Final Report of the Expert Advisory Group on GEOSS (EAG)

This document is submitted by the Expert Advisory Group on GEOSS to Plenary for discussion and Executive Committee for decision

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Assessment Period: March – October 2022

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Letter from the Expert Advisory Group on GEOSS (EAG) to the Executive Committee

Dear Members of the Executive Committee,

The Expert Advisory Group on GEOSS (EAG) is pleased to provide the final report of the assessment of the GEOSS Concept and its implementation. Tasked by the Executive Committee, the EAG assessed the concept of the Global Earth Observation System of Systems (GEOSS), its main goals, and whether the original concept of GEOSS remains relevant to the organization without modifications.

The EAG is comprised of 26 internationally renowned experts from across the world. The assessment was conducted between March and October 2022. The EAG assessment was guided by approved Terms of References and its included implementation plan. Two working groups were formed with leads and co-leads, and membership in each was assigned based on geographic location in the world.

This report presents key findings and recommendations based on evidence collected by the EAG through interviews, web-based surveys and reviews of GEO's key internal and external documents as well as informed discussions at technical meetings. The deliberations in the EAG have confirmed the diversity of perspectives on GEOSS, thus EAG has developed various options for the evolution of GEOSS, all implying a change, from the current model. The EAG did not perform an in-depth cost analysis for each of the options it developed. Although the report does not recommend one particular option for the further development of GEOSS, the report provides useful information for the Executive Committee and the GEO Plenary to consider for the further evolution of the GEOSS Platform.

The EAG would like to thank the Executive Committee and the Programme Board for guidance, the GEO Community for the invaluable input during the assessment as well as the GEO Secretariat for continued logistical and technical support.

The views represented in this document do not necessarily reflect the views of, nor imply endorsement by, the individual working group members or their affiliated organizations.

On behalf of the EAG.

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EXECUTIVE SUMMARY AND RECOMMENDATION

Amongst the key recommendations of the mid-term evaluation (MTE) of GEO was to review whether the concept of the GEO System of Systems (GEOSS) remains relevant to the objectives of GEO into the future. In April 2022 a 26-member Expert Advisory Group on GEOSS (EAG) comprised of internationally acknowledged EO experts across the geospatial sector was convened to assess two main questions:

1. whether the concept of GEOSS continues to be relevant to the GEO Mission and, if so, how this concept should be defined in the context of GEO's current understanding of its value proposition; and
2. whether GEO should continue to serve as a provider of geospatial information and services infrastructure and, if so, what main function the said infrastructure should provide.

The EAG conducted a survey of GEO community, receiving 155 responses containing perspectives on the use and functionality of GEOSS, and with recommendations for improving its ease of use and impact in future. Based on inputs from the survey, and the perspective and experience of members of the EAG, this report considers the technical, user and governance implications of three broad options for the future GEOSS:

DISCONTINUE INVESTMENT IN CURRENT GEOSS PLATFORM

This option would free resources currently used to support the existing infrastructure, but would eliminate a resource that is highly valued, particularly by data providers as a mechanism to validate and increase the visibility of their data sets

Pivot investments from the current GEOSS platform toward end-user needs

This option could include hosting GEOSS resources on an existing externally hosted platform, which could potentially increase their visibility and provide access to computing resources to supplement existing GEOSS functionality, which addresses a key perceived end user need. This option could build on existing relationships between GEO and cloud service providers and could potentially also enable a refocus towards supporting Low to Middle Income (LMI) countries, which are considered to be an important, and currently under-serviced end user community. This model may also enable a stronger focus on the support of in-situ data, which is considered to be a key opportunity and point of differentiation between GEOSS and other geospatial data repositories and service providers. A key opportunity for GEO in this model is to set the data sharing and interoperability standards for geospatial data across the platforms hosting GEOSS contents, which may influence these elements globally.

Continue investing in the GEO-hosted GEOSS Platform and enhance its functionality to support GEO impact areas

This option recognises value in retaining the functionality of the GEOSS Platform for stakeholders, and also recognises GEO as the most suitable host for the GEOSS contents. This option could involve continued investment in the GEOSS infrastructure, and enhancement of its functionality and facilities. Key elements requiring improvements include the data search and discovery functionality to ensure that search results are more relevant to the end users. This option could include the development of more targeted subsets of the GEOSS contents tailored to the needs of regional or thematically focussed GEO activities, initiatives and flagships. Supporting a closer integration of these datasets with the communities within the GEO activity areas could increase impact across a range of stakeholder groups. This option may best enable integration of the GEO Knowledge Hub with other GEOSS Platform facilities. The implications of enabling GEOSS subsets to be created for any purpose and by any user, similar to the Open Data Cube functionality, is also considered.

While the options in this report are presented as distinct, they are not mutually exclusive, and components of each could be implemented in a GEOSS of the future, depending on the resources available and the direction GEO decides to take with regard to the platform.

Key recommendations of this report include:

1. Discontinuing the use of the term and rebrand everything as GEO. Replace the name “GEOSS” with the name “GEO.” The GEOSS term is confusing. This includes removing all references to GEOSS on the GEO website;
2. Ensure that all GEO-endorsed datasets, including metadata, follow open, industry standards. Open standards facilitate interoperability and data exchange among different products and services and enable widespread use;
3. Consider improving in-situ data support. GEO is in a unique position globally to identify standards for in-situ data metadata and storage requirements. Providing in-situ data hosting facilities would provide a point of difference with existing geospatial compute and storage offerings and could provide additional functionality for the calibration and validation of geospatial datasets, and to support modelling.

ACKNOWLEDGEMENTS

The Expert Advisory Group on GEOSS (EAG) thanks all GEO Community members and survey respondents for providing their contributions and insights related to the Global Earth Observations System of Systems (GEOSS). The EAG would also like to thank the GEO Secretariat for the support and guidance provided throughout the seven months and for the contribution in developing and analysing the poll and web-based survey. Finally, the EAG thanks the EAG Coordinator, Dr Joerg Helmschrot (GEOCG, Namibia) for the invaluable support and guidance during the assessment and providing the information required, organizing well-prepared EAG meetings and documentation to assure that EAG could focus on the primary aspects of the assignment.

ACRONYMS

CEOS	Committee on Earth Observation Satellites
DEA	Digital Earth Africa
DWG	Data Working Group
EC	European Commission
EO	Earth Observation
EO4EA	Earth Observation for Ecosystem Accounting
EO4SDGs	Earth Observations for the Sustainable Development
ESA	European Space Agency
ESRI	Environmental System Research Institute
EU	European Union
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
GBIF	Global Biodiversity Information Facility
GBON	Global Basic Observing Network
GCOS	Global Climate Observing System
GEO	Group on Earth Observations
GEOGLAM	Group on Earth Observations Global Agricultural Monitoring Initiative
GEOGloWS	Group on Earth Observations Water Sustainability
GEO LDN	Group on Earth Observations Land Degradation Neutrality
GEOSS	Global Earth Observation System of Systems
GIDTT	GEOSS Infrastructure Development Task Team
GOS4M	Global Observation System for Mercury
LMIC	Low- and Middle-Income Countries
MTE	Mid-Term Evaluation

NASA	National Aeronautics and Space Administration
NOAA	National Oceanic and Atmospheric Administration
OGC	Open Geospatial Consortium
SDGs	Sustainable Development Goals
SMME	Small, Medium and Micro Enterprises
UN	United Nations
WDS	World Data System
WG	Working Group
WMO	World Meteorological Organization

1 BACKGROUND AND INTRODUCTION

An assessment of GEO's key successes and opportunities for improvement during the first five years of the implementation of the GEO Strategic Plan 2016-2025: Implementing GEOSS, as well as GEO's multi-faceted efforts including the GEO Work Programmes 2016 and 2017-2019, the Engagement Priorities, Societal Benefit Areas (SBAs) and GEO activities was conducted between February 2020 to June 2021. One of the key findings of this Mid-Term Evaluation (MTE) states that "GEO needs to reassess the concept of Global Earth Observation System of Systems (GEOSS), what the main goals are, and whether the original concept of GEOSS remains relevant to the organization without modifications. Specifically, GEO should evaluate and decide what it wants or needs to pursue in terms of data infrastructure, producing data products, and user services, how GEOSS can integrate and execute the Knowledge Hub, and whether GEO has the capacity to carry this out." This resulted in the recommendation to establish an Expert Advisory Group on GEOSS (EAG) to assess:

1. whether the concept of GEOSS continues to be relevant to the GEO Mission and, if so, how this concept should be defined in the context of GEO's current understanding of its value proposition; and
2. whether GEO should continue to serve as a provider of geospatial information and services infrastructure and, if so, what main function the said infrastructure should provide.

Nominated by the GEO Caucuses and the GEO Secretariat, 26 internationally acknowledged EO experts representing scientific, technical, socioeconomic and policy communities, strategic think tanks, development agencies, civil society and citizen science communities, reflecting the diversity of interests within the (G)EO community were selected in February 2022 and expected to provide expert knowledge for various deliverables to be finalised prior to the GEO Week in November 2022. The EAG provides complementary input to the ongoing re-evaluation process as discussed by the GEOSS Infrastructure Development Task Team. The EAG is supported by an EAG Coordinator at GEO Secretariat and reports to the Executive Committee.

The work modalities, deliverables and the implementation plan were outlined in the approved EAG Terms of References (ToR), affirmed by the Executive Committee in March 2022. The main deliverables to be presented at GEO Week in October 2022 are:

1. An assessment, with recommendations, of the overall relevance of the concept of the Global Earth Observation System of Systems (GEOSS) in the context of the present day and future GEO. Should the concept of GEOSS be retained, the document will provide an articulate definition and compelling value proposition to properly position GEOSS in relation to other core activities of GEO.
2. An assessment, with recommendations, of whether GEO should provide infrastructure support in service to its mission. If so, a description of the Infrastructure Foundational Task (FT) with a definition of the function and form of the service to be provided as well as the necessary set of actors, resources, timelines, governance and coordination mechanism to execute the task.
3. Set of recommendations (with rationale) for any item within EAG mandate but beyond the scope of the Infrastructure FT outlined in 2) that may need to be addressed by other components of GEO.

This report addresses the deliverables based on evidence collected through various community engagement activities and the experience and expertise of the members of EAG. Differences in time zones and work schedules meant that it was not always possible to engage with all members of the EAG at every meeting. In addition, the experience of individual EAG members was greater on some elements of GEOSS than others. These factors have intervened in how information was collected for this report within the ToRs described above.

2 METHODOLOGICAL APPROACH

The EAG agreed at the Inception Meeting in March 2022 to follow an integrated assessment approach combining desktop research, technical presentations, assessment of the existing infrastructure, technical meetings at EAG and working group level as well as GEO community interaction. To take advantage of the particular expertise of the EAG members and to overcome challenges due to the different time zones, two working groups were established. One focused on GEOSS as a concept (WG 1) and the providers of data. The other working group focused on users and utilisation of GEOSS and its components (WG2). For each working group, leads and co-leads coordinated the activities with support from the EAG Coordinator.

Desktop research: Key strategic and technical documents were compiled with support from the GEO Secretariat and made available in a shared folder. This compilation was regularly updated with relevant scientific and technical publications.

Utilisation of GEOSS infrastructure: In support of the technical meetings and working group discussions, EAG members were provided with relevant information and guiding documents and requested to access and become familiar with the GEOSS Platform. This was supported by technical presentations of technical staff from the GEO Secretariat who presented an overview of GEOSS at the first EAG Technical Meeting.

EAG Technical Meetings: In addition to the inception meeting, four technical meetings were conducted. The main purpose of the technical meetings was i) to inform all members on the findings and discussions of the working groups ii) to update all members on findings resulting from the GEO Community engagement and, iii) to have a guided discussion on technical aspects of the assessment. All technical meetings were supported by an agenda guiding the EAG members in the discussions.

GEO Community Interactions: To include both the provider and user perspective and to build on the outstanding expertise in the GEO Community, an important component of this assessment was the active engagement of various groups of the GEO Community. The groups engaged included the Executive Committee, the Programme Board, the GEOSS Infrastructure Development Task Team, EU High-Level Working Group, the Working Group on Data and the GEO Secretariat, as well as the GEO Community at large. Three main activities were conducted:

1. Presentations: Status reports were provided to inform the approach of EAG and the status of discussions. Feedback provided was incorporated in the assessment approach;
2. Participatory EAG Session at GEO Symposium: An open engagement with the GEO Community was undertaken at the EAG Session during the GEO Symposium. The session provided a platform for the GEO Community to share use cases and perspectives on GEOSS which was supported by a moderated discussion and a poll. The 1.5 hr session was attended by 104 participants. The relevance of GEOSS as a concept was debated, including the confusion of terms, its impact on GEO messaging, the value-added of GEO versus GEOSS, and what might be lost if the GEOSS concept is de-emphasized or no longer used. Activities such as GEOSS Platform Plus, NextEOS and Work Programme activities were presented and discussed. The outcome of the discussion and the poll were considered by the Expert Advisory Group (EAG) in the assessment;
3. User Survey: In order to extend the outreach of this process to the wider GEO community, and in particular to get more information from the GEOSS user base, a user survey with 22 questions was developed and sent to the GEO community. The survey focused on all user groups but particularly on the needs of users from Low- and Middle-Income Countries (LMIC).

3 USER SURVEY

3.1 Survey on Utilization and Users of GEOSS Platform

The EAG initiated an online survey to gain greater insight regarding the users and utilisation of the GEOSS Platform. In total, 22 questions asked respondents about the usage of the GEOSS Platform, potential and limitations of the current infrastructure, recommendations for improvement, and the origin and expertise of the respondents. In total, 155 people responded to the survey. The survey results were disaggregated to understand how many responses came from in Low- and Middle- Income Countries (80 respondents). Further, a specific analysis of the respondents using GEOSS infrastructure in their daily work (55 respondents) was undertaken.

3.1.1 Survey results

The key results of the survey are summarised below. The full results of the survey are included in Annex II at the end of this report.

1. Composition of the sample (N=155)

   The geographic distribution of the respondents is nearly equal across the major continents (Africa: 19%, Asia: 15%, Australia/Oceania: 6%, Europe: 26%, North America: 18% and South America: 16%). Separated by income level, 51% of the respondents were from Low- and Middle- Income Countries and 48% from High-Income Countries.

   About 78% of the respondents work in the public sector (including academia and research) with the remainder from the private sector (10%), NGOs (6%) or others. The respondents represent various user communities with research and academia being the largest (36%) followed by resource and data providers (21%), decision and policy makers (15%), implementers (12%), developers (6%) and funding agencies (2%). Most respondents (>80%) described the level of IT expertise as either expert, proficient or competent.

   While these respondents represent a small subset of the total GEO community, the EAG feel that these results provide a limited but valuable overview of many aspects of GEOSS from the GEO community and end-user perspective.

2. Utilisation of GEOSS platform

   With the option of multiple answers, 55 of the respondents (28%) stated they use the GEOSS platform and 20 indicated that they use GEONETCast. 40 respondents use the GEO Knowledge Hub (GKH) and 25 utilise AmeriGEOSS Community Platform. The majority of respondents using GEOSS (53) reported that they access it for EO "data analysis." It is worth mention the GEOSS platform does not provide data analysis capabilities, hence this may reflect 41 respondents use the platform for promoting EO data and 23 for EO data publication. Other purposes for using GEOSS infrastructure are for reporting purposes (22) and service development (21).

   The majority of respondents (68%) stated GEOSS infrastructure provides benefits to the GEO community due to its support in accessing EO data, capacity building, support for research and other uses. However, 19% of the respondents do not see benefits for the community, mainly due to its limited user-friendliness and support, incapability of accessing the raw data, and disconnect between research and decision makers.

   Limiting factors for fully utilising the GEOSS platform are mainly related to the user-experience including user-friendliness (7%), lack of tailored search functions (12%), user guidance (10%), large number of search results (9%) and applicability (9%). Besides these user-support related factors, the knowledge of available resources (26%) and difficulties to access GEOSS platform (9%) are considered limiting.

3. Improvement of GEOSS Platform

Consistent with the limiting factors identified above, the majority of respondents suggests improving user-friendliness including the search functionality (46%), but also the communication of existing tools (19%), capacity building in using the tools (14%) and accessibility (10%).

4. Engagement and Capacity Development

51% responded that they are already engaged or see no need to be engaged, while 32% of respondents prefer stronger engagement in co-development. Most respondents (62%) express their wish to be more engaged in the process of developing GEOSS infrastructure and tools while only 22% indicated that they are satisfied with the current level of engagement.

Almost 70% of respondents thought that tailored capacity development measures would increase the utilisation of GEOSS, including workshops (87 responses), online courses (87), guidelines and manuals (71), a GEOSS Wiki (42) and Blog (28).

5. Coverage of GEOSS and further development

A regional GEOSS would be more beneficial to most respondents (46%) while a global one would be preferred by 36%. A continental one is prioritised by 10%. The most common reasons for separating regional/continental from a global GEOSS were the possibility for accessing tailor-made data and products for a particular scale (52%) and stronger user-focus and support (27%).

Fifty-nine percent of respondents indicated added value from smaller and geographically or thematically targeted GEOSS subsets, however 27% of the respondents disagree. The overwhelming justification for this approach is to provide a closer link to diverse user groups and increased impact (95%).

The majority of respondents (77%) indicated that data access, management and quality control are the major challenges for the future GEOSS. Respondents indicated that the main gap that GEOSS should address and support in future are capacity development activities (76 respondents), coordination across national and international space agencies (73), access to cloud platform to support data processing (64), access to thematic EO data products (62) and direct access to the raw EO data (53).

3.1.2 Results of the survey and implications

The following results can be drawn from the survey:

1. The GEOSS Platform was used by 28% of the respondents. However, the selection of “data analysis” as one of the main aspects is somewhat unclear. While the GEOSS platform does not strictly provide facilities for data analysis, we interpret this to mean that these users access GEOSS platform to retrieve data for their analysis on other facilities. Overall, however, knowledge of resources accessible

through the platform and the user-friendliness are main limiting factors for increased utilisation of the GEOSS platform.

2. The main challenge for the utilisation of GEOSS platform appears to be insufficient communication of the tools and their functionality, along with confusion on the terminology used to identify and describe the GEOSS platform. The lack of capacity building activities supporting the use of the GEOSS Platform may also contribute to its under-utilisation.

3. There was very strong support for closer links between GEOSS platform and end user groups, and also for the development of smaller, geographically or thematically targeted subsets of GEOSS platform as one mechanism to achieve increased impact through GEO activities, projects and flagships.

3.2 GEO, GEOSS and its components

3.2.1 Scope of GEOSS

A central part of GEO's Mission was to build the Global Earth Observation System of Systems (GEOSS). GEOSS was intended to create a set of coordinated, independent Earth observations, information and processing systems that interact and provide access to diverse information for a broad range of users in both public and private sectors. GEOSS was to link these systems to strengthen the monitoring of the state of the Earth. The goal was to facilitate the sharing of environmental data and information collected from the large array of observing systems contributed by countries and organizations within GEO. Further, GEOSS was to ensure that these data are accessible, of identified quality and provenance, and interoperable to support the development of tools and the delivery of information services. Thus, the aim of GEOSS was to increase our understanding of Earth processes and enhance predictive capabilities to underpin sound decision-making: to provide access to data, information and knowledge to a wide variety of users.

The Global Earth Observation System of Systems' Platform (formerly called GEOSS Common Infrastructure, or GCI) aimed to link data of existing and planned observing systems around the world and support the development of new systems where there are gaps. The GEOSS Platform was intended to promote the use of common technical standards so that data from thousands of different instruments can be combined into coherent data sets.

For users with limited or no access to the Internet, GEONETCast is a global network of sustained and cost-effective satellite-based dissemination systems that enables the sharing of data across the GEONETCast network.

The GEO Discovery and Access Broker (GEO DAB) is the primary mechanism by which all data and information is discovered and accessed. The GEO DAB implements the necessary mediation and harmonization services through Application Program Interfaces (APIs). These APIs allow data providers to share resources without having to make major changes to their technology or standards.

Fehler! Verweisquelle konnte nicht gefunden werden. shows the main elements of GEOSS and their relationship to one another, along the key data supporting organisations and providers. More details can be found at: https://earthobservations.org/documents/gci/201711_gci_manual_01.pdf

During the process of evaluating GEOSS, the EAG focused on the GEOSS Platform. EAG did not focus on evaluating other GEO-related infrastructure, such as the GEO Knowledge Hub.

3.2.2 *Key findings*

1. The original concept of GEOSS in the early 2000's, as a global earth observing system of systems (GEOSS), was a grand vision and laudable goal. Since its beginning, GEO has consistently advocated for this vision to help meet the need of better understanding our changing planet. At the same time, the fast-evolving digital era has brought computing power to the masses, enabling multiple actors to provide a supply of earth observations, geospatial technology, and data analytics capabilities. While GEO has been challenged to maintain its own powerful "system of systems", it deserves credit for setting the vision that today is collectively being realized by a variety of diverse platforms, to include Digital Earth Africa, Radiant Earth's ML Hub, Google Dataset search tool, Google Earth Engine, Microsoft's Planetary Computer, and Earth on AWS.
2. Users of Earth observations and geospatial data are typically scientists, researchers, and practitioners, not policy-makers and decision-makers.
3. The terms "GEOSS" and "GEOSS data infrastructure" convey different meanings to different people. It is not clear which components of GEO's many investments over the years are considered as part of "GEOSS data infrastructure."
4. The current GEOSS Platform is supply-driven. It serves as a means for sharing metadata about Earth observation data, tools, and studies, through which some of the resources can be accessed.
5. Scientists, researchers, and practitioners (the "users"), need access to datasets, models, and computing capability, which the GEOSS Platform does not provide.
6. It is hard to find information within the current GEOSS Platform, including in-situ information. Results of the EAG survey (Q#10) sent to the GEO community indicated the following factors that limit utilizations of the GEOSS Platform:
    - User-friendliness;
    - Applicability;
    - Number of search results;
    - Lack of tailored filter tools for search results;
    - Knowledge of available resources.
7. Respondents to the EAG survey sent to the GEO community reported that the main gaps that GEOSS could support include the following (Q#22):
    - Access to raw satellite data;
    - Access to cloud platforms;
    - Coordination across national space agencies;
    - Capacity building activities.

8. The GEO Knowledge Hub is useful to users. It provides access to datasets, replicable code, and context of studies.
9. Many people, especially from lower and middle income (LMI) countries, learn about and engage with GEO through regional GEOs (AmeriGEO, AfriGEO, AOGEO, EuroGEO) and thematic flagships such as GEOGLoWS, GFOI, GEO-DARMA, GEOGLAM, and GEO BON.
10. GEO Principals indicated that a GEO infrastructure should address their needs and those of other key GEO thematic initiatives, to strengthen their role as GEO principals in their country, provide geospatial processing capabilities in their mother language, and provide training resources.

3.3 Options for future GEOSS infrastructure

There is a great diversity of perspectives on GEOSS as shown from the survey results above, and also from the comments received from members of the Programme Board and affiliated organisations during the writing of this report. This diversity complicates the process of providing evidence-based recommendations, as has been requested by some reviewers. While it has not been possible to find consensus on a definitive, clear and single path forward for GEOSS through this process, this report does make recommendations in terms of the key aspects that GEO should consider when assessing the viability of these options.

As an ad-hoc expert advisory group, however, and following the major themes of the survey results and comments below, we considered three options for GEOSS future implementation:

1. Discontinue investments in the current GEOSS Platform;
2. Pivot investments toward end-user needs;
3. Continue investments in the current platform, with enhancements.

3.3.1 Option 1: Discontinue Investments in the Current GEOSS Platform

Description: This option would involve discontinuing the operation of the current GEOSS Platform.

Technical Considerations: This option would eliminate the responsibility of maintaining the current GEOSS Platform and relieve GEO of keeping up with a fast-paced, ever-evolving ecosystem of digital information computing and technology.

User Considerations: The GEOSS Platform is used by data providers to make their information discoverable in the public domain. This option would eliminate this avenue for current providers of GEO data, causing disruption to find an alternative means for publishing their data.

Governance Considerations: This option would eliminate the need for GEO to support the GEOSS Platform. Discontinuation of the GEOSS Platform and the communication about these changes to stakeholders would need to be managed. This effort includes eliminating "GEOSS" terms and replacing any remaining infrastructure-related functions with the "GEO" brand name. Costs associated with maintaining the GEOSS Platform would no longer exist. There may be upfront costs in the short term with communications and rebranding efforts. This option may enable GEO to focus efforts towards supporting its success as a global convening body.

3.3.2 Option 2: Pivot Investments from the Current GEOSS Platform Toward End-User Needs

Description: This option includes ending support for the existing GEOSS Platform and ensuring that GEO content could be discoverable and available through other existing platforms that take advantage of cloud storage, computing, and an image processing environment. Several existing platforms include Digital Earth Africa, Radiant Earth's ML Hub, Google Dataset search, Google Earth Engine, Microsoft's Planetary Computer, and Earth on AWS, Esri's ArcGIS Online, those provided by national space agencies, or other appropriate platforms. To be discoverable by multiple platforms, GEO-related data will hold value by following open data standards that enable interoperability. GEO's role would continue to be one of promoting and enabling the use of open data by its members.

For GEO to take advantage of existing platforms, it is not a requirement that they be commercially operated. If there are other viable platforms available, they should also be considered. Both GitHub and the Humanitarian Data Exchange (HDX) are models to examine, as these fully open platforms help self-identified user communities make their data, code, and technical guidance freely accessible for sharing and collaboration. Another example platform that provides access to Earth observations and derived products is the Copernicus Climate Data Store supported by the European Commission.

A possibility under this model is to invest in improving access to large-scale, analytical computing, especially for Low to Middle Income (LMI) countries. In the EAG survey sent to the GEO community, 46% responded that GEOSS would be most beneficial to their work if it focused regionally (Q#16). This option could focus on supporting the regional GEOs (AfriGEO, AmeriGEO, AOGEO, EuroGEO) and thematic activities where most people in the community engage with what GEO has to offer. Scientists, researchers, and practitioners in LMI countries continue to face barriers for processing raw data and accessing cloud-based computing. To realize this option, GEO could focus on facilitating access to and use of data platforms with analytical modelling capabilities for end users.

An additional opportunity under this model is to invest in methods to include in-situ data (field data). In-situ data is fundamental for validating and calibrating satellite remotely sensed data. A considerable volume of in-situ data is collected by public institutions throughout the world, and a large proportion of this remains unpublished or not readily available. Establishing standards for collecting and disseminating in-situ data, for those scientific disciplines that GEO supports through their various GEO initiatives could further be supported by this option. This will enhance the satellite-derived products created by GEO-initiatives, flagships and provide additional resources to enhance analysis to users. This needs to be done in close partnership with the mandated organizations.

Technical Considerations: This option builds on the established relationships between GEO and geospatial service providers, such as the experience with the GEO Cloud Credits program with partners Google, AWS, and Microsoft, and explores the potential for scaling up further. The main data providers are already transferring to and hosting all their satellite datasets in the cloud and creating data in cloud-compliant formats, hence users worldwide would be interacting with cloud-infrastructures imminently. It could potentially reduce maintenance costs for GEO but may require the development of customized solutions to eliminate access barriers for LMI countries.

This model could be more sustainable than trying to manage the ever-changing technology platform ecosystem from within GEO. It could facilitate GEO thematic initiatives to build and maintain customized platforms to collect, share, and disseminate in-situ datasets. It could also facilitate improved access to critical, state-of-the art technology, including cloud computing in LMI countries.

User Considerations: Funding would be pivoted from the current, supply-driven platform to fundamentally shift direction toward a model that addresses the needs of users of earth observation data. Housing the resources on existing proven platforms may increase its visibility and user friendliness, improving impact. The focus on LMI countries may support a large group of end users who face computing barriers, to gain improved access to earth observations and computing power for big data analytics. This could include online analytical processing. This option considers the global GEO community needs to access and process geospatial information in a new era. It can strategically position GEO to achieve its global mandate to connect the demand for sound and timely environmental information with the supply of data and information about the Earth.

This option would require GEO to 1) encourage GEO-endorsed data providers to follow open, industry metadata and data standards that enable easy discovery by existing powerful, web-based platforms, and 2) provide an effective means for GEO principals and community members to collaborate across and within the different regional and thematic GEO initiatives. Focusing on the LMI countries ensures users from LMI countries have access to data and can perform analysis on the most appropriate platform as their needs require. It defines end-users as researchers, scientists, and practitioners, including those who are already associated with GEO initiatives and activities.

Governance Considerations: Responsibility for maintaining and continually improving a metadata search platform would decrease for GEO. This service of delivering metadata, links to the raw data and analytical computing power to analyse the data would be provided by other, well-resourced platforms that already exist for these purposes. Implementation of this option may require GEO leadership to leverage the well-defined, cooperative relationships it has established with selected tech-sector organizations that have a mutual interest in providing earth observation data and proven tools to a wide range of stakeholders. Governance under this option could be led by GEO to ensure a cloud-agnostic approach and provide the best computing solutions, depending on the analytical end-user needs. Governance of the housing and presentation of the GEOSS Platform resources could be delegated to the providers of the data, which would ensure control of the content. Once the metadata and data are in a standard format to be easily discoverable online, the delivery to end users could be removed from GEO's responsibility and control.

Research by the EAG revealed that losing direct control over the delivery of GEO-endorsed data is a concern of some within the GEO community. The concern is that owners of commercial platforms may decide to change their terms of service, which could negatively impact the ability of users to access the data that GEO would explicitly put there for effective delivery. However, GEO has open data and data sharing principles in place to prevent commercial sector overreach in its engagements. Earth observation data is already being provided and made available by third party platforms This concern could be offset through a contractual relationship with any commercial partners that may be involved.

3.3.3 Option 3: Continue Investing in the GEO-Hosted GEOSS Platform and Enhance Its Functionality to Support GEO Impact Areas

Description: The GEOSS Platform includes information related to many GEO activities (and a range of other activities that are not directly supported by GEO) for every part of the world. It is valued by the providers of the platform's content, which is primarily metadata about earth observations, models, studies, and applications. (EAG_SRef_04_2018_dpw and EAG Survey). However, to conduct their research and analyses, scientists need more than just the metadata that the platform currently provides.

This option recognises value in retaining the functionality of the GEOSS Platform for stakeholders, and also recognises GEO as the most suitable host. The GEOSS Platform would be enhanced to improve data retrieval and functionality, incorporate in-situ data and better target selected end user groups of interest, potentially providing greater support for GEO activities, Initiatives and Flagships. The following options consider a range of levels of development and extension of the GEOSS Platform, from less to more extensive.

1. Enhance only the functionality to search and discover information. While this option is potentially a low additional cost, it only partially addresses the specific concern of improving the relevance of the GEOSS Platform. Current geospatial data scientists and users are requesting more than a discovery platform.
2. Transform and upgrade the platform into one that provides customized data, products, and services for targeted GEO user groups. Developing GEOSS Platform subsets would create smaller and more targeted repositories of information that are easier to navigate and are more likely to return relevant results. This effort would reposition the GEOSS Platform to be more user-oriented and enable it to support specific GEO needs. It could include retaining a central, large GEOSS Platform and providing functionality to create linked, curated subsets of the GEOSS Platform content focused on thematic and regional needs. The subsets could provide more targeted repositories of data that are easier to navigate and are more likely to return relevant results. These subsets could also provide a logical place for the contribution of in-situ datasets. This option could also include integration of the GEOSS Platform functionality with the GEO Knowledge Hub.
3. In addition, this model could incorporate similar functionality to the Open Data Cube initiatives which enable a data cube to be created by anyone over any location. Similar functionality in the GEOSS Platform could support greater use of its contents for more specific applications across a wide range of domains. These subsets could potentially be housed on existing cloud computing resources (or a revitalised GEO infrastructure). Once established, the GEOSS Platform subsets could be curated and maintained by the relevant GEO project or initiative, but

aligned across the subsets and central GEOSS Platform repository to ensure data consistency.

Technical considerations: This option retains the central GEOSS Platform as a resource for data providers, and implements improvements to better support information retrieval for scientists, researchers, and practitioners. It also improves support for making available in-situ data, an important gap that is not currently addressed through other repositories of global earth observation data. This option facilitates the discovery of GEOSS Platform data for use by regional and thematic communities. It increases the range of datasets that can be easily linked to GEO and could drive the development of common data management and interoperability principles for geospatial and associated datasets globally.

One option would be for the upgraded platform to match, or significantly supplement the functionality of proven platforms that already provide comprehensive access to a powerful combination of earth observation data, analytics, and services using cloud-computing technology. (See list of these platforms in the "Key Findings" section and the Annex). GEO may not be best positioned to duplicate what others are already doing. This model is expected to be potentially expensive to achieve and maintain. It would require a significant extension of GEO's current capability and resources. This model implies the risk of replicating services provided by other specialist organisations as well as the potential duplication of datasets and products within the GEOSS Platform. An alternative would be for the upgraded platform to integrate, through relevant APIs and interoperability mechanisms, functionality provided by other proven platforms in order to leverage, among others, their data analytics capabilities.

New software tools would need to be developed to implement this option. Additional training materials and support resources may be required in the early stages of implementation to guide development of the subsets.

User considerations: This option could improve impact by closer connections to communities focusing on thematic and/or regional issues. It would directly integrate with the GEO Work Programme and Flagship activities by addressing specific needs of users in a thematic domain or region, and result in a more agile GEO Platform that can be tailored to meet the needs of any end user group. This option carries the risk of continuing to invest in a platform that remains supplier-driven.

Governance considerations: This option would retain the platform custodianship within GEO. This option would retain a requirement for maintenance via the existing relationships with the EU and others. Incorporating capabilities for end users to generate their own subset instances may influence data sharing possibilities from some data suppliers. Custodianship and maintenance of such functionality could also be transferred to the entity that generates the instance.

Regarding in-situ data, GEO is in a unique position to drive the development of global standards and principles for improving common data management and interoperability. The time and resources required to implement this option may be substantial, but align with GEO's goals.

4 CONCLUSIONS & RECOMMENDATIONS

While three options presented in this report are presented as distinct, they are not mutually exclusive. Components of each could be implemented by GEO in the future, depending on the resources available and the direction GEO decides to take with regard to the platform.

In addition, any future solution for GEO-supported data infrastructure should be accompanied by a deliberate socialization campaign and training for using an enhanced platform. Moving forward, a communications effort is in order for GEO to clarify the services and benefits it provides. Specifically, regarding data, technology, and infrastructure, people do not understand exactly what GEO currently offers. The communications effort would require consistent terms and branding to describe the work of GEO. One tangible action would be to replace the legacy term "GEOSS" with "GEO", regardless of whether GEO continues to further invest in the platform itself. This effort would also include a thorough review and updating of the GEO website and all related online documentation about GEO's work.

Regardless of further investments in the GEOSS Platform or infrastructure, GEO remains in a position to provide guidance, best practices, and standards for GEO-endorsed data and service providers. If GEO does move forward with future investments in data and technology services, it must appeal to a well-defined user community. Option 2 is directly oriented toward users of earth observation data and geospatial technologies. It leverages GEO initiatives and is more of a "bottom up" approach. Option 3 is oriented toward GEO impact areas. It recognizes the value of GEOSS for providers of GEO-relevant information, enabling GEO to remain the custodian of the platform, and it supports the development of facilities that enable improved discovery of GEO-endorsed information by GEO initiatives.

4.1 In-situ data opportunities

There is an additional opportunity for GEO to specifically support in-situ data, which is currently not well supported by other existing EO and geospatial data analytics platforms. Draft reports and concept papers made available to the EAG, describe some of the key challenges and complexities in meeting this opportunity:

a. Reduced public investment in in-situ data collection;
b. Lack of open data policies in many countries;
c. Time-limited nature of funding for in-situ data collection in many projects;
d. Lack of FAIR principles, and lack of access to in-situ data through many journals.

These reports describe the importance of addressing specific needs for each of the diverse types of in-situ data, which include:

1. <u>In situ data from continuous data collection services</u>
   This case is typical of meteorological, marine and hydrological data collected by public institutions with specific mandates, which include curation, preservation and dissemination. GEO can increase visibility of the benefits of sharing their datasets.

2. Data from census or similar field surveys
   The combined use of EO and census surveys for improved SDG indicators is one of the key areas of interest for GEO. GEO can encourage providers to make data freely available and promote innovative applications to use these data in new ways

3. Data from field surveys and unrelated satellite observations.
   This includes field data for surveys where space-based data are not the primary source of information, such as biodiversity data collection. GEO can support the use of trusted and accredited repositories of data that support the FAIR principles such as PANGEA, Oak Ridge DAAC, GBIF and the Environmental Data Initiative (EDI).

4. Data with field surveys related to satellite observations
   Usually associated with research papers and supported by short-term grants. Many of these datasets are lost or kept under close control by individual researchers. GEO should promote the practice of depositing data associated with papers in a long-term repository,

5. Data from citizen science and innovative technologies
   These include data collected by new means such as SMS, mobile communications and sensor networks. These approaches face challenges around how to convert spontaneous, unorganized contributions in trusted datasets, and providing long-term repositories for these datasets.

The in-situ reports from which the above summary is drawn note that, for certain of these data types, and from the perspective of certain user groups, GEO could make a major contribution if it were to build a long-term repository for these datasets.

4.2 Recommendations regarding terminology

Replace the name “GEOSS” with the “GEO” brand name. To streamline and improve communications about the purpose of GEO, identify all confusing and legacy “GEOSS” terms, and eliminate their use. This includes removing them from all instances on the GEO website, formal presentation slides, and public talking points/speeches. Below is an illustrative list of terms to discontinue:

- “GEOSS infrastructure”;
- “GEOSS infrastructure and tools”;
- “GEOSS common infrastructure”;
- “GEOSS data and infrastructure”;
- “GEOSS products”;
- “GEOSS suite of tools”;
- “GEOSS wiki”;
- “GEOSS blog”;
- “GEOSS concept”.

Annex I

Components of the GEOSS platform, supporting organisations and contributors

Annex II
Data and Infrastructure Providers

There is a plethora of satellite data available and being provided to the global GEO community. The information below even though it is incomplete, it is relevant, to have a perspective of the state-of-the art landscape for geospatial data availability, its volume, use and dissemination. The satellite data together with the number of geospatial platforms and software providers, becomes a powerful combination of resources available to the GEO user community that should be considered for the future of any GEO infrastructure.

1 DATA PROVIDERS

NASA data and data products exist for the purpose of furthering scientific research and are open to the public. NASA follows open science principles to ensure that all NASA data are available fully, openly and without restrictions. By March 2024, NASA aims to host and make available all of its operational archives in the cloud. In 2021, the accumulated data archive volume for all of NASA's Earth observing satellite missions was ~ 60 PetaBytes (PB). Based on current launch schedules, the archive volume is expected to grow to more than 250 PB by 2025. Planned missions such as NISAR, from NASA and the Indian Space Agency (ISRO) which will provide SAR L-band data globally will collect and serve 30TB of data daily.

There are multiple NASA Distributed Active Archive Centers (DAACs) in charge of distributing the multiple Earth observing satellite datasets. Table 1 below lists some additional key satellite data distributor entities and their respective platform sites.

2 SATELLITE DATA PROVIDERS

Table 1 is a partial list of open satellite data providers and their respective distribution platforms. As free and open satellite data sources increase, it is critical for potential users of these large datasets to have the capability to process them in a cost-effective manner using state-of-the art methods. Commercial data providers are also key players in this space, including but not limited to Planet Labs, Maxar Technologies, AIRBUS, and more.

3 INFRASTRUCTURE PROVIDERS

Both Google (Google Earth Engine, GEE) and Microsoft (Planetary Computer, PC) have significant footprints in the space of geospatial analytics services. Both offer users free (for non-commercial use) access to petabytes of satellite imagery and the ability to process their own data. GEE is a proprietary, closed-source code base, whereas PC is built on top of open-source components. In addition to Google and Microsoft, neither of which are traditional "geo" companies, there are offerings from other companies including Esri, Descartes Labs, Sinergise, Astraea, Maxar, Planet, and more, the majority of which are commercial offerings.

Table 1. Satellite data providers

Entity	DAAC	Short Name	Link
USGS		Landsat Data	https://www.usgs.gov/landsat-missions/landsat-data-access
NASA	NSIDC	National Snow and Ice Data Center	https://nsidc.org
	GHRC DAAC	Global Hydrometeorology Resource Center	https://ghrc.nsstc.nasa.gov/home/
	PO DAAC	Physical Oceanography Distributed Active Archive Center	https://podaac.jpl.nasa.gov
	ASF	Alaska Satellite Facility	https://asf.alaska.edu
	ORNL DAAC	Oak Ridge National Laboratory	https://www.ornl.gov
	LP DAAC	Land Processes Distributed Active Archive Center	https://lpdaac.usgs.gov
	GES DISC	NASA Goddard Earth Sciences (GES) Data and Information Services Center (DISC)	https://disc.gsfc.nasa.gov
	OB DAAC	NASA's Ocean Biology Distributed Active Archive Center	https://oceancolor.gsfc.nasa.gov/data/overview/
	SEDAC	NASA's Socioeconomic Data and Applications Center	https://sedac.ciesin.columbia.edu
ESA	Copernicus	Open Access Hub	https://scihub.copernicus.eu
JAXA	G-Portal	Globe Portal System	https://gportal.jaxa.jp/gpr/?lang=en
INPE	DGI	Image Generation Division	http://www.dgi.inpe.br/CDSR/ http://www.dgi.inpe.br/catalogo/ http://www2.dgi.inpe.br/catalogo/explore

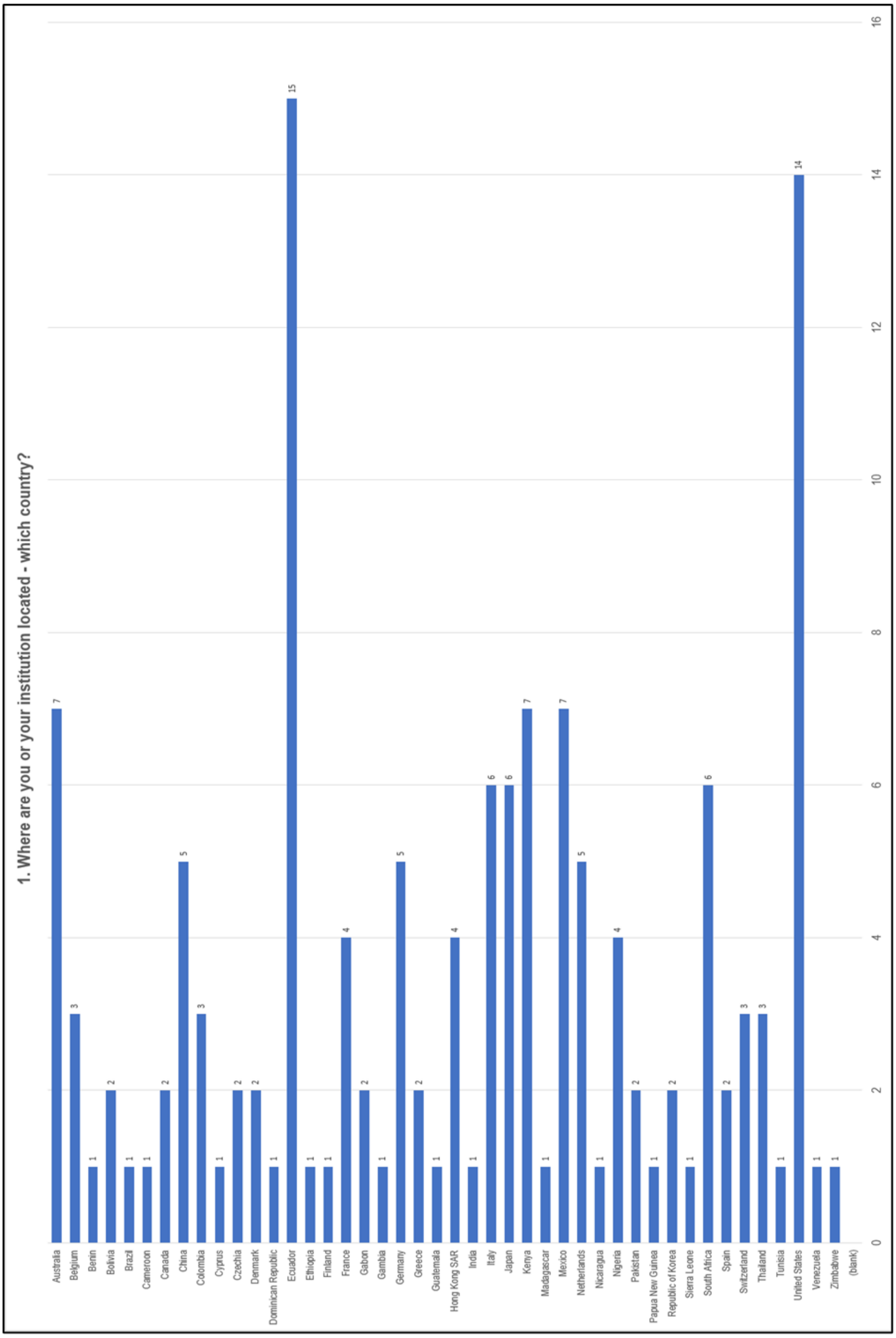
In addition, there are projects like the Open Data Cube, Pangeo, and Jupyter as well as implementations of these like Digital Earth Australia, Digital Earth Africa, or those offered by 2i2c. These platforms are aimed at allowing users to process large amounts of data at once, generally in the cloud, rather than working on a single scene basis. Traditional technologies like the Geospatial Data Abstraction Library (GDAL) are still important, and new technologies like the SpatioTemporal Asset Catalog (STAC) and the Cloud-Optimized GeoTIFF (COG) have been critical to fueling a new analysis paradigm. The table below provides a list of several software providers.

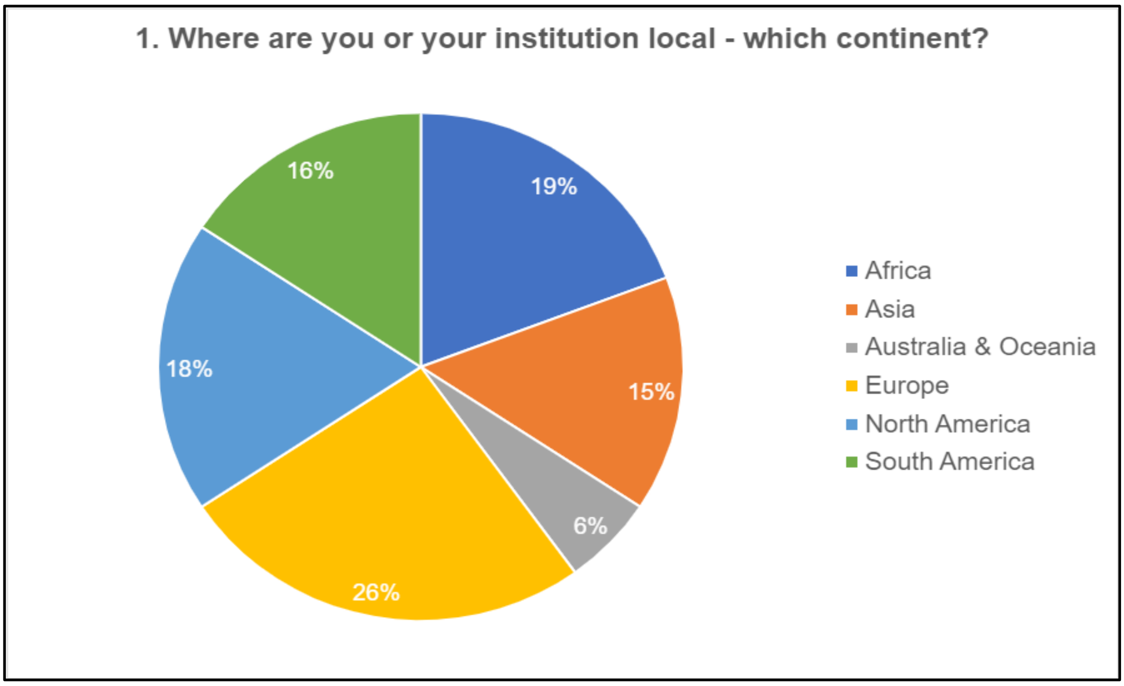
Table 2. Platform and software providers

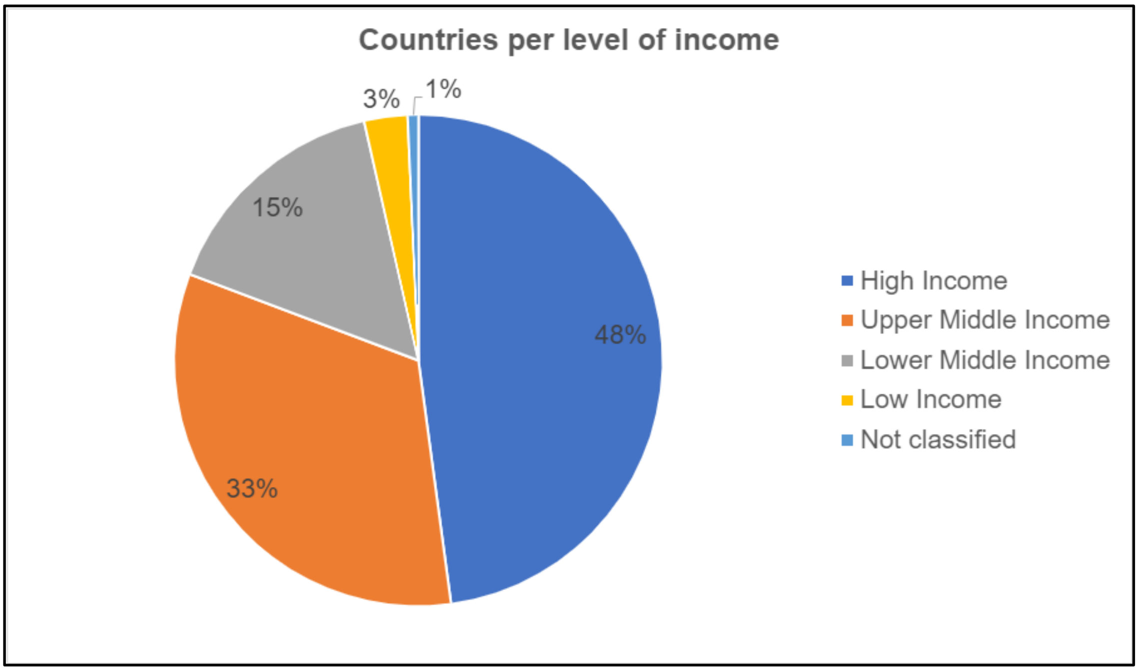
Entity	**Platform**	**Accessibility level**	**Link**
Microsoft	Planetary Computer	Free	https://planetarycomputer.microsoft.com/
Google	Google Earth Engine	Free/Paid	https://earthengine.google.com/
Sinergise	SentinelHub	Free/Paid	https://www.sentinel-hub.com/
Esri	ArcGIS Online	Paid	https://www.arcgis.com/index.html
Digital Earth Africa	Digital Earth Africa	Free	https://www.digitalearthafrica.org/
UN FAO	SEPAL	Free	https://sepal.io/
EOSDA	Landviewer	Free/Paid	https://eos.com/landviewer/
QGIS	Free and Open Source Geographic Information System	Free	https://www.qgis.org/en/site/
OpenScapes	2i2c JupyterHub	Free	https://openscapes.2i2c.cloud/hub/
Descartes Labs	DataHub	Paid	https://descarteslabs.com/platform/
Unfolded.ai	Platform & Studio	Free/ Paid	https://www.unfolded.ai/
Orbital Insight	GO	Paid	https://orbitalinsight.com/geospatial-technology

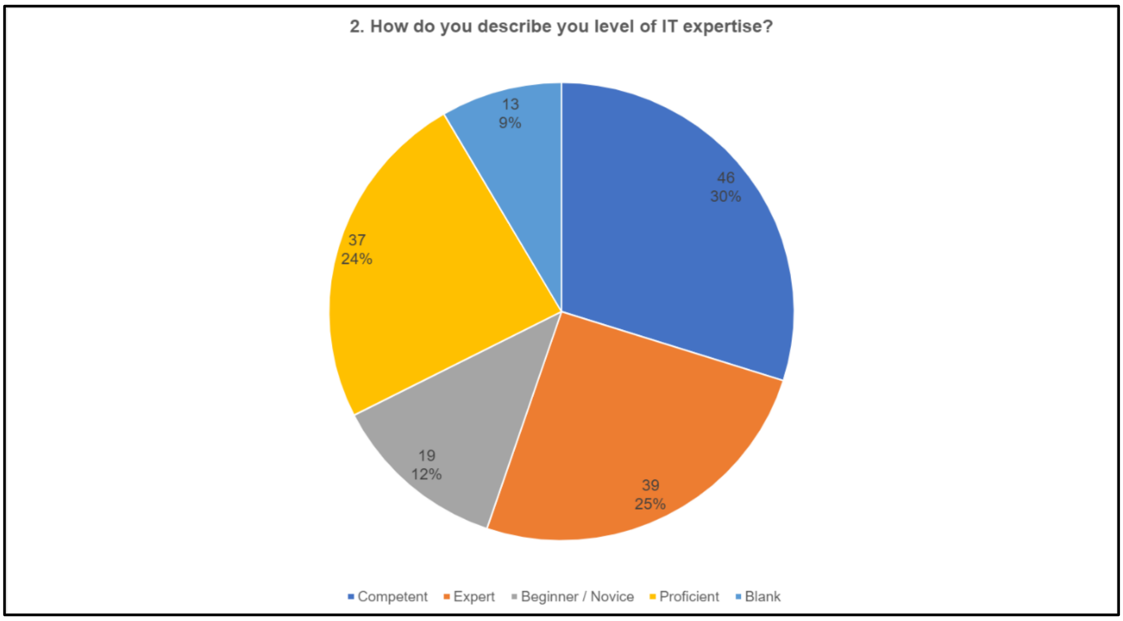
Annex III

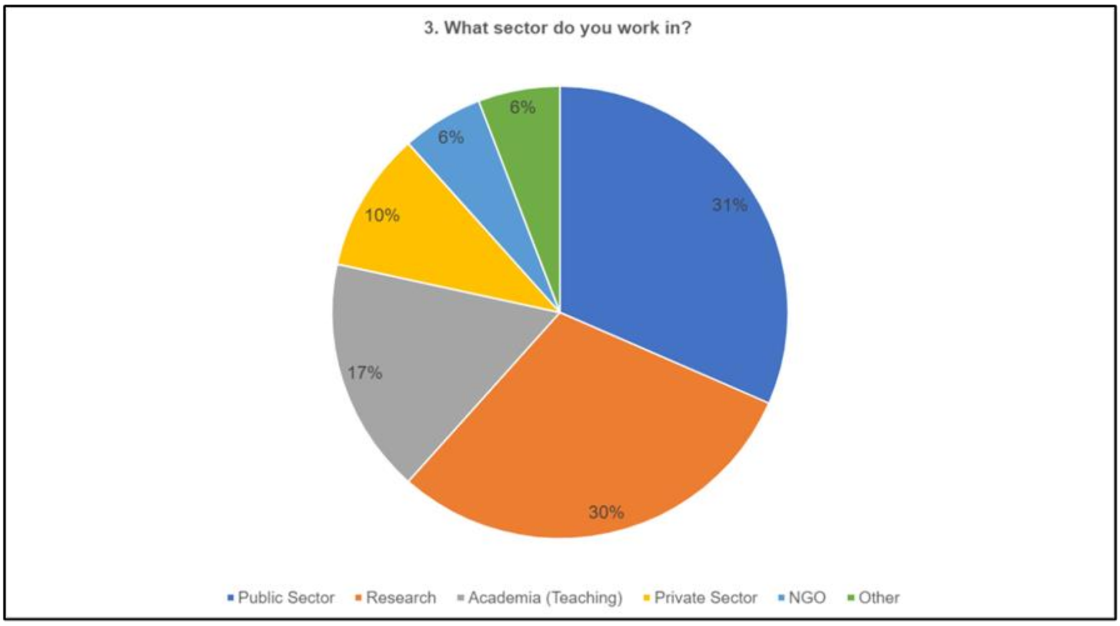
Survey results

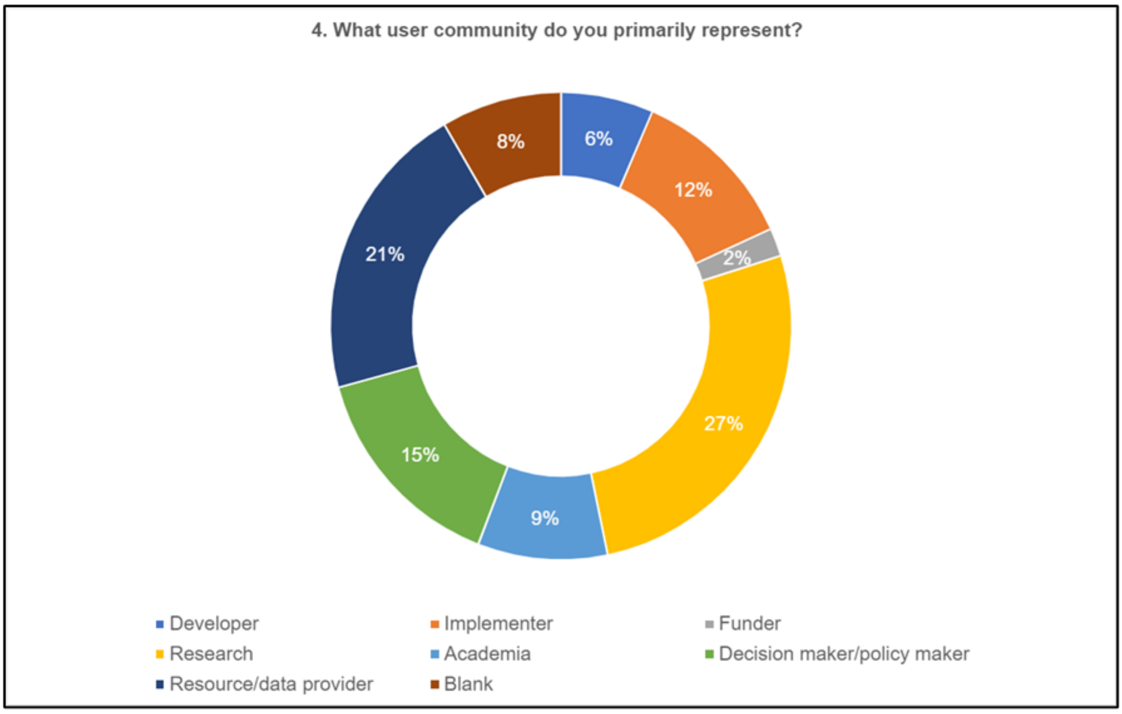


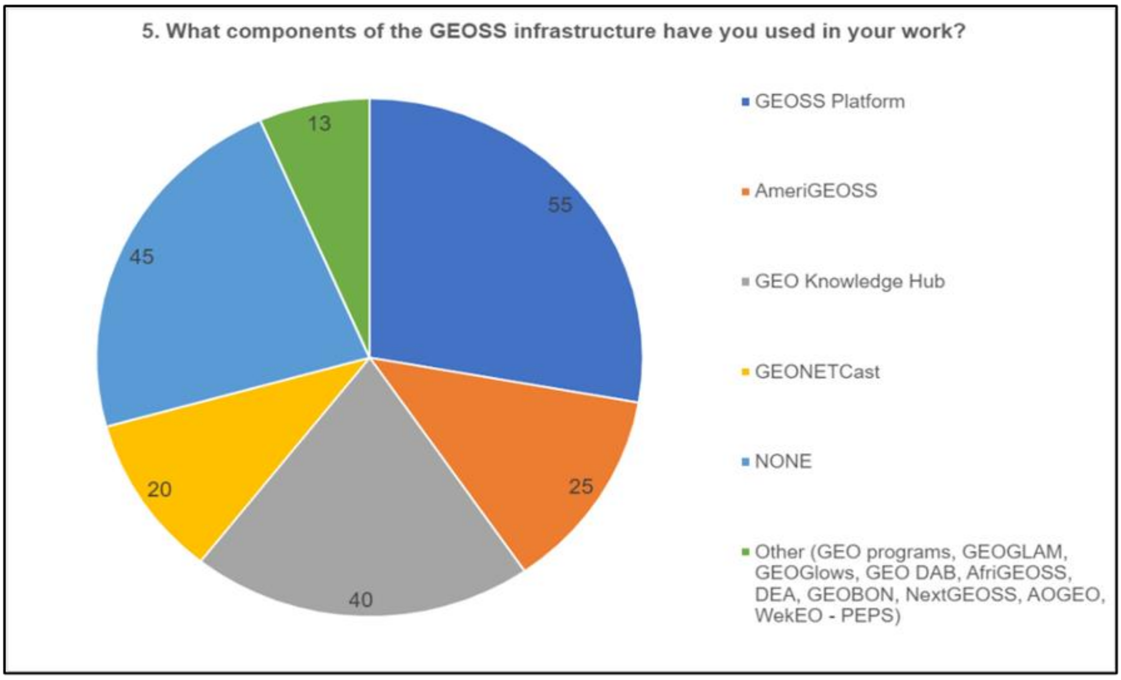

1. Where are you or your institution local - which continent?
19%
15%
6%
26%
18%
16%
Africa
Asia
Australia & Oceania
Europe
North America
South America

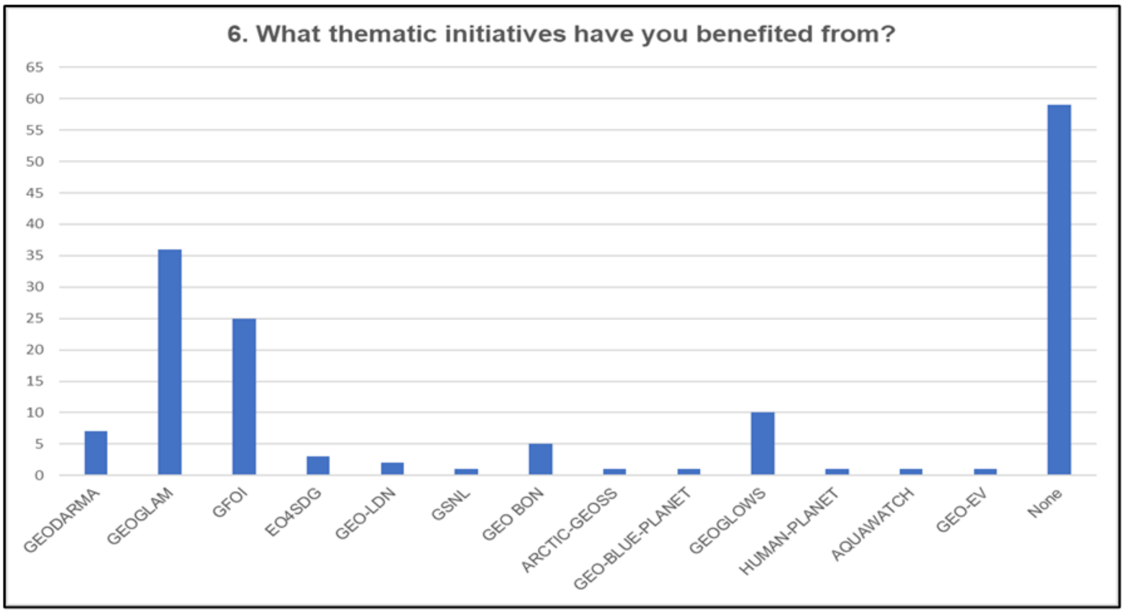

Countries per level of income
48%
33%
15%
3%
1%
High Income
Upper Middle Income
Lower Middle Income
Low Income
Not classified

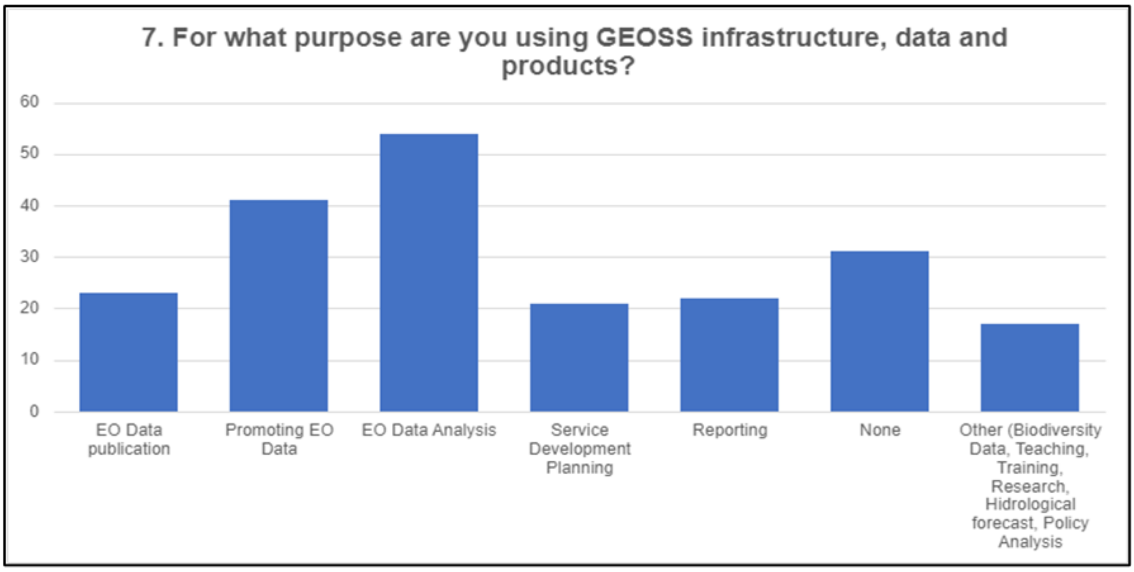

2. How do you describe you level of IT expertise?
46
30%
39
25%
19
12%
37
24%
13
9%
Competent
Expert
Beginner / Novice
Proficient
Blank

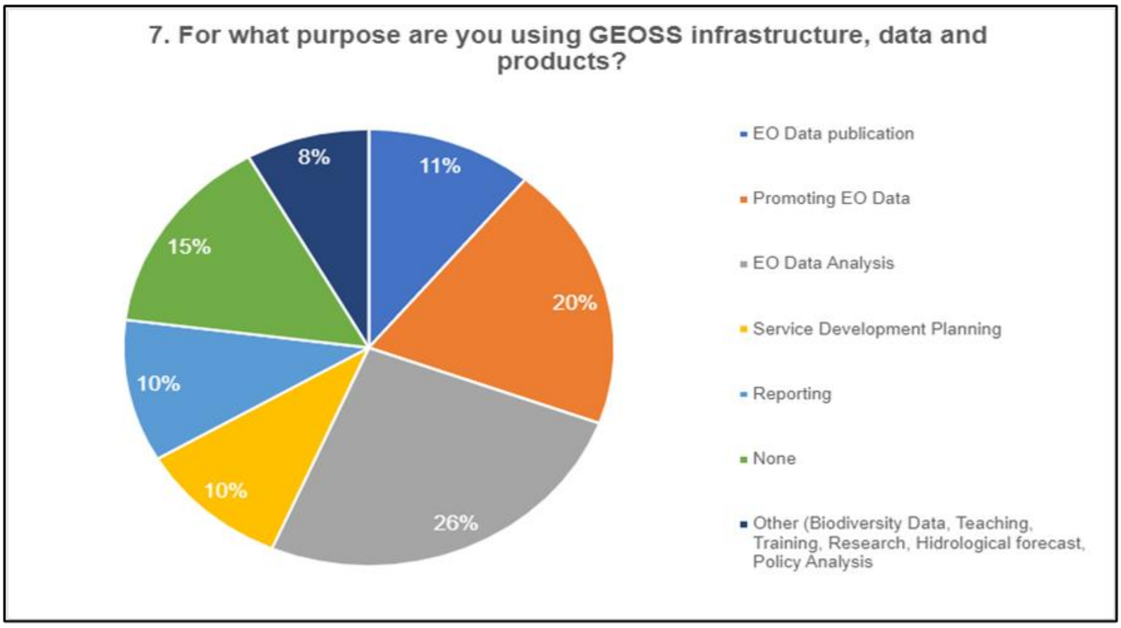

3. What sector do you work in?
31%
30%
17%
10%
6%
6%
Public Sector
Research
Academia (Teaching)
Private Sector
NGO
Other

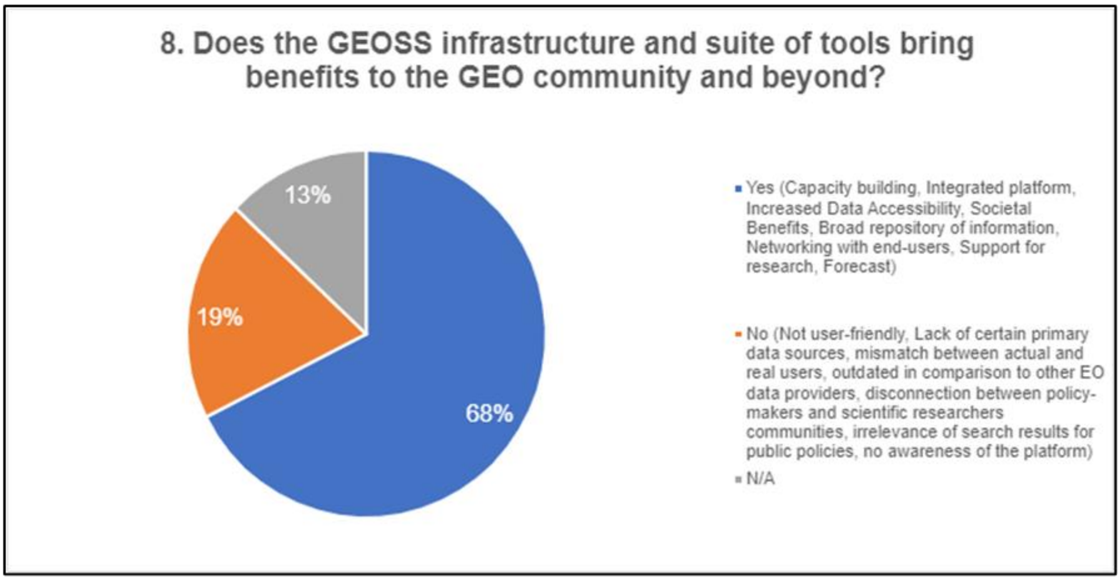

4. What user community do you primarily represent?
6%
12%
2%
27%
9%
15%
21%
8%
Developer
Implementer
Funder
Research
Academia
Decision maker/policy maker
Resource/data provider
Blank

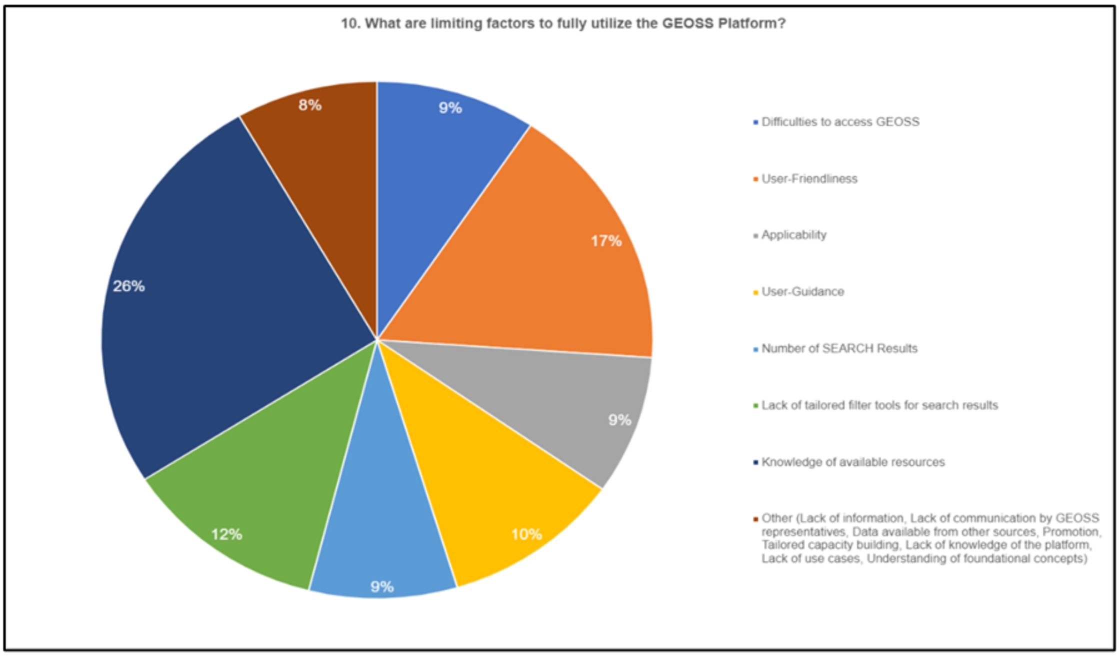

5. What components of the GEOSS infrastructure have you used in your work?
55
25
40
20
45
13
GEOSS Platform
AmeriGEOSS
GEO Knowledge Hub
GEONETCast
NONE
Other (GEO programs, GEOGLAM, GEOGlows, GEO DAB, AfriGEOSS, DEA, GEOBON, NextGEOSS, AOGEO, WekEO - PEPS)

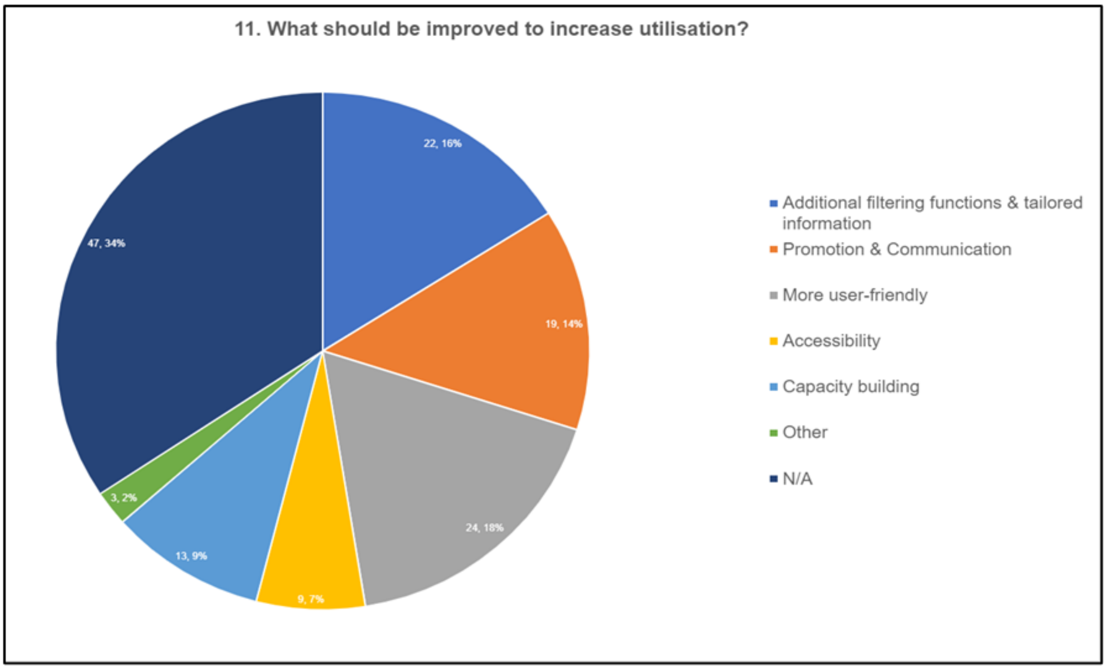

6. What thematic initiatives have you benefited from?
65
60
55
50
45
40
35
30
25
20
15
10
5
0
GEODARMA
GEOGLAM
GFOI
EO4SDG
GEO-LDN
GSNL
GEO BON
ARCTIC-GEOSS
GEO-BLUE-PLANET
GEOGLOWS
HUMAN-PLANET
AQUAWATCH
GEO-EV
None

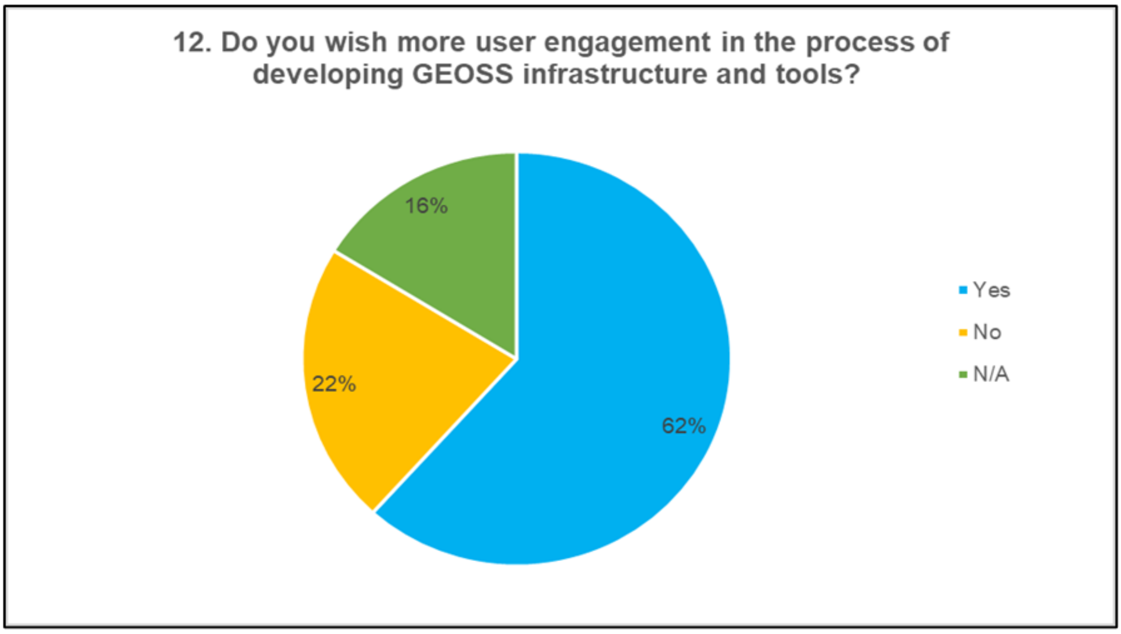

7. For what purpose are you using GEOSS infrastructure, data and products?
60
50
40
30
20
10
0
EO Data publication
Promoting EO Data
EO Data Analysis
Service Development Planning
Reporting
None
Other (Biodiversity Data, Teaching, Training, Research, Hidrological forecast, Policy Analysis

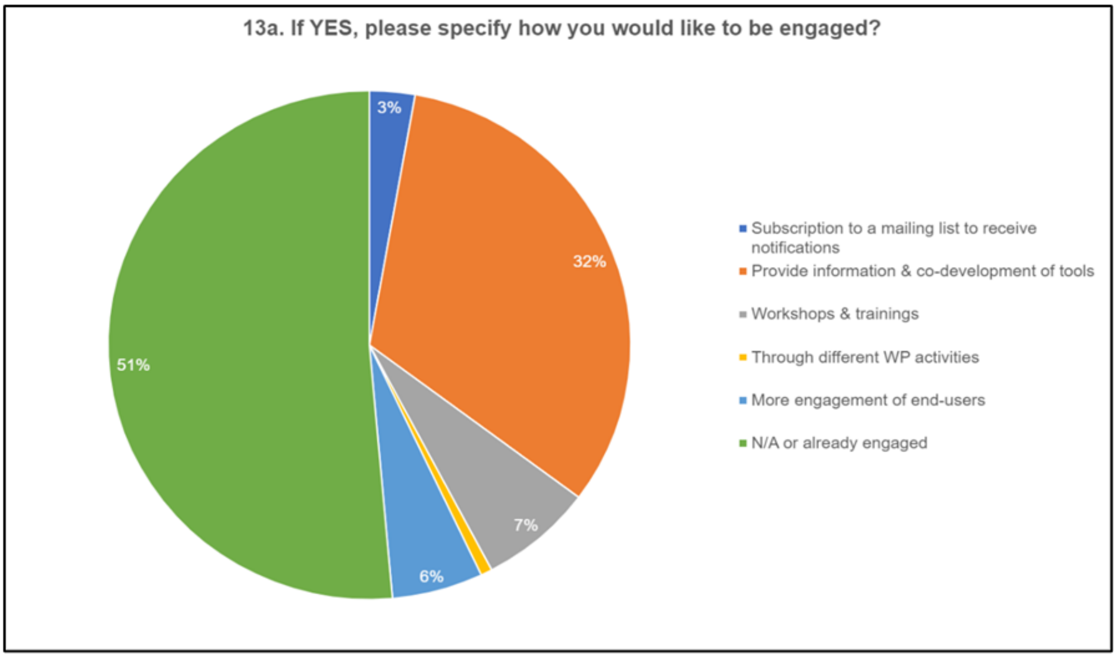

7. For what purpose are you using GEOSS infrastructure, data and products?
11%
20%
26%
10%
10%
15%
8%
EO Data publication
Promoting EO Data
EO Data Analysis
Service Development Planning
Reporting
None
Other (Biodiversity Data, Teaching, Training, Research, Hidrological forecast, Policy Analysis

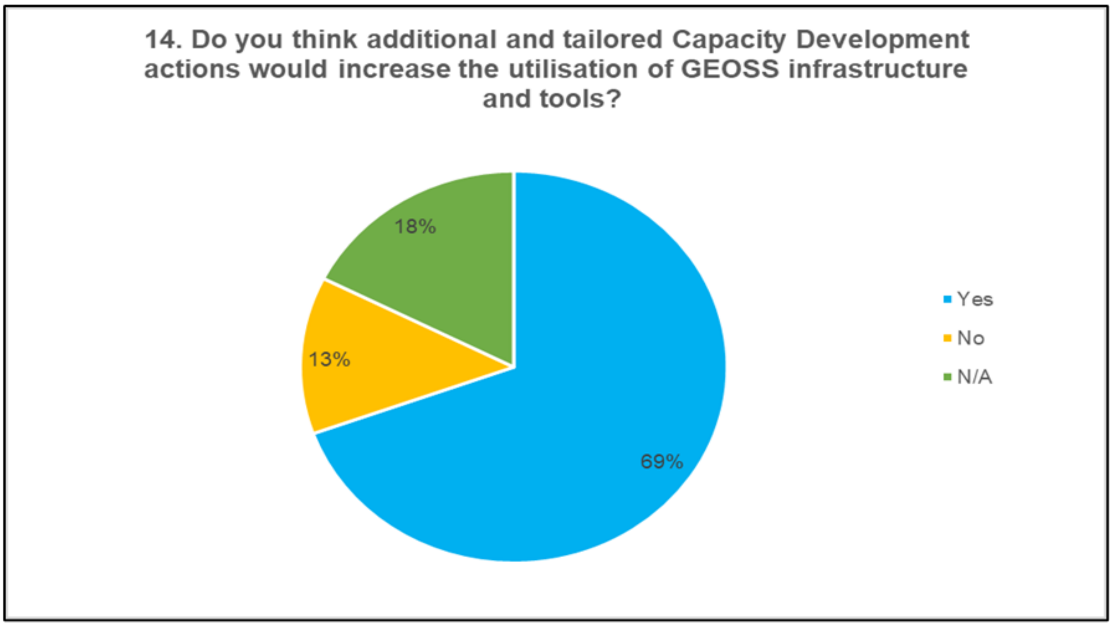

8. Does the GEOSS infrastructure and suite of tools bring benefits to the GEO community and beyond?
13%
19%
68%
Yes (Capacity building, Integrated platform, Increased Data Accessibility, Societal Benefits, Broad repository of information, Networking with end-users, Support for research, Forecast)
No (Not user-friendly, Lack of certain primary data sources, mismatch between actual and real users, outdated in comparison to other EO data providers, disconnection between policy-makers and scientific researchers communities, irrelevance of search results for public policies, no awareness of the platform)
N/A

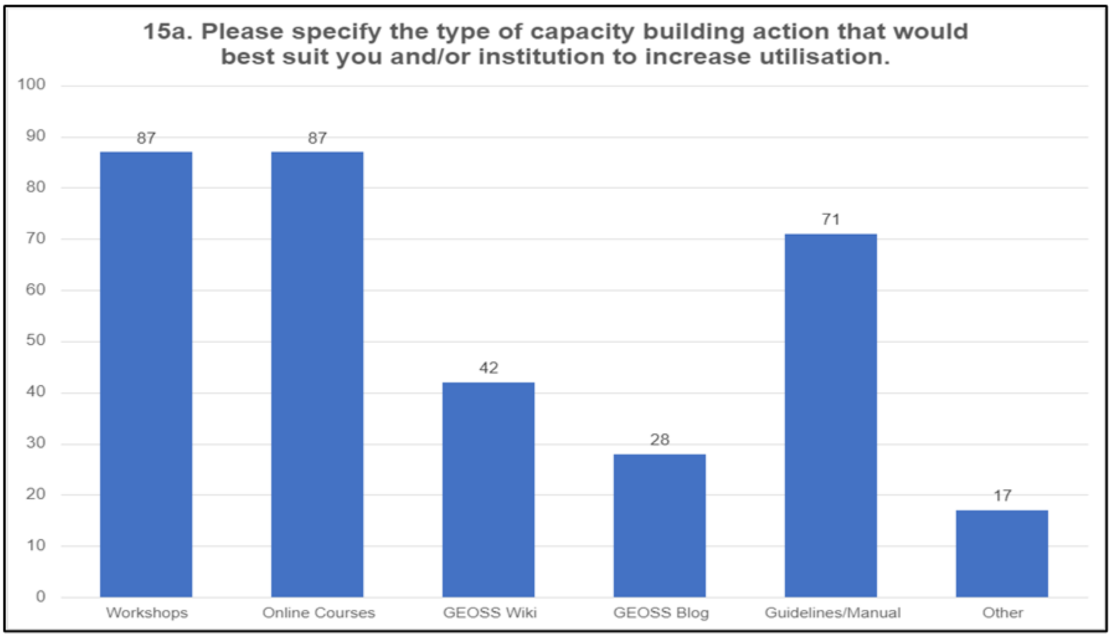

10. What are limiting factors to fully utilize the GEOSS Platform?
9%
17%
9%
10%
9%
12%
26%
8%
Difficulties to access GEOSS
User-Friendliness
Applicability
User-Guidance
Number of SEARCH Results
Lack of tailored filter tools for search results
Knowledge of available resources
Other (Lack of information, Lack of communication by GEOSS representatives, Data available from other sources, Promotion, Tailored capacity building, Lack of knowledge of the platform, Lack of use cases, Understanding of foundational concepts)

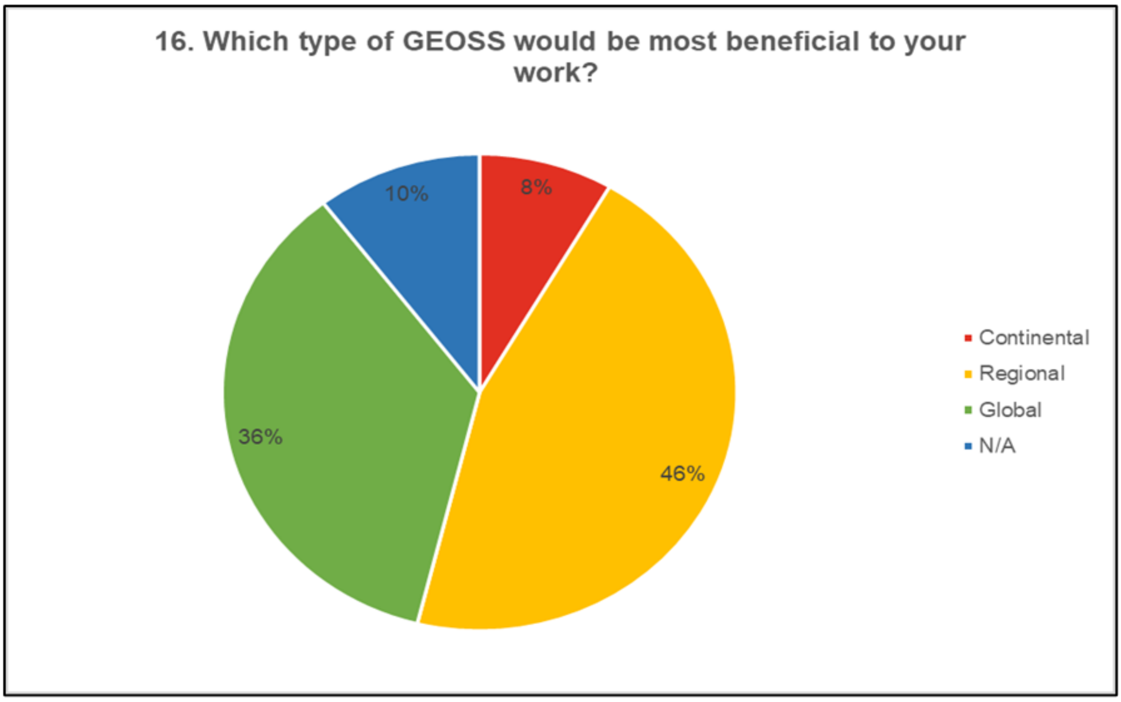

11. What should be improved to increase utilisation?
22, 16%
19, 14%
24, 18%
9, 7%
13, 9%
3, 2%
47, 34%
Additional filtering functions & tailored information
Promotion & Communication
More user-friendly
Accessibility
Capacity building
Other
N/A

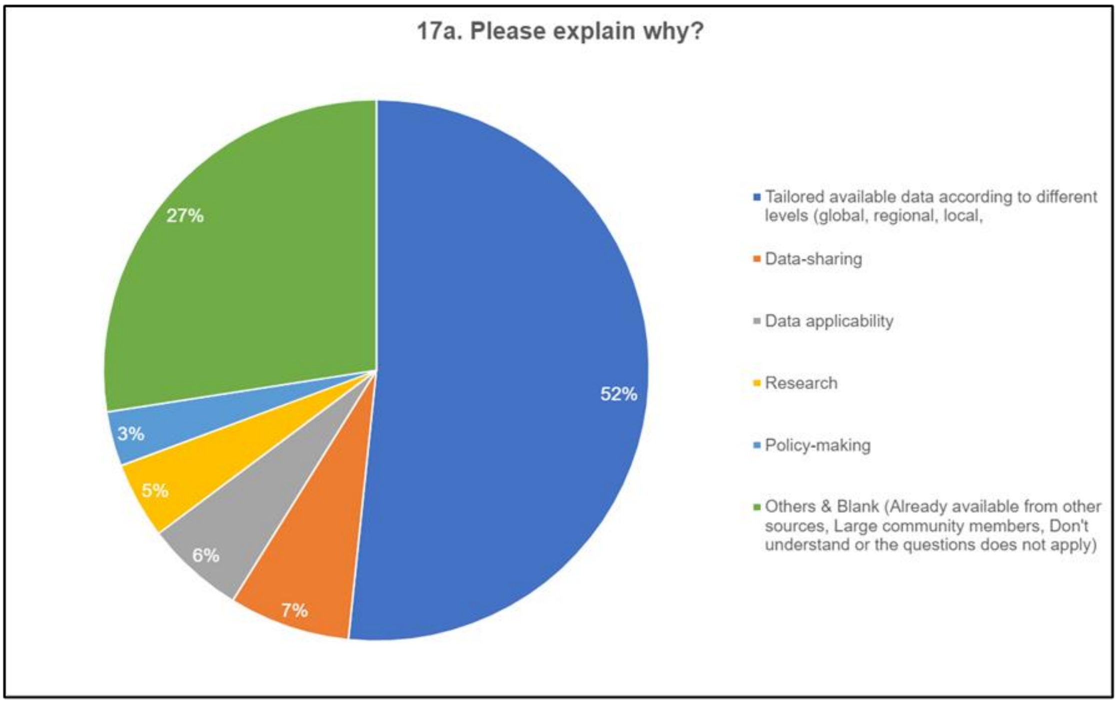

12. Do you wish more user engagement in the process of developing GEOSS infrastructure and tools?
16%
22%
62%
Yes
No
N/A

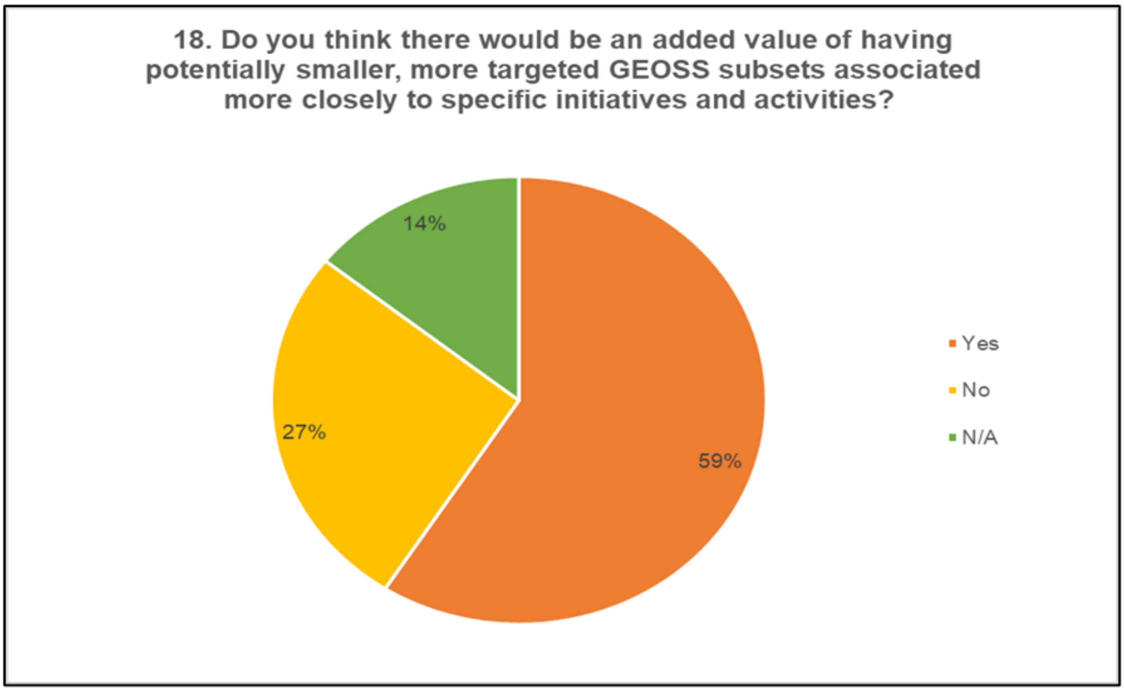

13a. If YES, please specify how you would like to be engaged?
3%
32%
7%
6%
51%
Subscription to a mailing list to receive notifications
Provide information & co-development of tools
Workshops & trainings
Through different WP activities
More engagement of end-users
N/A or already engaged

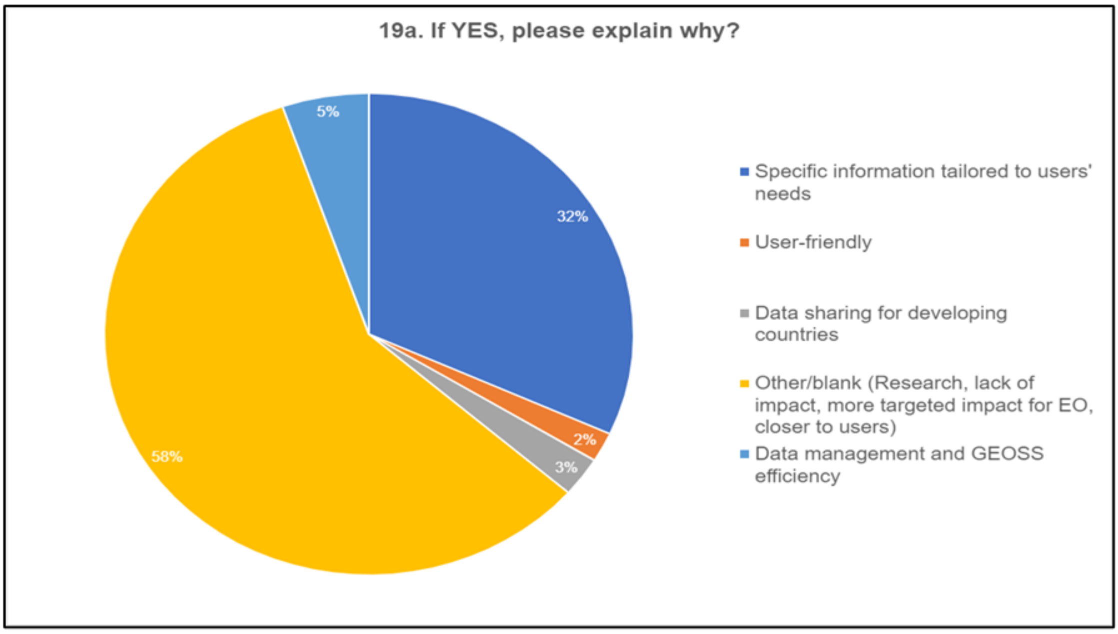

14. Do you think additional and tailored Capacity Development actions would increase the utilisation of GEOSS infrastructure and tools?
18%
13%
69%
Yes
No
N/A

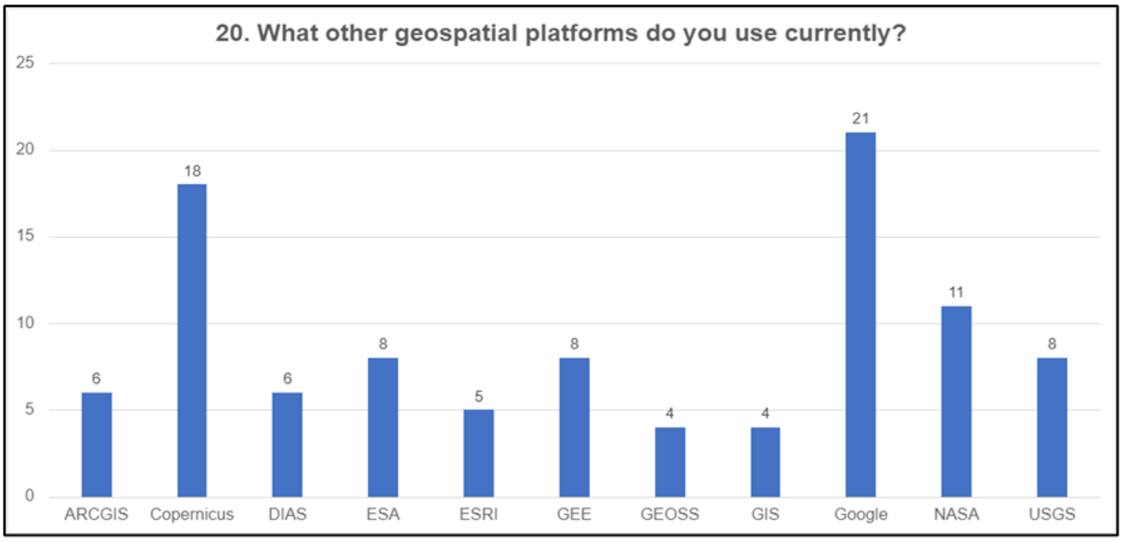

15a. Please specify the type of capacity building action that would best suit you and/or institution to increase utilisation.
100
90
80
70
60
50
40
30
20
10
0
87
87
42
28
71
17
Workshops
Online Courses
GEOSS Wiki
GEOSS Blog
Guidelines/Manual
Other

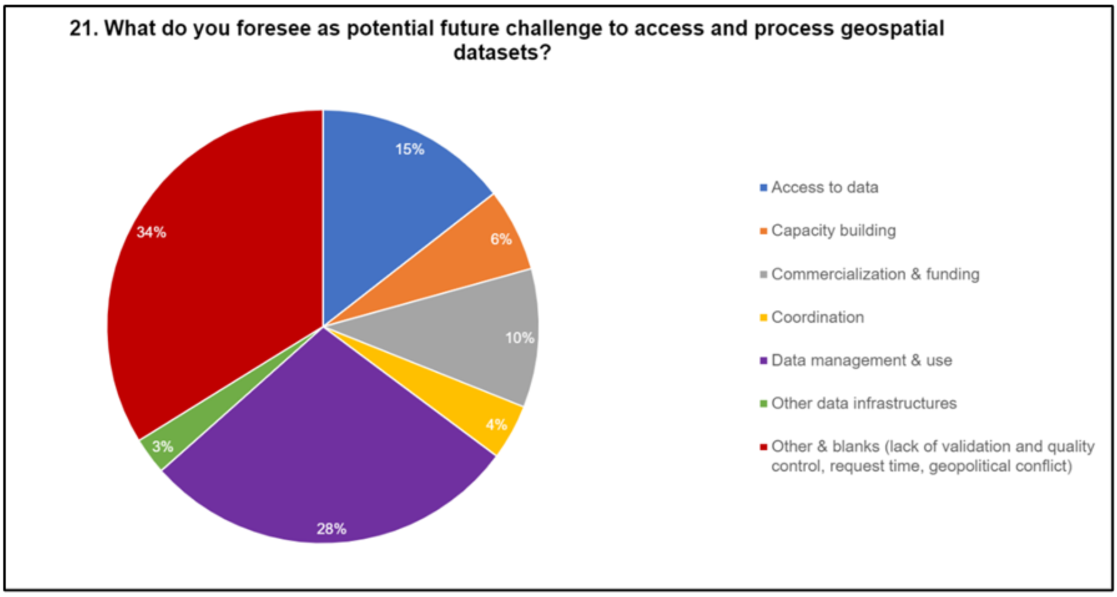

16. Which type of GEOSS would be most beneficial to your work?
8%
46%
36%
10%
Continental
Regional
Global
N/A

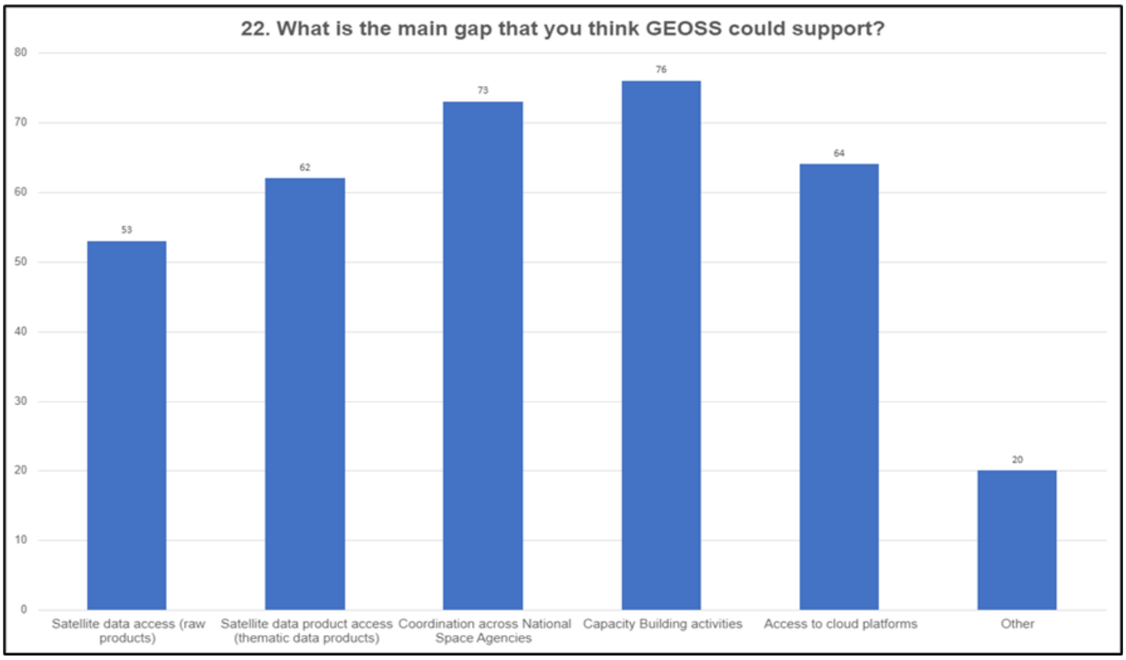

17a. Please explain why?
52%
7%
6%
5%
3%
27%
Tailored available data according to different levels (global, regional, local,
Data-sharing
Data applicability
Research
Policy-making
Others & Blank (Already available from other sources, Large community members, Don't understand or the questions does not apply)


18. Do you think there would be an added value of having potentially smaller, more targeted GEOSS subsets associated more closely to specific initiatives and activities?
14%
27%
59%
Yes
No
N/A


19a. If YES, please explain why?
5%
32%
2%
3%
58%
Specific information tailored to users' needs
User-friendly
Data sharing for developing countries
Other/blank (Research, lack of impact, more targeted impact for EO, closer to users)
Data management and GEOSS efficiency


20. What other geospatial platforms do you use currently?
25
20
15
10
5
0
6
18
6
8
5
8
4
4
21
11
8
ARCGIS
Copernicus
DIAS
ESA
ESRI
GEE
GEOSS
GIS
Google
NASA
USGS


21. What do you foresee as potential future challenge to access and process geospatial datasets?
15%
6%
10%
4%
28%
3%
34%
Access to data
Capacity building
Commercialization & funding
Coordination
Data management & use
Other data infrastructures
Other & blanks (lack of validation and quality control, request time, geopolitical conflict)


22. What is the main gap that you think GEOSS could support?
80
70
60
50
40
30
20
10
0
53
62
73
76
64
20
Satellite data access (raw products)
Satellite data product access (thematic data products)
Coordination across National Space Agencies
Capacity Building activities
Access to cloud platforms
Other

Annex IV
EAG Members

#	EAG Member	Affiliation	Country
1	Neil Sims (WG 1 Lead)	CSIRO	Australia
2	Africa Flores (WG 2 Lead)	SERVIR/NASA	USA
3	Gregory Giuliani (WG 1 Co-Lead)	University of Geneva	Switzerland
4	Tao Guo (WG 1 Co-Lead)	PIESAT	China
5	Mukosi Mukwevho (WG 1 Co-Lead)	SANSA (formerly)	South Africa
6	Carrie Stokes (WG 2 Co-Lead)	USAID	USA
7	Joe Flasher (WG 2 Co-Lead)	Amazon	USA
8	Jorge Arturo Cabrera Hidalgo (WG 2 Co-Lead)	SICA	San Salvador
9	Hamed Alemohammad	Radiant Earth	USA
10	Olivia Jimena Juárez Carrillo	INEGI	Mexico
11	Laura David	University of the Philippines	Philippines
12	Trevor Dhu	Microsoft	Australia
13	Marwa Elkabbany	Federal Competitiveness and Statistics Centre (UAE)	UAE
14	Benhamouda Fethi	Algerian Space Agency	Algeria
15	Dilek Fraisl	IIASA	Austria
16	Josep Soler Garrido	EC	Belgium
17	Chris Holmes	Planet VP /OGC Fellow (Associate/PO)	USA
18	Ronald Jansen	UN Statistics Division	USA

#	**EAG Member**	**Affiliation**	**Country**
19	Katrin Molch	DLR	Germany
20	Esther Onyekachi Ogbu	GEO Luminous	UK
21	Gilberto Queiroz	INPE	Brazil
22	Mandira Shrestha	ICIMOD	Nepal
23	Fred Stolle	World Resource Institute	USA
24	Julia Wagemann	independent	Germany
25	Anastasia Wahome	RCMRD	Kenya
26	Lan Wu	Chinese Academy of Surveying and Mapping (MNR)	China
27	Joerg Helmschrot (EAG Coordinator)	GEOCG	Namibia