

Report on Usage of the GEOSS Platform

This document is submitted by the GEOSS Platform team to the Programme Board for discussion.

1 EXECUTIVE SUMMARY

In the last 5 years, the GEOSS Common Infrastructure gradually evolved into a cloud-based platform: the GEOSS Platform. This was imperative to address the Big Data revolution and provide the necessary scalability in GEOSS.

The synergetic action of the GEO Infrastructure Implementation Board (GEO IIB), the GEOSS Platform Development team and in the beginning as well from the GEO Secretariat has allowed a constant and significant growth of providers, clients, and users of GEOSS via the Platform. In particular, the GEOSS Data Providers workshops (run from 2016 to 2018) reported an extraordinary success of participation and interest of the different stakeholders.

Today, GEOSS counts over 190 data providers, enabling the discovery of over 480M single data granules via a user-centric Portal (with more than 2K active sessions per month in the last 3 years) and machine-to-machine APIs (more than 15K unique clients for a total number of over 18M finalised requests in the last 5 years).

To the knowledge of this report Authors, the GEOSS Platform is the largest operational and public data platform, which builds on a global system-of-systems approach, that is, a multilateral collaborative approach.

With the advent of the GEO Regional Initiatives, the GEOSS Platform and a few Regional platforms started developing interoperability experiments.

After the GEO Plenary in 2016, the GEOSS Platform started developing pilots and prototypes to move from data to knowledge by adopting a service orchestration approach. More recently, with the introduction of the GEO Knowledge Hub (GKH), the GEOSS Platform and the GKH have started some interoperability experiments.

2 INTRODUCTION

The GEO Strategic Plan 2016-2025: Implementing GEOSS reads: "To realize its Vision and maximize the benefits that GEO can bring to users, through 2025, GEO defines three spheres of activity focusing on advocacy for the value of Earth observations as a fundamental component of timely information; engagement with stakeholder communities to address societal challenges; and delivery of critical data, information and knowledge to inform decision-making." A central part of GEO's Mission is to build the [Global Earth Observation System of Systems](#) (GEOSS). GEOSS is a set of coordinated, independent Earth observation, information and processing systems that interact and provide access to diverse information for a broad range of users in both public and private sectors. This 'system of systems', through its [GEOSS Platform](#), proactively

links together existing and planned observing systems around the world and supports the need for the development of new systems where gaps currently exist.

GEO has devoted considerable efforts to building the GEOSS infrastructure and capabilities that have made Earth observations discoverable. This report highlights the progress made in implementation and use of the GEOSS Platform since 2016.

3 ENHANCEMENTS TO THE GEOSS PLATFORM

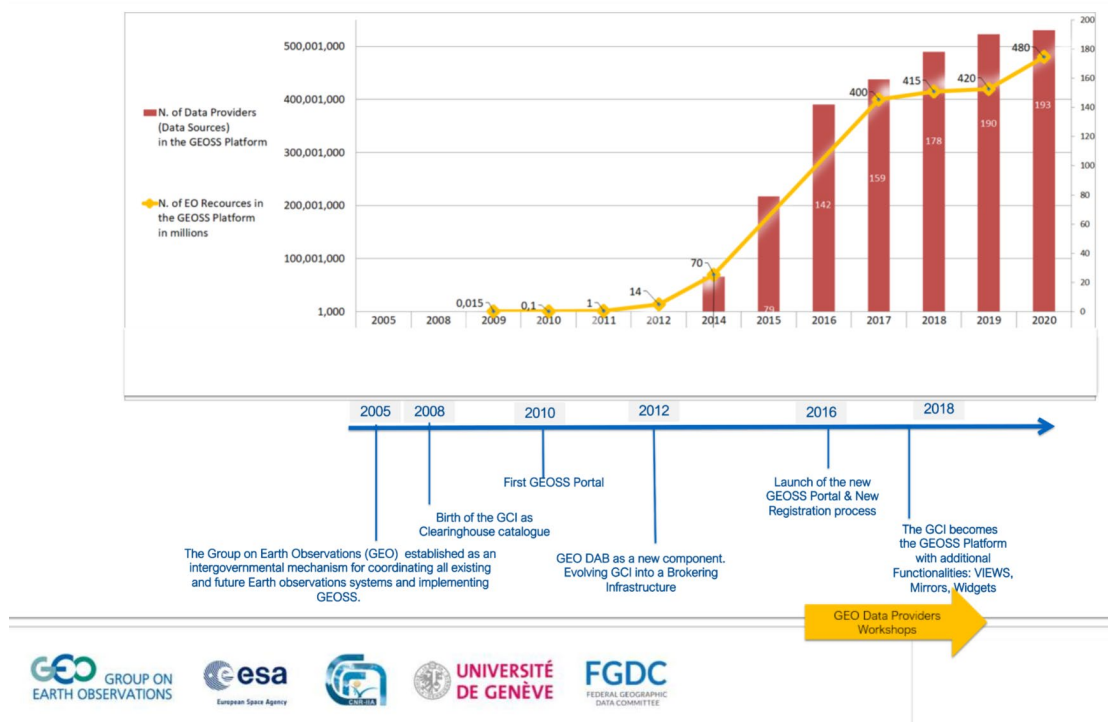
3.1 User-Driven GEOSS: Key Enhancements from the GCI to the GEOSS Platform

At the end of the first 10-year period of GEO, in 2015, despite the recognized advancement in terms of data interoperability, the GEOSS Common Infrastructure – that is, the technological core of GEOSS which enabled the connection of many systems and services, still suffered from a data-centric nature, which sometimes alienated the users. Evolution towards user-centrality was therefore required to stem user disaffection.

The gap between the GEOSS providers (of data and technology) and the users could only be bridged by working very closely with the user communities, understanding their needs for information and data, feeding this information to GEOSS and contributing to best practices in data sharing and management.

Responding to this need, the GCI became the GEOSS Platform in 2018 (see the GEOSS Platform journey below), which, in line with the GEO strategy for the period 2016-2025 and with the user-driven vision, was enhanced to engage relevant user communities from GEO, EC and other relevant initiatives, to deliver tailored solutions and to advocate the benefits of connecting to GEOSS.

Figure 1: GEOSS Platform Journey



Evolution from data-centrality towards user centrality inevitably brought with it a need for a knowledge-oriented platform, a need that was also made clear during the 3rd GEO Data Providers Workshop, held at ESRIN, the Italian establishment of the European Space Agency in Frascati, from the 2nd to the 4th of May 2018 (see the Executive Report). GEOSS Platform enhancements were prototyped not only to handle but as well to understand data and derive knowledge, experimenting the potential of GEOSS to support decision makers in taking well-informed decisions.

Specifically, the operational platform (geoportal.org) serves a large set of different communities by addressing 40 scenarios that carry out and promote solutions to real user needs. Users and stakeholders were directly and regularly involved in capturing requirements and in evaluating developed enhancements. As a result, the platform was evolved in terms of data discovery and access capabilities, look and feel, customizability and reusability, thus ensuring a better response to user needs, improving the user experience, serving a comprehensive community of users, and raising further awareness of GEOSS.

Precisely, the following capabilities were developed in response to these user-oriented scenarios:

- Resources (data, services, information) discovery and access with linked information (relationships);
- Service Execution - examples of value-added products generation and sharing were developed, exploiting different computing platforms (such as public and private clouds);
- Resources Registration, also providing (as proof of concept) the capability to add information and relationships regarding resources;
- Promotion and collaboration, through the implementation of user feedback mechanisms and techniques to increase user visits to the Portal;
- Analytical comparison of given variables from different sources or over time; and
- Exporting or enabling reuse and customization by different communities of discovery and access capabilities (including the graphical elements) via Widgets, Mirror Sites, APIs and Views.

In fact, user communities, which have their own data, portals and corresponding specific needs, can reuse some of the GEOSS Platform components customized and tailored to their specific requirements. Different stakeholders can benefit from the GEOSS Platform capabilities in different manners according to their needs.

3.2 Connecting and Increasing the Number of Users: GEOSS Portal

The 'GEOSS Portal' offers a single Internet access point for users seeking data, imagery and analytical software packages relevant to all parts of the globe. It connects users to existing databases and portals and provides reliable, up-to-date and user friendly information – vital for the work of decision makers, planners and emergency managers.

3.3 Connecting and Increasing the Number of Providers: GEO Yellow Pages and GEO DAB

Data providers who want their data accessible via the GEOSS Platform can register via the GEOSS Yellow Pages, which implements a simplified registration process for new Data Providers, and then have their data registered via the GEO DAB.

3.4 Connecting the EO Ecosystem and Increasing the Number of Clients

3.4.1 GEO DAB API and GEOSS Portal Widgets

Communities having their own portals/applications and wanting to exploit the Platform access and discovery functionalities, can develop their own graphical tools by using GEOSS APIs. Those who want to benefit as well from GEOSS Platform graphical tools can use the GEOSS Widgets.

3.4.2 Connecting the GEO Regional Initiatives

Some regional GEO initiatives have development infrastructures and platforms that can be connected to the GEOSS Platform by means of APIs (for example, the AmeriGEOSS Platform APIs). Commonly, those APIs provide data discovery and access services; in the next future, also analytical services sharing is expected.

3.4.3 GEOSS Mirrors

Communities interested in using the GEOSS Portal, possibly customized to their needs, or in using a dedicated version of it can opt for a GEOSS Mirror, configured to best respond to their specific needs, for example, filtering catalogues or search results by a specific theme, location of interest, etc.

3.4.4 GEOSS Views

Communities who want to benefit of subsets of specifically defined GEOSS resources using temporal, thematic and spatial criteria, can benefit from community-dedicated GEOSS Views that can be used via the GEOSS Portal, Mirror Sites, APIs and Widgets.

4 ANALYSIS OF CONTRIBUTIONS AND USAGE OF THE PLATFORM

The analyses of the GEOSS Platform capacity and usage is based on two sets of statistical records collected by GEO DAB and the GEOSS Portal. Collected data series cover different periods, spanning from 2014 to 2020.

4.1 How Contributions Have Changed Over Time

Currently, GEO DAB brokers 193 data sources. GEO DAB supports over 90 protocols to interoperate with data sources (including Web Services, Web APIs, etc.). Figure 1 shows the change in the number of data sources brokered by GEO DAB since 2014 to 2020. The trend shows that, soon after the switch to a brokering approach, there was a very hectic period for brokering the greatest number of data sources as possible. Then, we entered in a regime phase with an average increase of about 10 new data sources per year, in addition to a constant update of the already brokered data sources. However, it is worth to note that in the last few years the number of the new data sources was less than the average. This was mainly due to the following reasons: (i) there was no GEO Secretariat staff dedicated to the GEOSS Platform as in previous years, (ii) the GEOSS Data Providers' workshop was not held in the last couple of years and (iii) the GEOSS Platform did not receive the main visibility in the last couple of years.

The available information about the GEOSS providers were analyzed, based on the content of the GEOSS YP complemented with information from the GEO DAB data sources. Figure 2 shows the evolution in the number of data sources brokered by GEO DAB since 2014 to 2020, grouped by the data sources organizations' sector.

Figure 2: Number of Data Sources Brokered by GEO DAB 2014 to 2020

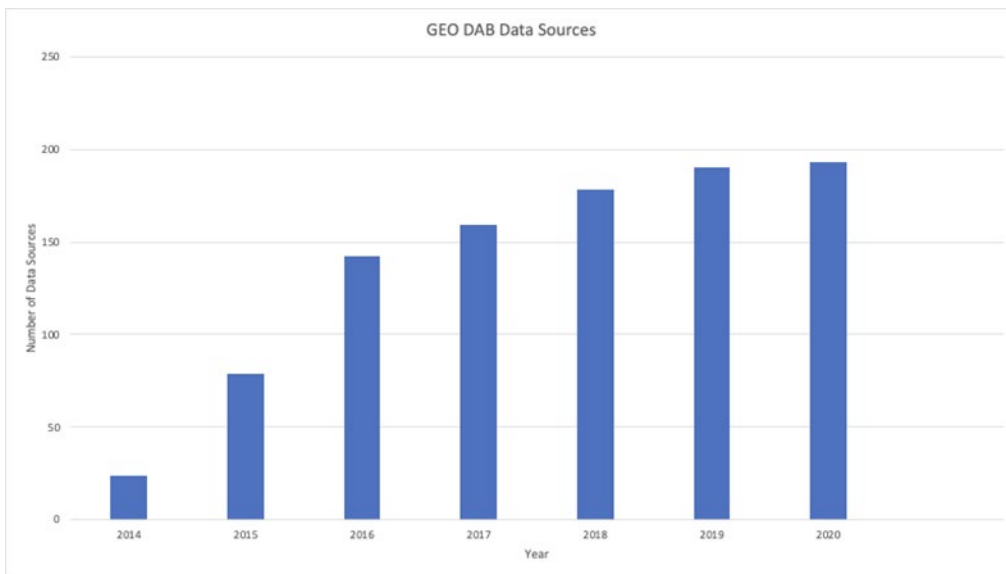
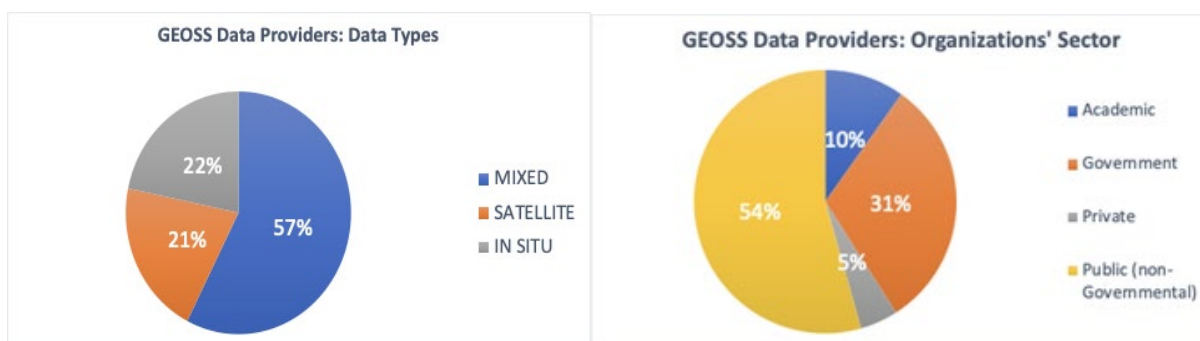


Figure 3: Number of Data Sources (Grouped by Sector) Brokered by GEO DAB 2014 to 2020



Figure 4: Percentage of GEO DAB Sources by Provider Organization (left) and Data Source Type (right)



and grouped according to the IP owner type. Figure 6 depicts the geolocation of the IPs, with different colors based on the identified IP owner type.

Figure 6: Total Requests to GEO DAB (raw data). 2019 and 2020 are still provisional

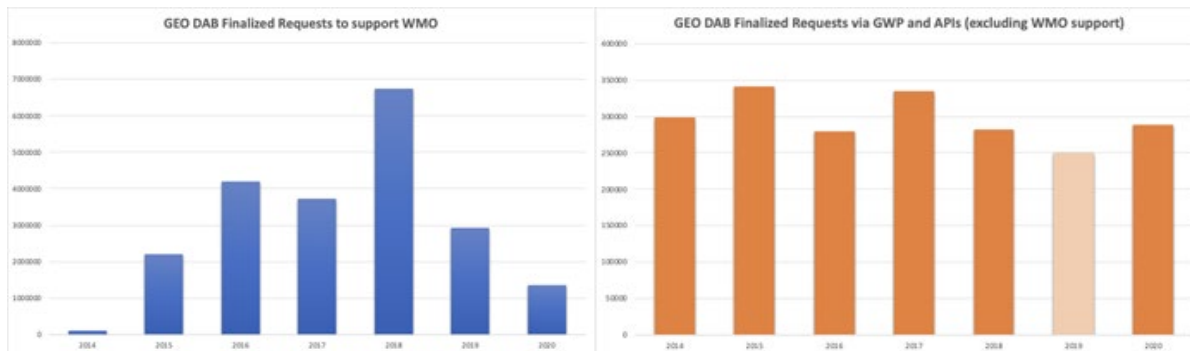
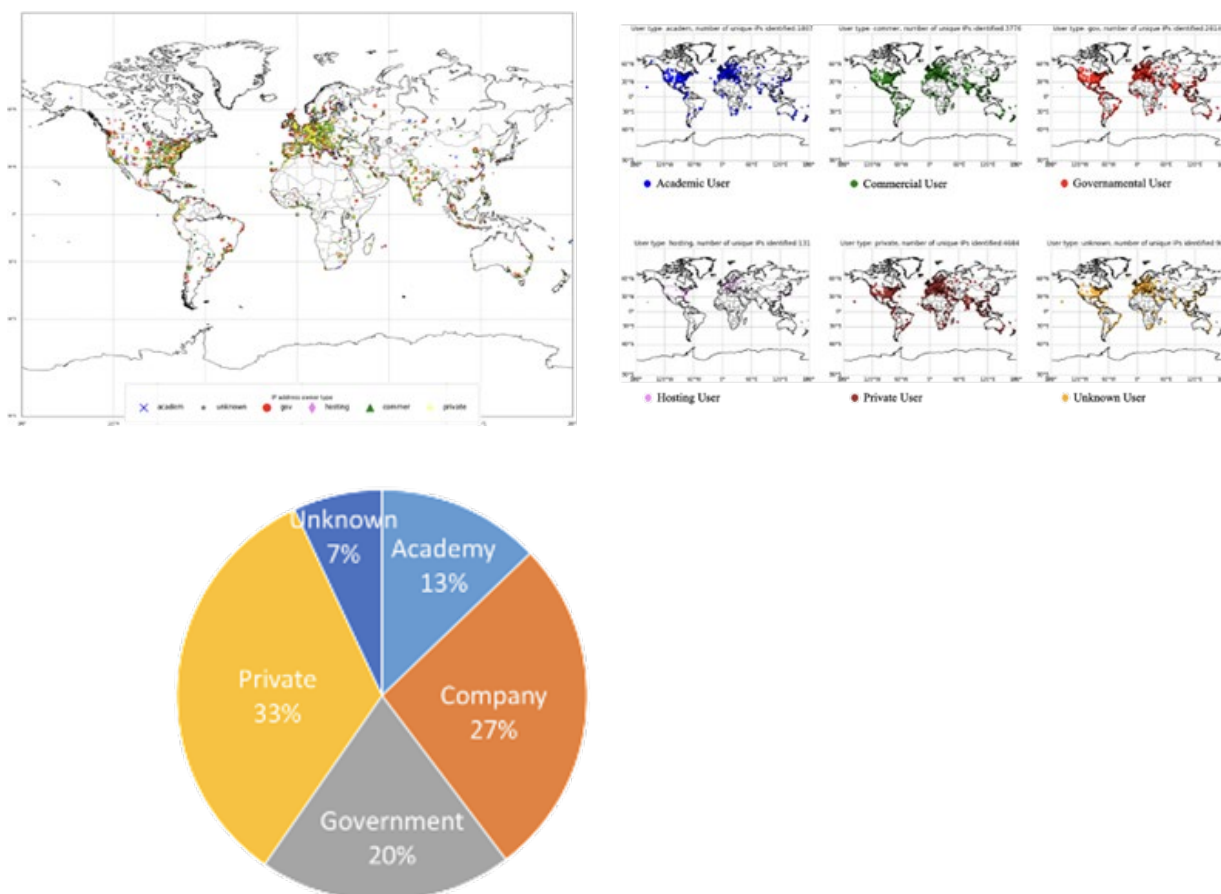
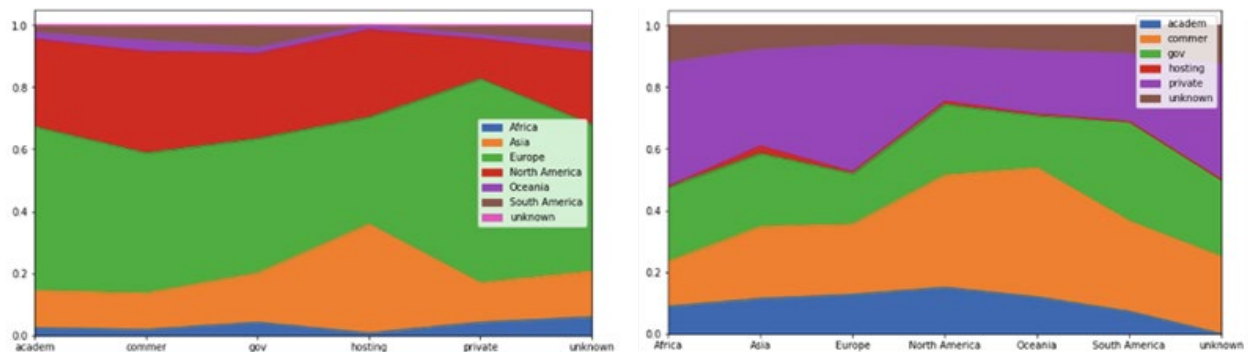


Figure 7: Geolocation of Unique IPs Submitting Requests to GEO DAB (2016-2017), grouped by IP owner type



Based on the analysis conducted by EC JRC of the GEO DAB raw data for years 2016 and 2017, Figure 8 depicts the user type share by continent (left) and the continent share by user type (right).

Figure 8: User type share by continent (left) and continent share by user type (right), based on unique IPs submitting requests to GEO DAB (2016-2017)



EC JRC will refine and extend (to 2020) the previous analysis to capture these statistics for the GEO DAB. To this aim, the EC JRC has already started a dedicated contract.

The GEOSS Portal collects and stores usage statistics since 2017. The next two figures show the number of active sessions on the GEOSS Portal and their top-10 geographical locations.

Figure 9: Number of active sessions per month on the GEOSS Portal between 2017 and 2020



Figure 10: Geolocation of users accessing the GEOSS Portal between 2017 and 2020

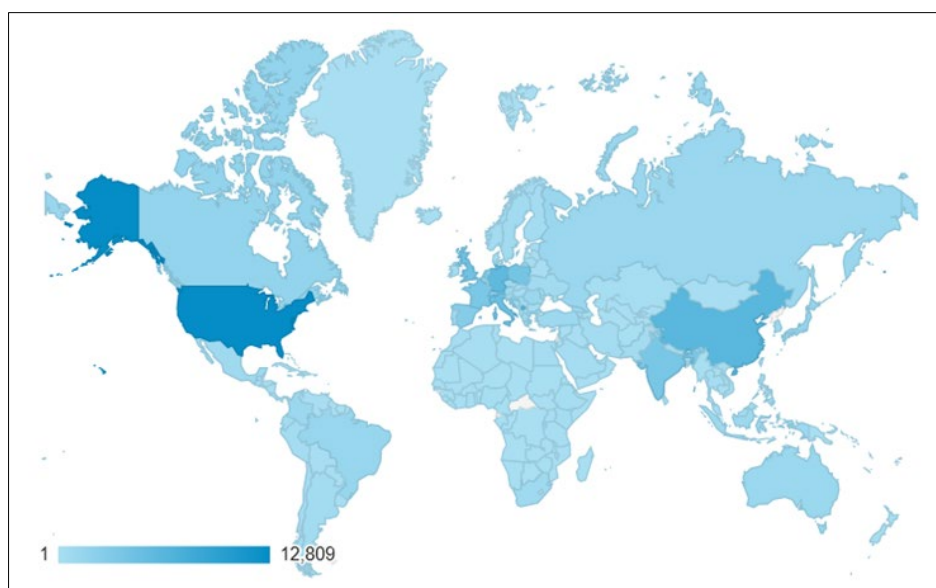
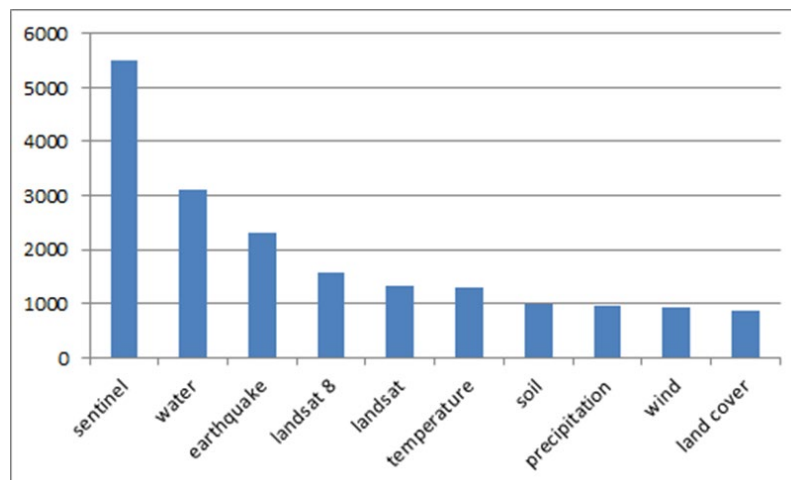


Figure 11: Top ten keywords searched by GEOSS Portal users between 2017 and 2020



4.3 User and Provider Engagement

The GEOSS Platform was enhanced following a user-centric approach, involving relevant stakeholders via a series of dedicated workshops (for example, GEO Data Provider and User Community) and direct connections. In total, 40 scenarios and over 100 requirements for evolving the GEOSS Platform and GEOSS at large were identified. A [Prezi presentation](#) is available describing the scenarios from two different perspectives: the thematic and the stakeholder view.

Various User Community and GEOSS Platform Workshops have been organized in coordination with the GEO Secretariat during which presentations, demonstrations and/or training were provided with the main objective to inform the attendees regarding the GEOSS Platform potential, functionality, capabilities, tools and accessible data and to collect community needs for discovery, access and use of Earth Observations. The main events have been reported in the Community Engagement section.

5 CONCLUSION

The GIDTT recognizes the valuable contributions from the GEOSS Platform team during the past five years and, on the basis of the analysis of the last years' experience and in order to support the action towards an advanced GEOSS Platform remaining the cornerstone of the Global Earth Observation System of Systems (GEOSS), recommends to:

- Ensure the GEOSS Platform remains operational;
- Ensure the GEOSS Platform team continues Platform evolution activities onboarding new users and new providers and responding the best way possible to the evolving user needs and GEO Engagement Areas;
- Strengthen the connection between the GEOSS Platform and the GEO Work Programme Activities and reinforce its adoption;
- Re-establish the GEO Data Providers Workshops;
- Re-establish user Engagement Activities;
- Re-establish the GEO Secretariat support to the GEOSS Platform Operations;
- Promote regular reporting and presentation activities dealing with the stakeholders' engagement with and the users' activities on the GEOSS Platform.

Annex A

References

Title	Source	URL	Date
Big Data challenges in building the Global Earth Observation System of Systems	Stefano Nativi, Paolo Mazzetti, Mattia Santoro, Fabrizio Papeschi, Max Craglia, Osamu Ochiai	Environmental Modelling & Software (vol. 68) https://www.sciencedirect.com/science/article/abs/pii/S1364815215000481	2015
Report on 2 nd GEO Data Providers Workshop	S. Nativi, P. Mazzetti, P. De Salvo, S. Ramage	https://scholar.google.it/scholar?oi=bibs&cluster=4696987999823868843&btnI=1&hl=it	2017
Exploring the depths of the global earth observation system of systems	Max Craglia and Jiri Hradec and Stefano Nativi and Mattia Santoro	Big Earth Data journal (Vol. 1, N. 1-2) https://www.tandfonline.com/action/showCitFormats?doi=10.1080%2F20964471.2017.1401284	2017
The GEOSS Platform Manual n. 1 - All you need to know to become a GEO Data Provider	GEO	https://earthobservations.org/documents/gci/201711_gci_manual_01.pdf	Nov 2017
From GCI to GEOSS Platform: a comprehensive response to user needs	ESA	https://bit.ly/3e4lzNn	2017
Executive Report of the 3 rd GEO Data Providers Workshop	GEO	https://earthobservations.org/documents/me_201805_dpw/me_201805_dpw_summary_report.pdf	2018
Discussion Paper: Challenges to be addressed in evolving the Global Earth Observations System of Systems	GEOSS Evolve Team	https://www.earthobservations.org/documents/pb/me_201809/PB-10.13_GEOSS%20EVOLVE%20Discussion%20Paper-ver5.0.pdf	Aug 2018
GEOSS Platform further enhanced	ESA	https://bit.ly/3aOGT7s	2018
Knowledge generation using satellite earth observations to support sustainable development goals: A use case on Land degradation	International Journal of Applied Earth Observation and Geoinformation	https://www.sciencedirect.com/science/article/pii/S0303243419311869	Jun 2020
From Data to Knowledge using the GEOSS platform to support Sustainable Development Goals	11 th International Symposium on Digital Earth	https://archive-ouverte.unige.ch/unige:138588	Jul 2020
GEOSS Platform documentation from the ESA-led, EC H2020 co-funded EDGE Project	GEO	http://www.earthobservations.org/article.php?id=458	Sep 2020

Title	Source	URL	Date
GEOSS Portal now more user-oriented	ESA	https://bit.ly/2R6CA06	Sep 2020
Evolving the GEOSS Infrastructure: discussion paper on stakeholders, user scenarios and capabilities	GPOT Team	https://drive.google.com/file/d/18VGhDBP0GTJE68m0V5lPWci2WjFvmp3l/view?usp=sharing	Sep 2020
The 40 GEOSS Platform Scenarios	GEO	https://bit.ly/3xwvov2	Oct 2020
Google Scholar reference results for GEOSS or GCI	Google Scholar	https://scholar.google.com/scholar?as_q=&as_epq=&as_oq=GEOSS+GCI&as_eq=&as_occt=any&as_sauthors=&as_publication=&as_ylo=&as_yhi=&hl=en&as_sdt=0%2C5	Mar 2021

Annex B

Community Engagement

Category	Event
GEO Workshops	GEO Work Programme Symposia
	GEO European Projects Workshop
	GEO Plenaries
	GEO Data Providers Workshops
	GEO Data Technology Workshop
	GEO Week Workshops
	GEOSS Portal Workshops
User Community Workshops	GCI for Disasters
	GCI or Water
	GCI for Climate
	GCI for SDG
	GCI for Food Security and Sustainable Agriculture
	EnergicOD Project meetings
	Digital Bar and Road (DBAR) Conferences
	ERA-PLANET Meetings
	ECOPOTENTIAL General Assembly
	SMURBS and the GEOSS Platform
	Marine Litter and the GEOSS Platform
	Caribbean Multi-Hazard Information and the GEOSS Platform
	The Sentinel Vision and the GEOSS Platform
	The Earth Starts Beating and the GEOSS Platform
	MUNDI DIAS and the GEOSS Platform
	All Atlantic Community and the GEOSS Platform
	GEO-GNOME Community Workshop
	WHO Community Workshop
GEO Blue Planet Community Workshop	

Category	Event
	EcoPotential Community Workshop
	GEOSS workshop for data providers in the AtlantOS and COOP+
	Global Covenant of Mayors (GCOM) Workshop
	Resilience Brokers Workshop
	BirdLife International Workshop
Other Meetings	EGU Meetings
	INSPIRE Conferences
	CEOS Groups
	ESA Living Planet Symposia
	CNR IIA conference
	OGC TC Meetings
	The ESA Earth Observation Φ -week EO Open Science and FutureEO
	Conferences on Big Data for Space (BiDS)