



An Ecosystem of Citizen Observatories for Environmental Monitoring

Citizen Science Interoperability Experiment (CitSciE)

Inception Report

Prepared by CREAM, JRC, ESA, IIASA

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WeObserve Partners



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List of abbreviations and acronyms

Abbreviation	Meaning
CoP	Community of Practice
CS	Citizen Science
CR	Change Request
CSGP	Citizen Science Global Partnership
ER	Engineering Report
DAB	Discovery and Access Broker
GEOSS	Global Earth Observation System of Systems
ICT	Information and Communication Technology
OGC	Open Geospatial Consortium
PPSR	Public Participation in Scientific Research

1 Summary

The goal of this OGC Interoperability Experiment (IE) is to demonstrate the interoperability within Citizen Science (CS) projects and the way OGC standards can be applied to Citizen Science. This IE specifically addresses the following topics:

- The use of OGC standards or (e.g. Sensor Web Enablement (SWE)) to support data integration among CS projects, and with other sources, esp. authoritative data (e.g by following SWE4CS);
- The integration of CS projects/campaigns in Single Sign-On system (SSO) federation;
- The relationship(s) between OGC standards and data and metadata standards currently used by CS projects.

This IE is promoted by the OGC Citizen Science Domain Working Group, and the WeObserve¹ and NextGEOSS² H2020 projects. This IE contributes not only to the interoperability and possibly standardization program of the OGC, but also to the Global Earth Observation System of Systems (GEOSS). There is also the newly emerging Citizen Science Global Partnership (CSGP) first call for participation. Regional and national Citizen Science Associations will equally benefit from the results of this OGC IE.

Citizen Science is highly heterogeneous by nature and current standardization efforts occur in the OGC (e.g. addressing data model and sharing issues) as well as outside the OGC (primarily addressing project descriptions and data set metadata). Citizen Science projects might benefit from concrete examples and best practices required to achieve the full benefits of interoperability. OGC is in the ideal position to develop and provide such best practice guidance to the international community. This IE Activity Plan proposes a tentative architecture. The precise architecture and scenario for showcasing working solutions will be defined during the kick-off meeting when all interested participants and their possible contributions are known. Even if this IE focuses on a particular scenario, developed solutions should be applicable to most Citizen Science projects. Findings from this IE will be generalized in this manner and might set the basis for additional experimentation in the future.

2 Initiators Organizations

The OGC members that are initiators of this Interoperability Experiment are:

- International Institute for Applied Systems Analysis – IIASA
- Joint Research Center (JRC)
- European Space Agency (ESA)
- Universitat Autònoma de Barcelona – CREAF

Contact information for initiator organizations is contained in Annex A.

¹ <https://www.weobserve.eu>

² <https://nextgeoss.eu>

International Institute for Applied Systems Analysis – IIASA and Universitat Autònoma de Barcelona – CREA are supported by the WeObserve project. WeObserve is funded by the European Union’s Horizon 2020 Research and Innovation Programme under grant agreement No. 776740.

3 Linked Activities

This activity is promoted and endorsed by the OGC Citizen Science Domain Working Group and:

- Contributes to the Citizen Science Association’s International Working Group on Citizen Science Data and Metadata (<http://citizenscience.org/association/about/working-groups/data-and-metadata-working-group/>).
- Contributes to the Citizen Science COST Action - CA15212: to promote creativity, scientific literacy, and innovation throughout Europe (<https://www.cs-eu.net/about/CA15212>).
- Contributes to the Citizen Science Global Partnership (CSGP) first call for participation (<https://www.wilsoncenter.org/article/concept-note-citizen-science-global-partnership>).
- Contributes to the Earth Observations and Citizen Science Community Activity of the GEO Work Program (<http://earthobservations.org/activity.php?id=142>).
- Contributes to the EuroGEOSS initiative (https://ec.europa.eu/info/research-and-innovation/knowledge-publications-tools-and-data/knowledge-centres-and-data-portals/eurogeoss_en).
- Is supported by the H2020 project WeObserve (<https://www.weobserve.eu>) (CoP3), the H2020 Citizens’ Observatory projects Grow (<https://growobservatory.org/>), Groudtruth 2.0 (<http://gt20.eu/>), Landsense (<https://landsense.eu/>) and Scent (<https://scent-project.eu/>), and the NextGEOSS project (<https://nextgeoss.eu/>).

4 Participant Organizations

The following OGC Member organizations are an initial list of participants in the CtiSciE.

- Universitat Autònoma de Barcelona – CREA
- International Institute for Applied Systems Analysis – IIASA
- Secure Dimensions
- Open Geospatial Consortium, Europe
- Institute of Communication and Computer Systems – ICCS
- Joint Research Center
- European Space Agency
- United States Geological Survey

A complete list of participating organizations will be created in the kick off meeting and might be regularly updated.

Contact information for participant organizations is contained in Annex B. Other organizations and their contributions, as they come onboard, will be updated in the OGC Web Portal project and in the WeObserve portal.

Organizations participating in this IE are encouraged to become members of the OGC before the interoperability experiment begins but this is not mandatory. The IE will be open to non-OGC member observers provided they sign a participant agreement. Participants are expected to get visibility of their activities and increase interoperability and plug-ability of their solutions. The Engineering Report (ER) resulting from this experiment will show their contributions and capacity and will be exposed as a public ER in the OGC website. One function of the IE and the resulting ER is to evaluate new technologies. Their participation will be acknowledged at the beginning and at the end of a video demonstration that will be produced showing the results.

5 Description

The primary focus of this experiment is to demonstrate the interoperability of Citizen Science (CS) projects and the way OGC standards can be applied to Citizen Science, including possible relationships to other relevant standards from the community. In particular, a subset of these topics will be addressed depending on the participant organizations:

- The use of OGC standards (e.g. SWE4CS³) to support data integration among CS projects, and with other sources, esp. authoritative data;
- The integration of CS projects/campaigns in Single Sign-On system (SSO) federation;
- The relationships between OGC standards and data and metadata standards currently used by CS projects.

The desired outcome of this experiment is to:

1. Successfully demonstrate how OGC standards (e.g. SWE) are applicable to Citizen Science, document available supporting tools, identify the challenges of using OGC SWE standards (or Internet of Things equivalent solutions) within current CS projects, and propose a way forward.
2. Determine the security considerations and the available tools to support a SSO federation that helps users in participating in several projects by using a single user account.
3. Assess the possible relationships of OGC standards (e.g. SensorML) with other existing standards in the field (e.g. Public Participation in Scientific Research (PPSR) - Core, the ontology developed by the COST Action on Citizen Science, and the Citizen Science Definition Service (CS-DS) developed in the NextGEOSS project).
4. Satisfy the necessary requirements to integrate CS into GEOSS by using OGC standards.

This experiment is designed to demonstrate how current ICT-based tools can be applied together to allow better citizen participation in CS projects and enable better reuse of the data gathered. The results of the experiment will be documented in an OGC Engineering Report (ER), be presented in a demonstration event that may result in a video recording, and may result in change requests to OGC standards as appropriate. Participants in the experiment are expected to contribute to the

³ https://portal.opengeospatial.org/files/?artifact_id=70328

interoperability experiment activities, demonstrations and the ER. This IE may also result in an OGC standardization best practice document or a new extension or profile of current OGC standards. These will be promoted by the Citizen Science Domain Working Group in OGC and the CS activities in the work plan of GEOSS.

5.1 Background

The FP7 Citizen Observatory Web (COBWEB) project was the first to propose the use of SWE in CS. This work resulted in an OGC public discussion paper available on the OGC website (OGC 16-129). The discussion paper describes a data model for the standardized exchange of citizen science sampling data based on SWE standards. This discussion paper was the initial motivation for this IE.

On the other hand, the Citizen Science Association's International Working Group on Citizen Science Data and Metadata that developed the (PPSR-Core), the ECSA has a working group that recognizes the value of standardization in the CS activities (supported by the COST Action). However, these activities could benefit from some experimentation that would be able to suggest common best practices while recognizing the particularities and current approaches in different thematic domains, such as biodiversity monitoring. Citizen Science can complement authoritative in-situ observations and fill the information gaps in numerous scientific disciplines that could be essential for informed decision making. In that sense, the way CS can be integrated into GEOSS (including GEOSS-Data Core as the pool to promote and share open and free data) is still under investigation.

The 'Ecosystem of Citizen Observatories (CO) for Environmental Monitoring' — WeObserve project is a Horizon 2020 funded project focused on improving the coordination between existing COs and related regional, European and international activities. WeObserve tackles three key challenges that face COs: awareness, acceptability and sustainability. The CoP3 is about Interoperability of Citizen Science projects. WeObserve project – via its CoP activities – represents an opportunity to promote interoperability experiment in collaboration with the OGC. Such collaboration would address questions raised in the SWE4CS discussion. In addition, it offers the possibility to directly feed the results into the OGC relevant standards and promotes their usage within GEOSS (as an important user community of OGC standards).

5.2 Use Case

Specific use cases that will be tested in this experiment include, but are not limited to:

- Conflation of the data sets from two or more CS projects, which deal with the same data types, into a single new integrated data set.
- Assimilation of data from CS projects with complementary authoritative data.
- Participation in two or more CS projects using a single user account.
- Exposing the outcomes (data) of a CS project as a data provider in GEOSS – ideally as part of the GEOSS-Data Core.
- Exposing a newly assimilated data set, including CS inputs in GEOSS.

5.3 Scenario

Technically speaking, the approach is applicable to any data type that a CS project may collect. During the kick-off meeting, and depending on the resources provided by the participants, a motivational scenario will be defined.

The scenario should propose the merging of CS projects datasets to cover a larger geographic area or coordinate topics in order to satisfy the needs of GEO in terms of providing data necessary to deal with climate change, measure the progress towards the Sustainable Development Goals (SDGs) and disaster management.

As a guiding example, the following motivational scenario could be inspirational. An outbreak of mosquito carried disease both in Spain and in Italy is detected. There is the need to create a global early warning system to monitor the evolution of the outbreak and prevent the contagious spreading of the disease. In the experiment, we discover the existence of some CS projects and we build an integrated database that is published and available through the GEOSS infrastructure.

5.4 Data

The following data will be available for the Interoperability Experiment:

- Existing CS projects datasets, for example a Mosquito Alert database, databases about Invasive Alien Species, etc;
- Relevant existing datasets, for example, existing authoritative data about species occurrences and remote sensing data will be made available;
- Existing metadata about CS projects.

5.5 Experiments

The experiment will attempt to address the following experiments:

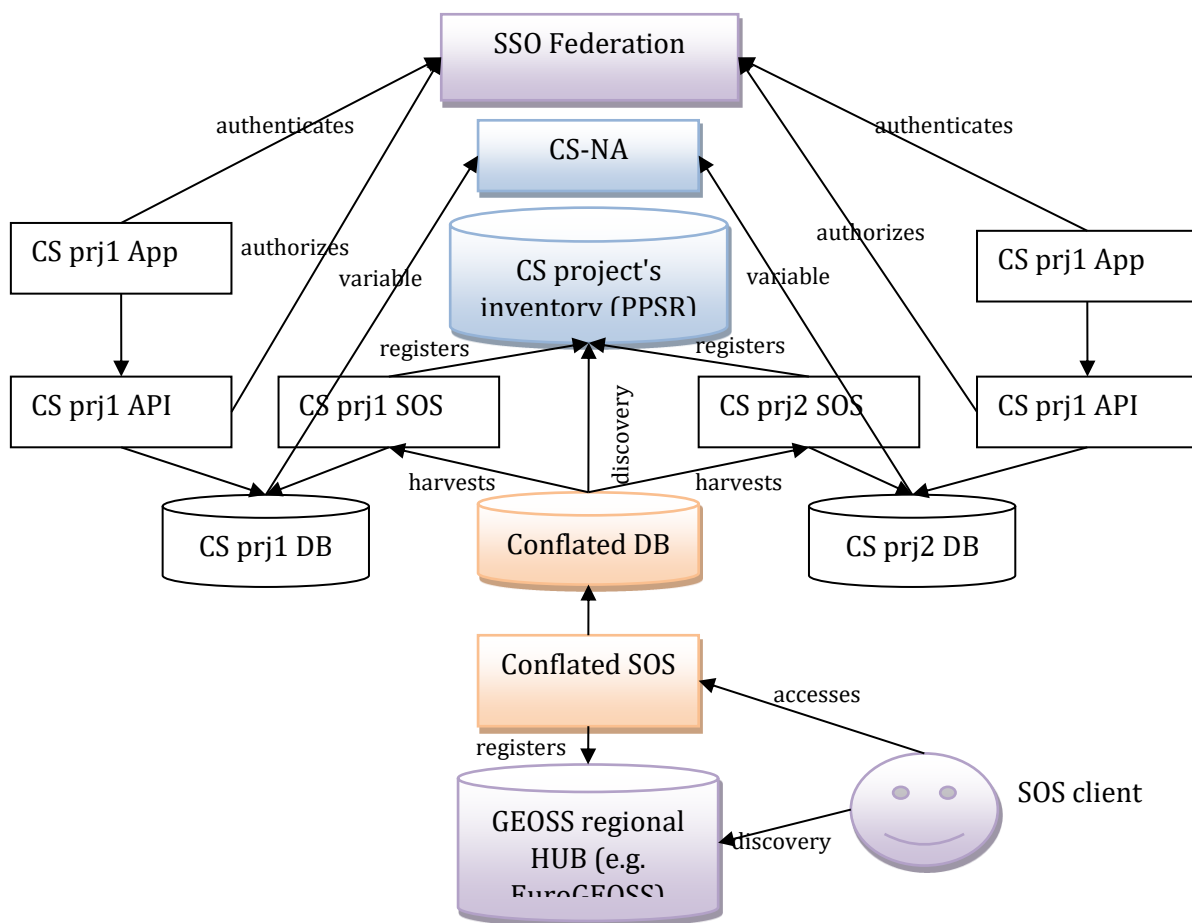
- **Experiment #1:** An expert needs to know the big picture about some topic, such as an outbreak of a mosquito carried disease or invasions of a particular alien species. They know that there is no (or little) authoritative data about the topic available, so they look for alternative CS projects that might provide the required data to analyze the problem at hand.
- **Experiment #2:** A conflated dataset is built based on local or regional CS projects' data.
- **Experiment #3:** The expert travels to different places to analyze the situation on the ground and then report what they see in two different CS projects apps using the same user account.

6 Technical Approach

The Technical Approach for this Interoperability Experiment focuses on leveraging existing OGC Standard and suggesting best practices and profiles for these standards to better meet CS requirements. The following section describes the Technical Approach in more detail.

6.1 Experimental Methodology

The proposed experiment overview is described in this section. Changes to this architecture can be agreed at the beginning of the experiment depending on the participant in-kind resources involved. The intent, however, is to maintain the general concept.



The diagram illustrates an architecture that can support the 3 experiments indicated in the previous section.

In both sides of the upper half of the diagram, we can see several CS projects. Please note that the diagram is a simplification representing two CS projects (in both sides of the picture) but it can be extended to more CS projects. The projects have an API to communicate with its respective App and they also have an OGC SOS service that provides a standardized endpoint to get the data. The CS projects participating in the experiment will need to have or to incorporate a component enabling the SOS protocol and expose their data model following the SWE4CS recommendations. They will also need to understand the utilization and evaluation of the O&M general model to encode human or machine related observations (as of the application profile provided in the SWE4CS documentation).

At the top we see a Single Sign On (SSO) federation component that enables the projects to share the same user account. Both the app and the server need to be connected to the SSO federation for authentication and authorization. In principle, the SSO federation shown in the diagram can be composed by more than one element (e.g. the NextGEOSS SSO and the LandSense federation) and this experiment can help determine existing technical barriers if any.

In the middle of the diagram (in orange) we see that a conflated database can be build by harvesting the data from the individual SOS services of the CS projects. This step might require some semantic mediation. This is represented by the fact that both are pointing to the same concepts in the CS-NA.

Even if both projects use SOS services, in practice they probably expose different data models characterized by the particularities and objectives of the individual projects. They should have a common ground if the data shares the same data types.

This database can also be exposed as an additional SOS Service and this one is registered in a GEOSS regional data hub that is eventually connected to the GEOSS Platform⁴ (not shown in the diagram). The elements that are foreseen as part of the GEOSS Platform are represented in purple in the diagram.

The interoperability experiment will start by agreeing on a common architecture and a set of components inspired by the ones presented in the diagram but conditioned by the resources contributed by the participants in the experiment.

6.2 Specification Development

The primary focus of this experiment will be in SWE4CS with a secondary focus on SSO. Resulting interface definitions will then be considered for change requests against existing OGC standards. The IE will also consider the project descriptions metadata standards and will give feedback to the COST Action on Citizen Science.

The list of OGC standards and other specifications that may be affected includes (but not limited to):

- OGC Sensor Observing Service (SOS)
- OGC SensorML
- OGC Sensor Things API
- OGC SWE4CS
- OGC Web Services Security
- Citizen Science – Definition Server (SC-DS)
- Project description metadata standards
- PPSR-Core
- W3C Semantic Sensor Network Ontology (SSN)

6.3 Contributed Components

The following components will be contributed concurrently by the responsible organization(s), to be completed by the execution end date.

Description	Contributor(s)
CS Project 1 app	
CS Project 2 app	
CS Project 1 service	
CS Project 2 service	
CS Project 1 SOS	
CS Project 2 SOS	

⁴ It is collection of components that facilitates System of Systems (GEOSS). It is currently composed by the GEOSS Portal the GEO Discovery and Access Broker (GEO DAB), the Yellow pages, etc. It was <http://www.earthobservations.org/gci.php>

Database for the Conflated CS dataset	
Conflated CS SOS	
CS SOS client	
SSO service	
DS-CS	NextGEOSS
European Regional Data Hub	NextGEOSS

The NextGEOSS Horizon 2020 project is committed to provide support to the experiment in terms of the Citizen Science Definition Service (CS-DS) and the NextGEOSS European regional data hub (as a proxy for a future EuroGEOSS data HUB).

Other related services/clients that will be included:

Description	Sponsor / Implementor(s)

6.4 Testing and Integration

This section lists some elements of the methodology for participating in the experiment:

- Establish a distributed virtual testbed environment where applications are hosted by participants with WeObserve support if needed.
- TWiki provided by the OGC for collaboration.
- GitHub
- Regular testing and integration that will be largely focused in implementation of the demonstration use cases.
- Two face-to-face or virtual testing and integration sessions are proposed, one at the beginning of the testing and integration period and one directly prior to the demonstration.
- During and immediately after the kickoff, establish a test plan and metrics to test objectives and use cases documented in this activity plan as appropriate.
- Biweekly teleconferences to report on the progress of the activities.
- Implementation of new services and connectors is not a requirement in this experiment but could be done if needed.

7 Deliverables

The documentation listed below will be considered the deliverable for the project.

7.1 Documentation

The following documentation will comprise the deliverables for the project. All artifacts and results associated with the experiment will be made available to OGC members.

- Engineering Report discussing the details and results. The report will include but not be limited to summaries of the activity plan, test plan et al supporting documentation as appropriate.

- Change Requests for OGC Standards as appropriate.
- Candidate OGC CS Best Practices as appropriate.

7.2 Demonstration

An Internet demonstration of all functioning components will be made towards the end of the experiment.

This demonstration will be made persistent using the resources of OGC Network.

A video recording of a public demonstration the experiment will be produced.

8 Schedule (Tentative)

Startup	
Draft activity plan presented to CS DWG:	Mar 19 th , 2018
OAB revision and approval:	June 4 th , 2018
Call for participation:	June 5 th , 2018
Pre-kickoff event ECSA conference in Geneva:	June 6 th , 2018
Execution	
Official Kickoff after the Stuttgart TC (adding participation of the non present in ECSA conference) (TBC):	September 14 th , 2018
Development, testing and bug fixing 2016	September to February
Presentation at GEO plenary in Tyoto	Oct 31 st – Nov 11 th 2018
Meeting at the Citizen Observatories for Natural Hazards and Water management Conference ⁵	Nov 27 th – Nov 30 th 2018
Planned end date:	March, 2019
Wrap-up and Reporting	
Technology Demonstration in a OGC TC	March 2019
Final report submission	June 2019

Note: Additional milestone dates will be added at the kickoff meeting.

⁵ <https://www.cowm.eu>

9 Resource Plan

The Initiative Manager will be Ester Prat, CREAM and Initiative Technical Lead will be Joan Masó, CREAM. The OGC Initiative facilitator will be Bart De Lathouwer, OGC.

The following resources will be available.

<i>Staffing</i>	<p>WeObserve will provide sufficient resources to ensure the main thread of this experiment is completed in accordance with the requirements of this activity plan and supporting documentation.</p> <p>NextGEOSS will provide additional support for the CS-DS.</p> <p>The other initiators agreed to support this activity to the degree necessary to ensure the completion of this experiment.</p> <p>Participants will provide sufficient resources to ensure completion of their agreed upon area of this experiment in accordance with this activity plan and supporting documentation.</p>
<i>Software</i>	As needed, mainly open-source tools, services, and client applications.
<i>Other Resources</i>	Machine, software and technical resources available at CREAM

10 Requirements for Participation

In order to become a participant in this experiment, an organization must be willing to make a resource commitment for a substantial contribution in one or more of the following areas:

- An service component exposing its resources, or
- a consumer application that can use the service to exploit the data, or
- testing of the Services/Clients, or
- a server to host a experiment component, or
- data to support the experiment, or

compilation of documentation into one or more of the experiment deliverables (note that all participants must also provide sub-reports for inclusion in the final reports)

Annex A: INITIATOR ORGANIZATIONS – Contact Information

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An Ecosystem of Citizen Observatories for Environmental Monitoring

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