GEO Infrastructure Implementation Plan

Revised GEO Infrastructure demonstration (GIDTT – October 2025)

This document is submitted to Plenary for decision, following its presentation to the Executive Committee at its 68th session in March 2026.

In support of the discussion and decision by the Plenary, a demonstration of the revised GEO Infrastructure will be presented, showcasing several of the proposed features outlined in the document that have already been implemented and are operational. This demonstration, developed by the GIDTT, illustrates the technical feasibility of the proposed infrastructure. Together, the document and the demonstration provide the basis for the Plenary to consider approval and operationalization of the revised GEO Infrastructure.

1 INTRODUCTION

The Post 2025 Strategy highlights "There is a clear need for a global partnership where data providers and users from all communities work together, leading to better coordination, greater inclusion, reduced duplication, and faster action" and "Building on the achievements of the past 10 years, GEO reaffirms its commitment to full and open access to Earth observation data, knowledge, products and services. GEO also reaffirms its commitment to promote data and knowledge sharing and the co-development of services that empower users to make sound environmental decisions, enable economic opportunities and promote good governance".

The GEO Infrastructure plays a pivotal role in advancing the Post 2025 Strategy, GEO's role within the international community and demonstrates the importance and impact that Earth Observations have in the decision-making process. It is in this framework that the GEO Infrastructure Development Task Team (GIDTT) is working to design a User-friendly, impactful and sustainable GEO Infrastructure that supports the Post 2025 Strategy objective "Earth Intelligence for All".

In April 2024 the GIDTT presented the 1st milestone document "Technical assessment of the GEO Infrastructure"

In April 2025 the GIDTT addressed the 2nd Milestone of the GEO Infrastructure Development Task Team, focusing on the GEO Infrastructure architecture and the identification of the requirements (governance, institutional, and financial). ExCom65-11_GIDTT 2nd Deliverable.pdf

In October 2025, the GIDTT addressed the 3rd Milestone of the GEO Infrastructure Development Task Team, presenting the Implementation Plan of the GEO Infrastructure aligned with the decision endorsed by the Executive Committee (ExCom) at its 65th session. The 3rd deliverable outlined the vision, technical architecture, governance, financial requirements to operationalize a user-centric, modular, and sustainable GEO Infrastructure in support of the Post-2025 Strategy objective "Earth Intelligence for All".

#	Document	Due date
1	Technical assessment of the architecture proposed by GEO Secretariat and GIDTT ExCom63-08_GIDTT_Technical_Assessment_of_the_GEO Infrastructure.pdf	Executive Committee - April 2024 **Completed**
2	Finalize the GEO Infrastructure Architecture & Identification of requirements (institutional, financial and governance) needed to implement the architecture ExCom65-11_GIDTT 2nd Deliverable.pdf	Executive Committee - April 2025 **Completed**
3	Evolved GEO Infrastructure Implementation Plan	November 2025 **Completed**
4	Demonstration and start of GEO Infrastructure operations	GEO Plenary – May 2026 **Expected**

2 VISION AND STRATEGIC OBJECTIVES

Over the past 20 years, GEO has been greatly advocating and advancing the Earth Observations Data Sharing, achieving great results in the Space-based data ecosystem as well in the advancement of the Open Knowledge (Data, software, algorithms, training materials). Some important efforts are still required for the in-situ data sharing.

Through the phase of re-designing the GEO infrastructure; GEO has the opportunity to not only continue the advocacy for data sharing, but to upscale data reusability adding knowledge sharing, and organize the EO data and knowledge with a domain-specific and geographical focus and therefore better support users in the discovery and accessing of resources for their specific issues. Doing so, GEO endorses the global shift from a data-centric to a user-centric paradigm.

The additional value of the GEO Infrastructure is representing a trusted, curated neutral, and inclusive platform that provides all the GEO Community with long-term EO data and

EO Knowledge preservation support, which, in a context of global change with long-term impacts, are part of humanity's heritage.

The GEO Infrastructure will be implemented to be:

- A **user-centric**, **sustainable** digital environment;
- A **trusted one-stop-shop** for discovering, accessing, and reusing community shared curated EO data and knowledge;
- **Harmonize access** of space-based, in-situ, and EO-derived data;
- **Inclusivity**: Empower all GEO Members, particularly under-resourced nations, through capacity building, open-source tools, and support for data sovereignty;
- **Discoverability and Usability**: Enable seamless discovery of EO resources across thematic areas via a 5W-driven interface and natural language interface;
- **Sustainability and Governance**: under expert domain governance, data stewardship, and long-term sustainable operational models;
- **Integration**: Fully integrate GEOSS Platform resources and GEO Knowledge Hub to eliminate fragmentation.

3 WHICH EO RESOURCES WILL BE MADE AVAILABLE THROUGH THE GEO INFRASTRUCTURE?

3.1 Satellite data and Data cubes

- Free and Open Satellite Data: Sentinels (-1 to –6), the Landsat collection, and others;
- Free Satellite Data subject to licensing;
- Commercial Satellite Data: e.g., Very High Resolution (VHR) satellite imagery for applications requiring detailed spatial data;
- Space-based resources from the Committee on Earth Observation Satellites (CEOS) community: MIM;
- Other international Space based databases such as GEOSATDB;
- Data cubes: e.g., Swiss Data Cube, Australian Data Cube, Brazil Data Cube, Dutch Data Cube, and others offering CEOS Analysis-Ready Data;
- Copernicus Data Space Ecosystem and similar platforms, providing access to data and computational resources to produce EO Applications;
- Other EO Portals and various Digital Earth Platforms;
- Cloud providers offering space-based catalog.

3.2 In-situ data

- In-situ data from various thematic domains and different geographical dimensions (international, regional, and national) with multiple formats, such as

NetCDF, CSV, and others, along with comprehensive metadata and provenance information;

- The GEO Infrastructure will support hosting in-situ data and provide information about suitable thematic repositories for those lacking secure storage (e.g., due to limited funding or completed projects). Edge cases with no other storage options will be hosted directly within the GEO Infrastructure to prevent data loss as indicated in the in-situ data strategy (GEO In situ data strategy presented to ExCom in October 2025);
- GEO Community tools will also be used to support the management of In-Situ data, including G-reqs for capture gaps and requirements and libinsitu to transform In-situ data to well-formatted binary NetCDF files: Open-source python library (libinsitu) available in the GEO Knowledge Hub to transform heterogeneous time series measurements into well-formed binary NetCDF files, compliant with CF convention. This library addresses the challenge of in-situ encoding heterogeneity, making them more reusable;
- Support in-situ data collected from both uncrewed aerial vehicles (UAVs) and crewed vehicles;
- Socio-economic data will be also considered as a new source to complement Earth intelligence is crucial for gaining a comprehensive understanding of socio-environmental phenomena. While Earth observation data provides valuable insights into physical and environmental changes, it often lacks context about human activities, vulnerabilities, and behaviors. Socio-economic data—such as income levels, education, population density, and access to resources—helps bridge this gap by revealing how communities are affected by and respond to environmental changes. Integrating these data sources supports more informed decision-making, equitable policy development, and effective responses to global challenges like climate change, urbanization, and resource management.

3.3 Executable Notebooks

- Jupyter Notebooks and RMarkdown: Interactive computational notebooks from multiple sources, including GitHub, GitLab, Google Colab, Kaggle, and others;
- Also, notebooks from training courses / platforms using Interactive notebooks, like the ones available in Eumetsat Training Hub Portal.

3.4 Services

- Reference to available services to access, process, and explore EO resources like STAC, FAO WaPOR, etc.

3.5 EO Derived and Statistical data

- EO Derived data from the GEO Work Programme Activities and other initiatives (e.g., Weather forecasts, Costal Classification, Land Use and Land Cover maps, Crop Type maps, Infrastructure Maps, and others).

3.6 Applications

- Complete Knowledge Packages providing EO-based applications created by the GEO Community and beyond.

3.7 Integration with other Knowledge Hubs

- KCEO;
- UN Spider Knowledge Hub;
- Earth Code - ESA;
- Others.

4 HOW WILL THE GEO INFRASTRUCTURE MAKE AVAILABLE ALL EO RESOURCES?

The GEO Infrastructure will make Earth Observation (EO) data and knowledge resources discoverable and accessible by creating and registering curated knowledge resources and knowledge packages in close collaboration with authoritative data and knowledge providers.

These knowledge resources and knowledge packages will combine EO data with detailed descriptions, contextual information, and guidance on how to use and understand the data. All resources are registered and organized using enhanced ontologies built around GEO's focus areas, essential variables, engagement priorities, and key international conventions.

As example to further simplify discovery of space-based data, the GEO Infrastructure also uses controlled vocabularies and thesauri from sources such as CEOS and GEOSATDB and other sources like Essential Variables (ECVs from GCOS) and other sources.

This structured approach allows users to search, discover, and access EO data and knowledge from multiple providers based on recognized, clear, meaningful categories and themes.

Each knowledge package provides a full description, helping users understand its content, relevance, and how to apply it effectively in their specific area of interest. This ensures that both technical and non-technical users can more easily find and use EO data for informed decision-making and research.

The evolution of the GEO Infrastructure reflects a transition from a large and complex system to a more reliable, user-focused, and pragmatic environment. Following the recommendations of the GIDTT and the decision of the Executive Committee (ExCom), the GEO Knowledge Hub (GKH) has been identified as the main entry point for users to access Earth Observation data, knowledge, and related resources from the GEO Community. By positioning the GKH as the central interface, the new infrastructure will be able to deliver a consolidated and coherent user experience, while integrating content from different sources and ensuring completeness and long-term sustainability.

To guide the evolution of the GEO Infrastructure, with the GEO Knowledge Hub positioned as its main component, the GIDTT has defined three principles that will shape all decisions in this document:

User first: design decisions will prioritize usability and clarity, ensuring that the infrastructure serves the real needs of technical and non-technical users.

Simple: instead of over-engineering interfaces or metadata structures, the focus will be on straightforward mechanisms that make access, discovery, and reuse easier, developed in close interaction with the GEO Community.

Pragmatism: While these principles provide direction, decisions must be made on a case-by-case basis, balancing resources, feasibility, and consensus within the community.

5 HOW WILL THE EO RESOURCES BE ORGANIZED?

The GEO Community produces a lot of data and knowledge resources covering multiple topics.

In the new GEO Work Programme Post 2025, these resources are revised into six focus areas (Figure 1):

1. Agriculture and Food Security;
2. Water and Land Sustainability;
3. Ecosystems-Biodiversity and Carbon Management;
4. Weather and Disaster Resilience;
5. Climate, Energy, and Urbanization;
6. One Health.

The organization of the EO resources from the GEO Community, GEO Members, GEO Work Programme Activities, GEO Participating Organizations, and GEO Associates in the GEO Infrastructure will be based on these focus areas. Resources will be linked to one or more focus areas, depending on the theme or activity from which they originated .

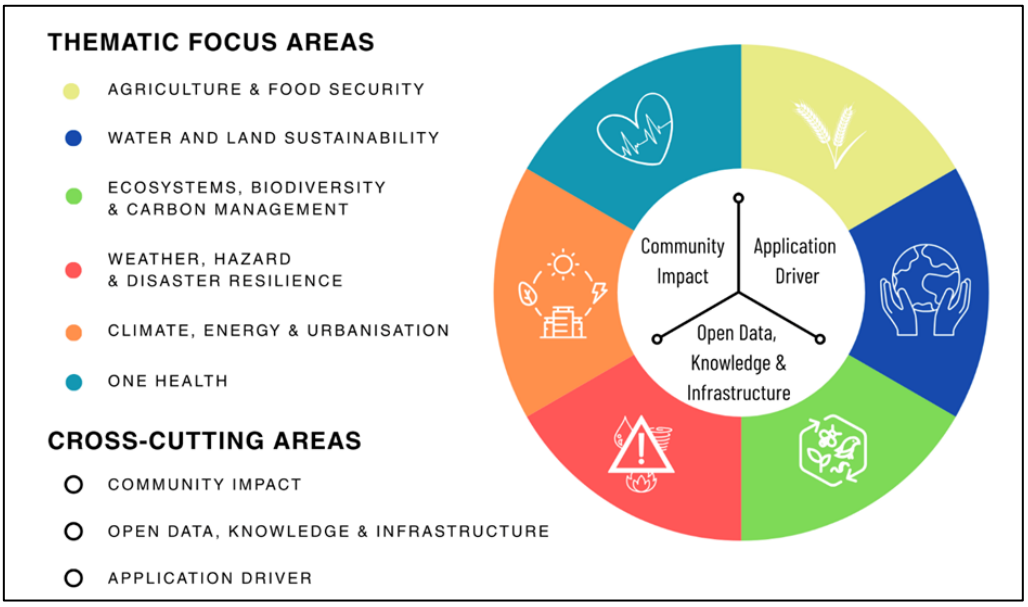


Figure 1. Post-2025 GEO Work Programme Focus Areas

5.1 Focus areas

Focus areas will represent the entry point for the GEO Infrastructure user interface, through which the user will be able to discover and access more easily the required EO resources, guided by the 5W approach through simple, intuitive questions, such as:

- **W**HY: What is the problem you are trying to solve;
- **W**HO: What is your profile, technical or non-technical;
- **W**HERE: Where is the area of interest;
- **W**HEN: Timeframe of the EO Resources required;
- **W**HAT: Which resources are you looking for.

The figure below (Figure 2) illustrates this 5W approach and how users can interact with the GEO Infrastructure to access tailored resources and best fit for use to their needs. It begins with identifying the problem to be solved (WHY), then resources suitable for technical and non-technical users (WHO) will be provided.

Users will then be able to explore resources based on location (WHERE) and time (WHEN) and access various tools and data (WHAT), including satellite data, in-situ measurements, services, tools, and EO-derived products. Applications such as Knowledge Packages and other knowledge solutions will also be available, making it easier for all users to address their specific challenges effectively.

5.2 Essential Variables

Essential Variables will also be another entry point for the GEO Infrastructure user to discover data and knowledge EVs are known to be critical for observing and monitoring a given facet of the Earth system.

Their inclusions within the GEO Infrastructure will harmonize data and Knowledge discoverability and access with organizations who are the leading entities for each of the EVs such as Climate (GCOS), Ocean (GOOS), Biodiversity (GEO BON), Geodiversity, Agriculture (GEOGLAM).

5.3 Engagement priorities and main conventions

Engagement priorities and main conventions will also be considered an entry point for the GEO Infrastructure allowing the user to discover data and knowledge via the such as New Urban Agenda, Paris Agreement; SDGs, Sendai Framework for DRR

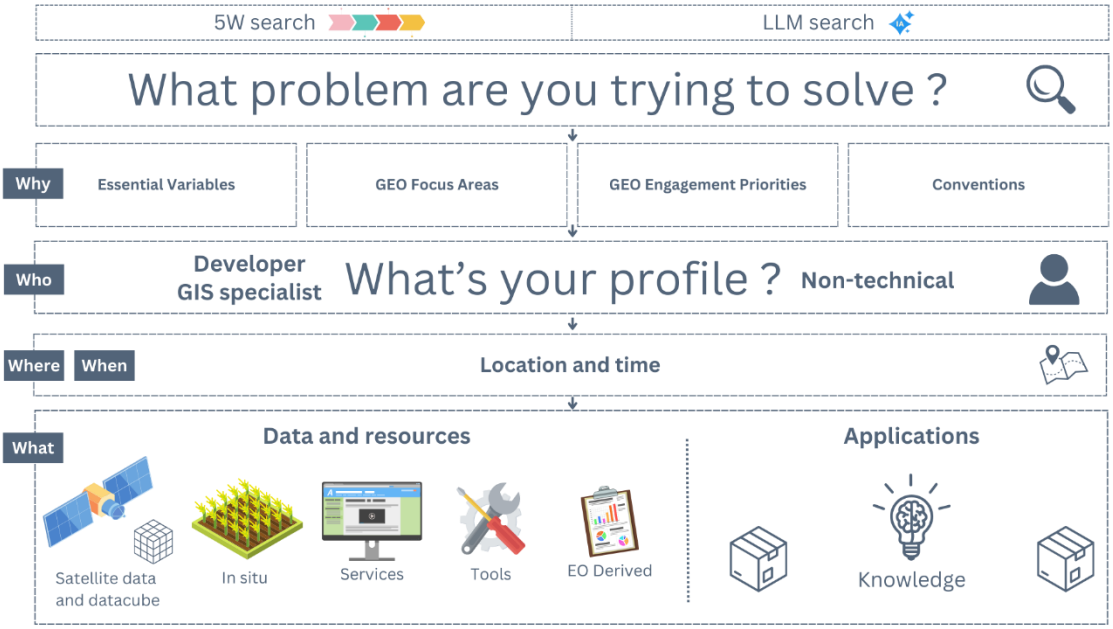


Fig. 2

On top of the 5W approach, the GEO Infrastructure will also integrate a Large Language Model (LLM), allowing users to interact with the system in natural language. This will enable intuitive, conversational access to the available content, simplifying discovery and making the infrastructure more inclusive.

To support the effective implementation of the GEO infrastructure, it is essential to ensure that all Earth Observation (EO) resources organized in knowledge resources and knowledge packages are described using a controlled vocabulary structured by thematic, spatial, and typological dimensions.

This structured annotation, combined with the inclusion of essential metadata, enables data and knowledge providers to contribute in a standardized manner. Such an approach not only facilitates discovery, access, and reuse of EO data but also reinforces adherence to the FAIR (Findable, Accessible, Interoperable, Reusable) principles and the GEO data management guidelines. The success of this infrastructure will ultimately rely on the commitment of data and knowledge providers to align with these governance frameworks, ensuring that data assets are shared in a consistent, high-quality, and semantically enriched format that supports broader scientific, policy, and operational applications.

Controlled and enhanced vocabularies, along with well-curated Earth Observation (EO) data and knowledge, form a critical foundation for the effective use of Large Language Models (LLMs) and AI in geospatial analysis and decision-making. By standardizing the terminology and classification of EO resources—across thematic (e.g., land use, climate), spatial (e.g., regional, global), and typological (e.g., satellite imagery, sensor data) dimensions - data becomes machine-readable and semantically coherent. This consistency is vital for training LLMs and AI systems, which rely on structured, high-quality data to learn accurate representations, identify patterns, and generate reliable insights.

When EO data is annotated with rich, standardized metadata and aligned with FAIR and GEO DMPs principles, it ensures not only accessibility but also interoperability across diverse platforms and applications.

5.4 Scenario Services

The list of example resources presented in the previous section shows the variety of content available in the modernized GEO Infrastructure that goes beyond data to make data more reusable, adding technology and science in a more user-FAIR approach.

The first step in organizing those resources is to map them against the new GEO Post 2025 focus areas and other categories such as EVs and Engagement priorities

Then, to facilitate its usage, these resources will be integrated into "scenario-services", which act as a cohesive framework that addresses specific real-world scenarios by combining multiple resources, providing actionable data and knowledge. This definition is a generalization of the one presented in the GEO Post 2025 documents for services, which specify: "Co-design user-oriented services by identifying policy and decision-making needs, designing the services needed to support these needs, creating the products to enable the services, and identifying affordable and trusted Earth observation components — from across the value chain — required to sustain these products. Integrate Earth observations, models, and innovative new technologies (including artificial intelligence, machine learning, digital twins, cloud computing) into the design of services that provide Earth intelligence." In this context, "scenario-services" are practical implementations of this strategy. For example, a "scenario-service" like "Crop type mapping" will combine satellite imagery, Machine Learning / Deep Learning models (ML/DL), methodologies (e.g., time-series analysis), training materials, and other resources, shared by the community, to fulfilling specific needs of agricultural policymakers or practitioners. These services are the "glue" that binds resources into reusable, scalable solutions, integrating EO Data and Knowledge, models, and advanced technologies to deliver actionable Earth intelligence. This approach ensures that the resources are well-organized and capable of addressing policy and decision-making challenges effectively and sustainably.

The implementation of the scenario services such as e.g. How to do a crop type mapping is a “knowledge package” that will be enhanced by the Natural language search capability, and this will be possible as the content will be structured with enhanced curated vocabulary.

- Co-designed with GEO Work Programme participants;
- Examples: Crop Type Mapping, Disaster Monitoring, Urban Growth Tracking;
- Includes integrated data, models, tools, training, and outputs.

6 TECHNICAL ARCHITECTURE

The GEO Community is built on a collaborative and voluntary basis. All activities rely on the participation of GEO Members, Participating Organizations, national GEOs, communities of practice, youth, and many other actors. This creates the right environment for collaboration, the development of new ideas, and approaches for accelerating the use of EO to respond to global and local needs. The GEO Infrastructure will play a central role in supporting these activities by ensuring access to, and preservation of, the knowledge generated by the GEO community.

In the same spirit, the GEO Infrastructure itself will be developed based on collaboration and contributions from multiple members of the community. This creates a unique opportunity to build the infrastructure on top of existing ideas, resources, services, and tools from across the community. At the same time, it also creates a challenge: the system must remain available and operational even in cases where some modules, once provided by community members, are no longer maintained.

From this, three main governance requirements for the GEO Infrastructure can be defined:

1. It must allow all willing members to contribute to the operation and evolution of the GEO Community;
2. It must be resilient to changes in the availability of components, as some may become unavailable due to financial, political, or organizational reasons;
3. It must have long-term reliability of content and services.

To meet these requirements, GIDTT is proposing a modular GEO Infrastructure. This modular approach allows different members to contribute with new capabilities, metadata enrichment services, and other resources, while ensuring that the overall infrastructure remains functional and sustainable.

In this approach, the GEO Infrastructure will be organized around two types of modules:

1. Core modules, which represent the minimum set of elements that must always be available for the GEO Infrastructure to operate;
2. Auxiliary modules, which provide added value to the infrastructure but are not strictly required for it to function. These may be unavailable at times due to resource limitations or other circumstances.

Based on these definitions, the following existing modules have been identified as core modules:

- GEO Knowledge Hub (including User Interface, Marketplace and National GKHs features available on it);

- GEO DAB.

And as auxiliary modules:

- GEO Yellow Pages;
- CEOS MIM;
- GEOSatDB;
- Geant Authentication;
- GEONetCast;
- External AI tools.

Figure 3 illustrates how these modules will be connected. At the center is the user interface provided by the GEO Knowledge Hub. The GKH will allow users to search for content, knowledge providers topreserve knowledge, and build Knowledge Packages and Knowledge Resources. To do this, users can upload their content, import from other websites, as well as use the in-situ and EO-derived data available in the GEO DAB. To manage and keep track of both data providers and Knowledge Providers, the Yellow Pages will serve as an auxiliary module.

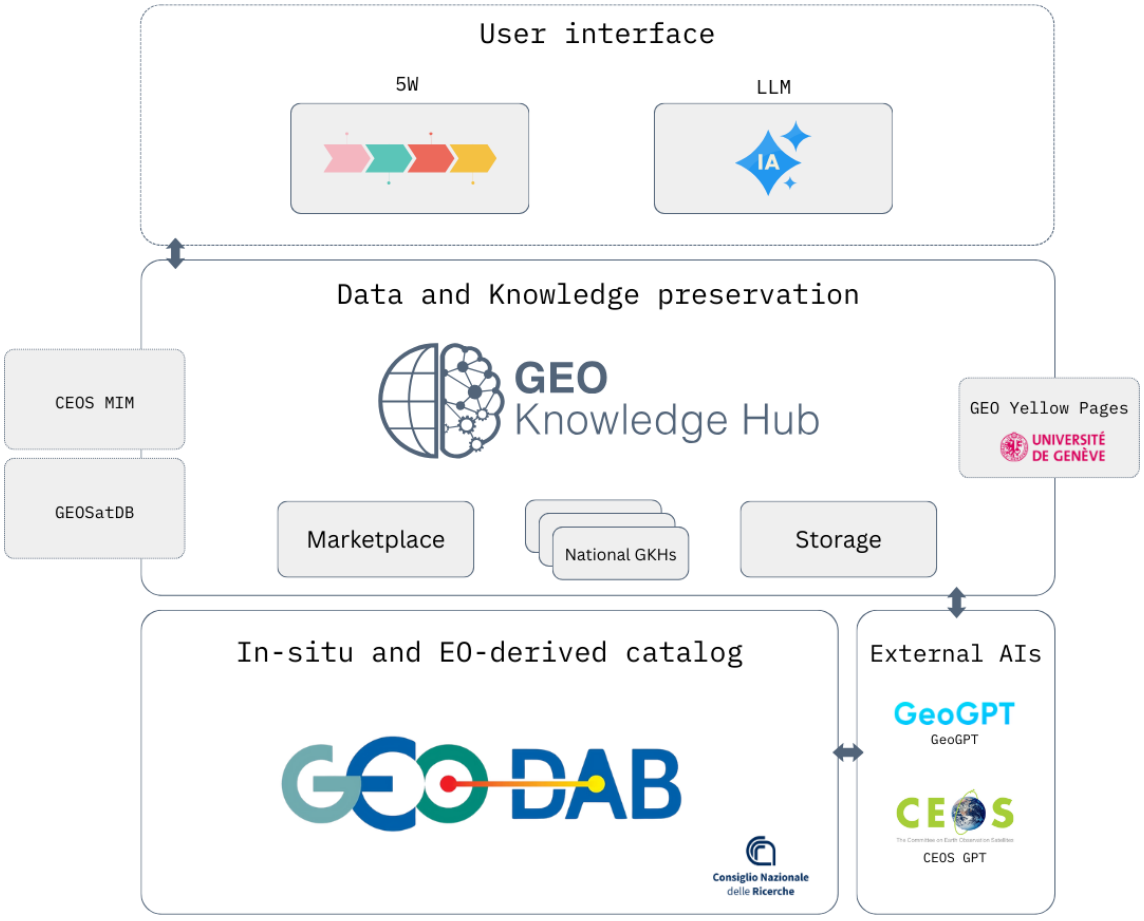


Fig. 3

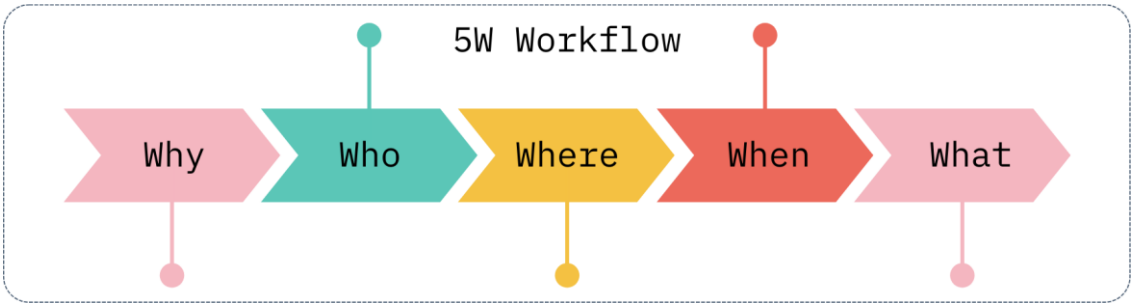
The section below describes each component in detail, followed by an explanation of how they will be integrated. The chapter concludes with a discussion of risk mitigation measures to ensure continuity and resilience of the GEO Infrastructure.

6.1 User Interface

The User Interface is part of the GEO Knowledge Hub and fully integrated with it. However, for the purposes of this document, it is presented as an individual module so that its responsibilities and expectations of the GIDTT are clearly described.

Role: Provided by the GEO Knowledge Hub, the User Interface is the main entry point where users interact with the GEO Infrastructure.

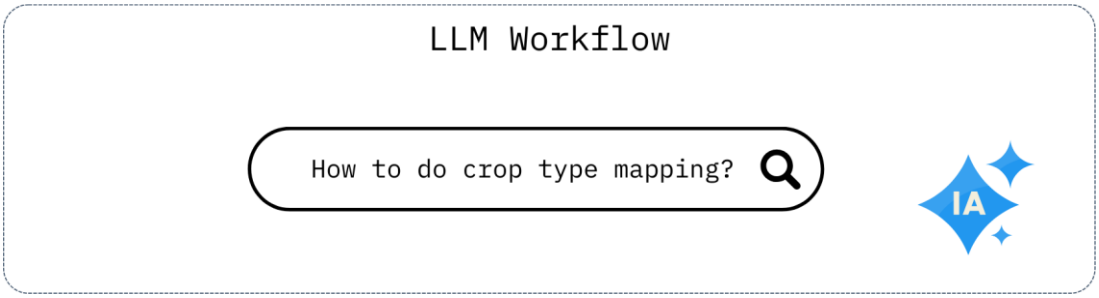
Solution description: The User Interface will offer two main workflows for exploring available content. The first is the 5W workflow, which guides users through a structured search by asking ***Who***, ***Why***, ***Where***, ***When***, and ***What***. This step-by-step approach is designed for more technical or advanced users who want to leverage the full capabilities of the GEO Knowledge Hub. It will allow filtering by GEO Focus Areas, geographic regions, or other metadata fields, enabling detailed and precise discovery.



The second workflow is based on a large language model (LLM). In this case, users can express their needs in natural language, for example:

- "*How to do crop type mapping?*"
- "*Applications developed with Sentinel-2*"
- "*What EO resources are available for land use monitoring in country X?*"

This approach is particularly designed for non-experts or beginners, making exploration more intuitive and lowering the barrier to accessing the data and knowledge available in the GEO Infrastructure.



6.2 GEO Knowledge Hub

Link: GEO Knowledge Hub

Type: Core component

Operated by: GEO Secretariat – GEO Knowledge Hub team

Role: The GEO Knowledge Hub (GKH) will provide search, access, and preservation capabilities for the data and knowledge available in the GEO Infrastructure. It will act as the digital library of the GEO Community, ensuring that content is stored, curated, and preserved for long-term use.

Solution description: The GKH is an existing component, developed on top of the InvenioRDM open-source software and tailored to meet the specific needs of the GEO Community.

The GKH will provide users with the ability to:

1. Access the high-level user interface, which combines two complementary approaches: the 5W workflow (Who, Why, Where, When, What), enabling structured and role-based discovery of resources, and the LLM-assisted workflow, allowing natural language interaction with the system;
2. Explore content available in the GEO Infrastructure;
3. Preserve data and knowledge as Knowledge Packages and Knowledge Resources;
4. Package Scenario-Services as Knowledge Packages.

6.3 GEO Knowledge Hub Marketplace

Type: Core component (part of the GEO Knowledge Hub)

Operated by: GEO Secretariat – GEO Knowledge Hub team

Role: The GKH Marketplace will serve as a dedicated module within the GEO Knowledge Hub to manage and publish content that is not fully open.

Solution description: This is an existing module of the GEO Knowledge Hub. It allows community members to publish restricted or not-fully open content in a dedicated space, facilitating collaboration of private-sector stakeholders and enabling cooperation between different types of actors from the GEO Community.

6.4 National GEO Knowledge Hubs

Type: Core Component of (Part of the GEO Knowledge Hub)

Operated by: GEO Secretariat – GEO Knowledge Hub team

Role: National GEO Knowledge Hubs extend the GEO Knowledge Hub to the country level, offering a single access point for EO data, tools, applications, and knowledge that

address national needs. They connect local capabilities (e.g., capacity building activities, services) with global GEO data and knowledge (e.g., knowledge packages) and improve coordination between government agencies, research institutions, and other stakeholders. These hubs provide a consistent way to access EO resources while allowing each country to focus on its specific priorities.

Solution description: National GEO Knowledge Hubs are scalable extensions of the main GEO Knowledge Hub that can be adapted for each country. They operate as specialized interfaces to the content already available in the GEO Knowledge Hub, meaning no duplication of data or knowledge is required. Instead, they filter and present the shared content in ways that match national contexts, while remaining fully integrated with the GEO Infrastructure and linked directly to the global GEO Knowledge Hub.

6.5 GEO Discovery and Access Broker (DAB)

Link: Home | geodab

Type: Core component

Operated by: CNR –IIA (Italy)

Role: The GEO DAB provides the brokering capability within the GEO Infrastructure. It enables users of the GKH to access distributed data and knowledge resources hosted on external platforms.

Solution description: The DAB is an existing component that will continue to serve as the bridge between the GKH and external data providers (in-situ and EO-derived). By brokering connections to multiple repositories and catalogues, the DAB will allow users to create Knowledge Packages and Knowledge Resources using content sourced from outside the GEO Infrastructure.

6.6 GEO Yellow Pages

Type: Auxiliary module

Operated by: UNIGE (Switzerland)

Role: The GEO Yellow Pages will facilitate the management and coordination of data and knowledge providers, improving visibility and communication across the community.

Solution description: This is an existing module that will be reused in the new GEO Infrastructure. It will serve as a registry of data and knowledge providers, supporting the management and engagement with them.

6.7 CEOS MIM and GEOSatDB

Links:

- The CEOS MIM Database | CEOS | Committee on Earth Observation Satellites
- GEOSatDB

Type: Auxiliary modules

Operated by: CEOS

Operated by: GEOSATDB (China)

Role: Metadata enrichment services that enhance the GEO Knowledge Hub by providing controlled vocabulary and standardized terms. These services allow content providers to be more expressive when describing the Knowledge Packages and Knowledge Resources they are sharing and preserving.

Solution description: The CEOS MIM Database and GEOSatDB will be managed as external metadata providers. Their content will be integrated as controlled vocabulary in the GKH and be available in publication workflows.

By improving the quality and consistency of metadata, these services will make GEO Data and Knowledge easier to discover and reuse. Users exploring the GEO Infrastructure will benefit from richer search results and more meaningful connections across content.

6.8 Authentication and authorization

Type: Auxiliary module

Operated by: GÉANT

Role: Provide centralized authentication and authorization capabilities to the GEO Infrastructure, allowing users to use all features of the platform with only one user identity.

Solution description: Authentication and authorization capabilities, leveraging GÉANT AAI (Authentication and Authorization Infrastructure) with:

- eduGAIN, eduTEAMS, and MyAccessID;
- Federated identity access for users across institutions;
- Support for virtual teams and role-based access control.

6.9 GEONETCast

Link: GEONETCast | EUMETSAT

Type: Auxiliary module

Operated by: EUMETSAT

Role: GEONetCast provides a global network for EO data dissemination. It is vital in supporting global data sharing, especially in regions with limited internet access.

Solution description: This is an existing module, operated independently by EUMETSAT, that will be reused in the new GEO Infrastructure. It will continue to serve as a major dissemination channel in the GEO Infrastructure.

6.10 External AI Tools

Type: Auxiliary module

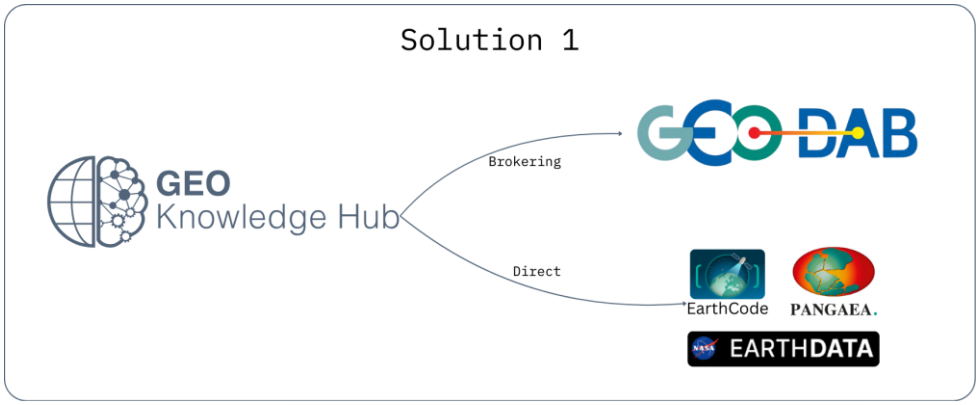
Role: External AI tools, developed and operated by third parties outside the GEO Infrastructure, may connect to the system to provide services such as advanced analytics, content summarization, or decision-support applications. These tools increase the value of GEO resources by enabling new use cases and fostering innovation across the community.

Solution description: External AI integration with the GEO Infrastructure will be permitted under defined governance rules. Such systems may connect through approved interfaces to deliver additional capabilities on top of the available content, for example, content summarization (e.g., GeoGPT) or analytical services (e.g., CEOS EOGPT) and others.

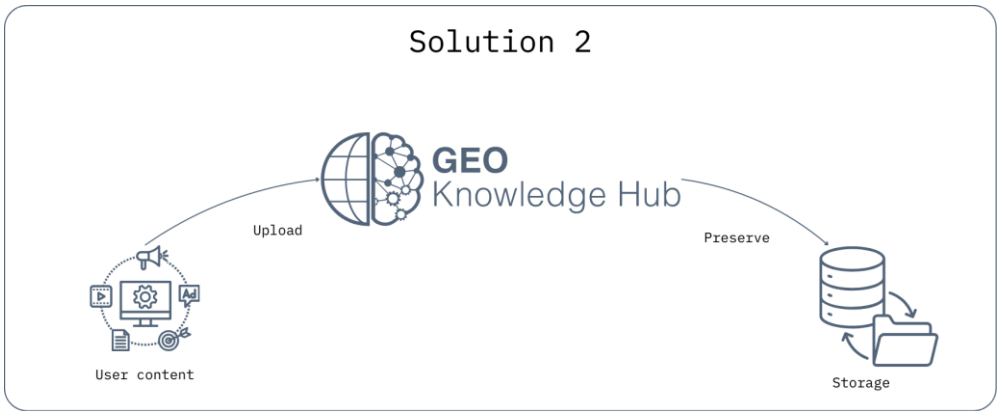
6.11 Integration approaches

The new implementation will rely on three complementary approaches to achieve its goal.

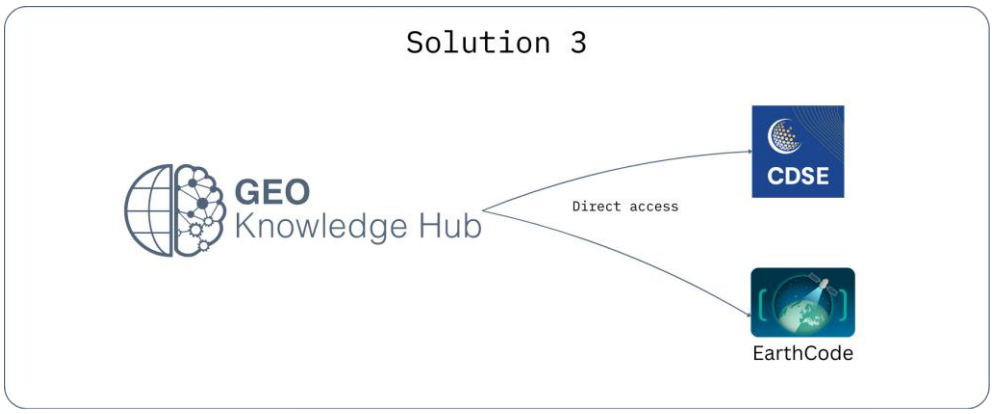
First, the GKH will connect with existing brokers such as the GEO DAB, with other repositories and hubs (e.g., Zenodo) to build Knowledge Packages and Knowledge Resources to centralize and preserve knowledge.



Second, the system will provide hosting capabilities for selected resources, particularly in-situ data, ensuring long-term preservation and access when no other reliable storage options exist.



Third, the GKH will link with external processing environments, such as the Copernicus Data Space Ecosystem (CDSE), providing users with a direct bridge from discovery to analysis and application.



6.12 Implementation considerations

In this document, GIDTT provides the key aspects, principles, and features that will be implemented in the GEO Infrastructure. Approaches used during implementation may vary depending on the implementer, available human resources, and technical context. However, there are elements that must remain consistent across all implementations to ensure trust, neutrality, and alignment with GEO Community values and GEO Data Sharing and Data Management Principles.

This subsection shows essential considerations that must be respected during GEO Infrastructure implementation and operation.

6.12.1 External AI integration with the GEO Infrastructure

Any AI system connecting to the GEO Infrastructure, such as content summarization agents (e.g., GeoGPT) or analytical agents (e.g., EOGPT), must strictly comply with the GEO Data Sharing and Data Management Principles and follows license terms associated with the accessed content. AI providers integrating with the GEO Infrastructure must be formally approved by GIDTT and operate in accordance with the governance rules and conditions established during the evaluation and onboarding process.

Also, as the GEO Community may have concerns around data privacy, intellectual property, and responsible use of content they are producing, in the GEO Infrastructure, Data and Knowledge providers will be explicitly given the choice to determine whether their content can be accessed, processed, or reused by external AI systems connected to the GEO Infrastructure. This opt-in approach is designed to empower providers to maintain control over their contributions while still enabling innovative and content curated AI-driven services.

6.12.2 LLM in-house deployment

If resources permits and LLM-based workflows are implemented as User Interface, the deployment must be fully in-house, hosted entirely within the GEO Infrastructure environment. This approach ensures that all processing, storage, and model inference occur under GEO-controlled infrastructure, eliminating dependency on external services that could compromise data sovereignty or introduce license issues or privacy concerns. By keeping the content internal, the GEO Infrastructure maintains full stewardship of the data and knowledge available in the infrastructure.

To align with the GEO Community's commitment to transparency, neutrality, and sustainability, the LLM features will be built using open-source solutions such as ollama tools, OpenSearch capabilities, and open models. This approach will enable the GEO Community to inspect, customize, and continuously improve the underlying models and pipelines, reducing vendor lock-in and ensuring long-term maintainability.

6.13 Infrastructure requirements

The successful implementation and long-term sustainability of the GEO Infrastructure depend on a robust, secure, and scalable technical foundation. To achieve these objectives, the underlying services, servers, tools, data centers, and all backbone components must be both secure and resilient.

To ensure these aspects are clearly defined, the general infrastructure requirements are presented below.

Servers and compute capacity

The GEO Infrastructure must operate on reliable, redundant servers capable of scaling as demand increases.

- High-availability servers for core services (e.g., GEO Knowledge Hub, GEO DAB) to eliminate single points of failure;
- Sufficient CPU and memory resources to support concurrent users, metadata indexing, and data processing activities;
- Support for containerized workloads and orchestration tools to streamline deployment, scaling, and upgrades.

Storage and data management

All Knowledge Packages and Resources, EO In-situ data and results, must be stored securely and remain reliably accessible.

- Scalable storage systems with redundancy, automated backups, and version control capabilities;
- Optimized indexing to ensure fast and efficient search and retrieval across distributed datasets;
- Strong data protection mechanisms, including encryption and integrity checks;
- All data and applications stored will have to follow clear Data management principles and documentation mechanism.

7 RISK MANAGEMENT

In the proposed architecture, modules are categorized as core or auxiliary modules. Core modules, such as the GEO Knowledge Hub and the GEO Discovery and Access Broker (DAB), represent the minimum elements required for the GEO Infrastructure to operate. Auxiliary modules, such as the GEO Yellow Pages and metadata enrichment services, provide additional value but are not essential for the system operation.

In the GEO Community, however, plans and contributions may change over time. Services and resources that are available today may not be available tomorrow. As mentioned earlier, this is why GIDTT is proposing a modular platform: a system that can adapt and survive under different scenarios, including funding cuts or other disruptions.

Being the heart of the GEO Infrastructure, the only module that must remain available in all cases is the GEO Knowledge Hub. To explain how this works, in the text below, a few "unavailability scenarios" of different modules are presented.

Starting with the GEO DAB as an example. It is considered a core module because it provides critical brokering capabilities to connect the GKH with distributed in-situ and EO-derived catalogues. However, even as a core component, the system has been designed to tolerate its potential unavailability. If the DAB is offline, the GKH, acting as the main interface, will continue to connect directly to limited number of repositories (e.g., EarthCode, Pangaea and others) with great limitations.

The same principle applies to auxiliary modules. For example, the GEO Yellow Pages will help manage providers and services, while metadata enrichment services such as the CEOS MIM Database and GEOSatDB will enhance search and discovery. Yet, if these services are temporarily unavailable, the infrastructure will continue to operate. They are designed as valuable complements, not as dependencies.

This risk management approach reflects the guiding principle of pragmatism: acknowledging the realities of limited and moving resources while ensuring continuity of service and protecting the user experience.

8 GOVERNANCE AND CONTENT CURATION

To ensure the GEO Infrastructure evolves in a sustainable and reliable direction, a formal governance structure is required to set out **roles, responsibilities, funding mechanisms, and policy enforcement**. Governance will provide clear processes for onboarding new contributors, conducting quality checks, and performing regular assessments. In parallel, **content curation will define the responsibilities of data and knowledge providers**, emphasizing continuous enhancement of metadata and quality control to ensure accessibility, reliability, and fitness-for-purpose. **Data stewardship protocols and quality assurance** mechanisms will be established, supported by validation tools such as link checkers to monitor accessibility.

The governance model will align with GEO Data Sharing and Data Management Principles, and incorporate FAIR, TRUST, and CARE principles for data lifecycle management. Finally, guidance on data and software licensing will be embedded to ensure consistency, transparency, and sustainability across the infrastructure.

The GEO Data and Knowledge Working Group (DK-WG) will play a central role in overseeing and enforcing governance by defining the musts and rules to be followed, coordinating contributions, and monitoring compliance with agreed principles.

GIDTT will continue to be the Task team working on the GEO Infrastructure and report the progress periodically to the Executive committee.

- Clear roles for content providers, curators, infrastructure stewards;
- Governance document to include:
  - Decision-making structures;
  - Access and quality policies;
  - Licensing and terms of use;
  - Reporting and accountability mechanisms.

9 FINANCIAL RESOURCE ACTUAL SITUATION AND REQUIREMENTS

Key Roles (from Scenario, Option 2)

Existing Components	Role	Leading Organization	License of the Components [4]
GEO Knowledge Hub	User Interface & Centralized digital Library for EO applications and EO Knowledge resources	GEO Data and Knowledge WG GEO Secretariat	MIT license (Open)
GEODAB	EO Data Broker	CNR(Italy)	AGPL-3.0 license (Open)

Yellow Pages	EO Data and Knowledge providers management	UNIGE	Open
GEONETCast *	Near-global Network for EO data dissemination	NOAA, EUMETSAT, and CMA	Open

**GEONETCast component is not included in the assessment of Human and Financial resources, as their operations and management body do not report to GEO funds. However, its high importance in a global distributed system is not questioned*

The table below shows the required Human and infrastructural resources to run the GEO Infrastructure with respect to the single modules.

It is crucial to highlight that all components that are considered Core should assure a long-term reliability, with support and funds from the all-member states.

The actual budget situation is the following:

- GEO Knowledge Hub team, beside the GEO Infrastructure coordinator, relies on its subsistence thanks to extrabudgetary funding (Funding received from Space Climate Observatory/CNES, 2025).

GIDTT highlights the risk of losing some components due to the lack of funding, notably:

- CNR-IIA (Italy) bears the cost of the entire GEOSS Catalogue and the cost of the Human resources to run the GEODAB without any visibility and support from Dec 2024.Funding was available until May 2025 through the GPP project. Now it is only based on kind contributions with high uncertainty to be maintained.

To consider:

- GEO DAB holds the metadata with all data providers with whom interoperability has been established so far in GEOSS. (400 ml data items)
    - If discontinued, what is the solution for preserving GEOSS resources? •
- GEO In situ data strategy refers to the GEO DAB as a tool for enhancing In-situ data discoverability and accessibility.
    - If discontinued, what is the alternative plan and available solution to establish interoperability with in-situ data providers worldwide with standards already established?
- GEO DAB technology, is now used by WMO for the WHOs (WMO Hydrological Observing Systems)

UNIGE bears the cost of the Yellow Pages (Funding was available for until Dec 31 2024 through the GPP project. Now it is only based on in kind contribution)

The GEO Infrastructure should rely on stable and earmarked funding from all GEO Members to be implemented in **a community collaborative approach**.

The following funding options were originally presented to ExCom-68. GIDTT is now presenting these options to Plenary for further discussion, suggestions, and decision on a sustainable collaborative solution to enable the operation of the GEO Infrastructure in a medium-long term funding plan.

Available funding options proposed by GIDTT:

- Equal Percentage of all GEO Members funds will be yearly allocated to the GEO Infrastructure (percentage to be defined by ExCom / Plenary);
- Open contribution from Data and Knowledge providers to support the GEO Infrastructure as service to manage and preserve data and knowledge;
- Open contribution from Participating Organizations to support the GEO Infrastructure as service to manage and preserve data and knowledge;
- Contribution from Data and Knowledge providers who are securing their work with the GEO Infrastructure as ending short term funded projects (e.g. H2020, e-shape, and others);
- Fixed contribution from the private sector data and knowledge providers to be part of the GEO Knowledge Hub Marketplace.

Module	GKH			GEO DAB			Yellow pages	
			End of Contract			End of funds		
Human Resources	1 GEO Infrastructure Coordinator	GEOSEC Trust Fund	1/11/2026	1 Operation Manager	CNR	No Funds from May 2025	1 Coordinator/Operator	UNIGE In kind contribution
	1 Software Developer	SCO /CNES Funds	31/03/2026	1 Software Developer	CNR			
	1 Content Curator	SCO/ CNES Funds	31/03/2026					
	1 GKH Remote Intern	SCO /CNES Funds	31/03/2026					
Infrastructure cost Cloud cost	8k			50k	CNR	No Funds from May 2025	2k	

10 USERS' ENGAGEMENT AND CAPACITY DEVELOPMENT

Partners: EOTECDEVnet and ITC

In 2024 and 2025 the GEO Knowledge Hub team has delivered a variety of thematic focus webinars (GEOGLAM, DEA and FAO) and this activity has been extremely appreciated by the GEO Community.

Furthermore the GEO Knowledge Hub team and EOTECDEVnet have joined forces on enhancing capacity building and thematic knowledge sharing events.

Webinars organized by the GEO Infrastructure and partners like EOTEC DevNet, will play a pivotal role in strengthening the Global Earth observation community and enhance open knowledge sharing.

10.1 Enhancing Global Equity in Earth Observations

By providing training, resources, and access to expert knowledge, these efforts promote more equitable participation in the global earth observation ecosystem.

10.2 Accelerating the Use of EO for Decision-Making

Through targeted thematic webinars, participants gain practical insights into how Earth observation data and applications can be applied in key areas such as disaster risk reduction, climate adaptation, food security, and environmental monitoring. This accelerates the translation of data into actionable policies and solutions.

10.3 Promoting Knowledge Exchange and Regional Collaboration

Knowledge sharing events foster dialogue and collaboration among diverse stakeholders—governments, research institutions, NGOs, and private sector actors. Thematic webinars, in particular, create platforms for regional case studies and best practices to be shared and scaled.

10.4 Building Technical and Institutional Capacities

By addressing both technical skills (e.g., data analysis, tool usage) and institutional processes (e.g., integration into policy frameworks), these initiatives contribute to the development of sustainable national and regional capabilities.

10.5 Supporting the GEO Work Programme and Global Agendas

These capacity-building efforts directly support the goals of the GEO Work Programme and contribute to global agendas such as the Sendai Framework, the Paris Agreement, and the Sustainable Development Goals (SDGs), by empowering users to leverage Earth observation data effectively.

10.6 Sustaining a Global Community of Practice

Regular knowledge sharing events reinforce a dynamic, cross-disciplinary community of practice that continually evolves with emerging technologies, user needs, and environmental challenges.

11 CONCLUSION

This implementation plan builds a future-proof GEO Infrastructure by focusing on **user-centric** design, and **sustainable architecture**. It enables GEO to meet its post-2025 vision of "Earth Intelligence for All".

The revised GEO Infrastructure is not merely a technical upgrade but a fundamental transformation. It addresses the **fragmentation, accessibility, and sustainability** challenges in the EO domain by unifying tools, enhancing usability, and aligning with real-world user needs through a scenario-based approach.

This implementation plan charts a concrete staged roadmap aligned with GEO's Post-2025 vision, delivering "**Earth Intelligence for All**".

11.1 Implementation Phases & Timeline

Phase	Timeline	Key deliverables
1. Planning & Governance	Q1 2026	Finalized architecture, governance model.
2. Technical Integration (MVP)	Q4 2025 – Q1 2026	Development of the new UI, Unified frontend, integration with GEODAB, curated dataset onboarding
3. Scenario Service Development	Q1 – Q3 2026	Pilot "Scenario-Services" (e.g., crop mapping, disaster alerts) in collaboration with GEO WP actors and presentation to the GEO Community
4. Testing & Feedback	Q3 – Q4 2026	User testing, quality assessment, metadata harmonization
5. Global Rollout	Q2 2027	Full public launch, support desk, onboarding guide