

A Roadmap for Citizen Science in GEO

The essence of the Lisbon Declaration

Key Messages for policy makers

To secure the integration of Citizen Science and Citizen Observatories into GEOSS, the following steps are recommended:

- Support the consolidation of a Citizen Science federation as a common technical infrastructure through strong governance, privacy protection under the GDPR and continuity in the European Citizen Science Association (ECSA).
- Connect the Citizen Science federation to the European Open Science Cloud (EOSC) as a scientific infrastructure and to the GEOSS platform as a decision making support infrastructure.
- Create and support an EuroGEO showcase on Citizen Science that continues the legacy of the current H2020 projects.

Earth Observation

Data and information collected about our planet, whether atmospheric, oceanic or terrestrial. This includes space-based or remotely-sensed data, as well as governmental, research and citizen's science in-situ data. Conveniently analysed, Earth Observation data enables decision makers to better understand the issues they face and to shape more effective policies.

Citizen Science

Citizen Science is an umbrella term for various forms of public participation in scientific knowledge production, including community-based monitoring, crowdsourcing, participatory action research and Citizen Observatories, among others.

Citizen Observatories

Citizen Observatories are participatory initiatives that engage citizens in community-based environmental monitoring, often with close links to policy and a long term focus. The European Union funded several Citizen Observatory projects in the 7th Framework Programme as well as under Horizon 2020.

Enabling Environment

In this policy brief, considered as the policy and funding framework that set the conditions and requirements for Citizen Observatories to function and sustain their activities.

Executive Summary

The relevance of Citizen Science and Citizen Observatories has only recently been considered in GEO activities. In order to advocate its importance and significance, this policy brief summarises three key messages from the Lisbon Declaration for European policy makers and describes how best to connect and integrate Citizen Science communities as well as their activities and outputs into GEO.

Group on Earth Observations (GEO)

GEO is a global intergovernmental partnership that coordinates and improves the availability, access and use of Earth Observation data for a sustainable planet. With an initial focus on promoting open, and sustained data sharing for space-based remotely-sensed data, it also encompasses all forms of in-situ data. GEO maintains and improves the Global Earth Observation System of Systems (GEOSS) that currently provides access to more than 400 million data and information resources. GEO is organised into regional organisations.

EuroGEO

EuroGEO is Europe's part in GEO. EuroGEO enables Europe to position itself as a global force in Earth Observation thanks to the vast knowledge gained through running the Copernicus programme as well as the in-situ research infrastructures.

INSPIRE

INSPIRE is the European Spatial Data Infrastructure. It enables the sharing of environmental spatial information among public sector organisations, facilitates public access to spatial information across Europe and assists in policy-making across boundaries. The INSPIRE Directive came into force in 2007 and will be implemented in various stages, with full implementation required by 2021.

Open Geospatial Consortium (OGC)

The OGC is an international voluntary consensus standards organization with more than 500 commercial, governmental, nonprofit and research organizations worldwide, collaborating via a consensus process to implement open standards to enable, for example, the sensor web and Internet of Things, geospatial data processing and data sharing.

Issues that impede the integration of Citizen Science into GEOSS

GEO focused initially on Earth Observation and, in particular on remote sensing data management. Current efforts are being made to extend Earth Observation to also consider in-situ data. In parallel, the European Union has funded Citizen Science and Citizen Observatory projects producing in-situ data. These should be acknowledged as a clear contribution to GEO. Yet a number of salient issues still impede their integration in GEOSS:

1. The data **interoperability requirements** requested by the GEO Data Access Broker (DAB) are reasonable for a data producing agency but may be too demanding to fulfill by Citizen Science projects with limited budget and personnel. In addition, the technical specifications are written for a specialised audience and may be difficult to understand for non-specialised Citizen Science projects.
2. Citizen Science projects are often more concerned about the **discoverability** of their data by web crawlers and web search engines than about **applying geospatial standards**. In addition, current standards recommended by the GEO DAB are not the ones that best fit earth observation data in general and in-situ data in particular. Sensor Web Enablement standards are the current OGC recommendation (e.g. Sensor Observation Service and SensorThings API), but these are not as widely supported by the GEO DAB as the common Web Map Service and Web Feature Service.
3. The **integration of a Citizen Science project into the GEO Platform is a manual process** that has several steps and tests (i.e. administrative registration, interoperability tests, service enhancements, etc.). Those steps are time consuming and present a bottleneck for integrating existing Citizen Science initiatives, especially when considering the number of Citizen Science data sets that are at least potentially relevant for GEO.

4. It is unclear **what benefits citizens receive** from their participation in GEO. Citizen Science does not only generate data; in many projects immense value is added by annotation and more advanced forms of analysis done by citizens. However, an appropriate mechanism that allows Citizen Scientists to access and analyse data from GEOSS is missing. Citizen Science projects rely on contributions from individuals and individuals are entitled to **privacy** by law (under the GDPR) as well as **attribution and recognition for their contributions**.
5. Most Citizen Science projects take place at a **local level** and, on their own, might not be tackling the global problems addressed by GEO. Efforts are needed to understand how data from local projects can support the global agenda of GEO and vice versa, how GEO and the Earth Observation community can help support local Citizen Science projects.
6. Citizen Science projects often use simplified methodologies and inexpensive sensors that provide **data with certain limitations**. These need to be carefully documented. Mechanisms must support provenance tracking, enable the documentation of key data improvements in cases where data are quality checked and enhanced as well as allow linking back to an initial data set.
7. A **federation and registration infrastructure** dedicated to making Citizen Science contributions available in EuroGEO is missing.

In addition, there are other **non-technical issues** affecting the integration of Citizen Science into GEO. For example, Citizen Science is not yet recognised as a complementary source for in-situ and remote sensing data inputs. GEO has yet to acknowledge the many opportunities that Citizen Science offers. It can empower people to make a difference at the local level as well as complement actions at national level based on improved knowledge on the problems that the planet is facing.



Way forward

Overcoming these technical and non-technical issues requires actions by a range of actors, namely Citizen Science project partners, decision makers in the so-called enabling environment as well as GEO.

Project-level action

Citizen Science and Citizen Observatory projects need to cooperate by i) creating a federation of technical resources and ii) supporting Citizen Science associations. Both actions can provide several advantages through reducing costs in and overcoming data silos.

1. Create a federation of Citizen Science and Citizen Observatories

A federation of Citizen Science and Citizen Observatory projects can...

- Host services that can be shared by several Citizen Science projects such as data translations, data sharing and data discovery.
- Provide facade services and act as brokers and translators, amplifying the interoperability of the project offerings.
- Work to create common vocabularies and procedures that aggregate Citizen Science data into bigger datasets. The GBIF biodiversity datasets are an example of this practice.
- Share specific data quality tools to assess and filter the quality of the data. In specific research areas, pools of experts can increase trust in the data and better generate and supervise knowledge.
- Provide centralised and trusted authorisation servers that can be used by Citizen Science projects as single entry points to all services. The identity of participants is protected by authorisation servers which only release the minimum agreed information necessary for the projects to function and as required under the GDPR.
- Keep data decentralised and within the Citizen Science projects' selected infrastructures as required by INSPIRE but provide hosting for projects that may not have the capacity to manage their data with their own resources.
- Take ownership over the data management process and provide data preservation services when Citizen Science projects end.
- Exploit current and future GEOSS data.

2. Join forces via Citizen Science associations

Citizen Science projects and Citizen Observatories can join forces by forming or joining existing Citizen Science associations in order to...

- Organise Communities of Practice to share knowledge and provide support to their participants.
- Evaluate and disseminate the value of being included in GEOSS and study the benefits that citizens receive from their participation in GEO.
- Better represent the interests of citizens in GEOSS as contributors to the system.
- Facilitate the co-design of solutions for identified gaps in GEO.

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- Release documents and recommendations to train Citizen Science projects on the GEOSS data sharing and data management principles, and the standards and tools to implement the principles.
- Help close the gap between citizens and GEOSS by visualising the contributions of citizens in GEOSS and promoting the usefulness of the GEOSS infrastructure for citizens.
- Set up the necessary governance structures to run an effective federation in support for Citizen Science.

Policy-level action

Policy makers are encouraged to consider the following actions needed to secure the integration of Citizen Science projects and Citizen Observatories into GEOSS:

- Create a permanent e-infrastructure to federate Citizen Science projects.
- Incentivise the creation of a catalogue of open source tools and services that can be reused by Citizen Science projects.
- Sponsor the creation of common vocabularies and methodologies and ensure their seamless integration with conventional and legacy data sources.
- Promote a mechanism for dealing with GDPR issues in circumstances where participants ask for acknowledgement (e.g., using appropriate Creative Commons licensing).
- Showcase the use of Citizen Science data as a complementary data source to in-situ and remote sensing data in downstream applications and operational use cases. This can be supported by the Copernicus in-situ component.
- Promote the European Citizen Science Association as a participant organisation in GEO, so it can have a voice in the GEO Plenary.
- Sponsor the GEO CitSci community activity to consolidate it in GEO and secure its continuity as a prerequisite to become a GEO initiative.
- Prepare a call for projects under Horizon Europe to make GEOSS offerings more attractive to citizens and Citizen Scientists, for example by focussing on communicating facts and evidence-based insights supported by data visualisations such as story maps and data dashboards.

GEOSS-level action

GEO members and participant organisations, in coordination with the GEO Secretariat, are encouraged to work with Citizen Science and Citizen Observatories to...

- Assess and understand the potential of Citizen Science data as a complementary data source to remote sensing and traditional in-situ data.
- Simplify the mechanism to include Citizen Science data in GEOSS by connecting the Citizen Science federation directly to the GEOSS platform.
- Provide services that are appealing to citizens and Citizen Scientists.
- Provide opportunities to Citizen Scientists to exploit current and future GEOSS data.

The people behind the Lisbon Declaration

The process of putting together a 'Lisbon Declaration' started in the EuroGEOSS face-to-face meeting in Lisbon (3 to 5 July 2019), facilitated by the WeObserve project. The final Lisbon Declaration can be found on Zenodo [1]. The following list of Citizen Observatories and Citizen Science practitioners ratify the content of the Lisbon Declaration:

- Rob Atkinson, OGC
- Lucy Bastin, Aston University, UK
- Anne Bowser, Woodrow Wilson International Center for Scholars
- Peter Brenton, Atlas of Living Australia
- Luigi Ceccaroni, Earthwatch
- Andy Cobley, University of Dundee
- Steffen Fritz, IIASA
- Margaret Gold, European Citizen Science Association, (ECSA)
- Joan Masó Pau, CREAM
- Andreas Matheus, Secure Dimensions
- Lukas Mocek, Sensor.Community
- Jaume Piera, Institute of Marine Sciences (ICM-CSIC)
- Jakub Trojan, Czech Academy of Sciences / Tomas Bata University in Zlin
- Valantis Tsiakos, Institute of Communication and Computer Systems
- Eveline Wandl-Vogt, Austrian Academy of Sciences, exploration space & Ars Electronica Research Institute "knowledge for humanity"
- Uta Wehn, IHE Delft Institute for Water Education

References

1. Masó, J. and Fritz, S. (2019) EuroGEO 2019 Citizen Science roadmap - "Lisbon Declaration", available at <https://zenodo.org/record/3946506#.Xw8f15MzZTY>

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WeObserve - An Ecosystem of Citizen Observatories for Environmental Monitoring



WeObserve is a three year project funded by the European Union's Horizon 2020 research and innovation programme. As a Coordination and Support Action, WeObserve is delivering the first European-wide Citizen Observatories knowledge platform to share best practices and to identify and address challenges to inform practitioners, policy makers and funders of (future) Citizen Observatories. The ultimate objective is to create a sustainable ecosystem of Citizen Observatories that can systematically address these identified challenges and help to move Citizen Science into the mainstream. In order to create the conditions for a sustainable ecosystem of Citizen Observatories that can tackle the challenges of awareness, acceptability and sustainability, the WeObserve project developed Communities of Practice to consolidate the current Citizen Observatory knowledge base and strengthen it to tackle future environmental challenges. WeObserve is coordinated by IIASA (Project Coordinator: Dr. Steffen Fritz) and runs from 2017 to 2021.



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