



GEOSS Evolve Initiative

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on behalf of the **GEOSS Evolve Team**

www.earthobservations.org
www.geoportal.org

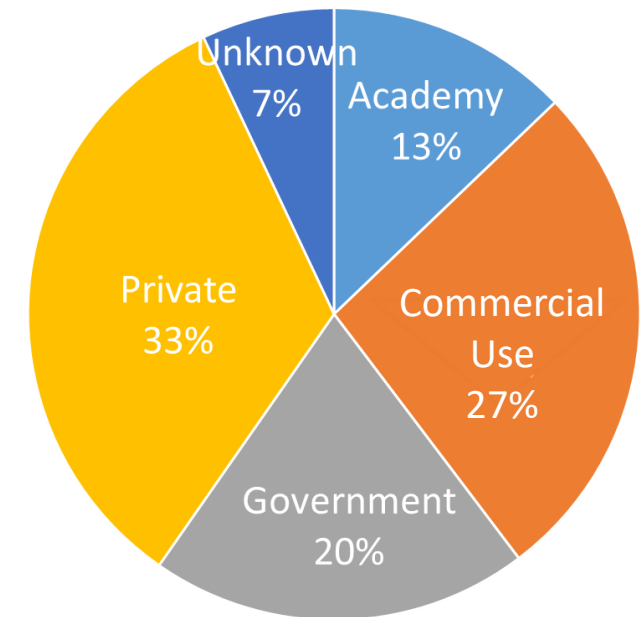
What is GEOSS?

[source: GEO Strategic Plan 2016-2025: Implementing GEOSS]

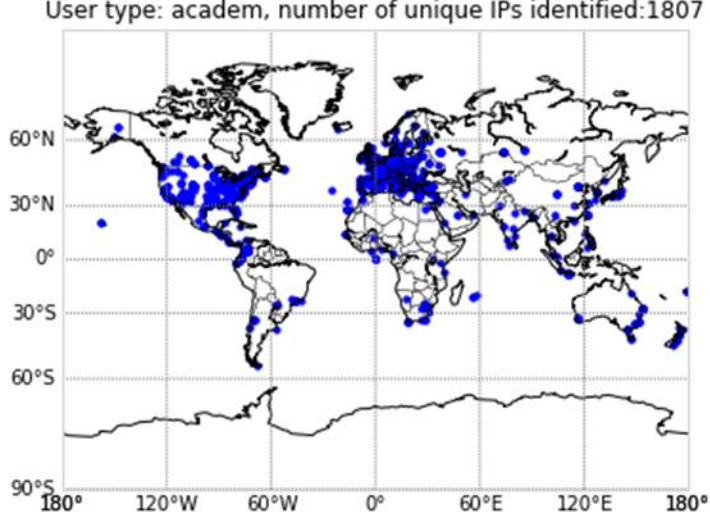
- *GEOSS, the Global Earth Observation System of Systems is a set of coordinated, independent Earth observation, information and processing systems that interact and provide access to diverse information for a broad range of users in both public and private sectors.*
- *GEOSS links these systems to strengthen the monitoring of the state of the Earth.*
- *It facilitates the sharing of environmental data and information collected from the large array of observing systems contributed by countries and organizations within GEO.*
- *Further, GEOSS ensures 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, GEOSS increases our understanding of Earth processes and enhances predictive capabilities that underpin sound decision-making.*

Who are the users of GEOSS?

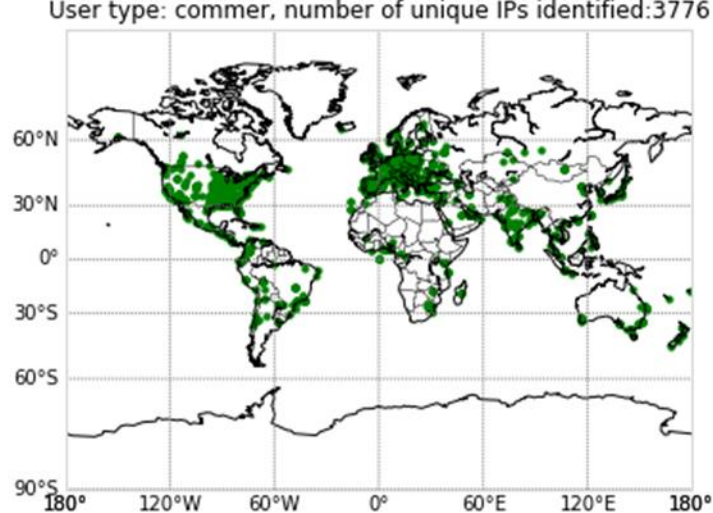
- Analysis by EC Joint Research Centre and Italian CNR
- **1.3 million requests** to GEODAB 2014-17
- **>14,000 unique IP** addresses
- **348,000 searches** to the GEODAB



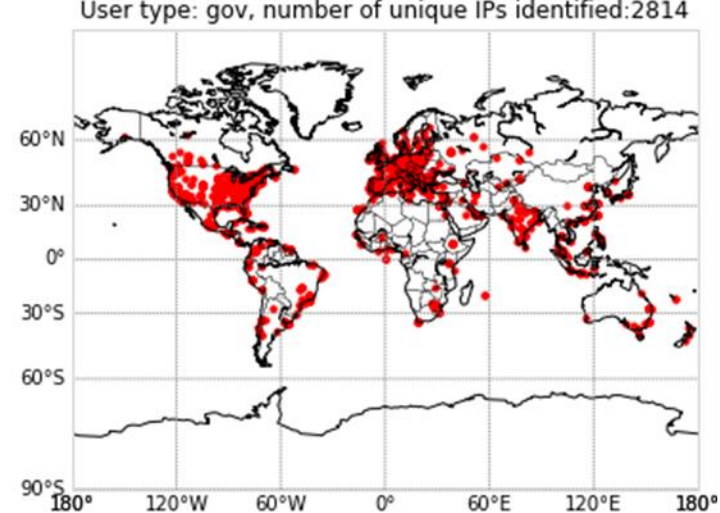
UNIQUE IP ADDRESSES



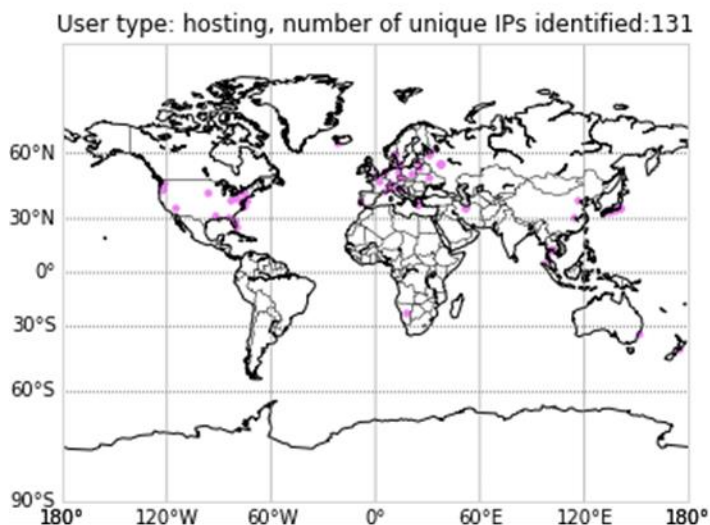
● Academic User **1807**



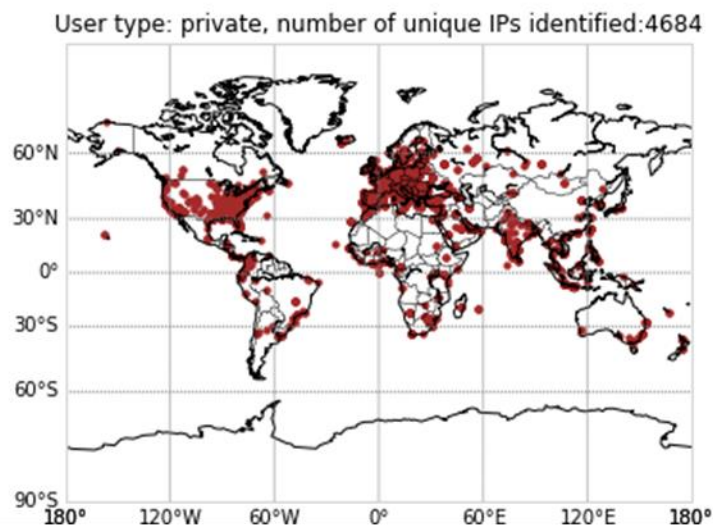
● Commercial User **3776**



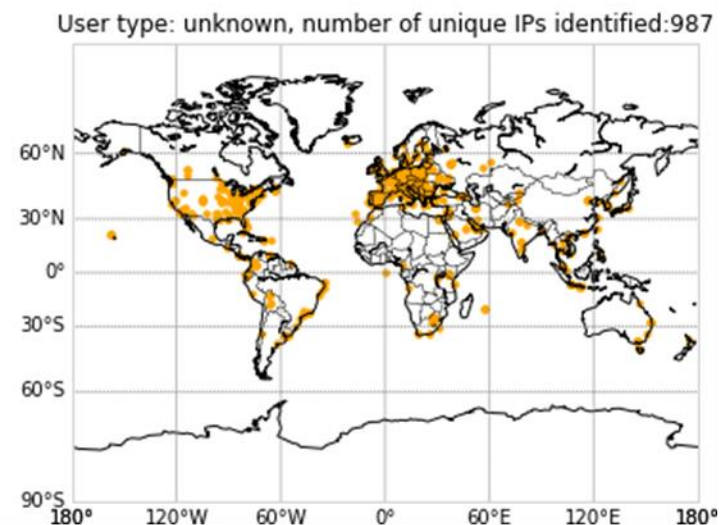
● Governmental User **2814**



● Hosting User **131**



● Private User **4684**



● Unknown User **987**

Which Evolution for GEOSS ?

[source: GEO Strategic Plan 2016-2025: Implementing GEOSS]

- *GEO has devoted considerable efforts to building the GEOSS infrastructure and capabilities that have made Earth observations discoverable*
- *To continue leveraging these successes through 2025, GEO will evolve GEOSS and its infrastructures to meet current and emerging needs by:*
 - **extending the user** audience to decision-makers and the general public;
 - placing additional focus on the **accessibility and usability** of Earth observation resources **to improve our scientific understanding** of the Earth processes, and **enhance our predictive capabilities** that underpin sound decision-making;
 - providing a service framework to **engage partners and user** communities in **evolving the current infrastructure** to enable collaborative tools for co-creation of products and services suitable **for effective exploitation** by user communities; and
 - **evolving the current system of systems** component based architecture with an open systems platform that is flexible, sustainable and reliable **for data access, integration and use, and the delivery of knowledge-based products and services.**

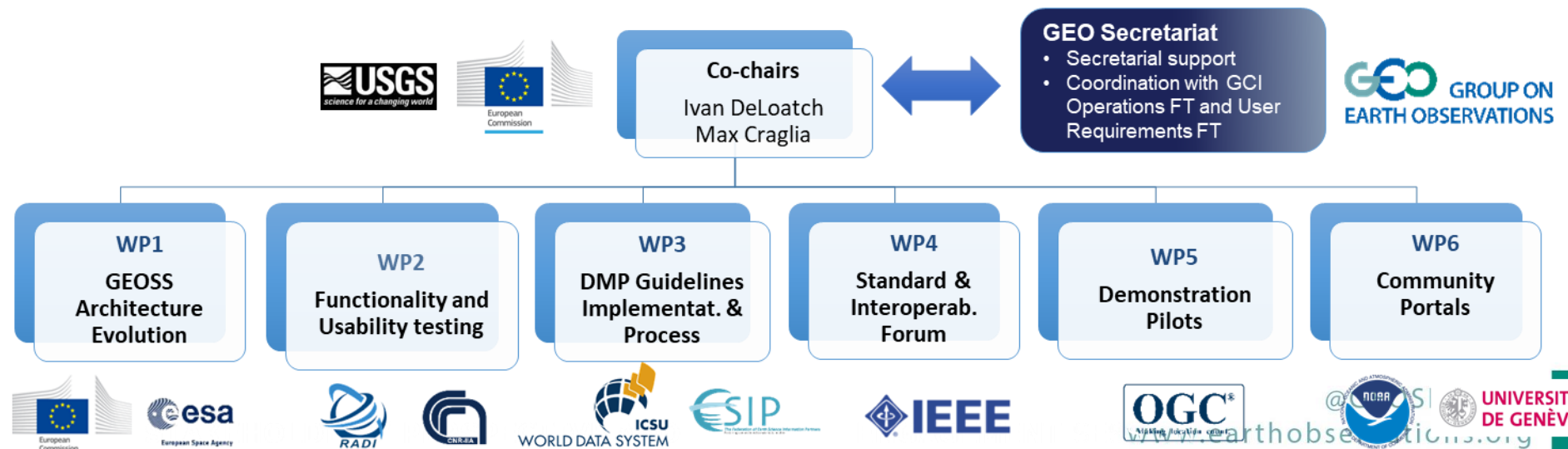
Design Constraints: GEO Principles

- **GEO Governance principles and decision-making processes**
[source: GEO Strategic Plan 2016-2025: Implementing GEOSS]
 - voluntary, non-binding participation
 - consensus-oriented decision-making
 - legitimacy of decision-making
 - accountability to Plenary and Ministers
 - transparent management of activities and funding
 - inclusive of Participating Organizations in the governance of GEO
- **GEO Architectural principles**
[source: GEO Strategic Plan 2016-2025: Implementing GEOSS]
 - Openness
 - Effectiveness
 - Flexibility
 - Sustainability
 - Reliability
- GEO Data Sharing Principles
- GEO Data Management Principles (inline with the FAIR principles)

The GEOSS Evolve Initiative

- To address the previous needs
- Objectives
 1. **Connecting better** the data services and products (from both space and in-situ) offered by GEOSS to **GEO flagships, initiatives, and community platforms**
 2. **Improving data management and sharing**
 3. **Ensure the evolution of the infrastructure** in the light of the **rapid technological developments**

Started in 2017



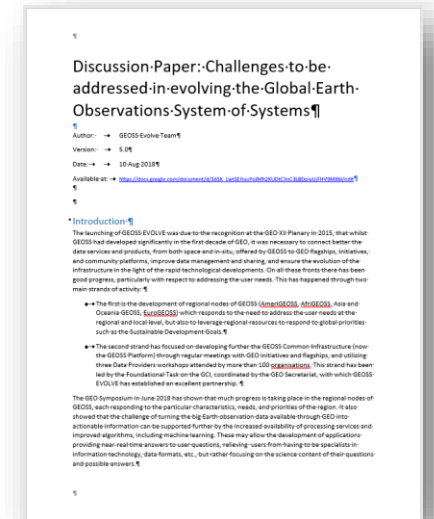
GEOSS is progressing along three strands

- 1. The development of regional GEOs (AmeriGEOSS, AfriGEOSS, Asia and Oceania GEOSS, EuroGEOSS) as extension of GEO Caucuses**
 - To coordinate regional GEO activities, foster engagement, mobilize resources
 - If they develop regional infrastructures they must abide to GEO data sharing, management, and architectural principles as agreed at PB10
- 2. The further development of GCI (now GEOSS Platform) engaging partners and user communities**
 - To link (i.e. access and use) the **new resources** (i.e. processing services and improved algorithms, including machine learning) to **turn the big Earth observation data, available through GEO, into actionable information**
- 3. The development of a strategy for a “result-oriented” GEOSS led by the GEOSec**
 - To transform the GEOSS Platform from a discovery and access facility to a knowledge hub.

Recognized Challenges

- We do not know yet what form a “result-oriented” GEOSS will take and how it will evolve from the current “resource-oriented” GEOSS platform.
- The Expert Advisory Group (established by the GEO SEC) has been tasked to address a number of questions
- GEOSS EVOLVE initiative helps such a process having already recognized a set of key issues structured around:
 - Architecture
 - Interoperability
 - Governance

Discussion Paper: Challenges to be addressed in evolving the Global Earth Observations System of Systems



10 Aug 2018



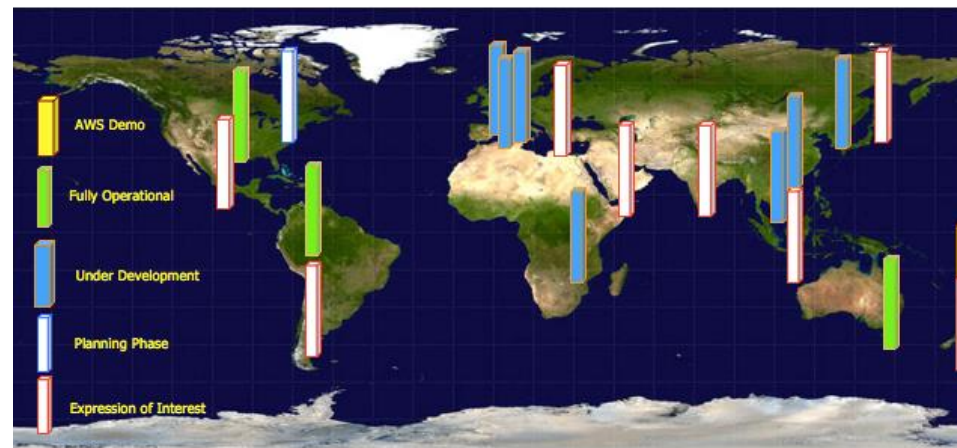
https://docs.google.com/document/d/16SK_LwtSEHuuYJmH2KUDtC3nC3LBDpiuUjFHV9M8bl/edit

Architecture

- What do we mean by “**Knowledge Hub**” and what key characteristics should it have?
- How best to implement the FAIR principles, and in particular the **Reproducibility** principle, in the GEOSS Platform?
- How can the GEOSS Platform best leverage **cloud infrastructure** and emerging new patterns such as **edge and fog computing**? Should GEOSS become just an aggregator of results with data and processing distributed globally at the edges of the network?

Interoperability

- How to ensure interoperability with **Regional GEO** if and when these develop technological infrastructures to support their mission?
- How to address the interoperability of **multiple data cubes** emerging globally?



Governance

- What institutional mechanisms need strengthening to increase **access and use of in-situ data**? What part can **Regional GEO** play in this?
- How will the **future GEOSS Platform** interact with the Regional GEOs initiatives, if these develop also infrastructures and platforms?
 - How can the whole remain bigger than the sum of the parts true to the GEOSS principles?
- How can development of the GEOSS Platform into a Knowledge Hub be made in connection with existing structures (**Flagships, initiatives, Foundational Tasks**?)
- Shall GEO focus on **in-situ data management**, only?

Possible Governance scenarios

- **Collaborative model:**

Regional nodes develop community related data, applications, tools, products services etc. and interact, coordinate efforts and share resources through an interoperable “Global Hub” that connects the GEO community

- **Acknowledged model:**





The regional nodes develop and maintain interoperability arrangements through open standards among them with a limited/or no need for further development of a centralized infrastructure except a GEO Web page pointing to the regional points of entry

- **Autonomous model:**

Each regional node develops autonomously and users go to the node responding better to their requirements, with no centralized infrastructure and no governed interoperability across nodes



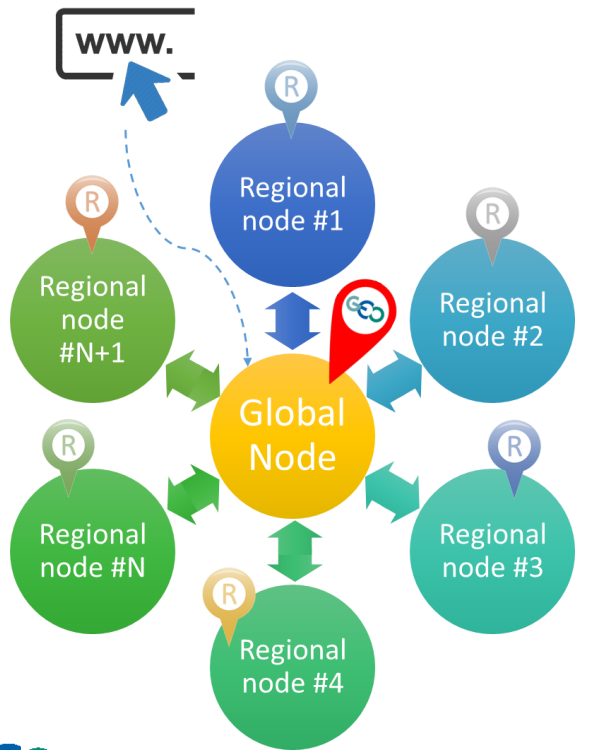
Possible architectural scenarios

-  GEO Web page
-  Main GEOSS entry point
-  Regional entry point
-  (microservices) open APIs



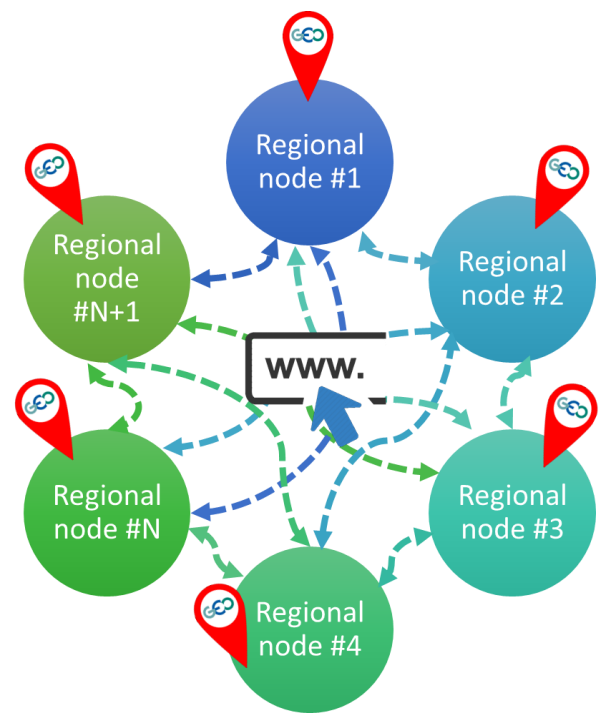
Star Model

Globally centralized System of System



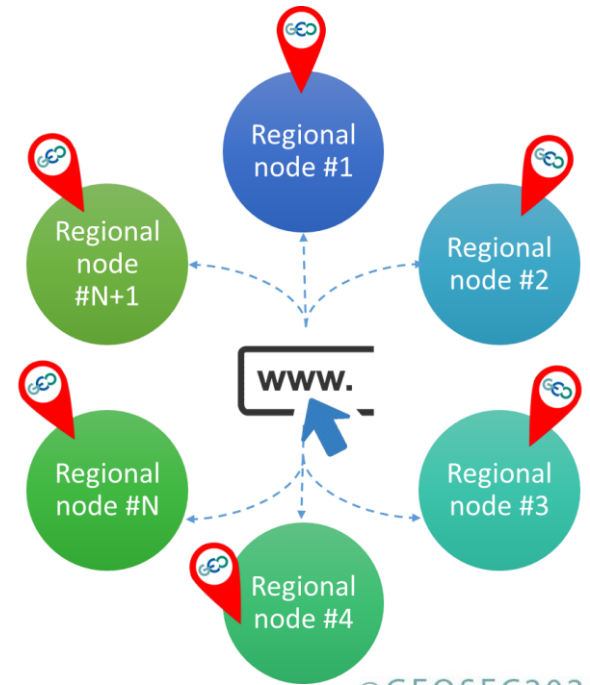
Mesh Model

Network of loosely-coupled Systems



Silos Model

Set of Enterprise Systems

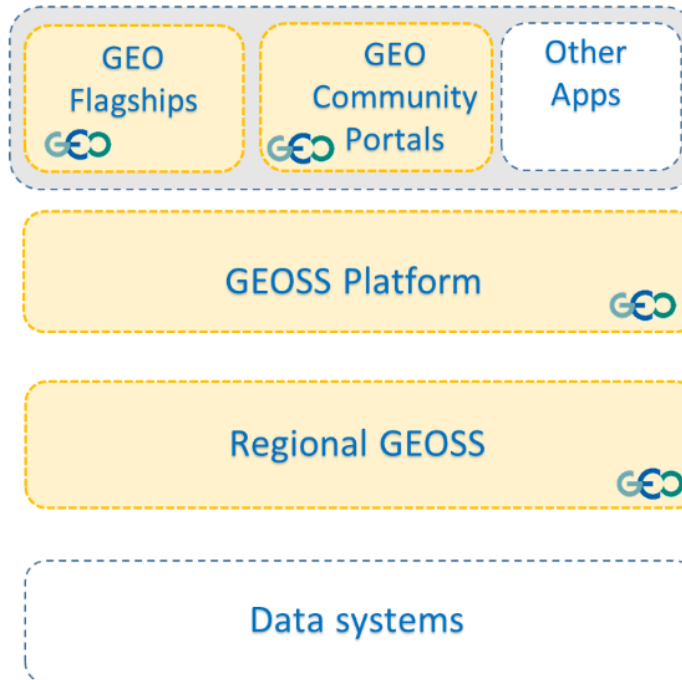


Important service components recognized

Service Components to be considered Infrastructures and Platforms Ecosystem

- African DataCube
- Australian DataCube
- DIAS
- Google Earth Engine
- Amazon ...

Open Analysis-Ready-Data
Infrastructures (e.g. Data cubes) &
Big Data Analytics systems
e.g. using AI/ML/DL



Thematic/International
Federation systems

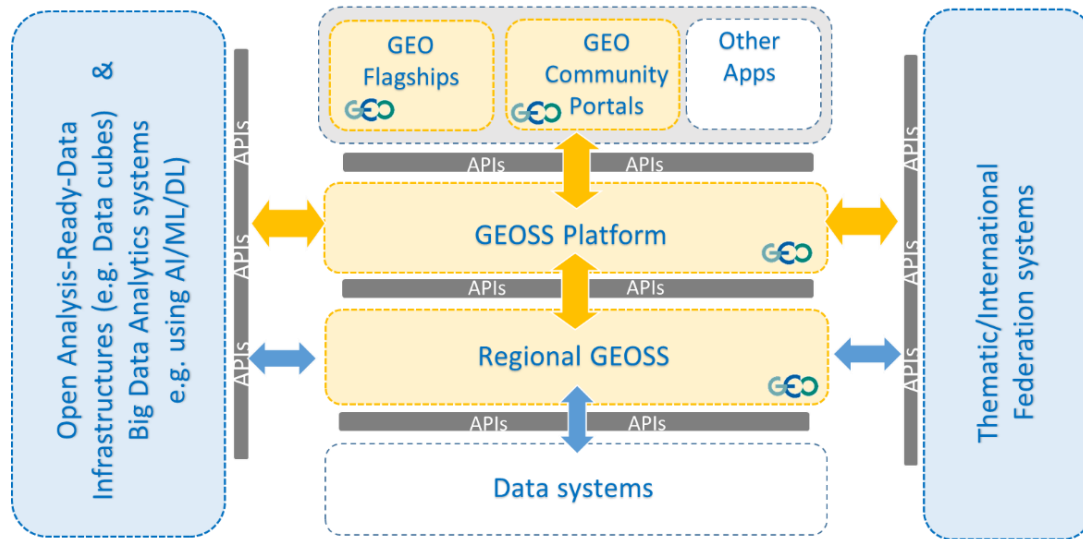
- WMO WIGOS
- UNEP live
- UN GPDD
- UN-GGIM
- CEOS
- ESA TEPS
- GBIF
- ...

Interoperability approach: *Tight interoperability*

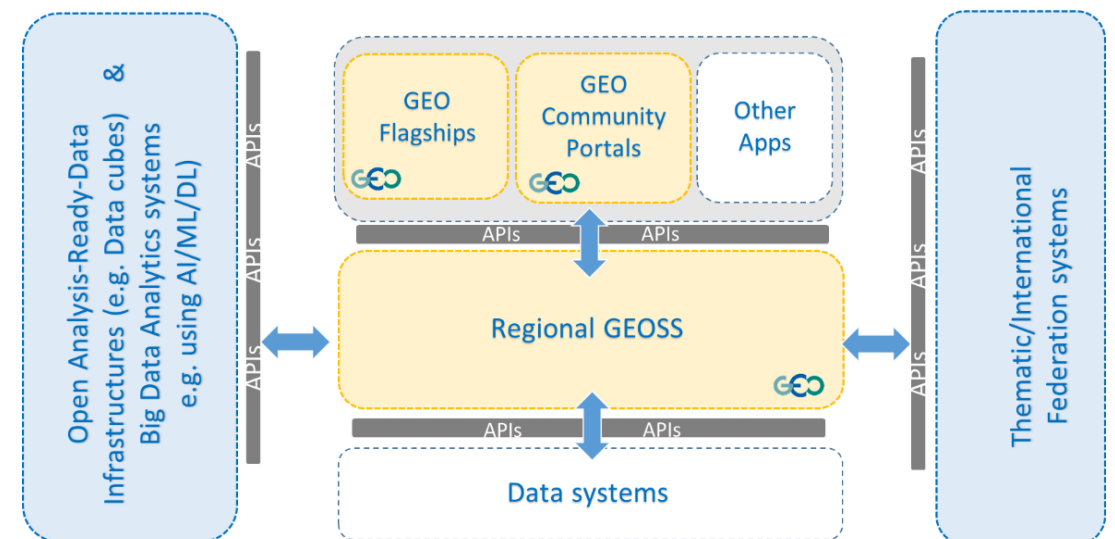
- Services communication applies a **fully service stack approach**



Tight Star Model



Tight Mesh Model

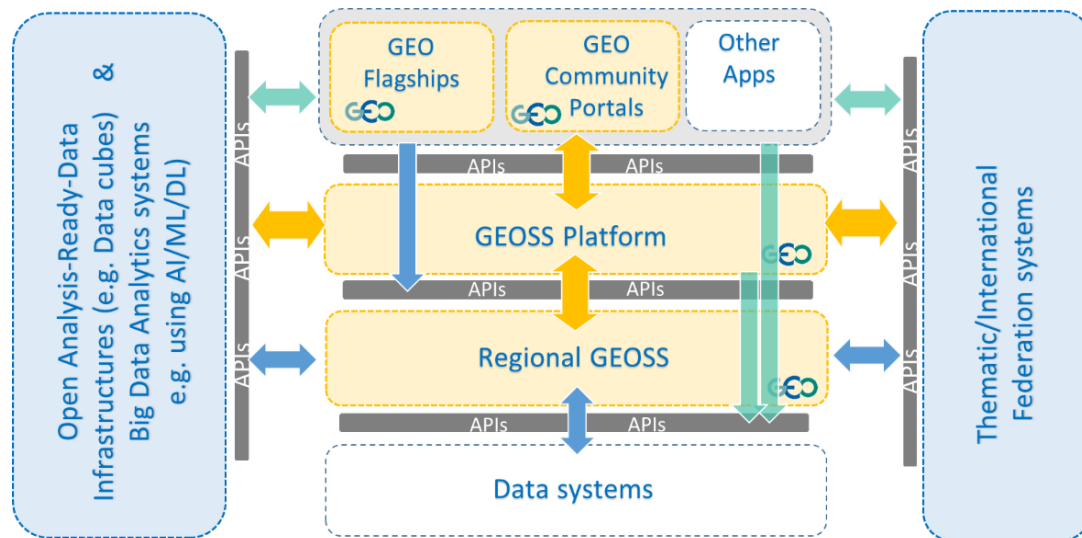


Interoperability approach: *Loose interoperability*

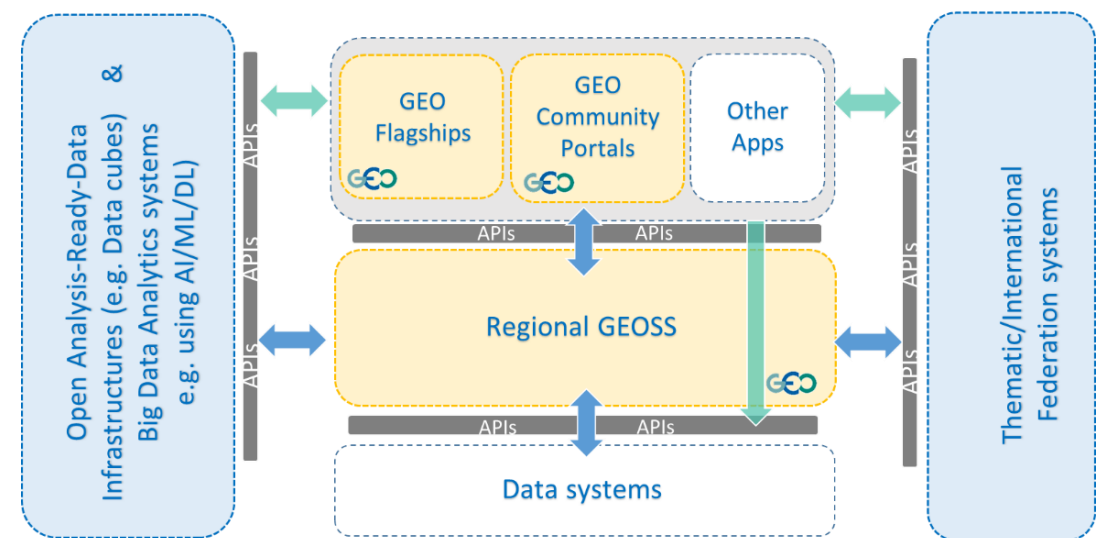
- Stack-based layers communication is relaxed



Loose Star Model



Loose Mesh Model



Recommendations 1/3

- The “Silos” model (*in which each regional node develops independently with limited or no interoperability with the rest*) could not satisfy the GEO Constraints for developing GEOSS
- The “Star” and the “Mesh” models (or a hybrid solution) would continue to support GEO Constraints for developing GEOSS
 - It does not matter so much if the emerging GEOSS is more regionalized or centralized, or whether the *Tight* or *Loose* interoperability model prevails

Recommendations 2/3

- GEO must:
 - **Leverage the new architectural structures and technological developments to extend and increase the level of service of the GEOSS to its Community** –of over 10,000 data providing organisations and over 14,000 user organisations
 - **Maintain the GEOSS as a System of Systems based on interoperability and the sharing of data and knowledge** –so that the whole continues to be greater than the sum of its parts.

Recommendations 3/3

- This calls for the following actions:
 - **Governing the evolution of the GEOSS so that it continues to develop in the desired direction.** This implies, for example, the need for a stronger collaboration between GEOSS EVOLVE, the GEOSS platform, the regional nodes and the GEO Flagships
 - **Reinforcing the process of formalizing, sharing, and making reusable the knowledge existing in the GEO community** so that the FAIR principles supporting reproducibility are achieved
 - **Ensuring interoperability with existing and new analytics systems** such as analysis-ready data, data cubes, Big Data analytics platforms, and manage their orchestration
 - **Reinforcing interoperability**, for example through open and standard APIs, **between GEOSS and the relevant global systems, platforms and initiatives**, such as the UN's SDG Knowledge Platform, GEOSS/WGISS, UNNGIM, UNEP, ICSU's World Data System

GEOSS Evolve 

<https://www.earthobservations.org/activity.php?id=120>

Thank You

Communicate and Collaborate with GEO:

