




An Ecosystem of Citizen Observatories for Environmental Monitoring

## WeObserve D.4.1. Citizen Observatories and GEO Community activities

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### Partners



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<b>2.0</b>	15/01/2020	IIASA	Revised submitted version

## Revision changes log

Section	Description of change
<b>Executive summary</b>	Updated executive summary
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## Glossary of terms

Term	Description
<b>Citizen Observatories</b>	Community-centric initiatives that build on the social change that is taking place where citizens become more active in collecting and sharing environmental information, typically harnessing the latest technological advances (e.g. ubiquitous Internet connectivity, Internet of Things (IoT), machine learning, social media, portable and inexpensive sensors).

## List of abbreviations and acronyms

Abbreviation	Meaning
<b>CO</b>	Citizen Observatories
<b>GEO</b>	Group on Earth Observations
<b>EO</b>	Earth Observations
<b>GEOS</b>	Global Earth Observations System of Systems

## Executive Summary

The aim of the Task reported here (Deliverable 4.1 - Citizen Observatories and GEO Community activities) is to incorporate the WeObserve ecosystem related initiatives into the GEO Work Programme. To address this Task, The Group on Earth Observations (GEO) has included a Citizen Observatories (COs) and Crowdsourcing Community Activity within its 2017-2019 Work Programme. This activity serves to demonstrate the value of COs in supporting and complementing Earth Observation (EO) monitoring systems, including the Global Earth Observation System of Systems (GEOSS) and Copernicus (the European Union's space applications program).

This has come about because the WeObserve consortium is already strongly embedded within this community and through the additional resources provided by WeObserve, the activity and this task will further facilitate the integration and adoption of COs into the European Union's EO initiatives. However, the scope of *in-situ* observations goes far beyond this and starts with the GEO *in-situ* foundational task (that is co-chaired by CREAM) and continues with all thematic activities such as the GEO biodiversity Observation Network (GEOBON – where IIASA is a member) and the GEO Global Agricultural Monitoring flagship (GEOGLAM) – where IIASA is a member.

This task will exploit the findings from the WeObserve communities of practice (CoPs) (T2.2) and place them within the GEO context to increase awareness and promote acceptability of environmental governance using participatory citizen science approaches. Furthermore, this task will demonstrate the value of COs to other *in-situ* communities in GEO. Some key aspects of the research strategy include:

- Engaging the WeObserve ecosystem of COs and citizen science communities to participate in GEOSS by providing an active forum in the GEO CO and Crowdsourcing community activity;
- Increase awareness of the citizen science activities within the rest of the GEO workplan and address potential synergies (e.g. GEOBON and GEOGLAM). Collect the requirements for COs from these monitoring systems and other research infrastructures to accept citizen observations as a quality-controlled data input;
- Share best practices (from WP2) for discovery and access to this kind of citizen-observed data through the GEOSS common infrastructure and GEOSS (including the Discovery and Access Broker and the new components coming from NextGEOSS);



- Strategies for implementing the GEOSS Data Management Principles in the CO community including the GEO label (in coordination with the relevant standards in Task 4.2)

Significant progress has been made to date in terms of incorporating WeObserve within the GEO Work Programme. First and foremost, there now exists a GEO Community Activity on Citizen Science which has been established and maintained over the past two years with strong support from WeObserve. Awareness has been raised through the strong networking efforts of the Activity, ranging from organized side events at GEO conferences, keynote presentations and relevant GEO meetings and technical meetings involving GEO members. In addition, liaison has been made between the various CoPs in WeObserve, their findings and GEO. The most recent findings will be provided in the updated Deliverable 4.3 – Citizen Observatories and GEO community activities.

## 1 Introduction

WeObserve is an H2020 Coordination and Support Action (CSA) which tackles three key challenges that Citizens Observatories face: awareness, acceptability and sustainability. The project aims to improve the coordination between existing Citizen Observatories and related regional, European and International activities. The WeObserve mission 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.

One of the International activities to which WeObserve is attempting to strengthen coordination with is that of the Group on Earth Observations (GEO). GEO is a partnership of more than 100 national governments and in excess of 100 Participating Organizations that envisions a future where decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations. To this end, the WeObserve consortium has helped to create and support the establishment of the GEO Community Activity on Earth Observations and Citizen Science.

This Community Activity greatly supported by members of the WeObserve consortium has had an impact on GEO since becoming active in 2017. With a membership of global experts, the Activity has helped organize side events, keynote addresses and meetings raising the profile of citizen science within GEO. Furthermore, WeObserve is also engaging with GEO and through its



Community of Practice on data interoperability and standards is addressing one of the main issues impeding uptake of citizen science data in GEO. Finally, we conclude with a look to the future considering the possible shift to a GEO Initiative and the Earth Challenge 2020.



## 2 Earth Observations and Citizen Science

### 2.1 The Group on Earth Observations

GEO is a partnership of more than 100 national governments and in excess of 100 Participating Organizations that envisions a future where decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations.

GEO is a unique global network connecting government institutions, academic and research institutions, data providers, businesses, engineers, scientists and experts to create innovative solutions to global challenges at a time of exponential data growth, human development and climate change that transcend national and disciplinary boundaries. The unprecedented global collaboration of experts helps identify gaps and reduce duplication in the areas of sustainable development and sound environmental management.

Together, the GEO community is creating a Global Earth Observation System of Systems (GEOSS) to better integrate observing systems and share data by connecting existing infrastructures using common standards. There are more than 400 million open data resources in GEOSS from more than 150 national and regional providers such as NASA and ESA; international organizations such as WMO and the commercial sector such as Digital Globe.

Ministers of the GEO member governments meet periodically to provide the political mandate and overall strategic direction for GEO. The Mexico City Ministerial Declaration from the GEO Ministerial Meeting in 2015 saw world leaders commit to support open Earth observation data for the next decade.

For more information: <http://www.earthobservations.org>

### 2.2 Citizen Observatories & WeObserve

The widespread adoption of mobile devices and social media platforms, coupled with the development of low-cost sensors, has made it easier for the public to contribute to and engage in scientific research and monitoring. This collaborative exchange with the scientific community, in which members of the public actively join the co-creation of new scientific knowledge, is known as Citizen Science.





In recent years, Citizen Observatories have been regarded as an effective tool for complementing in-situ monitoring systems towards a more sustainable system of environmental monitoring. Besides the technical, security/data protection and data quality challenges, the continuous engagement of the average citizen as well as citizen associations to environmental monitoring is the key target in this endeavour.

The European Commission (EC) is supporting the development and integration of new sources of in-situ EO data collection with the support of Citizens' Observatories in Europe. Citizens' Observatories are community-centric initiatives that build on the social change that is taking place where citizens become more active in collecting and sharing environmental information, typically harnessing the latest technological advances (e.g. ubiquitous Internet connectivity, Internet of Things (IoT), machine learning, social media, portable and inexpensive sensors). Citizens' Observatories empower citizens to get informed and actively participate in environmental decision making, raise awareness about environmental issues, and help build more resilient societies.

Five Citizens' Observatories (CITI-SENSE, WeSenseIt, COBWEB, Citclops and OMNISCIENTIS) were funded under the EC's FP7 programme, covering different environmental issues such as air quality, flood and water management, coastal ecosystems, biodiversity and odour annoyance. Following on the success of the pioneering Observatories, four Citizens' Observatories Innovation Actions—LandSense, Ground Truth 2.0, SCENT, and the GROW Observatory—have been recently funded under the Horizon 2020 programme. Each of these projects will demonstrate approaches to create actionable knowledge for participatory governance and policy making with a particular focus in the field of Land Use and Land Cover. Harnessing the power of the public through such observatories and other Citizen Science initiatives around the world will enhance and augment the influence of existing Earth Observation monitoring systems, including GEOSS and Copernicus.

To capitalize upon and consolidate these ongoing efforts, while leveraging the outcomes from the FP7 legacy COs, the WeObserve consortium aims to bring together the current set of European H2020 COs, enabling improved coordination between these COs and to promote related activities at the regional, European and international level. WeObserve will coordinate and deliver a crucially needed CO knowledge framework to avoid duplication, share best practices as well as identify barriers and synergies. This framework will also promote standards to ensure interoperability, maximize impact and facilitate uptake by environmental authorities to ensure



the sustainability of CO initiatives. Raising awareness and sharing this knowledge framework will not only foster the development of a sustainable ecosystem of citizen observatories, but also extend the geographical coverage of citizen-powered science to new communities. The anticipated knowledge framework will stem across sectors, national boundaries and language barriers as well as the public and private sectors.

## 2.3 GEO Community Activity: Earth Observations and Citizen Science

The GEO Community Activity: Earth Observations and Citizen Science began in its current form in 2017. The team members organized a Side event at the GEO-XIV Plenary in Washington, D.C. in October of 2017 on the role of citizen science in GEO and in particular regarding the SDGs. This built upon an already existing CS activity that had not been particularly active.

The current Leadership of the activity is comprised of three members of the WeObserve consortium based in Europe (Steffen Fritz – IIASA; Joan Maso – CREAM; Uta Wehn – IHE-Delft) and Lea Shanley from the South Big Data Innovation Hub based in the USA. They take turns in a rotating chair for a 1-year term. Various contributors from across the EU and US participate, with additional outreach to colleagues through our associated networks.

Monthly teleconferences are organized to maintain regular contact, hosted by the chair. The general agenda consists of an update on past and upcoming events, along with specific discussions around recent developments – in particular in reference to the activity’s goals and actions. One of the main roles of the activity is to organize presentations, keynote addresses, side-events and related meetings to advance the understanding and appreciation of the value of CS for GEO.

During the last decade, Citizen Science initiatives, which are based on knowledge generated from citizens both individually and collectively, have dramatically increased. Numerous initiatives have emerged that actively involve citizens in environmental monitoring and stewardship, supported by EO enabled applications. Citizens’ observations, data and information can complement official, traditional in-situ and remote sensing EO data sources in several areas, such as climate change, sustainable development, air quality monitoring, vector-borne disease monitoring, food security, flood, drought and natural perils’ monitoring, and land cover or land-use change, among other topics. There is an enormous potential to use citizen-driven



observations in combination with EO data from the Sentinel family of satellites, NASA Earth Observing Systems, and commercial imagery. For example, citizens can assist with satellite, aerial or ground-based image interpretation and classification, potentially in combination with machine learning. They can provide in-situ data for calibration and validation activities, and for the integration of satellite and citizen observations to fill existing gaps.

In North America, the US National Plan for Civil Earth Observations highlights the important role of Citizen Science in augmenting and enhancing EO, and “encourage[s] innovations for collection, exploitation, and wider use of Earth observations based on improved availability of open data, including new applications, new services, Citizen Science, and crowdsourcing.” The United States government is supporting over 400 Citizen Science projects across more than 60 federal agencies and organizations through coordination of the Federal Community of Practice on Crowdsourcing and Citizen Science. This support includes the development and integration of in-situ citizen observations with EO data through a variety of federally sponsored-projects, such as the collaborative partnership between the Soil Moisture Active Passive Mission (SMAP), the GLOBE Program and SciStarter, which engages citizens in gravimetric soil moisture measurements for calibration validation, and also NASA’s DEVELOP program, which is combining Citizen Science observations with earth observations to better understand the spread of vector-borne disease.

Building on the aforementioned and other initiatives and programmes in the field of crowdsourcing and Citizen Science around the globe, efforts within this GEO Community Activity focus on: promotion of standards and best practices in managing (collection, representation, annotation, processing, quality assurance) crowd-sourced data; exploration of linkages of Citizen Science data to the GEOSS and its common infrastructure (GCI); investigation of methods and tools to integrate citizen-generated data with official ones; knowledge sharing about citizen engagement practices, case studies and demonstration pilots; exploration of synergies with other GEO initiatives such as GEOGLAM and linkages to the Sustainable Development Goals (SDGs). Tasks will also include reviews of existing citizen observatories, projects, and related activities including assessments of their impacts on local, regional and national policy; finally, it will analyse and propose how Citizen Science can contribute to social innovation.

The following goals and actions were established to guide the Earth observation and citizen science community activity and allow for the ability to measure the impact of the efforts.

### 2.3.1 Overarching Goals

Three overarching goals guide the activity, namely:

- Awareness raising and promotion of Citizen Science among the GEO community at large.
- Addressing potential synergies between Citizen Science and GEO activities, foundational tasks, initiatives and flagships including GEO BON, GFOI and GEOGLAM.
- Determining best practices for discovery and access of citizen-observed data through GEOSS (including quality assurance and standards among others).

### 2.3.2 Near-term Actions

Three major sets of near-term actions were established. The current achievements are listed next to each action in italics.

- 1. Scoping and initiation of a global GEOSS Citizen Science inventory – reviewing already existing Citizen Science projects that are of relevance to GEOSS and providing access to the most relevant information**
  - Produce a collection of exemplary Citizen Science projects that can be of use in GEOSS: *a study, funded by the JRC, has resulted in a collection of over 500 CS projects in the environmental domain. This has been made public.*
  - Report on which Citizen Science projects can provide inputs for monitoring and supporting the SDGs: *an international workshop was held at IIASA in 2018 bringing together experts from the SDG and citizen science community. A publication has been submitted to Nature Sustainability.*
- 2. Analysing existing Citizen Science projects that are relevant for GEOSS and specifying recommendations for Citizen Science to cover gaps in in-situ observations: *this work is ongoing.***
- 3. Providing guidelines for using and managing Citizen Science in GEOSS – Part 1: use of existing standards for data collection and management:**
  - Conduct interoperability experiments and recommend how to offer access to Citizen Science through GEOSS: *this work is ongoing – initial efforts include placing collected data on official data repositories (e.g. Pangea).*

- Conduct interoperability experiments and produce recommendations on a single sign on mechanism: *these efforts are continuing, particularly within the LandSense CO and the NextGEOSS projects.*

### 3 Results

#### 3.1 GEO-Related Activities

The following GEO-related citizen science activities, supported by various WeObserve members, were organized since 2017. These activities were organized with the specific objective in mind of both awareness-raising on the part of Citizen Science within GEO and for gathering user requirements from the community on the potential needs for Citizen Science data.

Table 1. GEO-related citizen science events.

<b>Event</b>	<b>Location</b>	<b>Date</b>	<b>Description</b>
<b>GEO-Plenary</b>	Washington, DC, USA	October 2017	Side event
<b>GEO Symposium</b>	Geneva, Switzerland	June 2018	Keynote on role of CS in GEO
<b>GEO Workshop</b>	Geneva, Switzerland	September 2018	Keynote on CO's and GEO
<b>GEO-Plenary</b>	Kyoto, Japan	November 2018	Side event

#### 3.2 Value Added of CO's for GEOSS

Each of the currently active CO's is striving to demonstrate the added value of citizen science for GEO and GEOSS. Within GEO, there is a growing understanding and interest in the application of CS data to GEO. Already, several of the GEO flagships embrace citizen science data to varying degrees, namely GEOBON and GEOGLAM. GEOBON via GBIF, relies extensively on citizens to provide upwards of half of its data. While interest and understanding of citizen science within GEO is on the rise, there is a lack of information and resources available to the GEO community. In particular, citizen science data is not readily available in GEOSS via the GEOSS portal. The CO's as a group are attempting to remedy this situation by mobilizing vast amounts of citizen science



data in the land cover and land use domain that would be of high value for the GEO community.

### 3.3 The Role of WeObserve in GEO

In addition to the various activities that WeObserve, jointly via the Earth observation and citizen science community activity are organizing around GEO, WeObserve is helping to coordinate the various CO's around the technical requirements that would enhance implementation of CS in GEO. In particular, WeObserve is helping the CO's via the [Community of Practice on data interoperability](#) and standards – which would make it easier in the future for GEO to ingest citizen science data. One of the current issues facing GEO in terms of citizen science data is the general lack of standards in the wider community, and the wide variety of different data formats, types, standards etc. being employed. WeObserve is working closely with the CO's and others to harmonize and encourage standards across the sector.

### 3.4 Emerging Opportunities

Several emerging opportunities are seen on the horizon in terms of the enhancing the connection between EO and CS. One of these is the effort currently underway to bring the community activity of Earth Observations and Citizen Science up to a GEO Initiative, in time for the next GEO Workplan of 2020-2022. If successful it is envisaged that this will further enhance the linkage between EO and CS within GEO and potentially add further credibility to citizen science.

The recent initiative by the European Commission titled e-shape is also providing an additional opportunity for visibility and uptake of CS in GEO. Here again WeObserve members are active. At the global level, the Earth Challenge, planned for 2020 to acquire 1 billion new citizen science based measurements from around the globe (<https://www.earthday.org/earth-challenge-2020/>) is also being supported WeObserve, the community activity on EO and CS, and by GEO.

A strategy for 2<sup>nd</sup> period description will be provided in the updated deliverable D4.3 Citizen Observatories and GEO Community Activities, which is due at the end of January 2020.

## 4 Conclusion

In conclusion, citizen science is having an ever-increasing impact on GEO through, among other actions, the earth observations and citizen science activity supported extensively by WeObserve, together with the Citizen Observatories themselves. The community activity is actively meeting on a regular basis via telecons. The activity involves active participation from both European and North American partners, along with strong links to other CS experts around the globe. The activity has jointly organized numerous side-events, keynote presentations, capacity-building events and has generally succeeded in raising the profile of citizen science within the earth observation community and in particular within GEO.

WeObserve is also working to enhance the uptake of citizen science data within GEO and GEOSS by helping to develop standards on interoperability for CS data. This will help to ensure that all CO's apply similar standards to all of their data, simplifying the uptake of CS data in GEOSS. Currently this is seen as one of the stumbling blocks preventing a wider uptake of CS data.

Finally, the community activity on Earth observations and citizen science is planning to advance their actions to the level of a GEO initiative. If successful, this would come into effect for the 2020-2022 GEO Work Program. This would provide additional visibility for citizen science within GEO and would help to further the overarching goal of WeObserve, namely, to strengthen the contribution of citizen science to GEO and the reciprocal benefits for citizen science from such enhanced connectivity.

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