

## **Draft Report of the Open Data and Open Knowledge workshop**

*This document is submitted by the Secretariat to the Programme Board for discussion.*

### **BACKGROUND**

The Open Data and Open Knowledge (ODOK) workshop took place in Geneva, Switzerland on 15-16 June 2023 as the first in-person technical event organized by GEO since 2019. The following report summarizes the various sessions and practical demonstrations outcomes for the Programme Board members consideration.

This report and related resources (including slides for each session) may be accessed on the GEO Knowledge Hub at the following link: <https://doi.org/10.60566/bde67-mqp28>. Recordings of the sessions are currently being processed and will also be made available soon.

# Summary report of the 1<sup>st</sup> GEO Open Data Open Knowledge Workshop



GEO Open Data Open Knowledge organizing committee  
June, 2023

## Summary

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## Organizing committee

Building an event of excellence requires effort, dedication, and cooperation. For the Open Data Open Knowledge workshop (ODOK) to be carried out in the best possible way, an organizing committee was created. This group was responsible for coordinating the entire event, as well as for the creation of this report.

Below, the members of the organizing committee for ODOK are listed (Alphabetical order):

- Alessandro Scremin - *RHEA Group*
- Anastasia Wahome - *RCMRD*
- Bente Lilja Bye - *BLB*
- Bob Chen - *CIESIN*
- David Borges - *NASA*
- Derek Hanson - *NOAA Federal*
- Eldrich Frazier - *USGS*
- Ernest Acheampong - *GEO Secretariat*
- Felipe Carlos - *GEO Secretariat*
- Florian Franziskakis - *GEO Secretariat*
- Gregory Giuliani - *UNIGE*
- Helen M. Graves - *BGS*
- Joan Masó Pau - *CREAF*
- Joost Teuben - *ITC / GEO Secretariat*
- Joost Van Bemmelen - *ESA*
- Jordi Sansalinas - *University of Barcelona*
- Jose Miguel Rubio Iglesias - *EEA*
- Karel Charvat - *Plan4All*
- Lea Shanley - *International Computer Science Institute*
- Marco Minghini - *European Commission*
- Marie-Françoise Voidrot - *OGC*
- Paola de Salvo - *GEO Secretariat*
- Paolo Mazzetti - *CNR*
- Robert Downs - *CIESIN*
- Thierry Ranchin - *MINES Paris PSL University*
- Yuqi Bai - *Tsinghua University*

Besides them, we give a special thanks to SpaceTec Partners, for all work done on the visual identity of the event.

The work of all these highly committed people made the ODOK workshop a milestone for the GEO Community. Thank you!

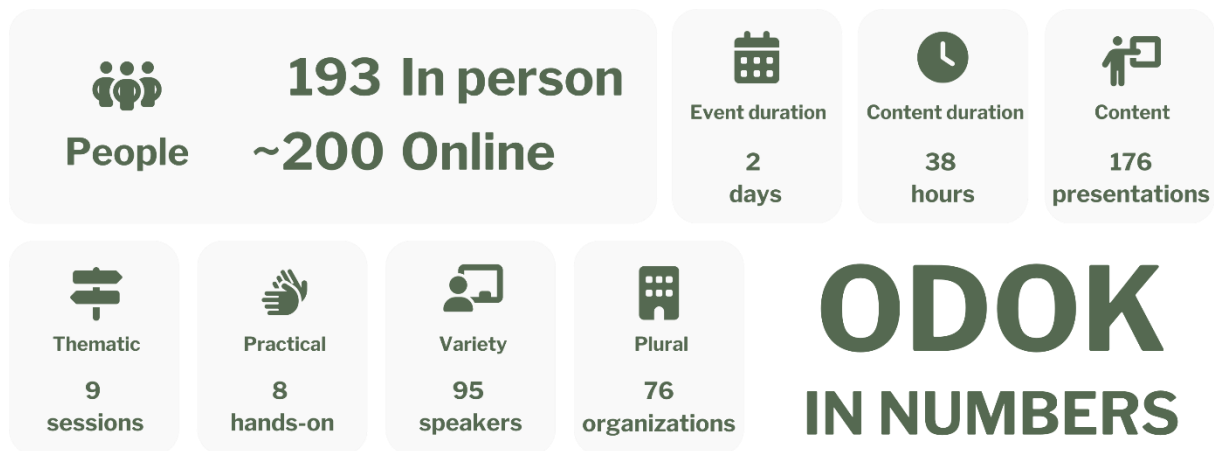
## Workshop factsheet

Following the great success of the Data Providers Workshops held in 2016, 2017, 2018 and 2019, the GEO Community was ready in 2020 to participate to the 1<sup>st</sup> Open Data and Open knowledge Workshop in China; Covid didn't allow it and therefore in 2023 the 1<sup>st</sup> GEO Open Data Open Knowledge workshop (ODOK) was held at the WMO Building, Geneva (Switzerland), from 15<sup>th</sup> to 16<sup>th</sup> June 2023. The workshop was organized by the Data Working Group, GEOSS Platform Team, and GEO Knowledge Hub Team with the overall coordination done by the GEO Secretariat and the GEO Community.

Being a workshop widely supported by the GEO community, in two days of the event, ODOK counted 17 sessions (Thematic and practical), totalizing 38 hours of content. To fill these sessions, 95 speakers from 76 different organizations from 5 continents participated (See Annex A).

With this large amount of available content, ODOK created the perfect atmosphere for sharing content and knowledge related to Open EO Data and Open EO Knowledge practices. As a result, ODOK had approximately 400 participants, 193 in person and nearly 200 online.

The figure below presents an overview of ODOK through some numbers. We can see that the GEO community actively participated in the event.



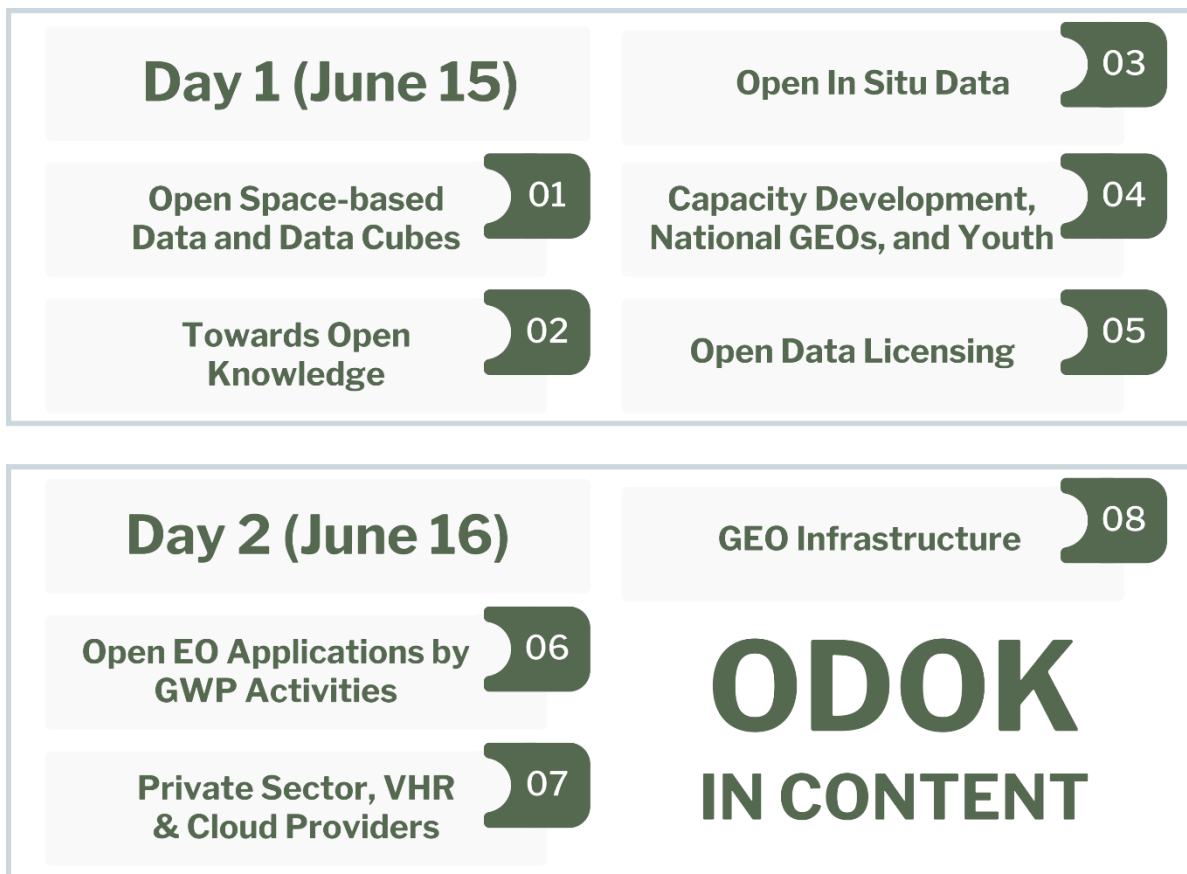
## Thematic sessions

To foster discussion on Open EO Data and Open EO Knowledge in the various areas of the GEO community, nine thematic sessions were held at ODOK. These sessions cover a wide range of topics:

- Space-based data and data cubes
- Very-high resolution data
- Cloud providers and Open Data and Knowledge

- In Situ Data
- Capacity development
- Youth community of practice
- Open Data & Knowledge principles and Data Licensing aspects
- Private sector contributions to the Open Data and Open Knowledge
- Role of Regional GEOs

The figure below shows the name of each session held during the two days of the event. In addition to the sessions presented, an opening session was held.



The workshop follows the endorsement of the GEO Statement on Open Knowledge in 2021. It aims to enable all GEO Work Programme activities to embrace open knowledge practices. Thus, with this wide variety of topics, the GEO community had the opportunity to discuss the benefits, opportunities, and challenges involved in Open Data and Open Knowledge activities.

### Practical sessions

To foster Open Knowledge practices, for the very first time, during the workshop, practical sections were held to allow GEO Work Programme Activities to present to the GEO community

how the data, tools, and knowledge produced in their initiatives can be used. Those sessions covered various topics:

- In situ data management
- Knowledge preservation and sharing
- Data Cubes applications
- Water management and forecast services
- Crop analysis
- Spatiotemporal analysis using open-source tools.

In total, eight practical sessions (hands-on) were held. The figure below shows the title of each session. This document deals with specific details of each session in the following topics.

## ODOK IN CONTENT

<p><b>GEO Mountain</b></p> <p>Efficient zonal statistics over complex geometries using PostGIS</p>	01	<p><b>GEOGLAM</b></p> <p>ASAP - Crop Conditions Crop Anomaly</p>	05
<p><b>GEOGLAM</b></p> <p>Cropwatch &amp; In situ Data collection apps "Field Watch &amp; GVG (GIS-Video &amp;GPS)"</p>	02	<p><b>Digital Earth Africa</b></p> <p>Digital Earth Africa Platform and available applications</p>	06
<p><b>GEO Knowledge Hub</b></p> <p>GEO Knowledge Hub: Knowledge Provider hands on session</p>	03	<p><b>GEOGLOWS</b></p> <p>Open EO App Delivery of actionable water information</p>	07
<p><b>GEO Vener</b></p> <p>Encoding heterogeneous in situ measurements into standardized and compact binary files, ready for sharing</p>	04	<p><b>INPE</b></p> <p>Satellite Image Time Series Analysis of Earth Observation Data Cubes</p>	08

Based on this broad community interaction, different initiatives were able to interact and discover that joint work can be done, thus showing that the approach of sharing not only the data but all the knowledge produced by the GEO Work Programme Activities is a game changer in the way the GEO community performs its activities. These interactions are hoped to generate new joint projects and activities in the GEO community.

## ODOK in Actions

Actions derived from each session

This session presents the main actions identified and that will be addressed by the GEO community. The content represents the summarization of the discussions held in the thematic sessions.

## Session 1: Open Space-Based Data and Data Cubes

### Session Objectives / Description

The objectives of this session were to showcase advancements in sharing space-based data, demonstrate the impact of the various Data Cubes across the globe, and enhance knowledge sharing between these initiatives.

Recent advancements of satellite data sharing and how the broader community uses it were presented. The session was divided into two parts:

- The first part touched upon open space-based data with regional examples of how data sharing is organized to respond to evolving needs of users. Representatives from space agencies discussed their efforts to open their archives in support of the SDGs and other multilateral environmental agreements.
- The second part emphasized the Data Cubes and Digital Earth programmes that have emerged in recent years in different continents, leveraging the Open Data Cube (ODC) and other open-source tools to organize, process and analyze large volumes of satellite imagery.

### Session moderators and rapporteurs

- Gilberto Câmara, *INPE* (Moderator)
- Florian Franziskakis, *GEO Secretariat* (Moderator)
- Robert Downs, *CIESIN* (Rapporteur)
- Kalamkas Yessimkhanova, *GEO Secretariat* (Rapporteur)

### Actions

For the community, the following actions were identified:

- A. Reinforce capacity development efforts so empowered users that have concrete needs have the possibility to create the products that solve these needs, based on local knowledge.
- B. Enhance visibility of satellite data providers from different regions, that have different resolutions and purpose, so the GEO community (especially GWP activities) can use all the data that is available.
- C. Enhance knowledge sharing between Data Cubes on critical topics like how to build, how to use and how to collaborate so more Data Cubes projects become operational.

For what concerns the GEO Infrastructure recommendations, the following were proposed:



- A. Increase computing power access to the communities in need following examples like the FAO SEPAL.
- B. Continue efforts to integrate more data types into the Data Cubes to transition towards a “Digital Earth” concept.
- C. Promote the implementation of STAC as the common language to catalog available resources from raw data to ARD and ultimately to Data Cubes assets.
- D. Continue efforts to achieve the “zero download model” where end users are able to work in the cloud as all data are accessible directly there.

## Session 2: Towards Open Knowledge

### Session Objectives / Description

Promote awareness and adoption of the GEO Open Knowledge Statement building on the work done for Data Sharing and GEO data Management principles implementation.

Engage, be inclusive, and interoperable across domains, regions, data/information/knowledge providers, users, and formats.

GEO endorsed the GEO Open Knowledge statement in 2021. Closely aligned with the GEO mission and vision, the GEO Open Knowledge statement includes the GEO open data principles while also comprising both open science and open knowledge. These principles and the open knowledge statement aim to support decision making within all GEO societal benefit areas and strategic focus. The statement identifies many strategies beyond open data sharing as well as open science to overcome the barriers for those who might benefit from and contribute to the development of authoritative knowledge.

The aim of the session was:

- a) To inform and understand what GEO Open Knowledge entails
- b) Where is the GEO community, and what are the following steps moving towards operational GEO Open knowledge implementation?

### Session moderators and rapporteurs

- Marie-Francoise Voidrot, *OGC* (Moderator)
- Bente Lilja Bye, *BLB* (Moderator)
- Jean-Philippe Aurambout, *EEA* (Rapporteur)
- Chris Schubert, *TU Wien* (Rapporteur)

### Actions

Focus on Human Factor: Engage and strengthen the community further increasing diversity and building a long-term strategy to engage with people by a low-threshold access to improve the

engagement by knowledge sharing and interaction with experts. Building capacity is key for open science, open software, open knowledge development and engagement.

Consultation is very important across different stakeholder groups and strengthening the role of GEO as Spokesman above party lines and dedicated interests. The value propositions to smaller players to elaborate benefits from open models is a step forward to see how sharing can increase value. Demonstrate success stories to share information and enhancing benefits about of institutional/organizational data sharing & data management policies and its narrative on attached to data usages in the value chain, could be a simple tool to spread out own directives and mission statements. GEO should showcase several usability challenges in a user centric manner, e.g., good data citation and its fragments, data curation and provenance to improve data quality of capacity development and open knowledge. This should be, at least much more visible like in Open Web analytics for data usage, metrics, APIs usage, Citation/use analysis.

Actions to be considered for GEO Infrastructure

- It is time to really engage with knowledge packages' end-users.
- Awareness needs to be increased in young generation of researchers. Access to universities to advocate open software / EO data use / GEO Knowledge Hub
- Importance of web analytics for reporting about users and use to encourage sharing
- We need to find champions across users of our products to promote GEO value

Any other Important aspect

- Material needs to be professionally prepared: easy to ingest.
- The language barrier should not be underestimated.
- Importance to have tools in-place to help convert algorithm to actual service, streamlining from development to operations
- Keep on advocating the move from provider centric approach to user centric to data provision.
- Important to assess socio-economic impact of shared resource (ZENODO assesses billion Swiss francs).

## Session 3: Open In Situ Data

### Session Objectives / Description

The GEO community continues to face challenges in accessing a qualitative as well as quantitative amount of in situ data to fulfill their mission, such as gaps in data coverage or limitations on reuse of data, hampered by fragmentation and heterogeneity in the in situ landscape. While some of these challenges have been compiled by the Data Working Group in a series of engagement calls with the GEO activities in 2022 and 2023, further efforts need to be made in order to open up more in situ data and make it accessible and usable for the benefit of the GEO Community, in line with the Canberra Ministerial Declaration in 2019 and the GEO mid-term evaluation report.

Therefore, the session, divided in two parts, aimed at discussing the needs from the GEO community in terms of in situ data and how these could be addressed by the in situ data providers.

The first part of the session focused on requirements for in situ data within the GEO community on GEO flagship initiatives. The needs from various essential variables across thematic domains such as climate, mountain environments, oceans, and urban resilience were presented under topic of interoperability.

The second part demonstrated the progress made in sharing in situ data based on the principles of GEO Data Sharing & GEO Data Management Principles and FAIR principles (Findable, Accessible, Interoperable, and Reusable). The different presentations explored the potential technical solutions to bridge gaps in data access and discuss the organization of communities in different regions, as well as how to foster international collaboration, including partnerships with UN agencies.

#### Session moderators and rapporteurs

- Helen Glaves, *BGS* (Moderator)
- Jose Miguel Rubio Iglesias, *EEA* (Moderator)
- Chris Schubert, *TU Wien* (Rapporteur)

#### Actions

During the discussions we could identify a number of potential actions for GEO to advance in opening up and sharing in situ data, addressing some of the challenges identified during the session:

- GEO should foster wider adoption of open data, knowledge and information, combining bottom-up actions by the community with top-down messages by the GEO Members.
- GEO Knowledge Hub can be a primary resource for practical implementation of open science/open knowledge/open information practices.
- Standards need to be advocated for the creation of more accurate products, with deeper consistency in definitions or relations, vocabularies and protocols, so as to support cross-domain collaboration.
- GEO has a unique position to facilitate discussions across different domains/thematic communities on requirements for EVs and on in situ data in general. Open solutions like G-reqs (GEO in situ data requirements database), developed by the GEO Data Working Group, can facilitate the identification in a systematic way of these requirements across the GEO initiatives, helping in the task to address the existing gaps and challenges. The collection of user-centric requirements is essential so as the GEO community can use their communications channels to express their in-situ data needs. Regional and National GEO are the right fora to connect local and regional users and stakeholders and in situ data providers. GEO should communicate more the value of open in situ data with the aim of promoting the sustainability of in situ infrastructures and networks.

## Session 4: Capacity Development, National GEOs and Youth: Efforts Towards Open Knowledge

### Session Objectives / Description

Capacity development is fundamental to national GEOs as it ensures that individuals, organizations, and institutions can be equipped with the necessary skills, knowledge, and resources to effectively undertake their roles and responsibilities within the coordination mechanism for Earth observations (EO). National GEOs play a crucial role in advocating for the adoption of open data policies, raising awareness about the benefits of open knowledge, and facilitating collaboration among various stakeholders.

The overall objective of the session was to discuss capacity development, the role and effort of national GEOs and the youth in promoting openness, fostering innovation, and driving societal development through the dissemination and utilization of EO open data and knowledge.

There were three sub-sessions:

The first sub-session was on Capacity Development with four presentations

1. What are the implications of open data/open knowledge for individuals, organisations and national GEO's - ITC
2. GEO LDN experience
3. UNOOSA - UN-SPIDER and GEO Knowledge Hub - how to leverage Open application in delivering training in the countries
4. National GEOs - A coordination mechanism for fostering open data and open knowledge

Sub-session 2: National GEOs - Enabling Open Data access, sharing and use

Four presentations sharing experiences from USGEO, South Africa GEO, Ghana GEO and Kenya GEO.

Sub-session 3: Youth Community with five presentations:

1. Lost in Space? Not anymore. ESA's Direction Earth/Space as a Tool of Engaging Youth with Creativity and Innovation
2. New Generation and Open Science: Top-Down or Bottom-Up
3. Youth engagement opportunities for big data validation and verification for environmental health science research- the GEO-Health CoP experiences
4. Youth entrepreneurship support in South Africa

5. How young generation is benefiting from learning cropwatch applications and using it in the field operations

### Session moderators and rapporteurs

- Anastasia Wahome, *RCMRD* (Moderator)
- Lela Gomersall, *GEO Secretariat* (Moderator)
- Kalamkas Yessimkhanova, *GEO Secretariat* (Rapporteur)
- Eldrich Frazier, *USGS* (Rapporteur)

### Actions

#### Sub-session 1: Capacity Development and Open Data / Open Knowledge

Main issues in capacity development are how to move the geo community to adopt open data and open knowledge and how to bring knowledge to a wider community for greater impact through the geo knowledge hub. They will require:

- New skills (manage large amounts of data, new technologies, legal, integrity, ethics issues)
- Change of attitude - from “protected data by default” to “open data by default”, respecting legal, and other constraints
- A holistic approach - Individual, organizational and institutional capacity development; national, regional, youth; policies, infrastructure, legal, technical, career guidelines, funding, networking and collaboration

GEO-LDN - National coordination through Capacity Development

- They have embraced a multi-faceted approach where capacity is being developed through post Graduate Program, Online Seminars and Dialog Forum, Capacity Accelerator Networks, Help desks, LDN Toolbox.
- All data is open and open-source tools are being used.
- They have leveraged partnerships and collaborations with existing institutions (UENR, RCMRD, GPSDD).

UNOOSA –UNSPIDER

- Leveraging Open applications in delivering training in countries
- UNSPIDER’s mandate – ensure that all countries have access to and develop the capacity to use all types of space-based information (EO, GNSS, SatComms) to support the full disaster management cycle.
- Regional Support Offices based at regional institutions
- Training on NSDI (Sri Lanka), TAM on space regulations, UNSPIDER knowledge portal

#### Sub-session 2: National GEOs - Enabling Open Data access, sharing and use

#### National Coordination Mechanisms for National GEOs

The presentation highlighted the GEO's community call for stronger country engagements and partnerships in the delivery of EO data, tools, and services. This call comes at a time when GEO is at a turning point, looking into the post-2025 to empower users to make sound environmental decisions, enable economic opportunities and promote good governance. The GEO Secretariat has been promoting national GEOs as an effective coordination mechanism. The presence of national GEOs is helping countries effectively define national EO priorities and requirements for data sharing, limiting overlaps across agencies, and leveraging investments for projects and initiatives for wider impact. Several operational models of national GEO exist in GEO member countries. Based on experiences from various countries, national GEOs have proven to be essential as they enhance countries' collective intelligence and capabilities to deploy EO data, tools, and services to address key national priorities.

### National GEOs presentations

All gave a detailed account of their activities, how they operate or plan to operate, organizational frameworks, open-data and open knowledge related activities and mechanisms, capacity building efforts.

A discussion was held looking at the following:

- Existing models of national coordination for open data and open knowledge;
- How to strengthen the capabilities of the GEO Community towards open and reproducible knowledge;
- How to ensure high-level political and institutional support for impact and policy influence;
- How to leverage existing national coordination mechanisms and platforms to improve data sharing and data use;
- Enabling conditions that could facilitate national coordination for open and reproducible knowledge;
- How to measure the impact of using open data and sharing reproducible knowledge
- Benefits that are realized from National GEOs:
  - Avoid duplication of efforts
  - Fit-for-purpose data and services
  - Promote co-development and ownership
  - Leverage existing capacities
  - Maximize return on investments
- Challenges faced by National GEOs:
  - Conflicting institutional mandates
  - Institutional Vs government's political mandate
  - Low or no political goodwill
  - Low awareness on value of data sharing
  - Poor infrastructure
  - Inadequate resources to address identified priorities
- Actions for GEO Community:

- GEO WP involvement at national level
- Improved Coordination with other communities
- Resources for GEO activities at regional and national level
- Joint activities – through MoUs, etc.
- Increase awareness – workshops and other forums
- Support by Government – role of GEO principles in enabling operations of National GEOs
- Alignment of policies with National GEO’s objectives
- Actions for Data and Infrastructure
  - Support for innovation – data, cloud access, software, open and reproducible tools, resources, forums
  - Open data coordination – at all levels
  - Re-usable apps and data
  - Common accessible repositories for in-situ data
  - Needs assessments at national level – thematic, or other
  - Capacity building at National GEO level

### **Sub-session 3: Youth Community with five presentations**

Throughout the ODOK, numerous youth engagement initiatives were showcased by GWP activities. Subsequently, it became apparent that youth engagement in GWP activities is not necessarily lacking, however, there is no current systematic mechanism that allows the GEO secretariat to track and connect youth with one another or with the broader GEO community.

Key Actions identified during the sub-session:

- Recognising that youth have their own drive to be involved within the EO world is key. To move towards this, it may be effective to work towards setting up a youth network of networks to help facilitate partnerships, knowledge exchange and networking opportunities.
- As a result of active climate advocacy involvement in young generations, it is important to adapt and update GEO online platforms with attractive language and new styles in communicating to more successfully engage young people.
- GEO must continue to advocate for open data and open knowledge in all areas of the GWP, as open knowledge was identified as a key factor in empowering youth to further their own Earth Observation knowledge and overall learning.
- More tangible youth engagement initiatives are needed such as workshops, trainings and friendly competitions which can be marketed towards youth and early career scientists. The Africa EO challenge was used as an example, which succeeded in engaging youth in real world problems.

## Session 5: Open Data Licensing

### Session Objectives / Description

This session was designed to promote awareness and adoption of recently approved GEO Data Licensing Guidance. It also sought the active participation of the audience to understand barriers to implementation and develop a plan for overcoming those barriers.

Six speakers shared their experience with data licensing, representing a diversity of data users and providers, government and non-government. They were joined by several audience members in the lengthy open discussion session, who shared their expertise and experiences.

### Session moderators and rapporteurs

- Lea Shanley, *International Computer Science Institute* (Moderator)
- Bob Chen, *CIESIN* (Moderator)
- Derek Hanson, *NOAA* (Moderator)

### Actions

- Near
  - Work with GEO activities towards applying a recommended open license to their data and products.
  - Ensure GEO platforms that host data or information (e.g., the GEO Knowledge Hub) require providers to include an open license.
  - Work with the GEO Secretariat to identify metrics to track adoption of standard open data licenses.
- Medium
  - Seek the support of the regional GEOs in implementing data licensing guidance.
  - Explore opportunities to highlight the importance of open data licensing at the GEO Ministerial.
  - Develop simple open data licensing implementation instructions.
  - Explore options for addressing stakeholder concerns about existing open data licenses, in collaboration with groups like Creative Commons (a GEO Participating Organization).
- Long-term
  - Consider potential need for guidance related to open licensing of software.

## Session 6: Open EO Applications by GWP Activities

### Session Objectives / Description

In this session, attendees were introduced to various practical applications developed by GEO Work Programme activities. The reusability of those applications based on the materials and resources available in the GEO Knowledge Hub was also highlighted.



Through these presentations, the audience was able to understand on a deeper level the potential of Open Data and Open Knowledge and how these can be leveraged to drive innovation and solve real-world problems.

The objectives of this session were to unveil the value of the GEO Knowledge Hub as open knowledge repository to access and re-use available open EO applications and showcase the available EO applications and their value to the users.

### Session moderators and rapporteurs

- Paola de Salvo, *GEO Secretariat* (Moderator)
- Bente Lilja Bye, *BLB* (Rapporteur)

### Actions

GEO Work Programme activities produce precious open EO-based applications. Through the Open Data and Open Knowledge movement, which started with the endorsement of the GEO Open Knowledge statement, the responsibility is to make these applications available widely and have users in Countries aware and trained.

Based on the discussions and suggestions made by the community, practical actions for the use of Open Knowledge practices in the GEO community were identified:

1. Development and sharing examples from concrete cases that have succeeded using Open Knowledge;
2. Improve the usability of the shared knowledge with interactive materials, such as step-by-step videos, guidelines, and so on;
3. Engage with Open Knowledge users (e.g., From the GEO Knowledge Hub) to learn from their experience and build a circular economy of Knowledge Sharing;
4. Increase in the GEO Community the use of DOI to ensure the long-term preservation of the knowledge produced and shared by the community;
5. Make available cloud computing capabilities for countries to run certain applications;
6. Create a GEO Academy / GEO Summer school on open EO applications.

### GEO Infrastructure

The GEO Knowledge Hub is a fundamental component of the GEO Infrastructure.

Actions are needed to integrate the Existing GEOSS Platform and its content with the GKH harmoniously to provide the end user with a unique entry point to Data and Knowledge.

## Session 7: Private Sector, VHR & Cloud Providers

### Session Objectives / Description

This session provided the opportunity to discuss the role of the private sector in the path to open knowledge, understand how private sector entities are contributing, and how to overcome barriers. It allowed GEO Work Programme activities to express their needs, notably in terms of very high-resolution satellite imagery, cloud platforms, and services.

This session has the following objectives:

- Learn about opportunities for GEO and organizations within the Commercial sector to collaborate and promote the uptake of Open EO and Open EO Applications.
- Understand how entities within the commercial sector can work together in a mutually beneficial way to improve open data and open knowledge opportunities internationally.
- Explore how GEO Members, Participating Organizations, and Associates in the private sector can contribute to efforts to improve data literacy, internationally.
- Discuss how EO Members, Participating Organizations, and Associates in the private sector can help to improve data sharing practices across government agencies and commercial entities.
- Identify benefits that the GEO Open Knowledge movement brings to the private sector.
  
- Discover how GEO Associates within the private sector can collaborate to improve data sharing practices.
- Discuss ways to improve the link between the GEO community and its initiatives with the private sector to promote Open Knowledge practices.
- Describe how GEO Members, Initiatives, and Work Programme activities collaborate with GEO
- Associates in the private sector to ensure that the quality of open data and knowledge resources is assessed and communicated effectively to potential users.

Identify ways in which GEO Members, Participating Organizations, and Associates in the private sector can collaborate to ensure that open data and information resources that are created today will be findable, accessible, interoperable, and reusable (FAIR) in the future and facilitate continuing use of open data and knowledge resources in a sustainable and reliable manner so that these resources will be available years from now.

Discuss ways to improve the link between the GEO community and its initiatives with the private sector to promote Open Knowledge practices.

### Session moderators and rapporteurs

- Robert Downs, *CIESIN* (Moderator)
- Chris Schubert, *TU WIEN* (Rapporteur)

### Actions

Provide community support to identify and respect appropriate licenses and related services for open access and use of EO data.

Provide support for the open scientific method and data management throughout the data lifecycle and for leveraging the private sector and cloud-based services to establish and improve repositories in an open and transparent way.

## Session 8: GEO Infrastructure & Closing Session

### Session description

The GEO Infrastructure needs to evolve to respond to the evolution of user needs and the emergence of new initiatives, platforms, and communities. Throughout the entire workshop, these aspects, whether technical (space and in situ data, data cubes, EO applications, clouds, licenses) or community-related (capacity development, national GEOs, youth engagement), will have been discussed and reported back to the audience for discussion, also including a focus on regional nodes. Moreover, this new GEO infrastructure will pave the way for the transition from open data to open knowledge that GEO has started with the GEO Knowledge Hub and the adoption of the Statement on Open Knowledge.

### Session objectives

Engage a discussion about the evolution of the GEO infrastructure, and how to integrate the various new components discussed in previous sessions.

### Session moderators and rapporteurs

- Joshua Delmonico, *USGS* (Moderator)
- Paolo Mazzetti, *National Research Council of Italy* (Moderator)
- Florian Franziskakis, *GEO Secretariat* (Rapporteur)
- Paola de Salvo, *GEO Secretariat* (Rapporteur)
- Felipe Carlos, *GEO Secretariat* (Rapporteur)

### Regional and Global Platform

A panel composed of Regional GEO representatives discussed the importance of regional platforms in the way forward for the common GEO Infrastructure, especially on their role for locally relevant data exchange in the multi-level architecture GEO is aiming to achieve. Despite the heterogeneity of Regional GEOs in terms of scope, governance and objectives, resources and services benefiting the community they provide were highlighted.

In Africa, sharing of knowledge through the GKH, of 13 packages from Digital Earth Africa that allows to go beyond only data sharing has been initiated. Another important aspect of the work done in AfriGEO has been the success in working more closely with the countries to develop data sharing infrastructure with both public and private solutions.

In the Americas, efforts have been made to establish national and open infrastructures and promote the use of standards to share the observations. An emphasis is being put on value metrics to advance the understanding of the impact of higher access to open data. Collaboration with commercial sectors to connect their assets like VHR is also being carried out, so the community is aware of what is available.

In Asia-Oceania, the transition from open data to open knowledge is critical. Open data efforts have been highlighted from public and private satellite imagery, including high resolution. The AO region also initiated the Data Cube that is now being taken up by other regions. Collaboration within the region is also key, through the data integration analysis system to use many types of data.

In Europe, the landscape is rich, complex, and fragmented, with projects that support GEO having mandatory open data, open knowledge, and open publication. The Destination Earth and the Copernicus Data Space Ecosystem will continue this effort by bringing together data, services, and open infrastructure, including computing power for free. Through e-shape, 37 services were developed and can be accessed in the GKH.

Common important aspects were noted by all regions including the need to avoid duplication of efforts and leveraging what is already being implemented in terms of infrastructures and programmes. Strengthening the collaboration between the Regional GEOs was identified as a possible way to increase their contributions to the global level, while keeping in consideration the specificities of each node (coordination, youth engagement, capacity development, in situ data sharing etc.).

With regards to the future of the GEO Infrastructure, the Regional GEO expressed the following needs:

- A. Technical support and necessary interoperability to plug in data that comes from the GEO Members, on which capacity building efforts can be established to support long-term sharing of data.
- B. Multi-level design (national, regional, global) to support the reusability of results, and that would be available for anyone to best use the applications developed.
- C. Equal access to resources from different regions to build trust between the partners of the GEO community and support actual knowledge sharing.
- D. Collaborative space to work with complex tools and data like Data Cubes to allow for more dissemination to stakeholders so they understand the value of the work of GEO and its impact.

### **GEO Infrastructure**

Nowadays, various new technologies benefit EO data storage, management, and use. For example, researchers and experts can take advantage of EO data cubes and cloud environments for processing big data to extract information that helps us to understand the changes on our Planet. The GEO infrastructure is evolving to keep up with these changes and bring more functionality to users.

To inform and foster discussions in the community about this evolution, a panel discussion was created in session 8. This panel presented the actions taken in 2023 by the GEOSS Infrastructure Development Task Team (GIDTT). Moreover, during this discussion session, what is already being done for the evolution of the GEOSS Platform with the GEOSS Platform Plus project was presented. For this, details on the progress of the project and the new functionalities that will be added to the platform were presented.

Besides these presentations, during the panel discussion, a presentation was made about Data Terra, a national infrastructure for data and knowledge access and processing for integrated observation of the Earth system and the environment. The objective of this presentation was to exchange experiences and bring new elements to the discussion of the GEO infrastructure.

The panel discussion was well received by community members, who supported the evolution of the infrastructure. The community also raised some aspects to consider during the evolution, like the importance of easy access to data and knowledge produced by the GEO community and the need for more actions to help users connect to the GEO Infrastructure, even when the internet connection is problematic.

## Practical Demonstrations: Operation Applications

The practical demonstration sessions were created to foster the sharing of knowledge and applications developed in the GEO community. In total, the community proposed and carried out 8 practical sessions. In these sessions, the speakers and the audience walked through practical examples of using the shared content.

The table below shows a detailed description of the contents covered in the practical sessions. The richness of content was made possible thanks to the collaboration and dedication of the GEO community, who, based on the principles of Open Knowledge, shared knowledge, materials, and tools in the most detailed and complete way possible.

<b>Efficient zonal statistics over complex geometries using PostGIS</b>
(GEO Mountains)
<b>Speaker:</b> James Thornton ( <i>GEO Mountain</i> )
<b>Description:</b> In this session, participants will develop the capacity to efficiently summarise and map spatio-temporal dynamics represented in geospatial datasets over regions of interest using open-source tools. Both raster and vector data will be in applied. These capacities are useful for research, as well as for “distilling” complex datasets for policy- and other decision-making purposes.
<b>GEO Knowledge Hub: Knowledge Provider hands on session</b>
(GEO Knowledge Hub)

**Speaker:** Felipe Carlos (*GEO Secretariat*)

**Description:** The GEO Knowledge Hub is the digital repository for storing and sharing the knowledge produced by the GEO community and its various initiatives. This session aims to introduce the GEO Knowledge Hub technologies and concepts and how the community can use the digital repository to share and preserve knowledge.

**Encoding heterogeneous in situ measurements into standardized and compact binary files, ready for sharing**

**(GEO VENER)**

**Speaker:** Raphael Jolivet (*GEO VENER*)

**Description:** In this session, we will demonstrate the practical application of F.A.I.R. principles, through the encoding of heterogeneous in situ data into standardized NetCDF files. We will show how the use of standardized and widely supported formats and the integration of metadata facilitate data manipulation and open the way to new tools and uses (QC, visualization, ...). The tools we developed and demonstrate are open source. Although this work focuses mainly on solar irradiation data, it can be applied to other sectors to encode and normalize your own data.

**Cropwatch & In situ Data collection apps “Field Watch & GVG (GIS-Video &GPS)”**

**(GEOGLAM)**

**Speaker:** Miao Zhang and Hongwei Zeng (*Chinese Academy of Sciences*)

**Description:** Remote sensing is an effective means of crop monitoring, but requires in situ data for calibration and validation. However, the traditional way of in situ data collection is known to be time-consuming, laborious, and expensive. Additionally, the commonly used harvesting method for actual yield measurement is destructive and inefficient, further limiting the acquisition of ground truth yield data. To overcome these limitations, crowd-sourced data acquisition methods using cell phones have emerged as the most efficient way on a large scale. During this hands-on training program focuses on two specific applications - GVG and FieldWatch. GVG enables efficient collection of crop type information and FieldWatch allows non-destructive sensing of crop yields based on AI and computer vision techniques. Training on the installation, registration, and using of the APPs will be provided. Both Apps are free for all.

**ASAP - Crop Conditions Crop Anomaly**

**(GEOGLAM)**

**Speaker:** Herve Kerdiles (*JRC*)

**Description:** This session aims at showing participants how to analyze crop or rangelands conditions of a country using the ASAP online system (i.e. understanding its automatic warnings derived from coarse resolution MODIS NDVI, CHIRPS rainfall and JRC crop water satisfaction index data and zooming to the field level with 10m resolution S2 data). Participants will need an access to internet to be able to explore ASAP. We will also show how the JRC standalone software CST (Crop Statistical Tool) can be used for forecasting crop yield through the analysis of the (linear) relationships between yield statistics and yield indicators (e.g. derived from ASAP at the 10 daily timestep) at region level during the crop season.

### Digital Earth Africa Platform and available applications

(Digital Earth Africa)

**Speaker:** Kenneth Mubea (*Digital Earth Africa*)

**Description:** The Digital Earth Africa (DE Africa) workshop will cover the introduction to the DE Africa platform <https://www.digitalearthafrika.org>, a continental platform, which provides analysis ready free and open earth observation data to help in decision making across all sectors from agriculture, water, and natural resource management. DE Africa provides a routine, reliable and operational service, using Earth observations to deliver decision-ready products enabling policy makers, scientists, the private sector and civil society to address social, environmental and economic changes on the continent and develop an ecosystem for innovation across sectors. At the end of the workshop, participants will be empowered to be able to manage their natural resources towards achieving national development goals, and Sustainable Development Goals (SDGs).

### Satellite Image Time Series Analysis of Earth Observation Data Cubes

(INPE)

**Speaker:** Gilberto Camara (*INPE*)

**Description:** Petabytes of Earth observation data are now open and free, making the full extent of image archives available for researchers and experts. Remote sensing experts can now track environmental change using satellite image time series. Using image time series, analysts make best use of the full extent of big Earth observation data collections, capturing subtle changes in ecosystem health and condition and improving the distinction between different land classes. This hands-on session introduces 'sits', an open-source R package for land use and land cover classification of big Earth observation data using satellite image time series. Users build regular data cubes from cloud services such as Amazon Web Services, Microsoft Planetary Computer, Brazil Data Cube, Swiss Data Cube, NASA Harmonised Landsat-Sentinel, and Digital Earth Africa. The "SITS" API provides functions for measuring quality of training samples, classifying cubes using machine learning and deep learning, and post-processing using Bayesian smoothing. It also includes spatial uncertainty measures, support for active learning, methods for ensemble prediction and for accuracy measures with best practices. Thus, "sits" provides an end-to-end solution to image time series analysis.

### Open EO App Delivery of actionable water information

(GEOGLOWS)

**Speaker:** Jim Nelson (*GEOGLOWS*)

**Description:** The GEOGloWS ECMWF Streamflow Model is a Hydrologic Model which provides forecasted and historically simulated river discharge. The GEOGloWS global streamflow forecasting service allows local stakeholders to focus on solving water management problems such as flooding, drought, and water/food security issues by providing the water intelligence they need to make decisions. It also benefits the global economy by providing water intelligence to sectors that need to make high-risk investment decisions such as the insurance and reinsurance industries.



## Event content

ODOK 2023 produced a lot of content. In this session, some of the content already available online is listed.

### Presentations

The files of all presentations and extra materials shared during the ODOK 2023 are now available on the GEO Knowledge Hub (<https://doi.org/10.60566/pfty5-y6482>).

### Photos

Photos of the event can be found in ODOK 2023 Flickr (<https://flic.kr/s/aHBqjALb9K>)

### Quotes from Participants

- *“Thank you all who have supported it. We need now to look for all the valuable information captured during the workshop to build on, producing results and new success stories strengthening GEO and its global Community”*
- *“Thank you all for a job well done!”*
- *“Thank you so much for your excellent job for the GEO ODOK workshop! It was very successful. Next generation for GEO was nice too”*
- *“I was expecting a “political” conference and found interesting technical presentations!”*
- *“First of all, let me express my enormous appreciation for the excellent work in organizing ODOK-2023. I am very grateful for the honor to present our work to the GEO community. Congratulations and thanks!”*
- *“Thank you for your hard and great work on the amazing workshop. Congratulations to the team”*
- *“Congratulations on a great job! Thank you for inviting me to this discussion. Looking forward to advancing the conversations from this meeting”*
- *“Big congratulations on the success of the event. You were really great, and I want to thank you personally for the warm reception”*

- *“Thank you for your email and opportunity to be part of the best Open Data and Open Knowledge Workshop 2023. Digital Earth Africa expresses its gratitude for the participation in the various sessions, connecting with participants from all over the world and establishing friendships that will blossom at the Geo Week 2023”*
- *“I enjoyed much the presentations, the discussions, and I am grateful for the excellent organization and support you offered to the whole community”*
- *“Thanks so much for the invitation, I event was very interesting, and I was very happy to attend”*
- *“Thanks again so much for the invitation to the workshop. It was great to see the geo community and hear about the challenges and projects going on”*
- *“Great conversations... glad to have been part of these discussions and sharing our perspectives. Thanks Group on Earth Observations (GEO) Secretariat for organizing this event and leading the conversation on Open Data Open Knowledge #ODOK2023 “*
- *“This was a great event. The community is there and engaged, many ideas are there too, it is our challenge now to take the best of it to implement FAIR GEO Open Knowledge. “*
- *“Intense days, significant exchanges with experts, stakeholders, decision makers. GEO is bringing together the geospatial community in way that facilitates dialogue, supports the definition of common goals, and strengthens and fosters new partnerships. Thank you GEO. “*
- *“Thanks colleagues at Group on Earth Observations (GEO) Secretariat for an intense and well organized event... Great conversations by the GEO community on Open Data and Open Knowledge. “*

## Next events

- During GEO Week 2023 an ODOK follow up workshop will be organized in Cape town South Africa
- ODOK 2024 location and dates will be announced asap.

## Annex A: List of Organizations represented at the workshop

Organization		
AfriGEO	AmeriGEO	AOGEO
APBON	ARMINES	AWS
BLB	British Geological Survey	International Research Center of Big Data for sustainable Development Goals
Center for Ecological-Noosphere Studies National Academy of Sciences	CERN	ChangGuang Satellite
CIESIN	CMA	CREAF
CropWatch	Data Terra	Digital Earth Africa
Ecosystem Atlas	European Environment Agency	Environmental Protection Agency of Aosta Valley
ENVRI-FAIR	European Open Science Cloud (EOSC)	European Space Agency

e-shape	Esri	EuroGEO
European Commission	European Space Imaging	FAO
GCOS	GEO Blue Planet	GEO Health CoP
GEO LDN	GEO Mountains	GEOGLAM
GEOGLOWS	GEO Vener	Ghana National GEO
Human Planet	Institute of Geographic Sciences and Natural Resources Research	International Long term ecological Research
Indigenous Alliance	Information Technologies Institute (ITI)	National Institute for Space Research (INPE)
International Committee for the Red Cross	International Computer Science Institute	International Space Charter
University of Twente	Jaxa	Joint Research Centre
Kenya National GEO	Kenya Space Agency	Mines Paris PSL University

National AIR Space Research and Development Agency	National Research Council of Italy	NOAA
Open Geospatial Consortium	OSGeo	Picterra
Planet	RCMRD	SAGEO
Space4Water	TEAMDEV	Terradue
UNIGE	University of Barcelona	UNOOSA
UNOSAT	UP42	USGEO
USGS	VITO	WMO
World Food Programme		

