT-107” is linked (Left) to EssentialVariable C_GHG (see page 86)

Gap “CGT-107” is linked (Left) to EssentialVariable C_TU (see page 85)

Gap “CGT-107” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-107” is linked (Left) to Theme“Climate” (see page 72)

Gap “CGT-107” is linked (Left) to Trace_102 (see page 104)

Gap “CGT-110”

NAME	CGT-110
GAPTYPE	No quality (6.3)
DESCRIPTION	Need for a scientific approach for the assessment of gaps in the existing networks measuring ECVs
OBSERVED	TBD (4)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap “CGT-110” is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap “CGT-110” is linked (Left) to EssentialVariable C_WVU (see page 85)

Gap “CGT-110” is linked (Left) to EssentialVariable C_CO2 (see page 85)

Gap “CGT-110” is linked (Left) to EssentialVariable C_GHG (see page 86)

Gap “CGT-110” is linked (Left) to EssentialVariable C_TU (see page 85)

Gap “CGT-110” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-110” is linked (Left) to Theme“Climate” (see page 72)

Gap “CGT-110” is linked (Left) to Trace_105 (see page 104)

Gap “CGT-128”

NAME	CGT-128
GAPTYPE	Vertical resolution (2.2)
DESCRIPTION	Tropospheric O3 profile data is limited
OBSERVED	TBD (4)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap “CGT-128” is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap “CGT-128” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-128” is linked (Left) to Theme“Climate” (see page 72)

Gap “CGT-128” is linked (Left) to Trace_110 (see page 105)

Gap “CGT-138”

NAME	CGT-138
GAPTYPE	Temporal extent (1.3)
DESCRIPTION	Spectroscopic uncertainties (H20, O3, CH4)
OBSERVED	TBD (4)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap “CGT-138” is linked (Left) to EssentialVariable C_WVU (see page 85)

Gap “CGT-138” is linked (Left) to EssentialVariable C_O3A (see page 86)

Gap “CGT-138” is linked (Left) to EssentialVariable C_GHG (see page 86)

Gap “CGT-138” is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap “CGT-138” is linked (Left) to Theme“Climate” (see page 72)

Gap “CGT-138” is linked (Left) to Trace_133 (see page 106)

Gap "CGT-142"

NAME	CGT-142
GAPTYPE	Temporal extent (1.3)
DESCRIPTION	In-situ calibration can be verified by involving new data (CO2, CH4)
OBSERVED	TBD (4)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-142" is linked (Left) to EssentialVariable C_CO2 (see page 85)

Gap "CGT-142" is linked (Left) to EssentialVariable C_GHG (see page 86)

Gap "CGT-142" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-142" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-142" is linked (Left) to Trace_134 (see page 106)

Gap "CGT-176"

NAME	CGT-176
GAPTYPE	Catalogue saturation (5.2)
DESCRIPTION	Lack of tools for Big Data analysis: merge timeseries, proper map and statistics visual representation
OBSERVED	RS (1)
PURPOSE	Big data
REMEDY	Develope the right tools for big data analysis and visualization
FEASIBILITY	Very high (4)|
IMPACT	High (3)|
COST	Low (1)|
PRIORITY	Low (5)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Solved (6)

Gap "CGT-176" is linked (Right) to GapAnalysisThread GAT-CG-BUT3 (see page 72)

Gap "CGT-176" is linked (Left) to Theme"All Themes" (see page 73)

Gap "CGT-176" is linked (Left) to Trace_168 (see page 108)

Gap "CGT-176" is linked (Left) to Review"Operational" (see page 115)

Gap "CGT-176" is linked (Left) to Recommendation"Operational" (see page 115)

Gap "CGT-180"

NAME	CGT-180
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Glacier, Glacier dammed lakes - near continuous global mapping needed
OBSERVED	Both (3)
PURPOSE	due to accelerating melt rates of many mountain glaciers, glacier lakes are an increasing hazard since many are in remote locations and hard to monitor
REMEDY	traditionally accomplished with visible imagery, but possible also with high resolution SAR
FEASIBILITY	Very high (4)|only a matter scheduling acquisitions and implementing automated change detection algorithms
IMPACT	Very high (4)|recently entire villages in Nepal were wiped out by GLOFs
COST	Medium (2)|depends on source, some data are free, some carry cost
PRIORITY	Very high (2)|the number of dangerous lakes is growning and existing monitoring programs are inadequate
TIMEFRAME	Short term (1)|
GAPSTATUS	Detected (1)

Gap "CGT-180" is linked (Left) to EssentialVariable C_GLA (see page 89)

Gap "CGT-180" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "CGT-180" is linked (Left) to Theme"Disasters" (see page 73)

Gap "CGT-180" is linked (Left) to Trace_172 (see page 108)

Gap "CGT-184"

NAME	CGT-184
GAPTYPE	Geographical extent (1.1)
DESCRIPTION	Glacier, Glacier velocity - has been determined for only a fraction of glaciers globally
OBSERVED	RS (1)
PURPOSE	velocity is important measure of glacier dynamics
REMEDY	feature tracking in visible imagery or inSAR can supply necessary dat
FEASIBILITY	Very high (4)|only a matter scheduling acquisitions and applying algorithms
IMPACT	High (3)|mostly pertains to outlet glaciers of the Greenland and West Antarctic Ice Sheets which have the potential to raise sea levels by 6m or more
COST	Medium (2)|
PRIORITY	Very high (2)|the fate of the GIS and WAIS is of critical, global importance
TIMEFRAME	Mid term (2)|
GAPSTATUS	Detected (1)

Gap "CGT-184" is linked (Left) to EssentialVariable C_GLA (see page 89)

Gap "CGT-184" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "CGT-184" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-184" is linked (Left) to Trace_172 (see page 108)

Gap "CGT-193"

NAME	CGT-193
GAPTYPE	Uncertainty (3.1)
DESCRIPTION	Land surface, Snow water equivalent
OBSERVED	RS (1)
PURPOSE	snow melt runoff is a major source of water in many regions and while the area covered by snow is mapped daily from satellite, this does not revveal the amount of water in the snow pack is unknown
REMEDY	existing in situ (e.g. snotel, GPS), airborne (gamma ray, lidar), and satellite (radar, lidar) methods each have limitations. new satellite mission dedicated to SWE is needed
FEASIBILITY	High (3)|both NASA and ESA have programs to develop spaceborne snow missions
IMPACT	Very high (4)|More than one-sixth of the world's population relies on seasonal snowpack and glaciers for water. Knowing amount and timing of runoff is of critical importance
COST	Very high (4)|new mission
PRIORITY	Very high (2)|
TIMEFRAME	Short term (1)|the technologies are mostly ready
GAPSTATUS	Detected (1)

Gap "CGT-193" is linked (Left) to EssentialVariable C_SNC (see page 89)

Gap "CGT-193" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "CGT-193" is linked (Left) to Theme"Climate" (see page 72)

Gap "CGT-193" is linked (Left) to Trace_183 (see page 108)

Gap "CGT-201"

NAME	CGT-201
GAPTYPE	Non well known format (5.5)
DESCRIPTION	Lack of interoperability in crowd-sourced data (e.g. ground-truth data, sightings, etc.), regarding standards and data models
OBSERVED	Both (3)
PURPOSE	Harmonization of crowd-sourced / Citizen Science data models
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-201" is linked (Left) to EssentialVariable EV (see page 98)

Gap "CGT-201" is linked (Right) to GapAnalysisThread GAT-CG-BUT3 (see page 72)

Gap "CGT-201" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-201" is linked (Left) to Trace_189 (see page 108)

Gap "CGT-206"

NAME	CGT-206
GAPTYPE	No easy access (5.4)
DESCRIPTION	No automated download of satellite images for real-time classification, mosaicking, change detection analysis, etc.
OBSERVED	RS (1)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-206" is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap "CGT-206" is linked (Left) to Theme"All Themes" (see page 73)

Gap "CGT-206" is linked (Left) to Trace_191 (see page 108)

Gap "CGT-208"

NAME	CGT-208
GAPTYPE	Spatial resolution (2.1)
DESCRIPTION	High resolution land cover/use data not available
OBSERVED	RS (1)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-208" is linked (Left) to EssentialVariable C_LCV (see page 90)

Gap "CGT-208" is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap "CGT-208" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-208" is linked (Left) to Trace_191 (see page 108)

Gap "SDG-GP-1"

NAME	SDG-GP-1
GAPTYPE	Conceptual
DESCRIPTION	No integrated environmental and socio-economic data bases.
OBSERVED	n/a
PURPOSE	Quantification of SDG indicators: many indicators require the integration of socio-economic and environmental data
REMEDY	Integration of socio-economic and environmental data.
FEASIBILITY	Medium (2)
IMPACT	Very High (4)|
COST	High (3)|
PRIORITY	High (3)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Accepted (3)

Gap "SDG-GP-1" is linked (Left) to Theme"SDGS" (see page 74)

Gap "SDG-GP-1" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "SDG-GP-1" is linked (Right) to EssentialVariable SDG-ALL (see page 98)

Gap "SDG-GP-2"

NAME	SDG-GP-2
GAPTYPE	Conceptual
DESCRIPTION	Insufficient accounting for environmental variables in SDG indicators
OBSERVED	n/a
PURPOSE	Integrating the environment into the monitoring framework: Monitoring progress towards many targets would benefit from additional or modified indicators that integrate more information on the environment.
REMEDY	Integration of socio-economic and environmental data.
FEASIBILITY	Very High (4)
IMPACT	High (3)|
COST	Low (1)|
PRIORITY	High (3)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Accepted (3)

Gap "SDG-GP-2" is linked (Left) to Theme"SDGS" (see page 74)

Gap "SDG-GP-2" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "SDG-GP-2" is linked (Right) to EssentialVariable SDG-ALL (see page 98)

Gap "SDG-GP-6"

NAME	SDG-GP-6
GAPTYPE	Educational
DESCRIPTION	Skills required for matching providers and policy makers.
OBSERVED	n/a
PURPOSE	Developing policies and actions for the implementation of SDGs: the matching of providers who can provide products and tools supporting policy developments for the implementation and the monitoring of SDGs with those engaged in the implementation and monitoring of SDGs is not happening sufficiently because of a lack of people with matching skills. Educational efforts need to be made to address this gap.
REMEDY	Develop educational programs that focus on inter-sectoral skills.
FEASIBILITY	Very High (4)
IMPACT	High (3)|
COST	Low (1)|
PRIORITY	High (3)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Accepted (3)

Gap "SDG-GP-6" is linked (Left) to Theme"SDGS" (see page 74)

Gap "SDG-GP-6" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "SDG-GP-6" is linked (Right) to EssentialVariable SDG-ALL (see page 98)

Gap "SDG-GP-7"

NAME	SDG-GP-7
GAPTYPE	Not measured.
DESCRIPTION	Many of the ESDGVs for the built environment are not measured.
OBSERVED	n/a
PURPOSE	For many of the SDG indicators, information on the built environment is crucial. However, this information is often not available.
REMEDY	Develop a research program to extract as much as possible imformation on the built environment from traditional EO as well as through crowd sourcing and citizen scientists.
FEASIBILITY	Medium (2)
IMPACT	Very High (4)|
COST	High (3)|
PRIORITY	High (3)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Accepted (3)

Gap "SDG-GP-7" is linked (Right) to EssentialVariable HS-ALL (see page **??**)

Gap "SDG-GP-7" is linked (Right) to Theme"Human Settlements" (see page 73)

Gap "SDG-GP-7" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "SDG-GP-7" is linked (Right) to Theme"SDGS" (see page 74)

6 Other Relevant Groups

In this section we produce list of instances in groups that were referred to in the previous sections. In the lists of gaps in the previous section, each gap is followed by a listing of the instances in the groups Themes, GapAnaly-

sisThreads, EssentialVariables, Traces, Reviews, and Recommendations to which an instances is linked. To reduce space, similar listings of linked instances are not included in the lists below. If desired, such lists can be easily extracted from the SEE-IN KB. The listing of links provides an easy means of cross-referencing. Thus, finding, for example, all gaps relevant for a particular EV is easy by looking at the links listed after this EV listing. This cross-referencing provides an easy means to explore the information provided in Sections 5 and 6 for various purposes. Using the SEE-IN KB, the cross-listing can be explored for more advanced searches.

6.1 Gaps Mentioned in the Deliverable

Gap "CGT-18"

NAME	CGT-18
GAPTYPE	No measured (7.1)
DESCRIPTION	In mineral resources there is the lack dedicated EO system or program and currently use EO systems and programs from other SBAs.
OBSERVED	TBD (4)
PURPOSE	Develop global coverage by high-spectral resolution sensors
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-18" is linked (Left) to EssentialVariable EV (see page 98)

Gap "CGT-18" is linked (Right) to GapAnalysisThread GAT-CG-TDT2 (see page 71)

Gap "CGT-18" is linked (Left) to Theme"Energy" (see page 73)

Gap "CGT-18" is linked (Left) to Trace_17 (see page 99)

Gap "CGT-70"

NAME	CGT-70
GAPTYPE	Non well known format (5.5)
DESCRIPTION	Lack of standardization in data reports with biases between networks of buoys.
OBSERVED	In-Situ (2)
PURPOSE	Improve and validate sea state forecasts. Essential for marine security and marine trade.
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-70" is linked (Left) to EssentialVariable C_SS (see page 87)

Gap "CGT-70" is linked (Right) to GapAnalysisThread GAT-CG-BUT1 (see page 71)

Gap "CGT-70" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-70" is linked (Left) to Trace_45 (see page 101)

Gap "CGT-173"

NAME	CGT-173
GAPTYPE	No fast access to big data (5.8)
DESCRIPTION	Lack of broadband connectivity for big-data fast visualization and processing
OBSERVED	RS (1)
PURPOSE	Connectivity
REMEDY	Improve client software to transmit only the necessary data. Use cloud or High Processing Computing (HPC) data processing.
FEASIBILITY	High (3)|
IMPACT	High (3)|
COST	Unknown (0)|
PRIORITY	High (3)|
TIMEFRAME	Short term (1)|
GAPSTATUS	Solved (6)

Gap "CGT-173" is linked (Right) to GapAnalysisThread GAT-CG-BUT3 (see page 72)

Gap "CGT-173" is linked (Left) to Theme"All Themes" (see page 73)

Gap "CGT-173" is linked (Left) to Trace_168 (see page 108)

Gap "CGT-173" is linked (Left) to Review"Developing" (see page 115)

Gap "CGT-173" is linked (Left) to Recommendation"Feasibility" (see page 115)

Gap "CGT-200"

NAME	CGT-200
GAPTYPE	Non well known format (5.5)
DESCRIPTION	Lack of interoperability in mobile sensor data, regarding standards and data models (CO2, NOX)
OBSERVED	In-Situ (2)
PURPOSE	Harmonization of access to mobile sensor data (e.g. vessels, gliders, cars, drones, ...)
FEASIBILITY	TBD (9)|
IMPACT	TBD (9)|
COST	TBD (9)|
PRIORITY	TBD (0)|
TIMEFRAME	TBD (99)|
GAPSTATUS	Detected (1)

Gap "CGT-200" is linked (Left) to EssentialVariable C_CO2 (see page 85)

Gap "CGT-200" is linked (Left) to EssentialVariable C_PRE (see page 86)

Gap "CGT-200" is linked (Left) to EssentialVariable N_NOI (see page 98)

Gap "CGT-200" is linked (Right) to GapAnalysisThread GAT-CG-BUT3 (see page 72)

Gap "CGT-200" is linked (Left) to Theme"Multiple" (see page 73)

Gap "CGT-200" is linked (Left) to Trace_189 (see page 108)

Gap "SDG-GP-0"

NAME	SDG-GP-0
GAPTYPE	Epistemological
DESCRIPTION	There is a lack of an epistemology for the creation of transition knowledge from the current state and system trajectory to the desired future identified in the Agenda 2030.
OBSERVED	n/a
PURPOSE	Implemetation on SDGs depends on transformation knowledge.
REMEDY	Development of an epistemology for the creation of transition knowledge.
FEASIBILITY	Low (1)
IMPACT	Very High (4)|
COST	Low (1)|
PRIORITY	High (3)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Accepted (3)

Gap "SDG-GP-0" is linked (Left) to Theme"SDGS" (see page 74)

Gap "SDG-GP-0" is linked (Left) to Trace_230 (see page 110)

Gap "SDG-GP-0" is linked (Left) to Trace_231 (see page 110)

Gap "SDG-GP-0" is linked (Left) to Trace_232 (see page 110)

Gap "SDG-GP-0" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "SDG-GP-0" is linked (Right) to EssentialVariable SDG-ALL (see page 98)

Gap "SDG-GP-3"

NAME	SDG-GP-3
GAPTYPE	Conceptual
DESCRIPTION	Missing link between SDGs and sustainability
OBSERVED	n/a
PURPOSE	Sustainable development requires a functioning Earth's life-support system and the SDGs need to acknowledge this need. The SDGs, Targets, and Indicators do not reflect sufficiently the need to safeguard the Earth's life-support system.
REMEDY	Review of all SDGs to determine their linkage with sustainability.
FEASIBILITY	Medium (2)
IMPACT	Very High (4)|
COST	High (3)|
PRIORITY	High (3)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Accepted (3)

Gap "SDG-GP-3" is linked (Left) to Theme"SDGS" (see page 74)

Gap "SDG-GP-3" is linked (Left) to Trace_223 (see page 109)

Gap "SDG-GP-3" is linked (Left) to Trace_225 (see page 109)

Gap "SDG-GP-3" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "SDG-GP-3" is linked (Right) to EssentialVariable SDG-ALL (see page 98)

Gap "SDG-GP-4"

NAME	SDG-GP-4
GAPTYPE	Capacity
DESCRIPTION	Missing tools and capacity to assess cross-SDG dependencies.
OBSERVED	n/a
PURPOSE	Developing policies and actions for the implementation of the SDGs: Modeling tools are needed to better link the indicators to the targets and to ensure that changes in the indicators are related to trends towards the targets.
REMEDY	Development of tools for exploration of SDG interdependencies.
FEASIBILITY	High (3)
IMPACT	High (3)|
COST	Medium (2)|
PRIORITY	High (3)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Accepted (3)

Gap "SDG-GP-4" is linked (Left) to Theme"SDGS" (see page 74)

Gap "SDG-GP-4" is linked (Left) to Trace_224 (see page 109)

Gap "SDG-GP-4" is linked (Left) to Trace_226 (see page 109)

Gap "SDG-GP-4" is linked (Left) to Trace_227 (see page 109)

Gap "SDG-GP-4" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "SDG-GP-4" is linked (Right) to EssentialVariable SDG-ALL (see page 98)

Gap "SDG-GP-5"

NAME	SDG-GP-5
GAPTYPE	Capacity
DESCRIPTION	Missing tools for assessing cross SDG impacts of policies.
OBSERVED	n/a
PURPOSE	Reducing negative impacts between SDGs: most policies for the implementation of SDGs will be developed by specific governmental departments. Modeling tools are needed to support departments in assess impacts of specific SDG policies on other SDGs handled by other departments.
REMEDY	Development of tools for exploration of policy impacts.
FEASIBILITY	High (3)
IMPACT	High (3)|
COST	Medium (2)|
PRIORITY	High (3)|
TIMEFRAME	Mid term (2)|
GAPSTATUS	Accepted (3)

Gap "SDG-GP-5" is linked (Left) to Theme"SDGS" (see page 74)

Gap "SDG-GP-5" is linked (Left) to Trace_228 (see page 110)

Gap "SDG-GP-5" is linked (Left) to Trace_229 (see page 110)

Gap "SDG-GP-5" is linked (Right) to GapAnalysisThread GAT-CG-TDT1 (see page 70)

Gap "SDG-GP-5" is linked (Right) to EssentialVariable SDG-ALL (see page 98)

6.2 Gap Analysis Threads

GapAnalysisThread GAT-CG-TDT1 "ConnectinGEO Top-Down Thread 1"

CODE	GAT-CG-TDT1
NAME	ConnectinGEO Top-Down Thread 1
SUMMARY	Identification of a collection of observation requirements and specifications from generic goals for sustainability of the global civilization as expressed in the GEOSS Strategic Targets, the SDGs, and the adherence to the planetary boundaries.
DESCRIPTION	This thread uses the *goal-based approach (GBA)* (see Plag et al., 2016) to identify observational requirements. Originally, the *Top-Down Thread 1 (TDT1)* was intended to start from a number of sets of goals and targets that current and future users of GEOSS might have. Based on these sets, indicators to measure progress towards the goals and targets could be identified. The EVs required to quantify the indicators would provide a basis to specify observational requirements. Examples of goal sets to be considered included the GEOSS Strategic Targets, the SDGs, the global boundaries, *Disaster Risk Reduction (DRR)*, and monitoring of global change. The feedback during the Midterm review of the project indicated that the focus of the gap analysis should be on the SDGs. This is consistent with the general development in GEO, which is paying increasing attention to the SDGs. In D6.1, the (slightly modified) steps for TDT1 were identified to be: 1. Define the gaps taxonomy. 2. Identifying the strategic goals we want to achieve. This can come from the SDG but also by scientific goals that we can identify in scientific literature. 3. Express the goals as precise user requirements. 4. Identifying the essential variables that can be used to measure the achievement of the goals. 5. Identifying the metrics and measurements used to achieve the goals. 6. Determine if the EO necessary fits the purpose of the user requirements. If not, a gap has been detected.
STATUS	Implemented
COMMUNITY	ConnectinGEO

GapAnalysisThread GAT-CG-TDT2 "ConnectinGEO Top-Down Thread 2"

CODE	GAT-CG-TDT2
NAME	ConnectinGEO Top-Down Thread 2
SUMMARY	Incorporation of material from international programs such as Future Earth, Belmont Forum, the Research Data Alliance and community assessments of socio-economic benefits of Earth observations.
DESCRIPTION	For the *Top-Down Thread 2 (TDT2)*, documents of international programs such as Future Earth, Belmont Forum, and the Research Data Alliance as well as community assessments of socio-economic benefits of Earth observations, including those of the IGOS-P Themes, have been studied with the primary goal to extract explicit observational requirements. In addition, other needs (such as infrastructure, capacity, technology and research needs) were considered. The extracted information is published in the SEE-IN KB so that it can be included in the gap analysis. An initial set of requirements is being compiled based on the review of literature done by the GEO Task US-09-01 and the reports published as a result of these task activities (Group on Earth Observations, 2012).
STATUS	Implemented
COMMUNITY	ConnectinGEO

GapAnalysisThread GAT-CG-BUT1 "ConnectinGEO Bottom-Up Thread 1"

CODE	GAT-CG-BUT1
NAME	ConnectinGEO Bottom-Up Thread 1
SUMMARY	A consultation process in the current EO networks, consisting of collaboration platforms, surveys and discussions at workshops and even involvement of citizen science.
DESCRIPTION	The consultation process of *Bottom-Up Thread 1 (BUT1)* has been implemented in form of a survey. This survey was conducted by WP 3 and the results are described in detail in Deliverable 3.4. The results of the survey are reviewed to extract gap information. The results were augmented during the Gap Analysis and Prioritization Workshop and ENEON Plenary in October 2016.
STATUS	Implemented
COMMUNITY	ConnectinGEO

GapAnalysisThread GAT-CG-BUT2 "ConnectinGEO Bottom-Up Thread 2"

CODE	GAT-CG-BUT2
NAME	ConnectinGEO Bottom-Up Thread 2
SUMMARY	A careful analysis of the observations and measurements that are currently in GEOSS Discovery and Access Broker complemented by other means (e.g. scientific literature).
DESCRIPTION	In this thread, a limited set of observational requirements was used to demonstrate the feasibility of the thread. The initial results in the *Bottom-Up Thread 2 (BUT2)* of the analysis of the observations and measurements that are discoverable through the GEOSS *Discovery and Access Broker (DAB)* has been presented at the Project meeting in April 2016 in Münster, Germany. The results were also presented at the Gap Analysis Workshop in October 2016. The result of this analysis are being reviewed to identify gaps and these gaps will be included in the SEE-IN KB.
STATUS	Implemented
COMMUNITY	ConnectinGEO

GapAnalysisThread GAT-CG-BUT3 "ConnectinGEO Bottom-Up Thread 3"

CODE	GAT-CG-BUT3
NAME	ConnectinGEO Bottom-Up Thread 3
SUMMARY	The realization of a series of real industry-driven challenges to assess the problems and gaps emerging during the creation of business opportunities.
DESCRIPTION	In the *Bottom-Up Thread 3 (BUT3)*, a series of industry-driven challenges to assess the problems and gaps emerging during the creation of business opportunities are carried out in WP 5. The challenges are described in detail in Deliverable D5.1. They include: 1. A experiment based on *Surface Solar Irradiance (SSI)* measurements and the gaps in them. ARMINES is leading this challenge. This activity started in August 2015. 2. An experiment to combine in-situ and satellite data. The text in the DoA frames the scope to SAR and atmospheric data for CalVal. Sentinel 1 will have a role. SandT is leading. Start was in September 2015. 3. Integrate more in-situ networks in the GEOSS DAB with the scope on CZEN and terrestrial ecosystems. CNR is leading and the activity started in July 2016. 4. A private sector challenge consisting of a competition. EARSC leads this activity and it started in December 2015. 5. An interdisciplinary cooperation on the *Food-Water-Energy Nexus (FWEN)*. This activity is lead by Tiwah and started in December 2015.
STATUS	Implemented
COMMUNITY	ConnectinGEO

GapAnalysisThread UNDEFINED

CODE	UNDEFINED

GapAnalysisThread GAT-GAIA-CLIM "GAIA-Clim Gap Analysis"

CODE	GAT-GAIA-CLIM
NAME	GAIA-Clim Gap Analysis
COMMUNITY	GAIA-CLIM

6.3 Themes

Theme "Climate"

NAME	Climate
DESCRIPTION	Partly covered in ENEON by a Carbon Cycle ambassador.
COMMUNITY	Climate Community

Theme "Oceans"

NAME	Oceans
DESCRIPTION	Partly covered in ENEON by a Marine Ambassador
COMMUNITY	Ocean Community

Theme "Water"

NAME	Water
COMMUNITY	Water Community of Practice

Theme "Water Cycle"

NAME	Water Cycle

Theme "Weather"

NAME	Weather
DESCRIPTION	Partly covered in ENEON by air pollution and atmosphere ambassadors.

Theme "Biodiversity"

NAME	Biodiversity
DESCRIPTION	Covered in ENEON by a biodiversity ambassador
COMMUNITY	Biodiversity

Theme "Disasters"

NAME	Disasters

Theme "Energy"

NAME	Energy

Theme "Health"

NAME	Health

Theme "Agriculture"

NAME	Agriculture

Theme "Human Settlements"

NAME	Human Settlements

Theme "Multiple"

NAME	Multiple
DESCRIPTION	This is a place holder for entries that are linked to multiple themes.

Theme "All Themes"

NAME	All Themes
DESCRIPTION	This is a place holder for a link to all themes at once.

Theme "SDGS"

NAME	SDGS
DESCRIPTION	Implementation and monitoring of Sustainable Development Goals.

6.4 Essential Variables

EssentialVariable EV-PSER-WAT "Water Supply Services"

CODE	EV-PSER-WAT
NAME	Water Supply Services
DESCRIPTION	Availability of water supply services
EXPDOMAIN	PubSER
GEOSYSTEM	BuildEnv
COMMUNITY	UN-SDG

EssentialVariable EV-PSER-EPO "Electrical power services"

CODE	EV-PSER-EPO
NAME	Electrical power services
DESCRIPTION	Availability of electrical power supply services
EXPDOMAIN	PubSER
GEOSYSTEM	BuildEnv
COMMUNITY	UN-SDG

EssentialVariable EV-PSER-SEW "Sewage Services"

CODE	EV-PSER-SEW
NAME	Sewage Services
DESCRIPTION	Availability of sewage services
EXPDOMAIN	PubSER
GEOSYSTEM	BuildEnv
COMMUNITY	UN-SDG

EssentialVariable EV-PSER-TRA "Transportation Services"

CODE	EV-PSER-TRA
NAME	Transportation Services
DESCRIPTION	Availability of public transportation services
EXPDOMAIN	PubSER
GEOSYSTEM	BuildEnv
COMMUNITY	UN-SDG

EssentialVariable EV-PSER-INT "Internet Services"

CODE	EV-PSER-INT
NAME	Internet Services
DESCRIPTION	Availability of Internet services
EXPDOMAIN	PubSER
GEOSYSTEM	BuildEnv
COMMUNITY	UN-SDG

EssentialVariable EV-PSER-MPH "Mobile Phone Services"

CODE	EV-PSER-MPH
NAME	Mobile Phone Services
DESCRIPTION	Availability of mobile phone services
EXPDOMAIN	PubSER
GEOSYSTEM	BuildEnv
COMMUNITY	UN-SDG

EssentialVariable EV-PSER-LPH "Landline Phone Services"

CODE	EV-PSER-LPH
NAME	Landline Phone Services
DESCRIPTION	Availability of landline phone services
EXPDOMAIN	PubSER
GEOSYSTEM	BuildEnv
COMMUNITY	UN-SDG

EssentialVariable EV-PSER-PHE "Public Health Services"

CODE	EV-PSER-PHE
NAME	Public Health Services
DESCRIPTION	Availability of public health services
EXPDOMAIN	PubSER
GEOSYSTEM	BuildEnv
COMMUNITY	UN-SDG

EssentialVariable EV-PSER-IPH "Internet Phone Services"

CODE	EV-PSER-IPH
NAME	Internet Phone Services
DESCRIPTION	Availability of internet phone services
EXPDOMAIN	PubServ
GEOSYSTEM	BuildEnv
COMMUNITY	UN-SDG

EssentialVariable EV-POP-MIGRATE "Population Migration"

CODE	EV-POP-MIGRATE
NAME	Population Migration
DESCRIPTION	Information on migration
EXPDOMAIN	Demography
GEOSYSTEM	Population

EssentialVariable EV-ESURF-VEG "Land cover vegetation"

CODE	EV-ESURF-VEG
NAME	Land cover vegetation
EXPDOMAIN	LandCover
GEOSYSTEM	Surface
COMMUNITY	UN-SDG

EssentialVariable EV-PHEALTH-MALA "Malaria infection potential"

CODE	EV-PHEALTH-MALA
NAME	Malaria infection potential
EXPDOMAIN	InfectDisease
GEOSYSTEM	Surface
COMMUNITY	UN-SDG

EssentialVariable EV-PROD-FOREST "Productivity of Forests"

CODE	EV-PROD-FOREST
NAME	Productivity of Forests
EXPDOMAIN	Forestry
GEOSYSTEM	Surface

EssentialVariable EV-PROD-FARM "Productivity of Farms"

CODE	EV-PROD-FARM
NAME	Productivity of Farms
EXPDOMAIN	Agriculture
GEOSYSTEM	Surface

EssentialVariable EV-AGRI-SUST "Sustainability of agriculture"

CODE	EV-AGRI-SUST
NAME	Sustainability of agriculture
EXPDOMAIN	Agriculture
GEOSYSTEM	Surface

EssentialVariable EV-AGRI-IRRI "Irrigation level of agriculture"

CODE	EV-AGRI-IRRI
NAME	Irrigation level of agriculture
EXPDOMAIN	Agriculture
GEOSYSTEM	Surface

EssentialVariable EV-AGRI-FERT "Fertilizer usage of agriculture"

CODE	EV-AGRI-FERT
NAME	Fertilizer usage of agriculture
EXPDOMAIN	Agriculture
GEOSYSTEM	Surface

EssentialVariable EV-CLIM-DROUGHT "Drought indicator"

CODE	EV-CLIM-DROUGHT
NAME	Drought indicator
EXPDOMAIN	Climate
GEOSYSTEM	Surface

EssentialVariable EV-CLIM-FLOOD "Flood level"

CODE	EV-CLIM-FLOOD
NAME	Flood level
EXPDOMAIN	Climate
GEOSYSTEM	Surface

EssentialVariable EV-PROD-PAST "Productivity of Pastures"

CODE	EV-PROD-PAST
NAME	Productivity of Pastures
EXPDOMAIN	Agriculture
GEOSYSTEM	Surface

EssentialVariable EV-ESURF-WATQ "Surface water quality"

CODE	EV-ESURF-WATQ
NAME	Surface water quality
DESCRIPTION	Quality of surface water on the land surface
EXPDOMAIN	Water
GEOSYSTEM	Surface

EssentialVariable EV-ESURF-WATST "Water stress"

CODE	EV-ESURF-WATST
NAME	Water stress
DESCRIPTION	Water stress in terms of demands compared to availability
EXPDOMAIN	Water
GEOSYSTEM	Surface

EssentialVariable EV-ESURF-LANDUSE "Land use"

CODE	EV-ESURF-LANDUSE
NAME	Land use
DESCRIPTION	Index for land use groups
EXPDOMAIN	LandCover
GEOSYSTEM	Surface

EssentialVariable EV-AIRQ-PM25 "Particulate matter PM2.5"

CODE	EV-AIRQ-PM25
NAME	Particulate matter PM2.5
DESCRIPTION	Particulate matter in the atmosphere with radius up to 2.5 micrometers
EXPDOMAIN	EXPD_AirQuality
GEOSYSTEM	Troposphere

EssentialVariable EV-AIRQ-PM10 "Particulate matter PM10"

CODE	EV-AIRQ-PM10
NAME	Particulate matter PM10
DESCRIPTION	Particulate matter in the atmosphere with radius up to 10 micrometers
EXPDOMAIN	EXPD_AirQuality
GEOSYSTEM	Troposphere

EssentialVariable EV-MASS-NITROGENE "Nitrogene flux"

CODE	EV-MASS-NITROGENE
NAME	Nitrogene flux
DESCRIPTION	Flux of Nitrogene into or out of an area
EXPDOMAIN	Agriculture
GEOSYSTEM	Surface

EssentialVariable EV-ECO-COASTAL "Coastal ecosystems"

CODE	EV-ECO-COASTAL
NAME	Coastal ecosystems
DESCRIPTION	Aggregation of coastal ecosystems
EXPDOMAIN	Ecosystems
GEOSYSTEM	Surface

EssentialVariable EV-ECO-WETLAND "Wetlands"

CODE	EV-ECO-WETLAND
NAME	Wetlands
DESCRIPTION	Wetland ecosystems
EXPDOMAIN	Ecosystems
GEOSYSTEM	Surface

EssentialVariable EV-CHEM-OCEANACID "Ocean acidity"

CODE	EV-CHEM-OCEANACID
NAME	Ocean acidity
DESCRIPTION	Ph of the ocean water
EXPDOMAIN	Oceans
GEOSYSTEM	Oceans

EssentialVariable EV-ECO-FISHSTOCK "Fish stock"

CODE	EV-ECO-FISHSTOCK
NAME	Fish stock
DESCRIPTION	Fish stocks for commercial and non-commercial fish
EXPDOMAIN	Oceans
GEOSYSTEM	Oceans

EssentialVariable EV-ECO-PROTECT "Protected area index"

CODE	EV-ECO-PROTECT
NAME	Protected area index
DESCRIPTION	Index for the protection status of a location
EXPDOMAIN	LandCover
GEOSYSTEM	Surface

EssentialVariable EV-ESURF-FORESTEXT "Forest area index"

CODE	EV-ESURF-FORESTEXT
NAME	Forest area index
DESCRIPTION	Index indicating type of forest
EXPDOMAIN	LandCover
GEOSYSTEM	Surface

EssentialVariable EV-ESURF-FORESTQUA "Forest status index"

CODE	EV-ESURF-FORESTQUA
NAME	Forest status index
DESCRIPTION	Index indicating the quality and healthiness of forest
EXPDOMAIN	LandCover
GEOSYSTEM	Surface

EssentialVariable EV-ESURF-MGCI "Mountain Green Cover Index"

CODE	EV-ESURF-MGCI
NAME	Mountain Green Cover Index
DESCRIPTION	Index for the land cover of mountanous areas
EXPDOMAIN	LandCover
GEOSYSTEM	Surface

EssentialVariable EV-ESURF-INVSPE "Invasive species index"

CODE	EV-ESURF-INVSPE
NAME	Invasive species index
DESCRIPTION	Index for invasive species
EXPDOMAIN	Biodiversity
GEOSYSTEM	Surface

EssentialVariable EV-ESURF-BIOD "Biodiversity index"

CODE	EV-ESURF-BIOD
NAME	Biodiversity index
DESCRIPTION	Index for biodiversity
EXPDOMAIN	Biodiversity
GEOSYSTEM	Surface

EssentialVariable EV-ESURF-ECOSERV "Ecosystem service index"

CODE	EV-ESURF-ECOSERV
NAME	Ecosystem service index
DESCRIPTION	Index for ecosystem services
EXPDOMAIN	Ecosystems
GEOSYSTEM	Surface

EssentialVariable EV-GHG-CO2E "CO2 Emission"

CODE	EV-GHG-CO2E
NAME	CO2 Emission
DESCRIPTION	Emission of CO2 per area
EXPDOMAIN	AirQuality
GEOSYSTEM	Troposphere

EssentialVariable EBV "All EBV"

CODE	EBV
NAME	All EBV
DESCRIPTION	This is the set of all Essential Biodiversity Variables.
EVSET	EBV
EXPDOMAIN	Biodiversity
GEOSYSTEM	Biosphere
COMMUNITY	Biology

EssentialVariable B_GCC "Co-ancestry (Genetic composition)"

CODE	B_GCC
NAME	Co-ancestry (Genetic composition)
EVSET	EBV

EssentialVariable B_GCA "Allelic diversity (Genetic composition)"

CODE	B_GCA
NAME	Allelic diversity (Genetic composition)
EVSET	EBV

EssentialVariable B_GCP "Population genetic differentiation (Genetic composition)"

CODE	B_GCP
NAME	Population genetic differentiation (Genetic composition)
EVSET	EBV

EssentialVariable B_GCB "Breed and variety div. (Genetic composition)"

CODE	B_GCB
NAME	Breed and variety div. (Genetic composition)
EVSET	EBV

EssentialVariable B_SPD "Species distribution (Species populations)"

CODE	B_SPD
NAME	Species distribution (Species populations)
EVSET	EBV

EssentialVariable B_SPA "Population abundance (Species populations)"

CODE	B_SPA
NAME	Population abundance (Species populations)
EVSET	EBV

EssentialVariable B_SPS "Population structure by age/size class (Species populations)"

CODE	B_SPS
NAME	Population structure by age/size class (Species populations)
EVSET	EBV

EssentialVariable B_STPH "Phenology (Species traits)"

CODE	B_STPH
NAME	Phenology (Species traits)
EVSET	EBV

EssentialVariable B_STB "Body mass (Species traits)"

CODE	B_STB
NAME	Body mass (Species traits)
EVSET	EBV

EssentialVariable B_STN "Natal dispersion distance (Species traits)"

CODE	B_STN
NAME	Natal dispersion distance (Species traits)
EVSET	EBV

EssentialVariable B_STM "Migratory behavior (Species traits)"

CODE	B_STM
NAME	Migratory behavior (Species traits)
EVSET	EBV

EssentialVariable B_STD "Demographic traits (Species traits)"

CODE	B_STD
NAME	Demographic traits (Species traits)
EVSET	EBV

EssentialVariable B_STP "Physiological traits (Species traits)"

CODE	B_STP
NAME	Physiological traits (Species traits)
EVSET	EBV

EssentialVariable B_CCT "Taxonomic diversity (Community composition)"

CODE	B_CCT
NAME	Taxonomic diversity (Community composition)
EVSET	EBV

EssentialVariable B_CCS "Species interactions (Community composition)"

CODE	B_CCS
NAME	Species interactions (Community composition)
EVSET	EBV

EssentialVariable B_EFNP "Net primary productivity (Ecosystem function)"

CODE	B_EFNP
NAME	Net primary productivity (Ecosystem function)
EVSET	EBV

EssentialVariable B_EFSP "Secondary productivity (Ecosystem function)"

CODE	B_EFSP
NAME	Secondary productivity (Ecosystem function)
EVSET	EBV

EssentialVariable B_EFNR "Nutrient retention (Ecosystem function)"

CODE	B_EFNR
NAME	Nutrient retention (Ecosystem function)
EVSET	EBV

EssentialVariable B_EFDR "Disturbance regime (Ecosystem function)"

CODE	B_EFDR
NAME	Disturbance regime (Ecosystem function)
EVSET	EBV

EssentialVariable B_ESH "Habitat structure (Ecosystem structure)"

CODE	B_ESH
NAME	Habitat structure (Ecosystem structure)
EVSET	EBV

EssentialVariable B_ESE "Ecosys. extent and fragmentation (Ecosystem structure)"

CODE	B_ESE
NAME	Ecosys. extent and fragmentation (Ecosystem structure)
EVSET	EBV

EssentialVariable B_ESC "Ecosys. composition by functional type (Ecosystem structure)"

CODE	B_ESC
NAME	Ecosys. composition by functional type (Ecosystem structure)
EVSET	EBV

EssentialVariable ECV "All EVC"

CODE	ECV
NAME	All EVC
DESCRIPTION	This is the set of all Essential Climate Variables
EVSET	ECV
EXPDOMAIN	Climate
GEOSYSTEM	Climate System
COMMUNITY	Climatology

EssentialVariable ECVA "Atmospheric"

CODE	ECVA
NAME	Atmospheric
EVSET	ECV

EssentialVariable C_TAS "Air temperature (Atmosphere surface)"

CODE	C_TAS
NAME	Air temperature (Atmosphere surface)
EQUIVALENT	EREV: Surface air temperature
EVSET	ECV

EssentialVariable C_WAS "Wind speed and direction (Atmosphere surface)"

CODE	C_WAS
NAME	Wind speed and direction (Atmosphere surface)
EQUIVALENT	EOV: Surface Wind (Physical surface)| EREV: Wind speed and direction
EVSET	ECV

EssentialVariable C_WVAS "Water vapour (Atmosphere surface)"

CODE	C_WVAS
NAME	Water vapour (Atmosphere surface)
EQUIVALENT	EREV: Surface humidity
EVSET	ECV

EssentialVariable C_PAS "Pressure (Atmosphere surface)"

CODE	C_PAS
NAME	Pressure (Atmosphere surface)
EQUIVALENT	EOV: Sea Level Pressure (Physical surface)| EREV: Surface atmospheric pressure
EVSET	ECV

EssentialVariable C_RAS "Precipitation (Atmosphere surface)"

CODE	C_RAS
NAME	Precipitation (Atmosphere surface)
EQUIVALENT	EREV: Precipitation; WaV: Precipitation
EVSET	ECV

EssentialVariable C_SRB "Surface radiation budget (Atmosphere surface)"

CODE	C_SRB
NAME	Surface radiation budget (Atmosphere surface)
EVSET	ECV

EssentialVariable N_APOL "Atmospheric pollutants: Heavy metals, Persistent organic pollutants, Tracers (Atmosphere)"

CODE	N_APOL
NAME	Atmospheric pollutants: Heavy metals, Persistent organic pollutants, Tracers (Atmosphere)
EVSET	NEW

EssentialVariable N_ACO "Atmospheric pollutants: CO"

CODE	N_ACO
NAME	Atmospheric pollutants: CO
EVSET	NEW

EssentialVariable C_TU "Temperature (Atmosphere upper-air)"

CODE	C_TU
NAME	Temperature (Atmosphere upper-air)
EVSET	ECV

EssentialVariable C_WNU "Wind speed and direction (Atmosphere upper-air)"

CODE	C_WNU
NAME	Wind speed and direction (Atmosphere upper-air)
EVSET	ECV

EssentialVariable C_WVU "Water vapour (Atmosphere upper-air)"

CODE	C_WVU
NAME	Water vapour (Atmosphere upper-air)
EVSET	ECV

EssentialVariable C_CLD "Cloud properties (Atmosphere upper-air)"

CODE	C_CLD
NAME	Cloud properties (Atmosphere upper-air)
EQUIVALENT	EREV: Cloud cover (demand in energy)
EVSET	ECV

EssentialVariable C_ERB "Earth radiation budget, including solar irradiance (Atmosphere upper-air)"

CODE	C_ERB
NAME	Earth radiation budget, including solar irradiance (Atmosphere upper-air)
EVSET	ECV

EssentialVariable C_CO2 "Carbon dioxide (Atmosphere composition)"

CODE	C_CO2
NAME	Carbon dioxide (Atmosphere composition)
EVSET	ECV

EssentialVariable C_GHG "Methan, and other long-lived greenhouse gases. Including nitrous oxide (N2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF6), and perfluorocarbons (PFCs). (Atmosphere composition)"

CODE	C_GHG
NAME	Methan, and other long-lived greenhouse gases. Including nitrous oxide (N2O), chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), hydrofluorocarbons (HFCs), sulphur hexafluoride (SF6), and perfluorocarbons (PFCs). (Atmosphere composition)
EVSET	ECV

EssentialVariable C_O3A "Ozone and aerosol (Atmosphere composition)"

CODE	C_O3A
NAME	Ozone and aerosol (Atmosphere composition)
EQUIVALENT	ECV: Aerosols (aerosol mass, size distribution (or at least mass at 3 fraction sizes: 1, 2.5 and 10 micron), speciation and chemical composition, Aerosol Optical Depth (AOD) at multiple wavelengths, AAOD, water content, ratio of mass to AOD, vertical distribution of extinction)
EVSET	ECV

EssentialVariable C_PRE "Mix-1"

CODE	C_PRE
NAME	Mix-1
EQUIVALENT	ECV: Reactive Gases, Trace gases (incl GHG), Ozone Precursors (Total ozone, profile ozone, surface ozone, NO, NO2 (surface, column, profile), PAN, HNO3, NH3, CO, VOC (isoprene, terpenes, alcohols, aldehydes, ketones, alkanes, alkenes, alkynes, aromatics
EVSET	Precursors (supporting the Aerosols and Ozone ECVs) In particular nitrogen dioxide (NO2), sulphur dioxide (SO2), formaldehyde (HCH

EssentialVariable C_SST "Sea-surface temperature (Ocean surface)"

CODE	C_SST
NAME	Sea-surface temperature (Ocean surface)
EQUIVALENT	EOV: Sea Surface Temperature (Physical surface)| EREV: Temperature, sea-surface, subsurface and deep-sea
EVSET	ECV

EssentialVariable C_SSS "Sea-surface salinity (Ocean surface)"

CODE	C_SSS
NAME	Sea-surface salinity (Ocean surface)
EQUIVALENT	EOV: Sea Surface Salinity (Physical surface)
EVSET	ECV

EssentialVariable C_SL "Sea level (Ocean surface)."

CODE	C_SL
NAME	Sea level (Ocean surface).
EQUIVALENT	EOV: Sea Level (Physical surface)
EVSET	ECV

EssentialVariable C_SS "Sea state (Ocean surface)"

CODE	C_SS
NAME	Sea state (Ocean surface)
EQUIVALENT	EOV: Sea State (Physical surface)
EVSET	ECV

EssentialVariable C_SICE "Sea ice (Ocean surface)"

CODE	C_SICE
NAME	Sea ice (Ocean surface)
EQUIVALENT	EOV: Sea Ice (Physical surface)
EVSET	ECV

EssentialVariable C_C "Surface current (Ocean surface)"

CODE	C_C
NAME	Surface current (Ocean surface)
EQUIVALENT	EOV: Surface Current (Physical surface)| EREV: Ocean, fixed and floating offshore wind, wave, tidal, currents, OTEC
EVSET	ECV

EssentialVariable C_OC "Ocean colour (Ocean surface)"

CODE	C_OC
NAME	Ocean colour (Ocean surface)
EQUIVALENT	EOV: Ocean Color (Physical surface)
EVSET	ECV

EssentialVariable C_CO2P "Carbon dioxide partial pressure (Ocean surface)"

CODE	C_CO2P
NAME	Carbon dioxide partial pressure (Ocean surface)
EQUIVALENT	EOV: Carbon Dioxide Partial Pressure (Physical surface)
EVSET	ECV

EssentialVariable C_OAS "Ocean acidity (Ocean surface)"

CODE	C_OAS
NAME	Ocean acidity (Ocean surface)
EQUIVALENT	EOV: Ocean acidity (Physical surface)
EVSET	ECV

EssentialVariable C_PLK "Phytoplankton (Ocean surface)"

CODE	C_PLK
NAME	Phytoplankton (Ocean surface)
EVSET	ECV

EssentialVariable C_TD "Temperature (Ocean sub-surface)"

CODE	C_TD
NAME	Temperature (Ocean sub-surface)
EQUIVALENT	EOV: Temperature (Physical sub-surface)| EREV: Temperature, sea-surface, sub-surface and deep-sea
EVSET	ECV

EssentialVariable C_SALD "Salinity (Ocean sub-surface)"

CODE	C_SALD
NAME	Salinity (Ocean sub-surface)
EQUIVALENT	EOV: Salinity (Physical sub-surface)
EVSET	ECV

EssentialVariable C_CD "Current (Ocean sub-surface)"

CODE	C_CD
NAME	Current (Ocean sub-surface)
EQUIVALENT	EOV: Current (Physical sub-surface)
EVSET	ECV

EssentialVariable C_NUTD "Nutrients (Ocean sub-surface)"

CODE	C_NUTD
NAME	Nutrients (Ocean sub-surface)
EVSET	ECV

EssentialVariable C_CO2D "Carbon dioxide partial pressure (Ocean sub-surface)"

CODE	C_CO2D
NAME	Carbon dioxide partial pressure (Ocean sub-surface)
EQUIVALENT	EOV: Carbon Dioxide partial pressure (Physical sub-surface)
EVSET	ECV

EssentialVariable C_OAD "Ocean acidity (Sub-surface)"

CODE	C_OAD
NAME	Ocean acidity (Sub-surface)
EQUIVALENT	EOV: Ocean Acidity (Physical sub-surface)
EVSET	ECV

EssentialVariable C_OOD "Oxygen (Ocean sub-surface)"

CODE	C_OOD
NAME	Oxygen (Ocean sub-surface)
EQUIVALENT	EOV: Oxygen (Physical sub-surface)
EVSET	ECV

EssentialVariable C_TRD "Tracers (Ocean sub-surface)"

CODE	C_TRD
NAME	Tracers (Ocean sub-surface)
EQUIVALENT	EOV: Tracers (Physical sub-surface)
EVSET	ECV

EssentialVariable C_RIV "River discharge (Land)"

CODE	C_RIV
NAME	River discharge (Land)
EQUIVALENT	WaV: Runoff/streamflow/river discharge
EVSET	ECV

EssentialVariable C_WTS "Water use (Land)"

CODE	C_WTS
NAME	Water use (Land)
EQUIVALENT	WaV: Water us/demand (agriculture, hydrology, energy, urbanization)
EVSET	ECV

EssentialVariable C_GWAT "Groundwater (Land)"

CODE	C_GWAT
NAME	Groundwater (Land)
EQUIVALENT	WaV: Groundwater
EVSET	ECV

EssentialVariable C_LAK "Lakes (Land)"

CODE	C_LAK
NAME	Lakes (Land)
EQUIVALENT	WaV: Lakes/reservoir levels and aquifer volumetric change
EVSET	ECV

EssentialVariable C_SNC "Snow cover (Land)"

CODE	C_SNC
NAME	Snow cover (Land)
EQUIVALENT	WaV: Snow cover
EVSET	ECV

EssentialVariable C_GLA "Glaciers and ice caps (Land)"

CODE	C_GLA
NAME	Glaciers and ice caps (Land)
EQUIVALENT	WaV: Glaciers/ice sheets
EVSET	ECV

EssentialVariable C_ICE "Ice sheets (Land)"

CODE	C_ICE
NAME	Ice sheets (Land)
EQUIVALENT	WaV: Glaciers/ice sheets
EVSET	ECV

EssentialVariable C_PFR "Permafrost (Land)"

CODE	C_PFR
NAME	Permafrost (Land)
EVSET	ECV

EssentialVariable C_ALB "Albedo (Land)"

CODE	C_ALB
NAME	Albedo (Land)
EVSET	ECV

EssentialVariable C_LCV "Land cover,including vegetation type (Land)"

CODE	C_LCV
NAME	Land cover,including vegetation type (Land)
EVSET	ECV

EssentialVariable C_FAPR "FAPAR (Land)"

CODE	C_FAPR
NAME	FAPAR (Land)
EVSET	ECV

EssentialVariable C_LAI "LAI (Land)"

CODE	C_LAI
NAME	LAI (Land)
EVSET	ECV

EssentialVariable C_AGB "Above-ground biomass (Land)"

CODE	C_AGB
NAME	Above-ground biomass (Land)
EVSET	ECV

EssentialVariable C_SC "Soil carbon (Land)"

CODE	C_SC
NAME	Soil carbon (Land)
EVSET	ECV

EssentialVariable C_FIRE "Fire disturbance (Land)"

CODE	C_FIRE
NAME	Fire disturbance (Land)
EVSET	ECV

EssentialVariable C_SM "Soil moisture (Land)"

CODE	C_SM
NAME	Soil moisture (Land)
EQUIVALENT	WaV: Soil Moisture/Temperature
EVSET	ECV

EssentialVariable EOV "All EOV"

CODE	EOV
NAME	All EOV
DESCRIPTION	This is the set of all Essential Ocean Variables
EVSET	EOV
EXPDOMAIN	Oceanography
GEOSYSTEM	Oceans
COMMUNITY	Oceanography

EssentialVariable O_AIR "Upper-Air (Physical surface)"

CODE	O_AIR
NAME	Upper-Air (Physical surface)
EVSET	EOV

EssentialVariable O_O "Oxygen (Physical surface)"

CODE	O_O
NAME	Oxygen (Physical surface)
EVSET	EOV

EssentialVariable O_TRA "Tracers (Physical surface)"

CODE	O_TRA
NAME	Tracers (Physical surface)
EVSET	EOV

EssentialVariable O_GHC "Global Ocean Heat Content (Physical sub-surface)"

CODE	O_GHC
NAME	Global Ocean Heat Content (Physical sub-surface)
EVSET	EOV

EssentialVariable O_OBIO "Oxygen (Biogeochemical)"

CODE	O_OBIO
NAME	Oxygen (Biogeochemical)
EVSET	EOV

EssentialVariable O_NUT "Macro Nutrients: NO3, PO4, Si, NH4, NO2 (Biogeochemical)"

CODE	O_NUT
NAME	Macro Nutrients: NO3, PO4, Si, NH4, NO2 (Biogeochemical)
EVSET	EOV

EssentialVariable O_CAR "Carbonate System: DIC, Total Alkalinity, pCO2 and ph, at least 2 of 4 (Biogeochemical)"

CODE	O_CAR
NAME	Carbonate System: DIC, Total Alkalinity, pCO2 and ph, at least 2 of 4 (Biogeochemical)
EVSET	EOV

EssentialVariable O_TRTR "Trascient Tracers: CFC-12, CFC-11, SF6, tritium, 3He, 14C, 39Ar (Biogeochemical)"

CODE	O_TRTR
NAME	Trascient Tracers: CFC-12, CFC-11, SF6, tritium, 3He, 14C, 39Ar (Biogeochemical)
EVSET	EOV

EssentialVariable O_SUSP "Suspended particulates (POC, PON or POM) and PIC ++ laboratory, beam attenuation, backscatter, acidiflabile, beam attenuation (Biogeochemical)"

CODE	O_SUSP
NAME	Suspended particulates (POC, PON or POM) and PIC ++ laboratory, beam attenuation, backscatter, acidiflabile, beam attenuation (Biogeochemical)
EVSET	EOV

EssentialVariable O_PMAT "Particulate Matter Export: POC export, CaCO3 export, BSi export (Biogeochemical)"

CODE	O_PMAT
NAME	Particulate Matter Export: POC export, CaCO3 export, BSi export (Biogeochemical)
EVSET	EOV

EssentialVariable O_NITO "Nitrous Oxide (Biogeochemical)"

CODE	O_NITO
NAME	Nitrous Oxide (Biogeochemical)
EVSET	EOV

EssentialVariable O_C13 "Carbon-13: 13C/12C of dissolved inorganic carbon (Biogeochemical)"

CODE	O_C13
NAME	Carbon-13: 13C/12C of dissolved inorganic carbon (Biogeochemical)
EVSET	EOV

EssentialVariable O_DOM "DOM: Dissolved organic matter, DOC, DON, DOP (Biogeochemical)"

CODE	O_DOM
NAME	DOM: Dissolved organic matter, DOC, DON, DOP (Biogeochemical)
EVSET	EOV

EssentialVariable O_CHL "Chlorophyll (Biology and Ecosystems)"

CODE	O_CHL
NAME	Chlorophyll (Biology and Ecosystems)
EVSET	EOV

EssentialVariable O_CRL "Coral Cover (Biology and Ecosystems)"

CODE	O_CRL
NAME	Coral Cover (Biology and Ecosystems)
EVSET	EOV

EssentialVariable O_MGV "Mangrove Area (Biology and Ecosystems)"

CODE	O_MGV
NAME	Mangrove Area (Biology and Ecosystems)
EVSET	EOV

EssentialVariable O_HAB "Harmful Algal Blooms HABs (Biology and Ecosystems)"

CODE	O_HAB
NAME	Harmful Algal Blooms HABs (Biology and Ecosystems)
EVSET	EOV

EssentialVariable O_ZPLK "Zooplankton:biomass/abundance (Biology and Ecosystems)"

CODE	O_ZPLK
NAME	Zooplankton:biomass/abundance (Biology and Ecosystems)
EVSET	EOV

EssentialVariable O_SMA "Salt Marsh Area (Biology and Ecosystems)"

CODE	O_SMA
NAME	Salt Marsh Area (Biology and Ecosystems)
EVSET	EOV

EssentialVariable O_LMV "Large marine vertebrates: abundance/distribution (Biology and Ecosystems)"

CODE	O_LMV
NAME	Large marine vertebrates: abundance/distribution (Biology and Ecosystems)
EVSET	EOV

EssentialVariable O_SGRA "Seagrass Area (Biology and Ecosystems)"

CODE	O_SGRA
NAME	Seagrass Area (Biology and Ecosystems)
EVSET	EOV

EssentialVariable O_LMVT "Tags and Tracking of species of value/large marine vertebrates (Biology and Ecosystems)"

CODE	O_LMVT
NAME	Tags and Tracking of species of value/large marine vertebrates (Biology and Ecosystems)
EVSET	EOV

EssentialVariable O_ZPKK "Zooplankton, Krill (Biology and Ecosystems)"

CODE	O_ZPKK
NAME	Zooplankton, Krill (Biology and Ecosystems)
EVSET	EOV

EssentialVariable AgV "All AgV"

CODE	AgV
NAME	All AgV
DESCRIPTION	This is the set of all Essential Agricultural Variables.
EVSET	AgV
EXPDOMAIN	Agriculture
GEOSYSTEM	Food system
COMMUNITY	Agriculture

EssentialVariable A_CA "Crop Area"

CODE	A_CA
NAME	Crop Area
EVSET	AgV

EssentialVariable A_CT "Crop Type"

CODE	A_CT
NAME	Crop Type
EVSET	AgV

EssentialVariable A_CC "Crop Condition"

CODE	A_CC
NAME	Crop Condition
EVSET	AgV

EssentialVariable A_CPH "Crop Phenology"

CODE	A_CPH
NAME	Crop Phenology
EVSET	AgV

EssentialVariable A_CY "Crop Yield (current and forecast)"

CODE	A_CY
NAME	Crop Yield (current and forecast)
EVSET	AgV

EssentialVariable A_CM "Crop Management and agricultural practices"

CODE	A_CM
NAME	Crop Management and agricultural practices
EVSET	AgV

EssentialVariable EREV "All EREV"

CODE	EREV
NAME	All EREV
DESCRIPTION	This is the set of all Essential Renewable Energy Variables
EVSET	EREV
EXPDOMAIN	Renewable Energy
GEOSYSTEM	Energy
COMMUNITY	Energy Suppliers

EssentialVariable E-SSI "Solar Surface Irradiance and its components (global, direct, diffuse)"

CODE	E-SSI
NAME	Solar Surface Irradiance and its components (global, direct, diffuse)
EVSET	EREV

EssentialVariable E-SUN "Sunshine duration (demand in energy)"

CODE	E-SUN
NAME	Sunshine duration (demand in energy)
EVSET	EREV

EssentialVariable E_LULC "Land use, Land cover, including urbanization, hydrology, grid description"

CODE	E_LULC
NAME	Land use, Land cover, including urbanization, hydrology, grid description
EVSET	EREV

EssentialVariable E-ELEV "Elevation, Orography"

CODE	E-ELEV
NAME	Elevation, Orography
EVSET	EREV

EssentialVariable E-LST "Land surface temperature"

CODE	E-LST
NAME	Land surface temperature
EVSET	EREV

EssentialVariable E-WAVE "Wave, height, direction, period"

CODE	E-WAVE
NAME	Wave, height, direction, period
EVSET	EREV

EssentialVariable E-TDL "Tidal (min, max, sea surface elevation)"

CODE	E-TDL
NAME	Tidal (min, max, sea surface elevation)
EVSET	EREV

EssentialVariable E-CUR "See current, speed, direction"

CODE	E-CUR
NAME	See current, speed, direction
EVSET	EREV

EssentialVariable E-BAT "Ocean bathymetry"

CODE	E-BAT
NAME	Ocean bathymetry
EVSET	EREV

EssentialVariable E-OFL "Ocean floor type"

CODE	E-OFL
NAME	Ocean floor type
EVSET	EREV

EssentialVariable E-URB "Urbanization"

CODE	E-URB
NAME	Urbanization
EVSET	EREV

EssentialVariable HeV "All HeV"

CODE	HeV
NAME	All HeV
DESCRIPTION	This is the set of all Human Health Essential Variables
EVSET	HeV
EXPDOMAIN	Human Health
GEOSYSTEM	Anthroposphere
COMMUNITY	Health

EssentialVariable H_FAM "Famine early warning"

CODE	H_FAM
NAME	Famine early warning
EVSET	HeV

EssentialVariable H_DES "Short term forecasting of comunicating diseases"

CODE	H_DES
NAME	Short term forecasting of comunicating diseases
EVSET	HeV

EssentialVariable WaV "All WaV"

CODE	WaV
NAME	All WaV
DESCRIPTION	This is the set of all Eessential Water Variables
EVSET	WaV
EXPDOMAIN	Hydrology
GEOSYSTEM	Hydrosphere
COMMUNITY	Hydrology

EssentialVariable W_EVA "Evaporation and Evapotranspiration"

CODE	W_EVA
NAME	Evaporation and Evapotranspiration
EVSET	WaV

EssentialVariable W_Q "Water quality"

CODE	W_Q
NAME	Water quality
EVSET	WaV

EssentialVariable EV "All"

CODE	EV
NAME	All
EVSET	All of them

EssentialVariable "None"

CODE	
NAME	None
EVSET	None of them

EssentialVariable N_NOI "Acoustic pollutants"

CODE	N_NOI
NAME	Acoustic pollutants
EVSET	NEW

EssentialVariable ?01 "All Global Numerical Weather Prediction (NWP) variables (e.g., PBL + Tropopause height) and others yet to be determined by WMO/GAW."

CODE	?01
NAME	All Global Numerical Weather Prediction (NWP) variables (e.g., PBL + Tropopause height) and others yet to be determined by WMO/GAW.
EQUIVALENT	NOTE: Requires more work to accept it
EVSET	ECV

EssentialVariable ?02 "Others: Actinic flux, fire radiative power, land proxies, lightning, dry and wet deposition, pollen (key species), OCS"

CODE	?02
NAME	Others: Actinic flux, fire radiative power, land proxies, lightning, dry and wet deposition, pollen (key species), OCS
EQUIVALENT	NOTE: Requires more work to accept it
EVSET	ECV

EssentialVariable SDG-ALL "All SDG EVs"

CODE	SDG-ALL
NAME	All SDG EVs
EVSET	ESDGV

6.5 Traces

Trace_1

DESCRIPTION	Pieter De Frenne and Kris Verheyen "Weather stations lack forest data"

Trace_2

DESCRIPTION	http://emep.int/publ/reports/2016/EMEP_Status_Report_1_2016.pdf

Trace_3

DESCRIPTION	http://www.msceast.org/reports/2_2016.pdf

Trace_4

DESCRIPTION	http://emep.int/publ/reports/2016/EMEP_Status_Report_1_2016.pdf

Trace_8

DESCRIPTION	EMEP PROGRESS IN ACTIVITIES IN 2009-2019 AND FUTURE WORK. Level 1

Trace_11

DESCRIPTION	http://www.msceast.org/reports/2_2016.pdf

Trace_14

DESCRIPTION	EMEP PROGRESS IN ACTIVITIES IN 2009-2019 AND FUTURE WORK. Level 2

Trace_15

DESCRIPTION	EMEP PROGRESS IN ACTIVITIES IN 2009-2019 AND FUTURE WORK. Level 3

Trace_16

DESCRIPTION	CA-01. GEO 2016 WORK PROGRAMME

Trace_17

DESCRIPTION	CA-06. GEO 2016 WORK PROGRAMME

Trace_19

DESCRIPTION	GEO 2016 WORK PROGRAMME. CA-027. Foster Utilization of Earth Observation Remote Sensing and In Situ Data for All Phases of Disaster Risk Management

Trace_20

DESCRIPTION	GEO 2016 WORK PROGRAMME. CA-028 Global Flood Risk Monitoring

Trace_21

DESCRIPTION	GEOBON- Global Biodiveristy Obvserbation

Trace_22

DESCRIPTION	ECOPotential WP2 meeting. Cited Herique Pereira

Trace_23

DESCRIPTION	Sentinel- 3 Mission Objectives

Trace_33

DESCRIPTION	O'Connor, B., Secades, C., Penner, J., Sonnenschein, R., Skidmore, A., Burgess, N. D., & Hutton, J. M. (2015). Earth observation as a tool for tracking progress towards the Aichi Biodiversity Targets. Remote Sensing in Ecology and Conservation, 1(1), 19-28.

Trace_36

DESCRIPTION	Geijzendorffer, I. R., Regan, E. C., Pereira, H. M., Brotons, L., Brummitt, N., Gavish, Y., ... & Schmeller, D. S. (2015). Bridging the gap between biodiversity data and policy reporting needs: An Essential Biodiversity Variables perspective. Journal of Applied Ecology.

Trace_37

DESCRIPTION	GI-16. GEO 2016 WORK PROGRAMME. GEO-DARMA = Data Access for Risk Manage-men

Trace_38

DESCRIPTION	_http://www.iagos.fr/web/images/map/map_iagos.png_

Trace_39

DESCRIPTION	Aichi targets Compilation. Target 19

Trace_40

DESCRIPTION	Argo program description from the Argo website: http://www.argo.ucsd.edu/About_Argo.html

Trace_42

DESCRIPTION	IEA Solar Heating and Cooling Program, [[http://task36.iea-shc.org][Tasks 36]] and [[http://task46.iea-shc.org][46]]. [[https://sbageotask.larc.nasa.gov/energy.html][GEO Task US-09-01a]]

Trace_43

DESCRIPTION	ConnectinGEO. [[https://www.youtube.com/watch?v=WpC5C6qnYkg][Exchanges with companies in various occasions]], including [[http://meetingorganizer.copernicus.org/EGU2015/EGU2015-6607.pdf][Copernicus events]]

Trace_44

DESCRIPTION	ConnectinGEO. Exchanges with companies in various occasions, including Copernicus events. [[http://tds.webservice-energy.org/thredds/marine-energy.html][IREMARE web site]], [[https://hal-mines-paristech.archives-ouvertes.fr/OIE/hal-01252768][EWTEC 2015]], [[https://hal-mines-paristech.archives-ouvertes.fr/OIE/hal-01252773][_Island Energy Transitions: Pathways for Accelerated Uptake of Renewables 2015_]]

Trace_45

DESCRIPTION	World Meteorological Organization (WMO), 2015: Status of the Global Observing System for Climate, October 2015, GCOS-195. Available at: http://www.wmo.int/pages/prog/gcos/Publications/GCOS-195_en.pdf

Trace_46

DESCRIPTION	Reynolds R. W., Chelton D. B., 2010: Comparisons of Daily Sea Surface Temperature Analyses for 2007-08, Journal of Climate, 23, 3545-3562

Trace_47

DESCRIPTION	Real time status of ARGO deployments through JCOMMOPS API, (http://www.jcommops.org/board?t=Argo)

Trace_48

DESCRIPTION	Fiedler E, Mao Ch., Maclaren A. 2015: SST: results and recommendations. E-AIMS Deliverable D4.3.3. Availbale at http://www.euro-argo.eu/content/download/83965/1049581/version/1/file/E-AIMS_4.3_SeaSurfaceTemperature_V2.pdf

Trace_49

DESCRIPTION	W. Walczowski, I. Goszczko 2015: Arctic float final evaluation, E-AIMS Deliverable 2.5.2, available at http://www.euro-argo.eu/content/download/89388/1101132/file/E-AIMS_D2.252.pdf

Trace_50

DESCRIPTION	Statistics from Coriolis Global Data Assembly Center (GDAC)

Trace_51

DESCRIPTION	Durack P.J., Lee T., Vinogradova N. T., D. Stammer, 2016: Keeping the lights on for global ocean salinity observation, NATURE CLIMATE CHANGE, vol 6. 228-231

Trace_52

DESCRIPTION	P. E. Land, J. D. Shutler, H.S. Findlay, F. Girard-Ardhuin, R. Sabia, N. Reul, J.-F. Piolle, B. Chapron, Y. Quilfen, J. Salisbury, D. Vandemark, R. Bellerby and P. Bhadury, 2015: Salinity from Space Unlocks Satellite-Based Assessment of Ocean Acidification, Environ. Sci. Technol., 2015, 49 (4), pp 1987-1994. DOI: 10.1021/es504849s

Trace_53

DESCRIPTION	Lagerloef G., Kao H.Y., Meissner T., Vazquez J., 2015: Aquarius Salinity Validation Analysis; Data Version 4.0, 30pp. Available at: ftp://podaac-ftp.jpl.nasa.gov/allData/aquarius/docs/v4/AQ-014-PS-0016_AquariusSalinityDataValidationAnalysis_DatasetVersion4.0and3.0.pdf)

Trace_54

DESCRIPTION	Pablos M., Piles M., Gonzalez-Gambau V., Vall-llossera M., Camps A., Martinez J., 2014: IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 7, 9, 3833-3844.

Trace_234

DESCRIPTION	W. Tang, A. Fore, S. Yueh, T. Lee, A. Hayashi, A. Sanchez-Franks, B, King, D, Baranowski, J, Martinez, submitted:Validating SMAP SSS with in situ measurements, Remote Sensing of Environment.

Trace_55

DESCRIPTION	Lagerloef G., Kao H.Y., Meissner T., Vazquez J., 2015: Aquarius Salinity Validation Analysis; Data Version 4.0, 30pp. Available at: ftp://podaac-ftp.jpl.nasa.gov/allData/aquarius/docs/v4/AQ-014-PS-0016_AquariusSalinityDataValidationAnalysis_DatasetVersion4.0and3.0.pdf)

Trace_56

DESCRIPTION	Ballabrera J., 2015: Sea Surface Salinity: Results and Recommendations D4.4.3, E-AIMS. Euro-Argo Improvements for the GMES Marine Service, E-AIMS: D4.443-v2. Available at: http://www.euro-argo.eu/content/download/91862/1123452/version/1/file/E-AIMS_D4.443-V2.pdf)

Trace_65

DESCRIPTION	A. Schiller, M. Bell, G. Brassington, P. Brasseur, R. Barciela, P. De Mey, E. Dombrowsky, M. Gehlen, F. Hernandez, V. Kourafalou, G. Larnicol, P.-Y. Le Traon, M. Martin, P. Oke, G. C. Smith, N. Smith, H. Tolman, K. Wilmer-Becker, 2015: Synthesis of new scientific challenges for GODAE OceanView, Journal of Operational Oceanography, 8:sup2, s259-s271, DOI: 10.1080/1755876X.2015.1049901

Trace_66

DESCRIPTION	P.-Y. Le Traon, D. Antoine, A. Bentamy, H. Bonekamp, L.A. Breivik, B. Chapron, G. Corlett, G. Dibarboure, P. DiGiacomo, C. Donlon, Y. Faugre, J. Font, F. Girard-Ardhuin, F. Gohin, J.A. Johannessen, M. Kamachi, G. Lagerloef, J. Lambin, G. Larnicol, P. Le Borgne, E. Leuliette, E. Lindstrom, M.J. Martin, E. Maturi, L. Miller, L. Mingsen, R. Morrow, N. Reul, M.H. Rio, H. Roquet, R. Santoleri and J. Wilkin (2015) Use of satellite observations for operational oceanography: recent achievements and future prospects, Journal of Operational Oceanography, 8:sup1, s12-s27, DOI: 10.1080/1755876X.2015.1022050

Trace_67

DESCRIPTION	P.R. Oke, G. Larnicol, E.M. Jones, V. Kourafalou, A.K. Sperrevik, F. Carse, C.A.S. Tanajura, B. Mourre, M. Tonani, G.B. Brassington, M. Le Henaff, G.R. Halliwell Jr., R. Atlas, A.M. Moore, C.A. Edwards, M.J. Martin, A.A. Sellar, A. Alvarez, P. De Mey and M. Iskandarani (2015) Assessing the impact of observations on ocean forecasts and reanalyses:Part 2, Regional applications, Journal of Operational Oceanography, 8:sup1, s63-s79, DOI:10.1080/1755876X.2015.1022080

Trace_68

DESCRIPTION	Pascual A., Faugere Y., Larnicol G., Le Traon P-Y., 2006: Geophysical Research Letters, vol. 33, L02611, doi:10.1029/2005GL024633

Trace_78

DESCRIPTION	JCOMMOPS (http://www.jcommops.org/board?t=Argo)

Trace_79

DESCRIPTION	IPCC, 2013: Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental. Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1535 pp. Available at: http://www.climatechange2013.org/images/report/WG1AR5_ALL_FINAL.pdf

Trace_83

DESCRIPTION	Fiedler E, Mao Ch., Maclaren A. 2015: SST: results and recommendations. E-AIMS Deliverable D4.3.3. Availbale at http://www.euro-argo.eu/content/download/83965/1049581/version/1/file/E-AIMS_4.3_SeaSurfaceTemperature_V2.pdf

Trace_84

DESCRIPTION	Argo program description from the Argo website: http://www.argo.ucsd.edu/About_Argo.html

Trace_86

DESCRIPTION	Durack P.J., Lee T., Vinogradova N. T., D. Stammer, 2016: Keeping the lights on for global ocean salinity observation, NATURE CLIMATE CHANGE, vol 6. 228-231.

Trace_87

DESCRIPTION	Holloway G., Nguyen A., Zeliang W., 2011: Oceans and ocean models as seen by current meters, Journal of Geophysical Research, VOL. 116, C00D08, doi:10.1029/2011JC007044

Trace_95

DESCRIPTION	Global Sea-Level Observing System (GLOSS) Implementation Plan - 2012, UNESCO/IOC, 41pp. 2012. IOC Technical Series No.100.

Trace_99

DESCRIPTION	GAIA-CLIM H2020- D1.3 GCOS AOPC Seidel et al., 2013

Trace_100

DESCRIPTION	GAIA-CLIM H2020- D1.3

Trace_101

DESCRIPTION	GAIA-CLIM H2020- D1.1

Trace_102

DESCRIPTION	GAIA-CLIM H2020- D1.4, D1.6, D1.8

Trace_105

DESCRIPTION	GAIA-CLIM H2020- D1.9

Trace_106

DESCRIPTION	GAIA-CLIM H2020- D1.9 Whiteman et al., 2011

Trace_107

DESCRIPTION	GAIA-CLIM H2020- D1.2

Trace_108

DESCRIPTION	GAIA-CLIM H2020- D1.3 Immler et al., 2010

Trace_109

DESCRIPTION	GAIA-CLIM H2020- D1.1, D1.4 Immler et al., 2010

Trace_110

DESCRIPTION	GAIA-CLIM H2020- n/a

Trace_111

DESCRIPTION	GAIA-CLIM H2020- D1.1, D2.1

Trace_115

DESCRIPTION	GAIA-CLIM H2020- D2.2, D2.4

Trace_117

DESCRIPTION	GAIA-CLIM H2020- D2.2 Wandinger et al., 2015

Trace_118

DESCRIPTION	GAIA-CLIM H2020- D?.?; Earlinet

Trace_119

DESCRIPTION	GAIA-CLIM H2020- D2.2 Veselovskii et al., 2012

Trace_120

DESCRIPTION	GAIA-CLIM H2020- D2.2 EU project website ACTRIS2: www.actris.eu

Trace_121

DESCRIPTION	GAIA-CLIM H2020- D2.2 Leblanc et al., 2008 ?ISSI report? Is it also for aerosol?

Trace_124

DESCRIPTION	GAIA-CLIM H2020- Leblanc et al., 2008 ?ISSI report?

Trace_125

DESCRIPTION	GAIA-CLIM H2020- Leblanc et al., 2008 ?ISSI report?

Trace_126

DESCRIPTION	GAIA-CLIM H2020- D2.1 Walker et al., 2011

Trace_127

DESCRIPTION	GAIA-CLIM H2020- D2.1

Trace_128

DESCRIPTION	GAIA-CLIM H2020- D2.1 EU Cost action TOPROF

Trace_131

DESCRIPTION	GAIA-CLIM H2020- NORS_D4.3_UB.pdf

Trace_132

DESCRIPTION	GAIA-CLIM H2020- NORS_D4.2_DUG.pdf

Trace_133

DESCRIPTION	GAIA-CLIM H2020- Hase et al., 2012 Frankenberg et al., 2011

Trace_134

DESCRIPTION	GAIA-CLIM H2020- Wunsch et al., 2011

Trace_135

DESCRIPTION	GAIA-CLIM H2020- Hase et al, 2012 Hase et al., 2013

Trace_139

DESCRIPTION	GAIA-CLIM H2020- NORS_D4.3_UB.pdf NDACC_UVVIS-WG_O3settings_v2.pdf

Trace_141

DESCRIPTION	GAIA-CLIM H2020- Hendrick et al., 2011

Trace_142

DESCRIPTION	GAIA-CLIM H2020- Eskes and Boersma, 2003

Trace_143

DESCRIPTION	GAIA-CLIM H2020- Herman et al., 2015

Trace_144

DESCRIPTION	GAIA-CLIM H2020- D2.1; Liu et al., 2006 Irie et al, 2011 Gomez et al., 2014

Trace_145

DESCRIPTION	GAIA-CLIM H2020- Same as for G2.31

Trace_146

DESCRIPTION	GAIA-CLIM H2020- D2.1; Liu et al., 2006 Irie et al, 2011

Trace_147

DESCRIPTION	GAIA-CLIM H2020- Ning, 2012

Trace_148

DESCRIPTION	GAIA-CLIM H2020- D3-1 (incl. Annex 1, 2 and 3)

Trace_149

DESCRIPTION	GAIA-CLIM H2020- D3-1 (incl. Annex 1, 2 and 3)

Trace_150

DESCRIPTION	GAIA-CLIM H2020- D3-1 (incl. Annex 1, 2 and 3)

Trace_154

DESCRIPTION	GAIA-CLIM H2020- Bell et al., 2008 Bohrmann et al., 2013 Doherty et al., 2015 Geer et al., 2010 Lu et al., 2011

Trace_155

DESCRIPTION	GAIA-CLIM H2020- Same as for G4.01

Trace_157

DESCRIPTION	GAIA-CLIM H2020- WPs 1,2,3

Trace_158

DESCRIPTION	GAIA-CLIM H2020- WP4 (+ Task 1.4/1.5)

Trace_160

DESCRIPTION	GAIA-CLIM H2020- http://www.gruan.org http://tccon.ornl.gov/ http://www.ndsc.ncep.noaa.gov/data

Trace_161

DESCRIPTION	GAIA-CLIM H2020- http://www.ucar.edu/tools/applications_desc.jsp

Trace_162

DESCRIPTION	GAIA-CLIM H2020- CCI toolbox Giovanni GSICS

Trace_163

DESCRIPTION	GAIA-CLIM H2020- WP5

Trace_165

DESCRIPTION	GAIA-CLIM H2020- ICARE multibrowse and associated graphical modules? Felyx project NOAA NPROVS

Trace_166

DESCRIPTION	GAIA-CLIM H2020- D5.1 Keppens et al., 2015 (traceability chain) QA4ECV: http://www.qa4ecv.eu/ QA4EO: http://qa4eo.org/

Trace_167

DESCRIPTION	GAIA-CLIM H2020- D5.1, D3.1 Lambert et al., 2012 Verhoelst et al., 2015 Fasso et al., 2014 Ignaccolo et al., 2015 ?EU FP6 GEOmon Technical Notes D4.2.1 and D4.2.2 (2008-2011)?

Trace_168

DESCRIPTION	Presented at ConnectinGEO -product award WP.5.5.

Trace_172

DESCRIPTION	GCW = http://globalcryospherewatch.org/reference/obs_requirements.php

Trace_183

DESCRIPTION	OSCAR = http://www.wmo-sat.info/oscar/themes/view/5

Trace_189

DESCRIPTION	To be documented in ConnectinGEO deliverable (i.e. D6.x + D7.2)

Trace_191

DESCRIPTION	ConnectinGEO "User Needs and Gaps Survey" - http://twiki.eneon.net/foswiki/bin/view/ConnectinGEOIntranet/

Trace_208

DESCRIPTION	Horizon 2020 Work Programme 2014-2015 in the area of Climate action, environment, resource efficiency and raw materials. SC5-18-2014/2015

Trace_209

DESCRIPTION	GEOSS Work Programme 2017-2019

Trace_210

DESCRIPTION	In the ENVRIplus 3rt workshop verbally

Trace_211

DESCRIPTION	EOEP-4 Data User Element (DUE), GlobDiversity

Trace_212

DESCRIPTION	http://onlinelibrary.wiley.com/doi/10.1111/gcb.13443/abstract

Trace_222

DESCRIPTION	ECOPotential internal discussions

Trace_223

DESCRIPTION	Griggs, D., Stafford-Smith, M., Gaffney, O., Rockström, J., hman, M. C., Shyamsundar, P., Steffen, W., Glaser, G., Kanie, N., and Noble, I., 2013. Sustainable development goals for people and planet, Nature, 495, 305-307.

Trace_224

DESCRIPTION	Lu, Y., Nakicenovic, N., Visbeck, M., and Stevance, A.-S., 2015. Five priorities for the UN Sustainable Development Goals, Nature, 520, 432-433.

Trace_225

DESCRIPTION	Rockström, J., Steffen, W., Noone, K., Persson, ., Chapin, F. S. I., Lambin, E., Lenton, T. M., Scheffer, M., Folke, C., Schellnhuber, H., Nykvist, B., De Wit, C. A., Hughes, T., van der Leeuw, S., Rodhe, H., Sörlin, S., Snyder, P. K., Costanza, R., Svedin, U., Falkenmark, M., Karlberg, L., Corell, R. W., Fabry, V. J., Hansen, J., Walker, B., Liverman, D., Richardson, K., Crutzen, P., and Foley, J., 2009. A safe operating space for humanity, Nature, 461, 472-475.

Trace_226

DESCRIPTION	Nilsson, M., Griggs, D., Visbeck, M., and Ringler, C., 2016. A draft framework for understanding SDG interactions, Tech. rep., ICSU - International Council for Science, Paris.

Trace_227

DESCRIPTION	Jules-Plag, S. and Plag, H.-P., 2016. Supporting Agenda 2030s Sustainable Development Goals - agent-based models and GeoDesign, ApoGeoSpatial, 31(4), 24-30.

Trace_228

DESCRIPTION	Jules-Plag, S. and Plag, H.-P., 2016. Supporting the implementation of SDGs, Geospatial World, 08/15/2016, http://www.geospatialworld.net/article/supportingimplementationsdgs/.

Trace_229

DESCRIPTION	Obersteiner, M., Walsh, B., Frank, S., Havlk, P., Cantele, M., Liu, J., Palazzo, A., Herrero, M., Lu, Y., Mosnier, A., Valin, H., Riahi, K., Kraxner, F., Fritz, S., and van Vuuren, D., 2016. Assessing the land resourcefood price nexus of the sustainable development goals, Science Advances, 2(9), 10.1126/sci-adv.1501499.

Trace_230

DESCRIPTION	Grunwald, A., 2015. Transformative Wissenschaft. Eine neue Ordnung im Wissenschaftsbetrieb?, GAIA-Ecological Perspectives for Science and Society, 24(1), 17-20.

Trace_231

DESCRIPTION	Wiek, A., Ness, B., Schweizer-Ries, P., Brand, F. S., and Farioli, F., 2012. From complex systems analysis to transformational change: a comparative appraisal of sustainability science projects, Sustainability Science, 7, 524.

Trace_232

DESCRIPTION	Miller, T. R., 2013. Constructing sustainability science: emerging perspectives and research trajectories, Sustainability science, 8(2), 279-293.

6.6 Reviews

Review "Time Resolution"

NAME	Time Resolution
DESCRIPTION	Most European countries have measurements, but many do not comply with required time resolution (24h).

Review "Uneven Spatial Coverage"

NAME	Uneven Spatial Coverage
DESCRIPTION	About 100 sites measure inorganic gases and particles in air. Uneven regional coverage, and some operate with insufficient temporal resolution

Review "NO2 Monitoring"

NAME	NO2 Monitoring
DESCRIPTION	There is extensive monitoring of NO2 across Europe, but with most sites at polluted locations. There is a need to have more sites with good data also on remote locations

Review "Semi-Volatile Compounds"

NAME	Semi-Volatile Compounds
DESCRIPTION	Filteerpack samling has artacts and cannot give the "true" distribution between particles and gases of semi-volitile compounds, but when combining with additional measurements, the distribution ban better be inferred

Review "Mass Concentrations"

NAME	Mass Concentrations
DESCRIPTION	Chemical resolved mass concentrations are only monitored at a limited number of locations in Europe

Review "NOx and VOC concentrations"

NAME	NOx and VOC concentrations
DESCRIPTION	Challenging to measure NOx + VOC concentrations with high precision at low ambient concentrations. Requires good instrumentation and proper QAQC routines associated with research grade monitoring.

Review "Aerosol Properties"

NAME	Aerosol Properties
DESCRIPTION	A full description of ambient aerosol properties (chemical and physical) is essential to have. This is currently in place in the framworks of EMEP, GAW and ACTRIS. Long-term funding is a challenge

Review "Understanding Climate Forcing"

NAME	Understanding Climate Forcing
DESCRIPTION	Important to measure to understand climate forcing and ozone layer depletion. Due to long atmospheric life time, site densities can be low. Presition of measurements must however be very high.

Review "Gap Duplication"

NAME	Gap Duplication
DESCRIPTION	This gap is somehow represented in gaps 103-104 (EGL)

Review "Similar Gap"

NAME	Similar Gap
DESCRIPTION	In addition this gap is somehow represented in gaps 100-103. (EGL)

Review "Spatial Resolution"

NAME	Spatial Resolution
DESCRIPTION	As far as i understand all the infrared radiometers (AVHRR, MODIS even in GEOSAT) are in real time, accessible and global coverage is not possible unless some combination with T from microwaves is combined, at least for the SST. The GHRSST Multi-Product Ensemble (GMPE) delivered through CMEMS (Copernicus marine) offers a near real-time product at 0.25x 0.25 degrees. So the gap should perhaps more focused on the type spatial resolution.

Review "Gap Effects EOV"

NAME	Gap Effects EOV
DESCRIPTION	According to the gap description, this gap affects the EOV: Ocean Color, not the EO: Sea State !$¡$br /$¿$$¡$br /$¿$This gap also should affect "Climate " theme because color is used as a aproxy of phytoplacnton that is a quite relevant C02 sink !$¡$br /$¿$$¡$br /$¿$I believe that MODIS and VIIRS on Suomi NPP are operating regularly on such bands. They are delivered in near real time but not at global coverage. In addition they are affected by the same problem as infrared radiometers, cloud cover, that in this case can not be solved by complementary radiometers as in the case of SST. The highest temporal resolution attainable is constraint by night/day conditions. MODIS and VIIRS are operating regularly on such bands

Review "Gaps Associated with ECV"

NAME	Gaps Associated with ECV
DESCRIPTION	I believe that if this gap is associated to ECV:Wind speed at the surface, the it should also be associated also to [EOV :Sea State] because surface stress is derived/related with. On the other hand winds at the surface are obtained in near real time by already running scatterometers !. Perhaps the way they measure and the number of scatteropmeters are not enough to produce synoptic winds fields with global coverage. There are already real time scatterometers running with global coverage

Review "Other EVs"

NAME	Other EVs
DESCRIPTION	I think that if this gap is also associated to [ECV:Sea State] (EGL)

Review "EBV Challenge"

NAME	EBV Challenge
DESCRIPTION	GEO BON network for facilitating inter-disciplinary dialogue and IPBES for achieving consensus on what biodiversity and ecosystem services need from EO

Review "Matching"

NAME	Matching
DESCRIPTION	Knowledge of established EO data providers must be matched with that of biodiversity conservation policy specialists to enable knowledge transfe

Review "Meteo Data"

NAME	Meteo Data
DESCRIPTION	Meteo data may originate from in situ measurements or from meteorological analyses

Review "Gap related to other gaps"

NAME	Gap related to other gaps
DESCRIPTION	This gap Is related mainly with gaps 64-70 and gap 28. In my humble opinion this gap could be partially merged with the others just by addding the "Energy Theme", merging together the gap description and/or the "Purpose column" (EGL. LW: Yes, I agree that this gap is consistent with 64, 65, 66, 68, 70, 71 and 72. However, two caveats. 1) this gap includes bathymetry and type of floor; 2) it originates from industry challenge

Review "Measurements"

NAME	Measurements
DESCRIPTION	Infrared provides 2-4 measurements per day (or less with cloud covers). Geostacionary satellites (e.g. METEOSAT, GOES) recurrent every 3 hour (clouds affect). Microwave observations from (e.g. AMSR) complement cloud cover areas at lower resolution and far from coast-land areas.

Review "Resolution"

NAME	Resolution
DESCRIPTION	Resolution of infrared radiometers are reasonable for coastal areas (aprox 1-2 km). Differencies arise between the analyses and interpolation procedures to obtain high level products.

Review "Climate Studies"

NAME	Climate Studies
DESCRIPTION	For climate studies the only valuable analysis is based on AVHRR data because extends back to 1981. ATSR and AATSR microwaves on ENVISAT between 1991 and 2012 has contributed to complement infrared observations. To ensure a long time monitoring, a successful combination with new radiometers (e.g. MODIS, SENTINEL) and microwaves instruments is needed providing higher resolutions, global coverage and overcome cloud cover problems of infrared captors.

Review "Different Interests"

NAME	Different Interests
DESCRIPTION	Somehow national agencies through the Argo program coordinate the strategy to deploy the array of floats. However the scientific community and research projects may have their own objectives which can not be in line with the need of a uniform coverage.

Review "ARGO in marginal seas"

NAME	ARGO in marginal seas
DESCRIPTION	Lack of Argo in marginal seas is more related with the coordination and efforts of agencies in riparian countries while the lack in shelf seas and shelf areas ($¡$ 200 m depth) is more a consequence of Argo planning decissions. On shelf areas the topography may be highly variable and the probability of beaching can be high to interrupt the monitoring. Polar areas covered by ice capes introduces further complexity to make transmission available.

Review "Gap merged"

NAME	Gap merged
DESCRIPTION	This gap has been merged with gap 53

Review "Gap Type Change"

NAME	Gap Type Change
DESCRIPTION	The gap type has been changed to better reflect the nature of the gap.

Review "Gap Type Change"

NAME	Gap Type Change
DESCRIPTION	The gap type has been changed to better reflect the nature of the gap.

Review "Gaps merged"

NAME	Gaps merged
DESCRIPTION	This gap has been merged with gap number 95

Review "Merged Gap"

NAME	Merged Gap
DESCRIPTION	Merged gap for both EV Temperature and Salinity (Subsurface)

Review "Merged Gap"

NAME	Merged Gap
DESCRIPTION	Merged for both EV Temperature and Salinity (Subsurface)

Review "Affects many Variables"

NAME	Affects many Variables
DESCRIPTION	This gap affects many variables. Probably the main measure is to reinforce the Argo program as the most satisfactory way of solve this gap. Somehow national agencies through the Argo program coordinate the strategy to deploy the array of floats. However the scientific community and research projects may have their own interests which can not be in line with the need of a uniform coverage. The lack of Argo sampling can however be partially compensated by exploiting observational synergies with offshore platforms devoted to oil-gas, marine energy and aquaculture activities.

Review "Merged Gap"

NAME	Merged Gap
DESCRIPTION	This gap affects many variables. This gaps has been merged with gap 91 Probably the main measure is to reinforce the Argo program as the most satisfactory way of solve this gap. Note however that for the SST there exist complentary in situ sampling comming from regular XBT sections.

Review "Merged Gap"

NAME	Merged Gap
DESCRIPTION	This gap has been merged with gap 89. It should be discarded.

Review "Ocean Currents"

NAME	Ocean Currents
DESCRIPTION	Ocean currents is probably the only variable that can be measured through many different direct and indirect methods and techniques (drifters, Doppler effect, dynamic topography, mechanical methods, etc).

Review "Developing"

NAME	Developing
DESCRIPTION	Developing

Review "Operational"

NAME	Operational
DESCRIPTION	Operational

6.7 Recommendations

Recommendation "Bathymetry"

NAME	Bathymetry
DESCRIPTION	Currently, companies must invest in very costly campaigns for collecting data on local bathymetry, type of floor, swell etc. These campaigns must last approx. 1 year and are very expensive, especailly outside Europe.

Recommendation "Feasibility"

NAME	Feasibility
DESCRIPTION	Need financing for final stage

Recommendation "Operational"

NAME	Operational
DESCRIPTION	Need awareness

Recommendation "EO Community Action"

NAME	EO Community Action
DESCRIPTION	EO community should work on this in near future!

Recommendation "In-Situ Data"

NAME	In-Situ Data
DESCRIPTION	To address this gap, in-situ data is needed.

7 Definitions and Controlled Vocabularies

Table 6. List of GapTypeCode values.
Column GCC gives the GAIA-CLIM class. Note that the gap types in groups 8 and 9 are added and not reflected in the GAIA-CLIM code table.

Code	Name	GCC	Definition
1.1	Geographical extent	1	Incomplete geographical extent
1.2	Vertical extent	1	Incomplete coverage in vertical extent (applicable for atmosphere, geology, oceanography etc)
1.3	Temporal extent	1	Incomplete coverage in temporal extent
2.1	Spatial resolution	2	Insufficient spatial resolution
2.2	Vertical resolution	2	Insufficient resolution of vertical column
2.3	Temporal resolution	2	Insufficient temporal resolution
3.1	Uncertainty	3	Uncertainties are too large for the application. (Uncertainty budget including calibration, i.e. uncertainties intrinsic to one measurement)
5.1	No catalogue	5	Lack of tools for discovery
5.2	Catalogue saturation	5	Difficulty for discovery due to to many similar products in catalogue
5.3	Can not be viewed	5	Lack of tools for visualization
5.4	No easy access	5	Lack of easy download
5.5	Known format	5	Format difficult to use, not well documented, proprietary format
5.6	Not processable	5	Lack of tools to process the data
5.7	Semantics	5	No clear semantics of the data
6.1	No access	6	Data is not available
6.2	No open access	6	Data policy incl. (free) data access
6.3	No quality	6	Unclear or undocumented QA/QC methodologies
6.4	No provenance	6	Traceability not documented
6.5	Bad metadata	6	Metadata is not complete or wrong
6.5	No metadata	6	Metadata cannot be found
6.6	No model or proxy	6	There is a lack of model to extract the variable from direct measurement or by a proxi
6.7	Long term data preservation	6	No long term data preservation strategy in place
6.8	No future	6	Insecure financing to continue the data acquisition activities.
7.1	Not measured	7	The variable is not measured
7.2	No parameter	7	An aspect of the variable is missing
8.1	Conceptual	n/a	Conceptual gaps, e.g. lack of integration, unmatched goals
8.2	Educational	n/a	Lack of skills and relevant educational programs
8.3	Capacity	n/a	Lack of capacity to carry out a task to generate knowledge.
8.4	No interdisciplinary coord.	n/a	Lack of coordination across disiplines
8.5	No coordination of obs. sites	n/a	Lack of coordination between observation sites
9.1	Epistemological	n/a	Lack of epistemological basis

Table 7. Codes for the mode of observation.

Code	RS/In-situ	Comment
1	RS	
2	In-Situ	
3	Both	
4	Not determined	

Table 8. Codes for Feasibility.

Code	Feasibility	Comment
9	TBD	
4	Very high	There is a mature technique
3	High	There was already research and maturing the technique is needed
2	Medium	There is an idea to fill the gap that needs research
1	Low	There is not technology forseen to fill the gap
0	Unknown	

Table 9. Codes for Impacts.

Note that in the CGT impact is measured in number of communities impacted by the gap. In the SEE-IN KB, impact is the societal benefit resulting from closing the gap.

Code	Impact	Comment
9	TBD	
4	Very high	Most of the communities or topics will be impacted
3	High	More than one community or topic will be impacted
2	Medium	A community or topic is identified
1	Low	Not able to identify a community of topic
0	Unknown	

Table 10. Codes for Costs.

Note that in the SEE-IN KB, the costs estimates for closing the gaps are given in USD, not EUR.

Code	Cost	Comment
9	TBD	
4	Very high	more than 20 MEUR
3	High	more than 5 MEUR less than 20 MEUR
2	Medium	more that 0.5 MEUR less than 5 MEUR
1	Low	less that 0.5 MEUR
0	Unknown	

Table 11. Codes for Timeframe to implement a solution.

Note that in the SEE-IN KB, the estimates for the time frame to close a gap are given in years.

Code	Timeframe	Comment
9	TBD	
4	Long term	more than 10 years
2	Mid term	less than 5 and more than 2 years
1	Short term	less than 2 years
0	Unknown	

Table 12. Codes for Priority.

Note that in the SEE-IN KB, codes ranging from 0 to 10 are used, with 10 being the highest priority and 0 having no priority at all.

Code	Description	Comment
0	TBD	
1	Crucial	
2	Very high	
3	High	
4	Medium	
5	Low	
6	None	

References

Group on Earth Observations, 2012. Task US-09-01a: Critical Earth Observation Priorities (Second Edition), Tech. rep., Group on Earth Observations, Available at http://sbageotask.larc.nasa.gov.

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