



# Deliverable D4.5

Report on standardisation  
contributions and interactions with  
relevant initiatives (GEOSS, INSPIRE,  
other CO projects)



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Abstract of deliverable	Ground Truth 2.0 delivers the demonstration and validation of six scaled up citizen observatories in real operational conditions, both in the EU and Africa. An important focus of WP4 was to coordinate with other relevant initiatives, such as GEOSS, INSPIRE and the EU projects funded under the same call, namely Grow, Scent and Landsense, to create mutual synergies. This document presents a summary of the interaction with standards organizations and the standards where Ground Truth 2.0 had editorial presence, of Ground Truth 2.0 activities conducted in GEO tasks for the work plan 2017 – 2020, interactions with relevant EU projects and initiatives as well as an overview of communication and dissemination activities, including the Ground Truth Week and online (social media) dissemination activities.

## Versions and Contribution History

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V0.2	28.10.2019	Dorothee Baur	Inclusion of Ground Truth Week material
V0.3	28.10.2019	Joan Masó	Standardisation contributions, Liaising with with GEO and other initiatives sections finalised Drafting Way forward and conclusions
V0.4	28.10.2019	Uta Wehn	Detailed structure for dissemination and communication activities
V0.5	29.10.2019	Ester Prat	Inputs for dissemination and communication activities
V0.6	30.10.2019	Uta Wehn	Input on dissemination and communication activities; edits throughout; finalisation of Future activities and

			Conclusions
V0.7	30.10.2019	Uta Wehn	Revision of minor aspects according to reviewers' comments; composition of Executive Summary.

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## List of abbreviations

AIP	Architecture and Interoperability Pilot
Cit Sci	Citizen Science
CitSciE	Citizen Science interoperability Experiment
CS-DS	Citizen Science Definition Service
CSGP	Citizen Science Global Partnership
CSS	Cascading Style Sheets
CoP	Community of Practice
DWG	Domain Working Group
ER	Engineering Report
ESA	European Space Agency
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GMU	George Mason University
HTML	HyperText Markup Language
MapML	Map Markup Language
Map4HTML	Map for HyperText Markup Language
NAD	Non Authoritative Data
NGA	National Geospatial Intelligence Agency
OGC	Open Geospatial Consortium
O&M	Observations and Measurements
PPSR	Public Participation in Scientific Research
WP	Work package
SDGs	Sustainable Development Goals
SWE	Sensor Web Enablement

SWE4CS	Sensor Web Enablement for Citizen Science
SSO	Single Sign-On system
TIE	Technology Integration Experiments
WCS	Web Coverage Service
WMS	Web Map Service
WMTS	Web Map Tile Service

## Executive Summary

The main objective of the Dissemination and Communication Work Package of the Ground Truth 2.0 project was to effectively communicate and disseminate information about the activities, progress and results of Ground Truth 2.0 to the widest possible range of key stakeholders in Africa and Europe. In line with this, an important focus of WP4 was to coordinate with other relevant initiatives, such as GEOSS, INSPIRE and the EU sister projects funded under the same call, namely Grow, Scent and Landsense, to create mutual synergies.

The Ground Truth 2.0 project has been able to support standardization process of citizen observatories by leading the **Open Geospatial Consortium** (OGC) Technical committee working meetings of a regular Citizen Science domain working group and an ad-hoc Non-Authoritative Data group. A total of thirteen individual meetings have been chaired contributing to the creation of a common view in the OGC on how to apply geospatial standards in citizen science project in all phases of the data management cycle but more focussed on that acquisition and data sharing. These meetings will continue with the support for the H2020 WeObserve and other future projects.

The Ground Truth 2.0 project was one of the main contributors in the **Citizen Science Interoperability experiment**, providing both services and clients that interacted with components provided by other participants in Technology Integration Experiments (TIE) demonstrating interoperability and integration of data coming from different sources.

The OGC API process has been actively monitored and has impacted on the original aim of the standardization process. The OGC SOS was initially recommended by a public discussion paper in the OGC website but the current tendency towards the use of web API based solutions suggest that the use of SensorThingsAPI is a better alternative that need more experimentation and documentation that would be addressed beyond the Ground Truth 2.0 project.

The **GEO Earth Observation Citizen Science Community Activity (GEO CITSCI)** under GEO was initially proposed by the European Commission before the Ground Truth 2.0 project started. During the Ground Truth 2.0 project, the group professionalised its activities and became fully international, embraced by American and Australian contributors and participants. This year has seen the establishment of the group's thorough modus operandi and contributions to the GEO Symposium 2019, the GEO Summit 2019 and the GEO Work Programme 2017-2020. Europe is still co-leading the group and will continue doing so throughout the duration of the WeObserve project.

For **coordination with other EU projects**, Ground Truth ensured a regular exchange of information on the progress of each project, joint participation in meetings upon request of the European Commission to promote the outputs of the projects and the alignment of dissemination and communication activities (common dissemination booster).

For **communication and dissemination** purposes, Ground Truth 2.0 used a wide range of tools, channels and measures to communicate about the project's existence and to disseminate specific results. In line with the project's Communication and Dissemination Strategy, distinct stakeholders and audiences were targeted, using different modalities. In total, Ground Truth 2.0 participated in **86 outreach events**. A milestone among these efforts was the **Ground Truth Week** which was held from 30 September – 4 October and consisted of both webinars, local events and a face-to-face event at IHE Delft, The Netherlands. **Social media** tools have been used to create a critical mass of "followers" of Ground Truth

2.0 activities and enabled the promotion of Ground Truth 2.0. The Ground Truth 2.0 Twitter account currently has 976 followers and the number of tweets, retweets, likes, tweet impressions and followers has steadily increased during the duration of the project.

**Future activities:** Now that Ground Truth 2.0 coming to an end, it is time to look for other means to continue doing what we have done. In our case, this is going to be particularly easy because both IHE Delft and CREAM are members of the H2020 WeObserve project that shares the objective to continue making progress on the standards and on the GEO connection.

# **1 Introduction**

## **1.1 Background**

Ground Truth 2.0 is a three year project funded under H2020 by the European Commission. It has delivered the demonstration and validation of six scaled-up citizen observatories in real, operational conditions, with four European and two African demonstration cases. Ground Truth 2.0 demonstrated the technological feasibility, the sustained use and the societal and economic benefits of such citizen observatories. The ultimate objective is the global market uptake of the concept and enabling technologies.

The main objective of the Dissemination and Communication Work Package (WP4) was to effectively communicate and disseminate information about the activities, progress and results of Ground Truth 2.0 to the widest possible range of key stakeholders in Africa and Europe. In line with this, an important focus of WP4 was to coordinate with other relevant initiatives, such as GEOSS, INSPIRE and the EU sister projects funded under the same call, namely Grow, Scent and Landsense, to create mutual synergies.

## **1.2 Purpose and Structure of this report**

The purpose of this report is to summarise the undertaken standardisation efforts, liaisons and dissemination and communication activities. This report is structured as follows. Chapter 2 summarises relevant standardisation activities and liaisons, while Chapter 3 reports on the collaboration with the Group on Earth Observation (GEO) and other initiatives. Chapter 4 presents the activities related to INSPIRE and Chapter 5 summarizes the dissemination and communication activities undertaken during the Ground Truth 2.0 project, including the Ground Truth Week and social media activities. Chapter 6 and 7 round off the report with an overview of future activities and conclusions.

## 2 Standardisation contributions

### 2.1 Contributions to the OGC Technical Committee meetings

Ground Truth 2.0 contributed to the management and content of two main working groups in the Technical Committee: Citizen Science Domain Working Group (DWG) and Non Authoritative Data ad-hoc group. In the Open Geospatial Consortium (OGC) these groups meet regularly in events that are happening every 3 months in different parts of the world. CREAM co-chaired these meetings and Ground Truth 2.0 was presented in many of them. The following subsections detailed the agendas for each one of them.

#### 2.1.1 OGC Citizen Science DWG

In 10 March 2016 in Washington DC Agenda the COBWEB project under the lead of the OGC developed a data model for interoperable exchange of Citizen Science information. The model was based on Sensor Web Enablement (SWE) and Observations and Measurements (O&M) and run under the name SWE4SC. The model was introduced to various domain experts in the OGC Technical Committee (TC) meetings such as at the 2015 Nottingham TC, Sydney TC and at Joint Research Center is to write a charter to form a Domain Working Group (DWG) initially chaired by Andreas Matheus. Since the COBWeb project came to an end, the beginning of the Ground Truth 2.0 project has taken the lead in organizing a face to face meeting of the OGC community interested in Citizen Science. The Citizen Science Domain Working Group (<https://www.opengeospatial.org/projects/groups/citizenscience>) addresses the citizen science relevant aspects of interoperability chartered by data life cycle:

- Hardware communication (standards used by sensors communicate e.g to a mobile phone);
- Data acquisition (how devices send data to repositories);
- Data storage and dissemination (how repositories make data discoverable and available); and,
- Data curation and preservation (how the data is maintained in particular in the long term when the actual data campaign is finished).

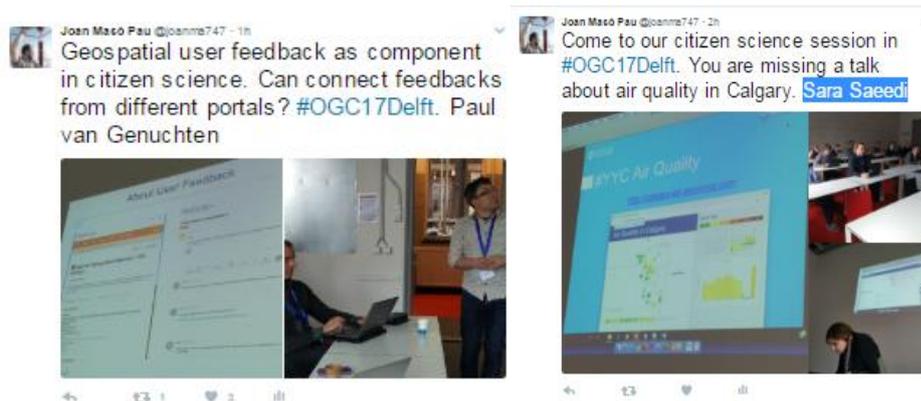
The DWG addresses additional aspects of interoperability that affects all stages of the data life cycle, including: Privacy, security, trust as well as quality and semantics. The DWG is chaired by CREAM as part of its contribution to Ground Truth 2.0/ Since the beginning, CREAM led a face to face session almost every 3 months with some interruptions when the TC meeting happens to far away.

Table 1 presents an overview of the OGC Technical Committee Meetings. The detailed agendas of these meetings can be found in Annex 1.

**Table 1 OGC Technical Committee Meetings**

Meeting No	Location	Date
102nd OGC Technical Committee	Delft, The Netherlands	23 March 2017
104th OGC Technical Committee	Southampton, United Kingdom	11 September 2017
105th OGC Technical Committee	Palmerston North, New Zealand	4 December 2017
106th OGC Technical Committee (incl discussion on Non Authoritative Data)	Orléans, France	18 March 2018
108th OGC Technical Committee (incl discussion on Non Authoritative Data)	Stuttgart, Germany	13 September 2018

109th OGC Technical Committee (incl discussion on Non Authoritative Data)	Charlotte, NC USA	11 December 2018
110th OGC Technical Committee	Singapore	28 February 2019
111th OGC Technical Committee		
112th OGC Technical Committee	Banff, Canada	12 September 2019
113th OGC Technical Committee	Toulouse, France	19 November 2019



### Non Authoritative Data

In addition to the regular Citizen Science sessions, the co-chairs of Data Quality DWG, Citizen Science DWG, Smart Cities DWG, and Geospatial User Feedback SWG the possibility of explored the creating a new group on Non Authoritative Data (NAD) that have met in an ad-hoc bases. The group was not finally established as a regular group despite having interesting discussions

The term 'non-authoritative data' describes any data contributed from other than officially recognized spatial data producers (a government agency or other nominated data custodian).

During the meeting a list of possible use cases was elaborated:

- Annotation of images to use in machine learning (<https://www.zooniverse.org/>)
- Artificial intelligence to assess the data quality.
- Combining data from different scales in a single dataset.
- Candidate geo-synchronization standard
  - [https://portal.opengeospatial.org/files/?artifact\\_id=76559&version=1](https://portal.opengeospatial.org/files/?artifact_id=76559&version=1)
  - Partially originated in Data synchronization and GeoPackage on Testbed 13.
- Crowdsourcing of more than one source: License IPR + harvesting APIs interoperability.
- Blockchain and provenance and traceability.
- Need for APIs (or web services) for *pushing* data around geo-synchronization (again)

## 2.2 Contributions to the OGC Interoperability Experiments

CREAF has led the process of the OGC Citizen Science interoperability Experiment (CitSciE). The CitSciE is designed to demonstrate how current ICT (Information and Communication Technologies)-based tools can be applied together in a standard way to better enable citizens to participate in Citizen Science projects, as well as improve the reusability of the data gathered, overcoming the isolation of individual initiatives. The CitSciE has demonstrated the interoperability of Citizen Science projects and the way that OGC standards (and maybe others) can be applied to Citizen Science data. Initially, the following topics were suggested:

- The use of OGC standards (e.g. Sensor Web Enablement for Citizen Science (SWE4CS)) to support data integration among Citizen Science projects, and with other sources, especially authoritative data;
- The integration of Citizen Science projects/campaigns in Single Sign-On system (SSO) federation;
- The relationships between OGC standards and data and metadata standards currently used by Citizen Science projects.

The desired outcome of this experiment was:

- Successfully demonstrate how OGC standards (e.g. SWE or SensorThings API) are applicable to Citizen Science, document available supporting tools, identify the challenges within current Citizen Science projects, and propose a way forward.
- 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.
- 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).
- Satisfy the necessary requirements to integrate Citizen Science into Global Earth Observations System of Systems (GEOSS) by using OGC standards.

On 6 June 2018, WeObserve - an EU-funded H2020 Coordination and Support Action - with assistance from NextGEOSS, held a pre-kickoff meeting for the CitSciE. About 25 people attended the meeting and two groups started discussions on data sharing and project description metadata. Our desire is that more participants can join when the official kick-off will take place.

The CitSciE is designed to demonstrate how current ICT (Information and Communication Technologies)-based tools can be applied together in a standard way to better enable **citizens** to participate in **Citizen Science** projects, as well as improve the reusability of the data gathered, overcoming the isolation of individual ...



**CitSciE**

**Citizen Science Interoperability Experiment | OGC**  
<https://www.opengeospatial.org/projects/initiatives/citsci-ie>

Figure 1 Citizen Science Interoperability Experiment

The Ground Truth 2.0 project contributed to the Interoperability Experiment in two ways. On one hand, we lead the process to start the interoperability experiment and coordinate the event. On the other hand we were one of the main contributors to interoperable clients and services showing data from the six citizen observatories built in the context of the Ground Truth 2.0 project. The Ground Truth 2.0 services were in the core of the experimented architectures as well as the H2020 Grow and the HackAir data. The following illustration indicates shows the Ground Truth 2.0 client interoperating with the HackAir data (represented as balloons).

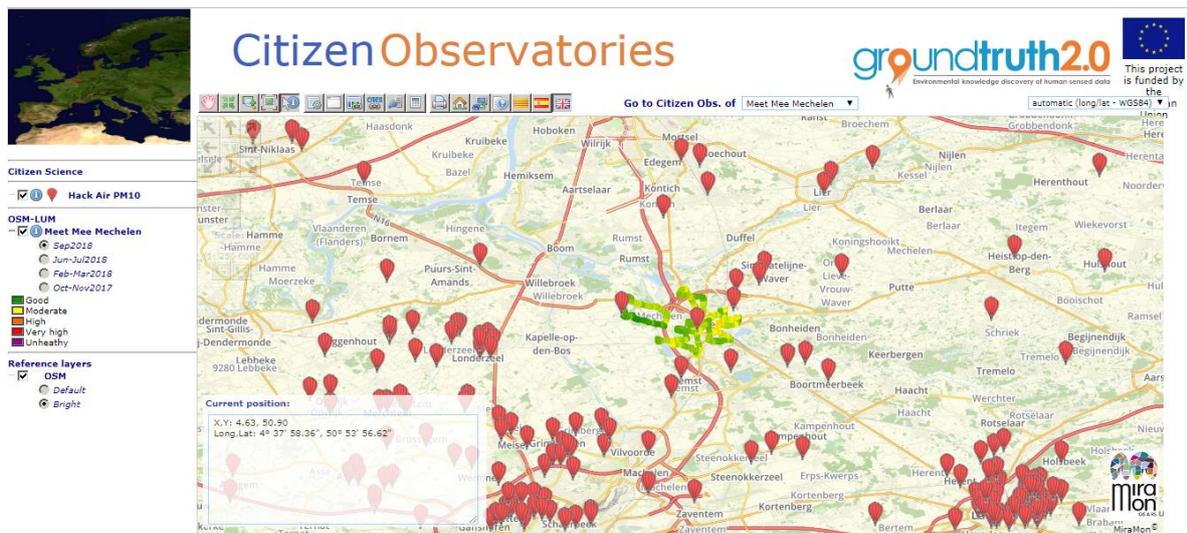
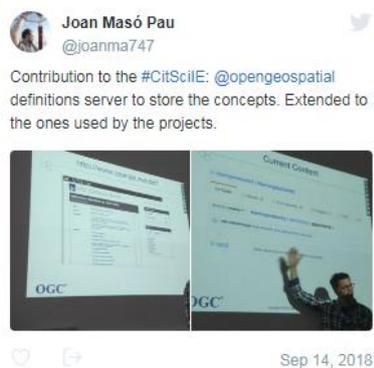


Figure 2 Ground Truth 2.0 client interoperating with the HackAir data

The following is the list of teleconferences where Ground Truth 2.0 was represented:

- [First telecon](#) (27 June 2018)
- [Second telecon](#) (28 August 2018)
- [3rd telecon](#) (10 October 2018)
- [4th telecon](#) (7 November 2018)
- [Focussed telecon](#) (3 December 2018)
- [5th telecon](#) (20 December 2018 3:00 PM CET)
- [6th telecon](#) (18 January 2019 3:00 PM CET)
- [7th telecon](#) (21 February 2019 1:00 PM CET)
- [8th telecon](#) (29 March 2019 9:30 AM CET)
- [9th telecon](#) (16 May 2019 4:00 PM CET)
- [10th telecon](#) (11 June 2019 3:00 PM CET)
- This is the list of face2face meetings where we attended:
- [Pre kick-off meeting](#) (June 2018)
- [Official kick-off meeting](#) (14 September 2018)
- [COWM conference meeting](#) (27 November 2018, 14.50) Venice
- [EGU conference meeting](#) (11 April 2019, 14.00) Vienna
- [BCN meeting](#) (25-27 November 2019) Barcelona

#### Stuttgart



#### Venice



#### e



The results of the Interoperability experiment will be captured in an Engineering Report that should be presented to the OGC technical committee meeting in Toulouse for approval as a public engineering report.

## 2.3 Contributions to the OGC API process

Recently, there has been some confusion between APIs and standards. In the old days, companies opted for closed systems with no documented formats or interfaces. Recently many vendors release some tailored APIs (many times paired to tailored JSON formats). The Google maps and the Twitter APIs are two well-known examples. This document recognizes that a Citizen Science project that publishes the API endpoint and the API documentation has done an important step to openness but this has nothing to do with interoperability. Open APIs allow others to build clients on top of some systems; but this position assumes that the others need to adapt their products to our personal view. In most cases, this reflects a dominant position in the market by providing a “single” web service that interacts with many clients, all of them technological lock-in to the server vendor. This approach does NOT provide interoperability between server systems, in the sense that clients and services from different vendors can communicate and be replaced if needed. It also does not reflect any aim to create the necessary consensus in the community to develop standards that many vendors can openly adopt and implement.

Nevertheless, we have to learn from the market that the approach based on web APIs is more dominant than the perspective of web services. The web APIs are an effort to adopt HTTP as the main protocol of the web and use it respecting the spirit of the original web that Roy Fielding formalized in his PhD dissertation "Architectural Styles and the Design of Network-based Software Architectures" at UC Irvine. Recently OpenAPI (formerly known as Swagger) has gained popularity as a way to document and present an API. Recently, the OGC has started a modernization of his web services to adapt them to the OpenAPI paradigm.

In order to leverage the capabilities offered by the APIs, OGC has initiated a body of work to develop draft standards for OGC APIs. But perhaps the most important impact was the leap of the OGC Web Feature Service (WFS) to rebuild the WFS standard as and API that uses an OpenAPI definition to describe of how to build against the standard. Clemens Portele and Panagiotis (Peter) Vretanos developed a major draft revision to the standard (then known as WFS3) and a group of developers tested the concepts and improved the content through a two day Hackathon in 2018.

Other OGC web service Standards Working Group (SWG) have been independently assessing OpenAPI and watching the WFS/FES SWG work closely. Numerous discussions occurred at OGC quarterly Technical Committee (TC) Meetings to consider those elements being developed in each SWG which should be common to all web API standards. These discussions came to a head at the February 2019 TC Meeting in Singapore, where the pattern “OGC API [resource]” was coined. The discussions in Singapore also resulted in the planning of an OGC API Hackathon to define and test common elements from Coverages, Catalogue, Map Tiles, and Processing standards work using foundational material from the Features work. The hackathon was hosted by the Ordnance Survey at the Geovation Hub in London, UK from 20 - 21 June 2019. The European Space Agency (ESA), Ordnance Survey and Geovation sponsored the event. The hackathon was also supported by the US National Geospatial Intelligence Agency (NGA). The goal of the hackathon was to advance the development of OGC API specifications by providing an environment and opportunity for the geospatial community to collaborate and work together. More than 70 individuals, included two members of CREAM participated in the event. Working collaboratively, the participants formed teams around the draft standards to develop, deploy, and test a variety of

implementations of OGC APIs. CREAM members focused on developing the new OGC API Map and Tiles and the OWS Common specification.



The new generation of OGC service will provide requirements for services that will mandate dual discovery mechanism based on landing pages and OpenAPI documents. If the approach gets traction other services including the Sensor Observation Service could also adopt the same approach and influence the standards selected for Citizens Science data.

Actually the SensorThings API was one of the first standards to adopt a RESTful approach and define an API that predates the new OGC API process. SensorThings API is based in ODATA (OASIS) that, despite being a RESTful standard is different from the OGC API Features approach. We hope that next version of SensorThings API can migrate to a common paradigm. SOS and SensorThings API are two very important standards for Citizen Science as they can support the data capture and data access part of the data management.

## 2.4 Contributions to the OGC Testbed

During the Ground Truth 2.0 project, CREAM actively participate in three big interoperability experiments that contributed to the advance of the applicability of some standards in the OGC in particular to the issue of data quality

Testbed-13: 2017

During Testbed-13, CREAM participated providing the following deliverables:

FA002: Data Quality Specification: <http://docs.opengeospatial.org/per/17-018.html>

OGC 17-018 (Testbed-13 Data Quality Specification Engineering Report) provides methods to quantify the quality concepts defined in OGC 17-032 and a way to include the quantifications in service descriptions. It extends QualityML quality metrics (that already includes ISO 19157) into the aviation domain. It lists a set of quantitative and conformance measurements that are specified in terms of quality measures, domains, and metrics (value types and units) and are appropriated for each quality type and data type. Secondly, it extends the SDCM to be able to encode and include the above mentioned quality information for each service in a interoperable way.

NR002: MapML ER: <http://docs.opengeospatial.org/per/17-019.html>

This Engineering Report discusses the approach of Map Markup Language (MapML) and Map for HyperText Markup Language (Map4HTML) described in: <https://github.com/Maps4HTML> and supported

by the community in <https://www.w3.org/community/maps4html/>. The objective of MapML is to define a hypermedia type for geospatial maps on the web that can be embedded in HyperText Markup Language (HTML) pages. MapML is needed because while Web browsers implement HTML and Scalable Vector Graphics (SVG), including the <map> element, those implementations do not meet the requirements of the broader Web mapping community. The semantics of the HTML map element are incomplete or insufficient relative to modern Web maps and mapping in general. Currently, robust web maps are implemented by a variety of non-standard technologies. Web maps do not work without script support, making their creation a job beyond the realm of beginners' skill sets. In order to improve collaboration and integration of the mapping and Web communities, it is desirable to enhance or augment the functionality of the <map> element in HTML to include the accessible user interface functions of modern web maps (e.g. panning, zooming, searching for, and zooming to, styling, identifying features' properties, etc.), while maintaining a simple, declarative, accessible interface for HTML authors. The objective of this Engineering Report is to explore how MapML can be harmonized with the OGC standards mainstream and contribute to the progress of the specification avoiding unnecessary duplication. In particular, the ER proposes Web Map Service (WMS) or Web Map Tile Service (WMTS) as services that can be used to deliver MapML documents with small modifications. Another consideration on the ER is the inclusion of the time dimension and directions operation in MapML.

#### **2.4.1 Testbed-14: 2018**

During Testbed-14, CREAM participated providing the following deliverables:

D012 - MapML ER: <https://docs.opengeospatial.org/per/18-023r1.html>

This is the second Engineering Report (ER) about the Map Markup Language (MapML) cite:[Rushforth2018] resulting from OGC Testbed initiatives. To find an introduction of MapML and how it works, please, refer to the previous ER OGC 17-019 cite:[Maso2018]. MapML is a new media type that can be included in a <layer> element of a <map> section, in a Hypertext Markup Language (HTML) page. This document is mainly focused on the description of the MapML media type and its evolutions. In particular, it considers issues about the Coordinate Reference System (CRS) types in MapML, feature and properties encoding, Cascading Style Sheets (CSS) symbolization, multidimensional data etc. This document describes two implementations done in OGC Testbed-14: a Cloud-based Proxy (cascade) for MapML done by CubeWerx and a ServiceWorker Proxy for MapML done by George Mason University (GMU). Finally, this document reviews how the next generation of OGC services can integrate MapML files as part of the designing of use cases and discusses how MapML can be used by social media. This document proposals increases functionality in MapML and makes proposals for increasing the interoperability of the proposed encoding with the OGC standards baseline and future generations of OGC standards for maps and tiles.

#### **2.4.2 Testbed-15: 2018**

During Testbed-15, CREAM participated providing the following deliverables:

#### D014 - WMTS draft specification:

The OGC API Maps and Tiles draft specification described in this ER builds on the precedent of the OGC API - Features - Part 1: Core standard. The OGC API - Tiles draft specification describes a service that retrieves data representations as tiles (generally small compared with the extent of the data. Tiles are organized into Tile Matrix Sets consisting of regular tile matrices available at different scales or resolutions. The OGC API – Tiles draft specification is described as a building block that can be plugged into an OGC API - Features service to retrieve feature based tiles (sometimes called vector tiles) or to an OGC API – Maps implementation to retrieve rendered tiles (sometimes called map tiles). In the future, other standards could adopt OGC API - Tiles as an extension, one possible candidate being OGC API - Coverages. This draft specification implements some functionalities specified by the Web Map Tile Service (WMTS) 1.0 standard related to the use of styles by using the Style draft specification also elaborated in the Testbed-15 Open Portrayal Framework.

#### D016 - WMTS-T draft specification.

The OGC API Images draft specification described in this Engineering Report (ER) builds on the precedent of the OGC API Features - Part 1: Core. The OGC API Images draft specification describes a standard service that stores a set of images such as a remote sensing product distributed as granules and offers an interface to manage these image sets. An image set is exposed by the image server as a list of images that has an id. The image service concept is new to the OGC family. Although the proposed service has some overlap with OGC Web Coverage Service (WCS). The image service is designed to be simpler to implement and focuses on regular gridded coverages only and has the capability to manage image sets by being able to specify operations to retrieve, add, modify or delete images set of images thus allowing for transactions to be done.

The Changeset building block describes a mechanism for partial updates to maintain synchronization between a server and a client cache that could be applied to any data service. Each retrieval of data from the server has associated a checkpoint id that is used in further communications. The standard specifies filter parameters that include the checkpoint as part of the query with the objective of retrieving only the elements that have changed in a image-set since the last checkpoint was retrieved. The draft specification also includes a specialization focused on how to use changesets in the OGC API tiles draft specification.

### 3 Liaising with GEO and other initiatives

The main contribution of Ground Truth 2.0 to GEO was the co-leadership by IHE Delft of the GEO Citizen Science Community Activity. Other contributions are also detailed in the sub-sections below.

#### 3.1 GEO Citizen Science Community Activity

Back in 2014, Citizen Science had no visibility in the GEO work plan (now renamed as work program). As a request from the EC, the FP7 Citizens Observatories projects (CITI-SENSE, WeSenseIt, COBWEB, CITCLOPS, OMNISCIENTIS) were included in the Task IN-04 GEOSS Communication Networks<sup>1</sup>. In 2016, at the St. Petersburg GEO Plenary, Jose Miguel Rubio (at that time working with the European Commission, proposed the creation of a community activity stating that "Citizen-generated data can fill in important gaps in in-situ Earth observations, strengthen environmental capacities and trigger innovation". The role of EO, inc. Citizens' Observatories, to address global societal challenges (e.g. SDGs) was also emphasized<sup>2</sup>. The initial composition of the group was: Steffen Fritz (IIASA), Linda See (IIASA), Ian McCallum (IIASA) Inian Moorthy (IIASA) Joan Maso (CREAF) Athanasia Tsertou (ICCS), Luigi Ceccaroni (1000001labs), Jose Miguel Rubio Iglesias (European Commission) Suvodeep Mazumdar (University of Sheffield), Drew Hemment (University of Dundee), Uta Wehn (IHE Delft), and Alena Bartonova (NILU). In 2017, Jose Miguel Rubio left the European Commission and Ground Truth 2.0 Team took a leading role in continuing the initiative. Initially, the Citizen Science Community Activity (CA) was mainly European, but this was about to change.

During 2018, more regular interactions were set up. As of 2019, the GEO Citizen Science CA has been co-lead by Uta Wehn (Ground Truth, IHE Delft) and Lea Shanley (University of Wisconsin-Madison, US). This year has seen the establishment of the group's thorough modus operandi and contributions to the GEO Symposium 2019, the GEO Summit 2019 and the GEO Work Programme 2017-2020.

With CREAM as the Spanish representative in the GEOSS Program Board, Ground Truth 2.0 contributed to the GEO interim 2016 Work Program and the new 2017-2020 GEO Work Program in order to ensure that citizen observatories are considered in the new GEOSS architecture and in the foreseen European Data Hub. Additionally, Ground Truth 2.0 participated in the GEOSS Science and Technology Service Suite (S&T) Stakeholder workshops and in the Architecture and Interoperability Pilot (AIP) lead by OGC (the Open Geospatial Consortium). In order to stimulate participation in the citizen observatories at national level and to ensure GEO visibility in them, Ground Truth 2.0 collaborated with the GEO national initiatives such as GEO Spain, GEO Sweden, etc.

For coordination with other EU projects, Ground Truth ensured a regular exchange of information on the progress of each project, joint participation in meetings upon request of the European Commission to promote the outputs of the projects and the alignment of dissemination and communication activities (common dissemination booster).

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<sup>1</sup> [ftp://wmo.int/geo/TEMP/2012-2015\\_WorkPlan/2015\\_Update\\_Comments/European%20Commission\\_%20Rubio%20Iglesias.pdf](ftp://wmo.int/geo/TEMP/2012-2015_WorkPlan/2015_Update_Comments/European%20Commission_%20Rubio%20Iglesias.pdf)

<sup>2</sup> [https://digitalearthlab.jrc.ec.europa.eu/mygeoss/files/CitizenGEOSS/20161108\\_CitizensObservatories\\_JMRubio.pdf](https://digitalearthlab.jrc.ec.europa.eu/mygeoss/files/CitizenGEOSS/20161108_CitizensObservatories_JMRubio.pdf),  
[https://www.earthobservations.org/uploads/514\\_20161108\\_citizen\\_geoss\\_agenda.pdf](https://www.earthobservations.org/uploads/514_20161108_citizen_geoss_agenda.pdf)

### **3.1.1 GEO Citizen Science Meetings**

Three annual meetings were organized during the Ground Truth 2.0 project that are detailed below.

#### **3.1.1.1 GEO Citizen Science meeting during the GEO Week 2017 in Washington DC, USA**

This meeting had an important effect on the group because it made possible the truly internationalization of the Citizen Science in GEO. Krystal Wilson (Secure World Foundation), Lea Shanley (South Big Data Innovation Hub) and Anne Bowser (Woodrow Wilson International Center for Scholars) joined the leadership of the group creating a core group of people that continues today. On 24 October 2017, 4.5 hours side event was organized<sup>3</sup>.

#### **3.1.1.2 GEO Citizen Science meeting during the GEO Week 2018 in Kyoto, Japan**

On 29 October 2018, a substantial side event (3.45 hours) was organized. There was a general agreement that the activity should remain in the new work program remastered as a GEO initiative. This was an important step that required more regular meetings. From then on, the group will meet every month by teleconference first to discuss the objectives of the group in the new work program and later to decide the format of the next plenary meeting. From that time, IHE Delft took a more prominent leading role (Uta When from IHE Delft as co-Chair, together with Lea Shanley from the US), supported by CREAM when needed.

#### **3.1.1.3 GEO Citizen Science meeting during the GEO Week 2019 in Canberra, Australia**

In 2019, the GEO side events were restructured into key side events and targeted events. The GEO Citizen Science Community Activity (GEO CITSCI) found its place as a 1 hour targeted event with the title "*With a Little Help from Our Friends: The Value and Use of Citizen Science for GEO*" on 4 November 2019. A teaser was prepared to promote the event via social media:

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<sup>3</sup> <http://www.earthobservations.org/geo14.php?seid=577>

Save the date

# GEO Week 2019 Targeted Event on CITIZEN SCIENCE

4 November 2019 from 9.00 - 10.30 hrs



*With a Little Help From Our Friends:  
The Value and Use of Citizen Science for GEO*

GEO Week 2019 is hosted by the Australian Government in Canberra, Australia's capital city  
Venue: National Convention Centre Canberra, Australia

This targeted side event on Citizen Science will demonstrate the value of citizen science for GEO in tackling critical data gaps that impede progress on pressing global challenges

Activities will include:

- Interactive session and demonstrations;
- Panel discussion on how citizen science may help to address the needs of the GEO community;
- Showcases of the impact of Citizen Science on policy and society.

Join us to explore how the Citizen Science community can help GEO to achieve impact!

Find out more:  #CS4GEO #GEOWEEK19  [www.earthobservations.org](http://www.earthobservations.org)



And this is how it looks like in twitter:



**Uta Wehn** @UtaWehn · Oct 24

Heading to the #GEOWeek19? Then join us for this fresh & early session on how #citsci can help @GEOSEC2025 achieve #impact!

Save the date  
**GEO Week 2019 Targeted Event  
on CITIZEN SCIENCE**  
4 November 2019 from 9.00 - 10.00 hrs

With a Little Help From Our Friends:  
The Value and Use of Citizen Science for GEO

GEO Week 2019 is hosted by the Australian Government in Canberra, Australia's capital city  
Venue: National Convention Centre Canberra, Australia

You and 3 others



To connect with the local community in Australia and to collaborate with other GEO Community Activities (e.g. GEO Aquawatch, GEOBON, Indigenous People Community of Practice) and Initiatives that have an interest in Citizen Science, a meeting has been planned for Sunday 3 November 2019 for informal networking across these groups and initiatives, facilitated and sponsored by Ground Truth 2.0.

Given Ground Truth's role as current Co-Chair of the GEO Citizen Science CA (Uta Wehn), the CA will also be formally represented via participation in the Key Side event 'EO and the World's Indigenous People on Tuesday, 5 November 2019) and as a member of the Citizen Science Global Partnership (CSGP) delegation to Canberra at the following UNEP meetings: Second Scoping Meeting of its Governing Consortium, 4-5 November 2019; High-Level Working Group on Big Data and Frontier Technologies, 6-8 November 2019.

### 3.1.2 Efforts to move to a GEO Initiative on Citizen Science

In 2018, the GEO Citizen Science Community Activity (GEO CITSCI) initiated the process of becoming a GEO initiative with the focus on the following goals: (1) Demonstrate the value of citizen science data for advancing the GEOSS priorities in terms of research and informing policy; (2) Facilitate the creation of a linked ecosystem of open citizen science data and supporting resources under GEOSS and the GEOSS Data Management Principles; and, (3) Increase the use of Citizen Science in GEO by supporting global coordination and collaboration within and beyond GEO.

In consultation with the GEO Programme Board review team, the GEO Secretariat approved EO & Citizen Science as a Community Activity in the 2020-2022 GEO Work Programme. There was an agreement that it would be best for now that this activity remain as a Community Activity until it had progressed a bit further. They were also in agreement, though, that this activity has great potential and they believe it will bring an important perspective to the GEO community.

So for the 2020-2022 GEO Work Programme, GEO Citizen Science group will continue as a community activity.

### **3.1.3 Other initiatives in the GEO work program with GT2.0 presence**

CREAF is also actively participating in other activities in the work program that has some overlap with the citizen science one. This work items are:

GEO Community Activity on Essential Variables – GEO-EVs: It aims to be a panel of experts to discuss the current status of the EVs, exchange knowledge, experiences and methodologies in EVs definition, analyse the usefulness of some of them in creating SDG indicators and the gaps to be solved in communities in the near future. This Community Activity does not have the intention to interfere in the on-going communities already working on the definition of the EVs, but to become a common point to share expertise and to have a single voice inside GEO regarding EVs

Data Sharing and Data Management Working Group: It is convened to work with the GEO community and all GEO Work Programme activities, to enable effective uptake and implementation of the GEOSS Data Sharing and Data Management Principles.

GEO ECO Initiative: it intends to utilise existing Earth Observation data, results, and information in order to generate tools, information, and decision support elements that facilitate the management and well-being of Protected Areas and both staff and decision makers entrusted with their care. This will support Protected Areas of continental and global relevance, extending the analysis to vulnerable, unprotected areas by adopting the view of ecosystems as "one physical system" with their environment.

### **3.1.4 EuroGEO Working Groups participation**

Ground Truth 2.0 has explored the possibility to include citizen science activities in EuroGEO (formerly EuroGEOSS). At the time of writing these lines, the European Commission prefers to structure the EuroGEOSS working groups thematically and with the mandate to present clear examples of the European contribution to GEOSS in terms for contributing to the SDG indicator development. In this respect, the role of citizen Science has an enormous potential but this is not enough critical mass in the EuroGEOSS regular participants to build a case on citizen science and, for the moment, the possibility of showcase a citizen science contribution has been postponed.

## 4 Activities and interactions with INSPIRE

Ground Truth 2.0 took the interaction with INSPIRE very seriously. In the first month of the project (26-28 September 2016), Ground Truth 2.0 participated in Barcelona in the Volunteered geographic information (VGI) and Citizen Observatories INSPIRE Hack, a three day event organized by Karel Charvat, Arne J. Berre, Tomas Mildorf and Sven Schade. On the first day, a block on 'User needs and requirements from new projects' and ideas was attended by the new Citizen Observatory projects SCENT, Ground Truth 2.0, LandSense and GROW. On the third day, Uta Wehn (Ground Truth 2.0 Coordinator) presented the core ideas of the project, with a presentation entitled "From citizen-based data collection to joint knowledge creation: the Ground Truth 2.0 citizen observatories". The three days created the space, where those with the interest in the potential of VGI and Citizens Observatories could meet, present their tools and components from existing projects, and discuss and explore how results, ideas and knowledge could be combined in possible ways for new projects and for new project ideas. The VGI and Citizens Observatories INSPIRE Hack ran through the first three days of the INSPIRE conference. At that time, Ground Truth 2.0 provided a new perspective, going far beyond the classical role of data provision for citizens (i.e. the core of VGI), to empowering citizens to interact with policy makers in more direct ways that are facilitated by scientifically-designed campaigns.

At the same time, in the parallel session program, Joan Masó (CREAF) and Alaitz Zabala presented "Quality and user feedback metadata: theoretical aspects and a practical implementation in the MiraMon metadata editor"<sup>4</sup>. The ideas presented in that intervention were later successfully adapted to the citizen observatories in the Ground Truth 2.0 project.

The INSPIRE hackathon in 2016 was the first of a series of hackathons that were collocated with the INSPIRE conferences. In 2017, Ground Truth 2.0 was not present in the conference but we were still able to participate remotely in the hackathon as TEAM 8 with the idea of the Geospatial User Feedback that was considered as one of the data quality approaches in Ground Truth 2.0<sup>5</sup>. The jury considered our idea as the second best among those presented. This participation was repeated in 2018 with a similar idea in TEAM 16: GUF API. In addition, CREAM presented "PROTECTED AREAS from SPACE. Viewing products with data quality and geospatial user feedback" and "What can bring MapML to the INSPIRE community" that reported on new standards that could be applied in INSPIRE. The developments done in the Protected areas from space map browser in the context of H2020 project ECOPotential were used in Ground Truth 2.0 to present and compare land cover map. In 2019, there conference did not take place and next edition will take place in 2020.

One of the strategic advantages of Ground Truth 2.0 is the use of international standards such as SOS, WFS and WMS that are the same recommended by INSPIRE. Actually, the SOS standard is one of the later additions to the INSPIRE standard set that can be found on the INSPIRE in practice website: <https://inspire-reference.jrc.ec.europa.eu/vocabularies/geospatial-standards/sos-20> and in the Technical Guidance for implementing download services using the OGC Sensor Observation Service (<https://inspire.ec.europa.eu/id/document/tg/download-sos>).

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<sup>4</sup>[https://inspire.ec.europa.eu/events/conferences/inspire\\_2016/schedule/submissions/340.html](https://inspire.ec.europa.eu/events/conferences/inspire_2016/schedule/submissions/340.html),  
<https://www.youtube.com/watch?v=EEiSt2Rmsg8>

<sup>5</sup> <https://www.plan4all.eu/inspire-hack-2017/>

## 5 Summary of dissemination and communication activities

Most of the foreseen activities in the GT2.0 Communication & dissemination strategy considered knowledge sharing with specific target audiences through the participation in technical groups, conferences, networking events and meetings, incl. GEO and Citizen Science activities. The primary objective was helping to disseminate the concept and the results of the project within the scientific, political, business, GEO and financial groups. Here is a summary of the dissemination and communication activities carried out to achieve this goal.

### 5.1 Summary of dissemination and communication activities

The Ground Truth 2.0 project has used a wide range of channels and measures to communicate about the project's existence and to disseminate specific results. In line with the project's Communication and Dissemination Strategy (D4.1), distinct stakeholders and audiences were targeted, using different modalities. A summary of these activities is presented in Table 1 and full details are provided below, per channel. In total, Ground Truth 2.0 participated in 86 events.

**Table 2** Summary of dissemination and communication activities

Channels and Measures	Target Audiences					
	Social Community	Scientific community	Business community	Political community	Financial	GEO community
Presentation at conference (27)	XXXXX XXX	XXXXX XXXXX XXXXX XX	XXXXX	XXXXX XXXXX XXX	XX	XXXXX XX
Keynote at conference (9)	XXX	XXXXX	XX	XXX	X	
Session at conference (8)	XXXX	XXXXX X	XXX	XXXX	XXX	XX
Scientific publications (4)		XXXXX		X		
GEO Events (5)		XXXXX	XXXXX	XXXXX	XXXXX	XXXXXX
INSPIRE events (3)		XXX	XXX			XXX
OGC Forums/Events (12)		XXXXX XXXXX XX	XXXXX XXXXX XX			XXXXX XXXXX XX
EGU Forums/Events (2)		XX		XX		XX
Event participation (16)	XXX	XXXXX XXXX	XXXXX	XXXXX	XXX	XXXXX XX

#### Presentations at conferences

1. **10th GEO European Projects Workshop**, 30 May – 1 June 2016, Berlin (Germany). Uta Wehn (IHE Delft) presentation *Ground Truth 2.0: From citizen-based data collection to joint knowledge creation*; Panel member *Regional dimension for GEO and capacity building priorities*.
2. **AfriAlliance Launch Conference**, 22 March 2017, Ekurhuleni (South Africa). Partners present: IHE Delft, Akvo. Presentation *Ground Truth 2.0: Environmental knowledge discovery of human sensed data*.

3. **III Congreso Ciudades Inteligentes**, 26-27 April 2017, Madrid (Spain). Ester Manzano Pelaez (Altran) presentation *GT2.0: el reto de "enganchar" al ciudadano científico en la mejora de las condiciones de vida y el medioambiente*.
4. **4th Día de la Ciencia Ciudadana, Barcelona Science Festival**, 25 May 2017, Barcelona (Spain). Elizabeth Gil-Roldán (Starlab).
5. **Geo European Projects Workshop**, 19-21 June 2017, Helsinki (Finland), Uta Wehn (IHE) presentations: 1) Acceptance, quality and integration of Citizen Science data: Experiences from the WeSenseIt project and 2) Citizens' observatories to fill data gaps: What are the secrets to engaging citizens?. Panel member *GEO capacity development, contribution to SDGs and realization of regional impacts derived from GEO*.
6. **Next GEOSS Summit**, 22 June 2017, Helsinki (Finland). Joan Masó (CREAF) presentation about the GT2.0 Demo Cases.
7. **Resilience 2017**, 20-23 August 2017, Stockholm (Sweden). Tessy Cerratto-Pargman et al. (SU) presentation *Citizen Observatories: A demonstration of how socio-technical innovation could drive transformational change towards sustainability*.
8. **Geospatial Sensor Webs Conference**, 28-30 August 2017, Munster (Germany). Joan Masó (CREAF).
9. **Management of municipal watersheds in mountain regions (FAO Workshop)**, 4-6 Sep 2017, Prague (Czech Republic). Partners present: EW.
10. **WMO MOXXI workshop** –Innovation in Hydrometry, from ideas to operation, 5 Sep 2017, Geneva (Switzerland). Presentation Maurizio Mazzoleni et al. (IHE Delft) *Towards real-time assimilation of crowdsourced observations in hydrological and hydraulic modelling*
11. **EIP Water conference**, 27-28 September 2017, Porto (Portugal). Uta Wehn (IHE) participated in a panel on engagement. It was a very well-attended and interactive session, and a [nice blog](#) has been written about it.
12. **3rd GEO Data Providers Workshop**, 2-4 May 2018, Frascati (Italy). Joan Masó (CREAF). 'Lightning talk' on Citizen Science.
13. **2nd ECSA Conference**, 3-5 June 2018, Geneva (Switzerland). Presentation: Leveraging the social innovation potential of citizen observatories
14. **Adaptation Futures**, 18-21 June 2018, Cape Town (South Africa). IHE, WWF. Presentation about GT2.0 methodology and co-creation.
15. **Geospatial Sensor Web Conference**, 4 September 18, Munster (Germany), Joan Masó (CREAF). Contribution about quality Indicators of Citizens Observatories using Sensor web standards, presenting the Ground Truth 2.0 case.
16. **Samen meten, samen weten**, 13 Nov 2018, Brussels (Belgium). Stijn Vranckx (VITO) *Meet Me Mechelen* presentation.
17. **JRC workshop on Citizen Science and Environmental Monitoring: Benefits and Challenges**, 21-22 November 2018, Ispra (Italy). Nina Costa.
18. **KNMI Workshop Citizen Science**, 15 February 2019, Wageningen (NL). Marten Schoonman et al. (Akvo) presentation *Ground Truth 2.0: social dimensions of citizen observatories combined with enabling technologies*.
19. **CitSci2019**, 13-17 March 2019, Raleigh, North Carolina (USA). Luigi Ceccaroni (EW) Lightning talk about the Ground Truth 2.0 Methodology.
20. **Doing it together beyond DITOs**, DITOs Final event, 3 April 2019, Brussels (Belgium). Uta Wehn (IHE Delft) Lightning talk about Ground Truth 2.0 (among other projects).
21. **Resistance is in the Air**, International interdisciplinary symposium, 26 April 2019, Brussels (Belgium). Stijn Vranckx et al. (VITO) *Beyond data collection on air quality: forging new relationships via the Meet Mee Mechelen citizen observatory*

22. **LIMITS 2019 - Fifth Workshop on Computing within Limits**, 10-11 June 2019, Lappeenranta (Finland), Cerratto-Pargman et al. (SU) presentation: *Experimenting with Novel Forms of Computing - The case of the Swedish Citizen Observatory for Water Quality Conservation*.
23. **iSCAPE Summer School 2018**, 17 and 18 September 2018, Universiteit Hasselt (Belgium). Partners present: VITO. Presentation: *Air Quality Sensing and approaches for mitigation using smart solutions and citizen engagement*.
24. **ASSIST-UK**, 9-10 September 2019, Manchester (UK), Uta Wehn (IHE). Presentation: *Co-designing local knowledge co-production for sustainability: the Ground Truth 2.0 methodology*.
25. **Copernicus "Eyes on Earth" Roadshow**, 24-25 Sep 2019, Rotterdam (Netherlands). Partners present: IHE, CREAf. Presentation on Do's and Don'ts in Citizen Science.
26. **ENVIROINFO 2019**, 23-26 September 2019, Kassel (Germany), Almomani, A., Wehn, U. and Irvine, K. (IHE) Community-based environmental monitoring: Incentives and barriers for participation by the trio of key actors.
27. **Joint Final Event 4 sister CO projects**, 8-10 Oct 2019, Brussels (Belgium). Uta Wehn (IHE Delft) presentation *Ground Truth 2.0 - Achievements and challenges*. Partners Present: IHE Delft, CREAf, Altran, Starlab.

#### Keynote/invited speeches

1. **UK-Brazil Collaboration on Leveraging Crowdsourced and Sensor Data to Support Decision Making towards Urban Resilience**, 5 – 7 October 2016, University of Warwick (UK). Uta Wehn (IHE Delft) *Citizen science for citizen engagement in flood risk management – simply 'plug & play'?*
2. **150 year anniversary of Gymnasium Wermelskirchen** 15 March 2018, Wermelskirchen (Germany). Keynote Uta Wehn (IHE Delft) *Ist der Weg in die Nachhaltigkeit digital?*
3. **2018 PERCCOM Summer School**, 11-15 June 2018, Lappeenranta University (Finland). Keynote Uta Wehn (IHE Delft) *Co-designing citizen observatories for sustainability*.
4. **Ocean Summit The Hague – The Future of the Oceans** 28-29 June 2018, The Hague (The Netherlands). Uta Wehn (IHE Delft) *Collecting, exchanging & using data & knowledge - The role of citizens*.
5. **X Iberian Congress of Water Management and Planning**, 6-8 September 2018, Coimbra (Portugal). Keynote Joan Maso (CREAF) *Observatorios ciudadanos para la gestión del agua: Avances y retos*.
6. **General Assembly of European Council of Spatial Planners (ECTP-CEU) General Assembly**, 16-17 November 2018, Brussels (Belgium). Uta Wehn (IHE Delft), *Co-designing citizen observatories for sustainability – lessons learned*.
7. **Erasmus+ programme IMETE, Circular Cities summer school** 12 September 2019, Ghent University (Belgium). Uta Wehn (IHE Delft) *Co-designing citizen science for participatory environmental governance*.
8. **4th International EVOCA (Environmental Virtual Observatories) Workshop**, Wageningen University (NL), 27-29 August 2019. Uta Wehn (IHE Delft) *Citizen science & participation in decision making in African contexts*.
9. **INTCATCH conference**, 4-6 September 2019, London (UK). Keynote Uta Wehn (IHE Delft) *Citizen Science: opportunities and challenges for water monitoring & decision making*.

#### Session at conferences

1. **11th GEO European projects workshop**, 19-21 June 2017, Helsinki (Finland). IHE, CREAf, Tahmo.

2. **Stockholm World Water Week 2017**, 27 Aug – 1 Sep 2017, Stockholm (Sweden). Partners present: IHE, EW, SU, Gavagai and Akvo. Joint session: Citizen observatories empowering people in integrated water and waste management.
3. **EU Green Week**, 21-25 May 2018, Brussels (Belgium). Partners present: VITO, IHE. Stijn Vranckx (VITO) presentation *Engaging Citizens through Citizen Observatories*.
4. **8th Living Knowledge Conference 2018**, 30 May – 1 June 2018, Budapest (Hungary). Workshop (IHE lead) *What can make or break a citizen observatory?*
5. **Stockholm World Water Week**, 26-31 August 2018, Stockholm (Sweden). Partners present: IHE, Upande. Session: African Spatial Delights - supermarket for innovative water and ecosystems services.
6. **Stockholm World Water Week**, 26-31 August 2018, Stockholm (Sweden). Partners present: IHE, EW, SU, Gavagai, Akvo. Joint session: *Participated sustainable development: the role of citizen observatories*.
7. **Citizen Observatories for natural hazards and Water Management conference**, 27-29 November 2018. Partners present: IHE, CREAM, EW, VITO. Session: *Designing for impact: leveraging the social innovation potential of citizen observatories for science, policy and practice*.
8. **11th International Symposium on Digital Earth (ISDE 11)**, 24-27 Sep 2019, Florence (Italy). Partners present: IHE, CREAM, Upande, Starlab. Joint session: *Transforming society with citizen observatories*.

#### Scientific publications

1. Fritz, S., See, L., Carlson, T., Haklay, M., Oliver, J., Fraisl, D., Mondardini, R., Brocklehurst, M., Shanley, L., Schade, S., Wehn, U., Abrate, T., Anstee, J., Arnold, S., Billot, M., Campbell, J., Parker, A., Gold, M., Hager, G., He, S., Hepburn, L., Hsu, A., Long, D., Masó, J., McCallum, I., Muniafu, M., Moorthy, I., Obersteiner, M., Weissplug, M., and West, S., (2019) **Citizen Science and the United Nations Sustainable Development Goals**, *Nature Sustainability*, October 2019, 922-930.
2. Gharesifard, M., Wehn, U., and van der Zaag, P. (2019) **What influences the establishment and functioning of community-based monitoring initiatives of water and the environment? A conceptual framework**, *Journal of Hydrology*, Volume 579, 124033, <https://doi.org/10.1016/j.jhydrol.2019.124033>.
3. Gharesifard, M., Wehn, U. and van der Zaag, P. (2019) **Context matters: a baseline analysis of contextual realities for two community-based monitoring initiatives of water and environment in Europe and Africa**, *Journal of Hydrology*, Volume 579, 124-144.
4. Wehn, U. and Almomani, A. (2019) **Incentives and barriers for participation in community-based environmental monitoring and information systems: a critical analysis and integration of the literature**, *Environmental Science & Policy*, Special Issue on Shared Environmental Information System (SEIS), forthcoming.

#### GEO events

1. **GEO Week 2017/Ministerial Summit**, 23-27 October 2017, Washington D.C. (USA). Partners present: CREAM. This session on citizen science was the kick-off for the citizen science working group in GEO.
2. **GEO Symposium 2018**, 11-12 June 2018, Geneva (Switzerland). Partners present: Joan Masó (CREAM).
3. **GEO Week 2018/Ministerial Summit**, 31 Oct – 1 Nov 2018, Kyoto (Japan). Partners present: CREAM. Joint session proposal (GEO CS).

4. **GEO Symposium 2019**, 27-29 May 2019, Geneva (Switzerland). Partners present: CREAM.
5. **GEO Week 2019/Ministerial Summit**, 4-9 Nov 2019, Canberra (Australia). Partners present: IHE.

#### **INSPIRE Conferences/Hacks**

6. **INSPIRE conference (Infrastructure for Spatial Information in European Community) 2016**, 26-30 September 2016, Barcelona (Spain). Partners present: IHE, CREAM, Starlab
  - IHE Delft presentation *Ground Truth 2.0: From citizen-based data collection to joint knowledge creation*.
  - CREAM participation in **Volunteered geographic information (VGI) and Citizen Observatories INSPIRE Hack**.

**INSPIRE conference 2017**, 4-5 September, Kehl (Germany) and 6-8 September, Strasbourg (France). Partners present: CREAM.

- Presentation "PROTECTED AREAS from SPACE. Viewing products with data quality and geospatial user feedback" and
- Presentation "What can bring MapML to the INSPIRE community"
- Remote participation in **VGI and Citizen Observatories INSPIRE Hack**

**INSPIRE conference 2018**, 18-21 September 2018, Antwerp, Belgium. Partners present: CREAM.  
Presentations

- Participation in **VGI and Citizen Observatories INSPIRE Hack**

#### **OGC Forums/Events**

1. **OGC Technical and Planning Committee Meeting**, 20-24 March 2017, Delft (Netherlands). Meeting of the CitSci working group. Joan Masó (CREAM).
2. **102nd OGC Technical Committee**, 23 March 2017, Delft (The Netherlands).
3. **104th OGC Technical Committee**, 11 September 2017, Southampton (United Kingdom).
4. **OGC Technical and Planning Committee Meeting**, 11-15 September 2017, Southampton (England). Alberto Masa (Altran).
5. **105th OGC Technical Committee**, 4 December 2017, Palmerston North (New Zealand).
6. **106th OGC Technical Committee**, 18 March 2018, Orléans (France).
7. **108th OGC Technical Committee**, 13 September 2018, Stuttgart (Germany).
8. **109th OGC Technical Committee**, 11 December 2018, Charlotte, NC (USA).
9. **110th OGC Technical Committee**, 28 February 2019, Singapore.
10. **111th OGC Technical Committee**
11. **112th OGC Technical Committee**, 12 September 2019, Banff (Canada).
12. **113th OGC Technical Committee**, 19 November 2019, Toulouse (France).

#### **EGU Forums/Events**

1. **EGU General Assembly**, 8-13 April 2018, Vienna (Switzerland). IHE and CREAM. Session on Citizen Science and PICO presentation.
2. **EGU General Assembly 2019**, 7-12 April 2019, Vienna (Austria). Partners present: IHE, CREAM.

#### **Participation in Events**

1. **Improving data standardization and interoperability**, Meeting of the Working Group 5 Citizen Science Cost Action, March 2017, Novi Sad (Serbia). Partner present: CREAM.

2. **Freshwater Science Annual Meeting**, 4-8 June 2017, Raleigh, North Carolina (USA).
3. **British Ecological Society Annual Meeting 2017** 11-14 December 2017, Ghent (Belgium). Partner present: EW.
4. **2nd ECSA conference**, 3-5 June 2018, Geneva (Switzerland). Partners present: IHE, EW, CREAM, VITO.
5. **FOSS4G-2018**, 27 Aug – 2 Sep 2018, Dar Es Salaam (Tanzania). Partners present: IHE, Upande.
6. **EuroGEOSS Workshop**, 12-14 September 2018, Geneva (Switzerland). Partners present: IHE, CREAM.
7. **XXVIII Congreso Latinoamericano de Hidráulica e Hidrología**, 18-21 Sep 2018, Buenos Aires (Argentina). Partner present: IHE Delft.
8. **Workshop on SDGs and CS**, 3-5 October 2018, IIASA, Vienna. Partners present: IHE, CREAM.
9. **UN World Data Forum 2018**, 22-24 October 2018, Dubai (United Arab Emirates). Partner present: CREAM.
10. **Africa Water Week**, 29 Oct -2 Nov 2019, Libreville, Gabon. Partners present: IHE, Akvo.
11. **Conference on Earth System Governance**, 5-8 November 2018, Utrecht (The Netherlands). Partners present: IHE
12. **ESA Earth Observation  $\Phi$ -week EO Open Science and Future EO 2018**, 14 Nov 2018, Frascati (Italy). Partners present: Starlab, CREAM.
13. **Living Planet Symposium**, 13-17 May 2019, Milan (Italy). Partners present: Starlab.
14. **EARSel Symposium**, 1-4 July 2019, Salzburg (Austria). Partners present: CREAM.
15. **Stockholm World Water Week 2019**, 25-30 Aug 2019, Stockholm (Sweden). Partners present: Akvo, IHE, EW.
16. **Earth Observation Phi-Week**, 9-13 Sep 2019, Frascati (Italy). Partners present: Starlab.

## 5.2 Ground Truth 2.0 Week 2019

The Ground Truth Week was held from 30 September – 4 October and consisted of both webinars, local events and a face-to-face event at IHE Delft, The Netherlands. The week started with local events in the demo cases in the Netherlands, Belgium, Spain, Sweden, Zambia and Kenya as well as three introductory webinars on the Ground Truth 2.0 project overall, the Ground Truth 2.0 methodology and the Ground Truth 2.0 outputs (see figure 3 for an overview of the program). Furthermore, videos from the citizen observatories in Africa and Europe that Ground Truth 2.0 had helped to set up as well as a video on the whole project were launched. Both the webinars and the videos are available here on the Ground Truth 2.0 website. In the second half of the week, a face-to-face event at IHE Delft was held with dynamic sessions and discussions about the journeys the seven citizen observatories have taken to set up their platforms and to achieve impact on decision making. For an overview of the program of the face-to-face part of the program, please see figure 4. Detailed information per day is available in Annex 3, which includes daily blog posts on the Ground Truth Week that were published on the Ground Truth 2.0 website, as well as a list of the 52 participants of the two day F2F event at IHE Delft.

Ground Truth 2.0 Deliverable D4.5 Report on standardisation contributions and interactions with relevant initiatives (GEOSS, INSPIRE, other CO projects)

**Ground Truth 2.0 Week 2019 Programme**

	Sun 29 Sept	Mon 30 Sept	Tue 01 Oct	Wed 02 Oct	Thu 03 Oct	Fri 04 Oct
		Workshop on Citizen Science for Climate Change, Livelihoods and Biodiversity Management				
		Local workshop/panel				
			School activity Climate change and water management event			
			Local workshop on water quality monitoring			
	FENOMARATÓ (Bioblitz Campaign)	Local workshop/panel			Face-to-Face event at IHE Delft, Delft, The Netherlands (all day)	Face-to-Face event at IHE Delft, Delft, The Netherlands (all day)
		Local workshop on heatstress in St. Andries, Antwerp	Information evening on Mechelen's soundscape: how can liveability and liveliness go together?	Q&A event on Meet Mee Mechelen's vision on air quality for the city		
		Introductory webinar about GT2.0 (1 hour) & exhibition (IHE Delft)	Webinar about GT2.0 methodology (1 hour) & exhibition (IHE Delft)	Webinar about GT2.0 outputs (1 hour) & exhibition (IHE Delft)		

Find out more: [www.gt20.eu](http://www.gt20.eu) | [gt20@un-lhe.org](mailto:gt20@un-lhe.org) | [@GroundTruth20](https://www.facebook.com/groundtruth20) | [#gt20week](https://twitter.com/gt20week)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No.689744.

Figure 3 Ground Truth 2.0 Week 2019 Programme

**GT2.0 Week 2019 Face-to-Face Programme**

Thursday 03 October		Friday 04 October	
08:15 - 09:00	Registration	09:00 - 09:15	Opening of the GT2.0 market place and pitches
09:00 - 09:30	Introduction and overview of Ground Truth 2.0	09:15 - 10:30	Ground Truth 2.0 Tools and outputs market place
09:30 - 10:30	Context matters	10:30 - 11:00	Coffee Break
10:30 - 11:00	Coffee Break	11:00 - 12:00	Passing the Torch - Panel and Closing remarks
11:00 - 12:30	The Ground Truth 2.0 Citizen Observatories	12:00 - 13:00	Lunch
12:30 - 13:30	Lunch	<p><b>Follow the events live on Twitter via #gt20week</b></p>	
13:30 - 15:00	Impacting decision making in natural resource management with Citizen Observatories		
15:00 - 15:30	Coffee and networking		
15:30 - 16:30	Sustainability of the Citizen Observatories		
16:30 - 18:00	Outdoor activity - optional		
18:00	Dinner		

Find out more: [www.gt20.eu](http://www.gt20.eu) | [gt20@un-lhe.org](mailto:gt20@un-lhe.org) | [@GroundTruth20](https://www.facebook.com/groundtruth20) | [#gt20week](https://twitter.com/gt20week)

This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No.689744.

Figure 4 Ground Truth 2.0 Week 2019 Face-to-Face Programme

### 5.3 Social media statistics

Social media tools have been used to create a critical mass of “followers” of Ground Truth 2.0 activities and enabled the promotion of Ground Truth 2.0. The objective was to promote the Ground Truth 2.0 activities and inform about its outcomes, establish contact with other key groups and networks, keep

online connection and keep the project “alive” and proactive in promotion. These activities have been leveraged by the project partners' existing strong online presence. Following is a statistics summary of the most used network, our @Ground Truth20 Twitter account.

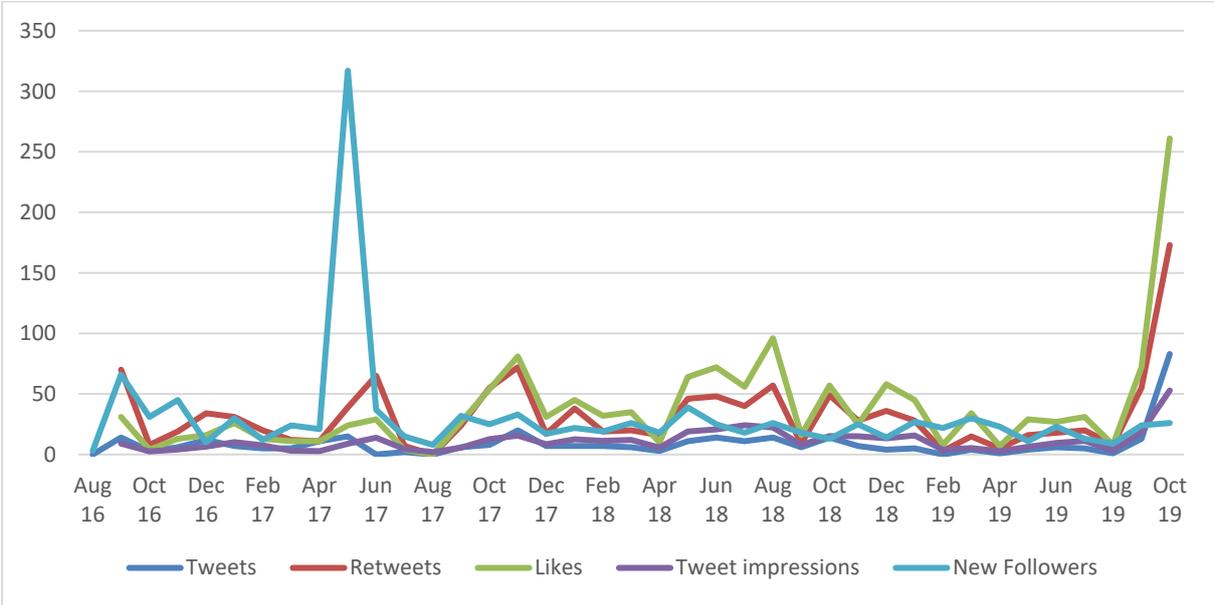


Figure 5 Twitter indicators per month

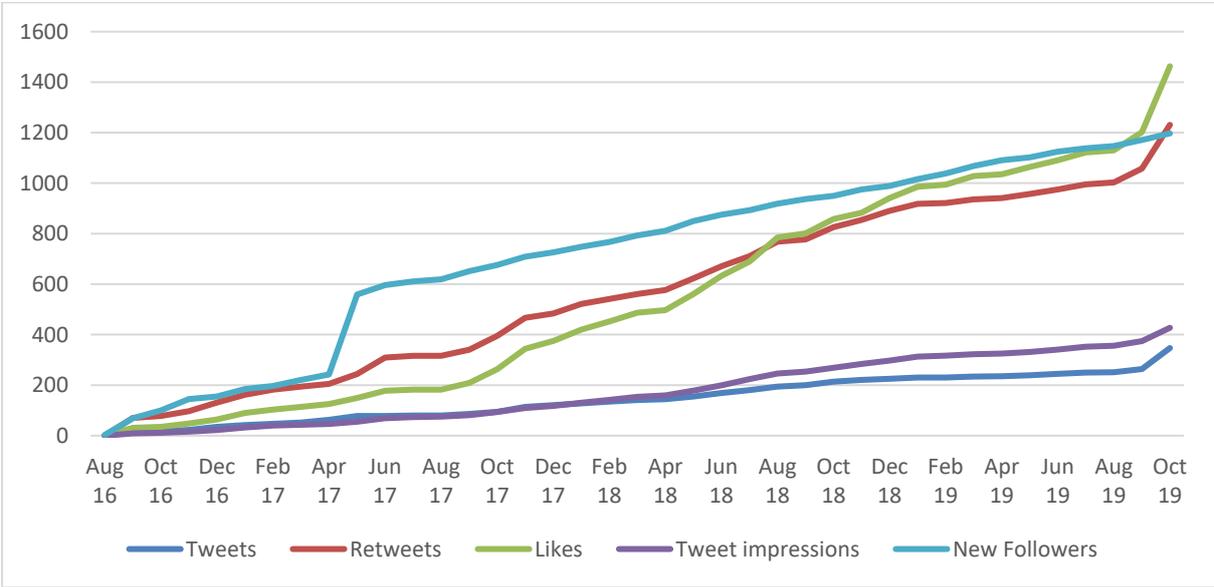


Figure 6 Evolution of Twitter indicators during the project

**Feb 2019** · 28 days

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TWEET HIGHLIGHTS

**Top Follower** followed by 79K people



**EU Environment**   
 @EU\_ENV FOLLOWS YOU

The official account for @EU\_Commission Directorate-General for Environment (DG ENV). Rts and likes are not necessarily endorsements.

[View profile](#) [View followers dashboard](#)

**Sep 2019** · 30 days

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TWEET HIGHLIGHTS

**Top Tweet** earned 5,898 impressions

Advancing agreement between @meteocat and @RitmeNatura last Friday in Barcelona! This is a great outcome of our project! Strengthening social and academic collaborations! Know more about the @GroundTruth20 outputs and results in the GT2.0 Week: [gt20.eu/gt20week](http://gt20.eu/gt20week) [twitter.com/RitmeNatura/st...](https://twitter.com/RitmeNatura/st...)

↻ 4 ❤️ 5

[View Tweet activity](#) [View all Tweet activity](#)

**Jul 2019** · 31 days

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TWEET HIGHLIGHTS

**Top Tweet** earned 3,079 impressions

Our experience in building #citizenobservatories being shared at 39th Annual EARSeL Symposium. How @GroundTruth20 #CitizenObservatories are enhancing #EarthObservation? By @joanma747 @UtaWehn @CREAF\_ecologia @ihedelft @EU\_H2020 [twitter.com/WeObserveEU/st...](https://twitter.com/WeObserveEU/st...)

↻ 9 ❤️ 10

[View Tweet activity](#) [View all Tweet activity](#)

**Top Follower** followed by 1,492 people



**Nature Reviews Earth & Environment**   
 @NatRevEarthEnv FOLLOWS YOU

An online-only journal publishing high-quality Review, Perspective and Comment articles across Earth and environmental science. Tweets by Graham and Laura.

[View profile](#) [View followers dashboard](#)



Figure 7 Examples of recent Twitter statistics

## 6 Future activities

Now that Ground Truth 2.0 is close to an end, it is time to look for other means to continue doing what we have done. In our case, this is going to be particularly easy because both IHE Delft and CREAM are members of the H2020 WeObserve project that shares the objective to continue making progress on the standards and on the GEO connection.

### 6.1 Way forward in the standards community

In WeObserve the Community of Practice on Interoperability can support the continuation of both the OGC Domain working group and the interpretability experiment. Actually, The WeObserve CoP is already discussing on the second phase of the interpretability experiment on Citizen Science. There are three main topics that we believe we have to develop:

#### 6.1.1 Way forward in the Citizen Science interoperability experiment

Experiment with the SensorThings API

In the first phase of the interoperability experiment we focused on the use of SOS as a standard service to distribute data coming from citizen science observations. This idea was based in the COBWEB recommendation to use the classical OGC services in the Sensor Web Enablement. The result was positive allowing for some Technology Integration Experiments (TIE) where clients were able to visualize data coming from services from other vendors and projects alongside their own data. Unfortunately, while this happened, OGC was increasingly experimenting with OpenAPI approaches and concluded that a new generation of services will implement web API based on resources instead of the old web services paradigm. Despite some fundamental conceptual differences, both approaches use the web standards as baselines and the client and server architecture, so they are not so difficult to replace on technology by the next one. Actually the OGC sensor world already produced a sensor API that has been around for two or three years that is called SensorThingsAPI. In the second phase of the interoperability experiment we would like to experiment with SensorThingsAPI clients and services and demonstrate their applicability for citizen science. If the new experiment successful, the final aim is to update of the OGC discussion paper SWE4CS into a new version explaining how to use SensorThingsAPI for citizen Science.

Design and architecture for a Citizen Science (Cit Sci) federation

In each topic there are myriads of citizen science projects that are very dynamic in nature and require recruiting voluntaries to run their campaigns. AS an example, the "inventory of citizen science activities for environmental policies"<sup>6</sup> detected 503 useful projects around biodiversity in Europe. This is ok if citizens are going to participate in one project only but this is not always the case. Expert users and dedicated volunteers will participate in several of them. The heterogeneity of platforms, use accounts and data licenses can become a stopping factor both for data acquisition and exploitation. The H2020 Landsense federation offers a federation architecture based on single sign on technologies that provides uniform login on heterogeneous platforms and full control on personal data privacy. Meanwhile, initiatives such as the Earth Challenge 2020 are building an infrastructure for coordinated citizen science around the world and GEO is discussing about the best way to include in-situ data and citizen science data in the GEOSS platform. This topic wants to experiment on extending the Landsense federation to

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6 [1] <http://data.europa.eu/euodp/data/dataset/jrc-citsci-10004>

the cloud (in particular to the EOSC in the umbrella of the H2020 CO4Cloud project) where biodiversity projects and infrastructures should be integrated and in contributing to propose new elements that should complement the current GEOSS Platform to include citizen science data.

Integration of the OGC definition server in Cit Sci projects

One of the main difficulties in combining small citizen science projects into large datasets is the lack of common vocabularies and acquisition strategies. The OGC definitions server is proposed as an open linked platform that will store definitions on variables and procedures done for capturing citizen science data. By publishing their definitions, projects will be more transparent to their users, other projects will be able to adopt the same definitions and procedures and scientist gain confidence on the data because they will be able to understand it. In this topic, we will experiment of how to include the variables collected into the definition server and we will text how easy is for two projects to converge on the same definitions.

### 6.1.2 Way forward in standards for Citizen Science

As mentioned in the previous subsection, the next phase of the interoperability experiment should update of the OGC discussion paper SWE4CS into a new version explaining how to use SensorThingsAPI for citizen Science. This document should be brought to the OGC Technical Committee meeting for approval as a public discussion paper and, with time, to an OGC best practice. Since a discussion papers does not represent an official position of the OGC, moving it to a best practice will be the way to get an OGC endorsement on how to use an existing standard in the citizen Science domain.

## 6.2 Way forward in GEO

The current agenda of the Earth Observations and Citizen Science Community Activity contributions to GEO (GEO CITSCI) needs to be implemented during the coming years with the initial support of WeObserve and other current or future projects.

The expected outcomes of the GEO CITSCI Community Activity are:

**Goal 1:** Demonstrate the value of citizen science for advancing the GEOSS priorities in terms of research and informing policy.

Documentation (e.g., whitepaper) of exemplary citizen science projects that can support GEOSS, particularly if citizen science data are combined with EOs (2019).

Documentation (whitepaper/ academic publication) of exemplary Citizen Science projects that can provide inputs for monitoring and supporting the SDGs (2019).

One or more interactive platform harmonizing citizen science data with other sources of information, including Earth Observations, for Earth Challenge 2020 (2020).

**Goal 2:** Facilitate the creation of a linked ecosystem of open citizen science data and supporting resources under GEOSS and the GEOSS Data Management Principles.

Outputs of the interoperability experiments underway within the OGC and the WeObserve Community of Practice on interoperability and standards in CS (2019):

A technical report and a demonstration on how to connect Citizen Science to GEOSS (metadata and data) based on the work done for the Earth Challenge 2020 needs and proposals and the Citizen Observatories; guided by the OGC Citizen Science interoperability experiment (2019).

A series of lightweight “data profiles” and data collection protocols aligned with Earth Challenge 2020 research questions (2020).

**Goal 3:** Increase the use of Citizen Science in GEO by supporting global coordination and collaboration within and beyond GEO

Report analysing of potential contributions of citizen science to the GEO work programme and alignment with other GEO initiatives shared at the GEO plenary (2020).

Two or more workshops (side events) advancing the discovery and interoperability of citizen science data at strategic convenings of citizen science associations including CSA and ECSA (2019-2020).

Workshop (side event) on the benefits of Citizens Science in GEOSS and the Benefits that GEOSS provides to Citizen Science (2022).

Documentation (“case studies report”) of exemplary citizen science projects that can support GEOSS and particularly if citizen science data are combined with EOs (2019), including highlighting successful impacts on public policy at a range levels. In addition, survey of the legal, policy and institutional barriers to the integration of citizen science of national Earth Observation policies and related strategic documents.

At least two of the outcomes listed have been achieved already:

- Documentation (whitepaper/ academic publication) of exemplary Citizen Science projects that can provide inputs for monitoring and supporting the SDGs (2019).
- A technical report and a demonstration on how to connect Citizen Science to GEOSS (metadata and data) based on the work done for the Earth Challenge 2020 needs and proposals and the Citizen Observatories; guided by the OGC Citizen Science interoperability experiment (2019).

Others will require continuous efforts and resources.

## 7 Conclusions

The Ground Truth 2.0 project has been able to support standardization process of citizen observatories by leading the OGC Technical committee working meetings of a regular Citizen Science domain working group and an ad-hoc Non-Authoritative Data group. A total of thirteen individual meetings have been chaired contributing to the creation of a common view in the OGC on how to apply geospatial standards in citizen science project in all phases of the data management cycle but more focussed on that acquisition and data sharing. These meetings will continue with the support for the H2020 WeObserve and other future projects.

The Ground Truth 2.0 project was one of the main contributors in the Citizen Science Interoperability experiment, providing both services and clients that interacted with components provided by other participants in Technology Integration Experiments (TIE) demonstrating interoperability and integration of data coming from different sources.

The OGC API process has been actively monitored and has impacted on the original aim of the standardization process. The OGC SOS was initially recommended by a public discussion paper in the OGC website that Ground Truth 2.0 followed giving it a strategic advantage because SOS is one of the standards recommended by INSPIRE in their Technical Guidances. Nevertheless, the current tendency towards the use of web API based solutions suggest that the use of SensorThingsAPI is a better alternative that need more experimentation and documentation that would be addressed beyond the Ground Truth 2.0 project.

The Earth Observation Citizen Science Community Activity (GEO CITSCI) under GEO was initially proposed by the European Commission before the Ground Truth 2.0 project started. During the Ground Truth 2.0 project, the group became fully international, embraced by American and Australian contributors and participants. Europe is still co-leading the group and will continue doing so throughout the duration of the WeObserve project. Despite the adoption of some internationally recognize standards, there are still many pending issues to address in terms of the relation of the group with other GEO initiatives as well as the infrastructure needed for the integration of citizen science in the GEOSS platform that partially overlaps with similar gaps in the in-situ component in GEOSS.

The lack of presence of Citizen Science in the EuroGEO (formerly EuroGEOSS) activities is justified by the current focus on concrete showcases towards the delivery of indicators for the SDGs but should not be a permanent situation. Citizen Science and Citizen Observatories have been one of the main contributions of the European Union to GEO and should be represented in EuroGEO.

For communication and dissemination purposes, Ground Truth 2.0 used a wide range of tools, channels and measures to communicate about the project's existence and to disseminate specific results. In line with the project's Communication and Dissemination Strategy, distinct stakeholders and audiences were targeted, using different modalities. In total, Ground Truth 2.0 participated in 86 outreach events. A milestone among these efforts was the Ground Truth Week which was held from 30 September – 4 October and consisted of both webinars, local events and a face-to-face event at IHE Delft, The Netherlands. Social media tools have been used to create a critical mass of "followers" of Ground Truth 2.0 activities and enabled the promotion of Ground Truth 2.0. The Ground Truth 2.0 Twitter account currently has 976 followers and the number of tweets, retweets, likes, tweet impressions and followers has steadily increased during the duration of the project.

The Ground Truth 2.0 website will remain online beyond 2019 for another three years, albeit with clear indication that the project itself will have finished in December 2019. This way, the project's role as the gate way for the citizen observatories it has helped to set up will be maintained while the observatories

themselves are maturing and while the EU.citizenscience project is being fully implemented, to add as a longer inventory of Citizen Science and citizen observatory initiatives.

## **Annex 1 – Agendas of OGC technical committee meetings**

### **102nd OGC Technical Committee**

Delft, The Netherlands. 23 March 2017

Agenda:

- *Deploy 500 air quality sensors through citizens across Canada* Dr. Steve Liang, SensorUp Inc.
- *Research user feedback in spatial catalogues and realise a prototype implementation inside GeoNetwork. ELISE project.* Paul van Genuchten, GeoCat.
- *A Stakeholder Analysis on Citizen Science Data Interoperability.* Anne Bowser Wilson Center.
- *Land Cover and Land User Citizen Science data collected through Geo-Wiki; and the way forward within the LandSense Citizen Observatory* PERGER Christoph, IIASA.
- *Ground Truth2.0 project. 6 case studies to interoperate with.* Joan Maso, CREAM.
- *Discussion and way forward .*

### **104th OGC Technical Committee**

Southampton, United Kingdom, 11 September 2017

Agenda:

- Announcement about the CS workshop in the GEO Plenary in Washington DC.
- On Data Interoperability for Public Participation in Scientific Research, Sven Schade (JRC).
- Standards for data access: Applying SWE4CS to Ground Truth 2.0 demo cases, Joan Maso (CREAF).
- Standards for project description (in connection with the COST Action CA15212, Joan Maso (CREAF).
- How to move an interoperability experiment to integrate mosquito CS projects into a UN Global Mosquito Alert, Anne Bowser (Wilson Center).
- Discussion on practical things we can do. Citizen Science Interoperability Experiment.

### **105th OGC Technical Committee**

Palmerston North, New Zealand, 4 December 2017. Run by teleconference.

Agenda:

- Welcome: Joseph Abhayaratna.
- Atlas of Living Australia. Peter Brenton.
- The history of how this DWG came into being. Joan Masó (CREAF.)
- From Citizen Science to include crowdsourcing and VGI. Discussion.
- Any other business.

### **106th OGC Technical Committee**

Orléans, France, 18 March 2018

Agenda:

- CitSci interoperability pilot promoted by WeObserve, Joan Masó (CREAF).
- Federated Login and its impact on the LandSense Engagement Platform, Christoph Perger (IIASA).

- MapML, Peter Roshforth (NRCan).
- NAD adhoc session follow up and possible actions in the CitSci group (discussion).

### **108th OGC Technical Committee**

Stuttgart, Germany, 13 September 2018

- Citizen Science COST action status. Project metadata community standard draft, Sven Schade (JRC-ISPRA).
- Citizen Science Interoperability Experiment objectives and activity plan. Joan Masó (CREAF).

### **109th OGC Technical Committee**

Charlotte, NC USA, 11 December 2018

Agenda:

- Landsense engagement platform and the options to globally interoperate for a better collaboration in citizen science, Andreas Matheus (Secure Dimensions).
- Data quality and provenance annotations, Lucy Bastin (JRC).
- Report on the Citizen Science Interoperability Experiment, Joan Maso (CREAF).
- Relation to NAD group. Small discussion.

### **110th OGC Technical Committee**

Singapore, 28 February 2019

Agenda:

- Progress on the Citizen Science Interoperability experiment , Joan Masó (CREAF).
- Earth Challenge 2020: Research Questions to Help Citizen Science Scale, Anne Bowser (Wilson Center).

### **111th OGC Technical Committee**

- The LandSense Authorization Server - High Availability in the Cloud, Andreas Matheus (Secure Dimensions).
- First Citizen Science IE Conclusion and Preparations for the Next One. Joan Maso. (CREAF).
- Status of the Project Metadata vocabulary and the PPSR v2. Sven Shade (JRC).
- Discussions on how to connect cit Sci projects into GEOSS, Sven Shade (JRC).
- Updates on interoperability challenges for Earth Challenge 2020, Anne Bowser, (Wilson Center).
- OGC Definition Server to store Cit Sci relevant vocabularies, Ingo Simonis (OGC).

### **112th OGC Technical Committee**

Banff, Canada, 12 September 2019

Agenda:

- Citizen Science Interoperability conclusions, Joan Masó (CREAF).
- Public Participation in Scientific Research (PPSR) Metadata Schema and role of OGC Definitions Server in supporting Implementation, Rob Atkinson (OGC).
- What can we do in the next IE. Joan Masó (CREAF).

### **113th OGC Technical Committee**

Toulouse, France, 19 Novembre 2019

Agenda:

- JRC approach to collect, share and expose information about Citizen Science projects (20 min), Sven Shade (JRC).
- Interactive Map Making: Using a Collaborative and interoperable Citizen Science infrastructure (20 min), Frank Wassermann, Johannes Lauer (HERE Technologies).
- Topics for the next phase of the CitSciE, Joan Maso (CREAF).

### **108th OGC Technical Committee**

Stuttgart, Germany, 13 September 2018

Agenda:

- Citizen Science and Data Quality. Alison Parker Woodrow (Wilson Center).
- Citizen Science Interoperability Experiment objectives and activity plan. Joan Masó (CREAF).

### **109th OGC Technical Committee**

Charlotte, NC USA, 11 December 2018

Agenda:

- Crowdsourcing and Volunteered Geographic Information (VGI) document, Joseph Abhayaratna.
- The future of this group as stable DWG group, Joan Maso (CREAF).

During the meeting a list of possible use cases was elaborated:

- Annotation of images to use in machine learning (<https://www.zooniverse.org/>).
- Artificial intelligence to assess the data quality.
- Combining data from different scales in a single dataset.
- Candidate geo-synchronization standard
  - [https://portal.opengeospatial.org/files/?artifact\\_id=76559&version=1](https://portal.opengeospatial.org/files/?artifact_id=76559&version=1)
  - Partially originated in Data synchronization and GeoPackage on Testbed 13.
- Crowdsourcing of more than one source: License IPR + harvesting APIs interoperability.
- Blockchain and provenance and traceability (too much for that?).
- Need for APIs (or web services) for *pushing* data around geo-synchronization (again).

## Annex 2 – Daily blog posts Ground Truth Week

### Ground Truth Week 2019 – Day 1

On Monday, at IHE Delft in the Netherlands, we gave a webinar with an overview of the Ground Truth project and what to expect during the Ground Truth Week, both online and F2F. We were honoured by the presence of local stakeholders from the Maasai Mara Citizen Observatory who shared the relevance and importance of this citizen observatory for their local communities as well as for the students at Maasai Mara University (MMU). This session also marked the launch of a video on MMCO workshop celebrating Ground Truth Week in Kenya – [watch it here](#) – with a mapathon for the MMU students and a field trip to the Mara Reserve.

Recording of the webinar, in English, can be found [here](#).



### Ground Truth 2.0 Week Overview

**“How to impact decision making with citizen observatories”**

Dr. Uta Wehn, Ground Truth 2.0 Project Coordinator, Associate Professor, IHE Delft

Ground Truth Week 30 September – 4 October 2019 – Webinar 1



This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 689744. © Ground Truth 2.0



In Spain, RitmeNatura held a session focused on how to become a phenological observer to contribute to better knowledge on climate change. We had great talks that covered the main groups of species affected by our changing climate, like birds, butterflies and plants. The Meteorological Agency of Catalonia explained how valuable the historical phenology datasets are and explained how their Fenocat network of observers functions. And different initiatives like the Ritmenatura CO, Calendari Natural de Vallcarca and Natusfera applied to schools were explained. The session was attended by 83 people and especially relevant to teachers who got great ideas of how to use citizen science initiatives for scientific curricular activities for students.



In Belgium, the Antwerp citizen observatory KlimaatRobuust held an event in which the first results of the heat stress measurement campaign were discussed. A heat stress modelling expert from VITO explained the scientific background to the data that had been collected at 17 points throughout the city, which varied in surface, amount of shadow and amount of greenery. The measurements were taken between June and August 2019 and only on days above 25 degrees Celsius, and the measurement unit was the Wet Bulb Globe Temperature (WBGT). The results showed a strong variation between areas with lots of trees and those with hard surfaces, even within five meters distance between points. The discussion on the results focussed on concrete recommendations for the city and the way it plans in neighbourhoods such as St. Andries, the area of the city where the citizen observatory is based. These key recommendations are shadow provided by trees, shaded pathways across open spaces and to create indoor and outdoor cool places in the city and communicate about these places, so that sensitive groups know where to go on a hot day.



## Ground Truth Week 2019 – Day 2

Day two of the Ground Truth Week was kicked off with the second webinar in the Ground Truth 2.0 Webinar series, showcasing the GT2.0 co-design methodology. Its application in local communities in four European and two African countries has resulted not only in the development of demand-driven citizen observatories that help address locally-relevant environmental issues but also in distinctly different digital social platforms that tailored to the respective stakeholders' ambitions in terms of joint environmental monitoring, cooperative planning or even environmental stewardship.

Recording of the webinar, in English, can be found [here](#).



#gt20week

## Ground Truth 2.0 Week

### Co-design methodology & citizen observatories

Dr. Uta Wehn, Ground Truth 2.0 Project Coordinator, Associate Professor, IHE Delft

Ground Truth Week 30 September – 4 October 2019 – Webinar 1



In the Netherlands, the 'Grip op water Altena' citizen observatory celebrated Ground Truth week with a public meeting and discussion on what the future will bring for the observatory. Despite, or maybe because, the heavy rains that night the meeting was well attended. The results of a campaign aimed at raising awareness of the observatory were presented and discussed. With the support of the Ground Truth 2.0 team coming to an end in December 2019, there was a lively discussion about the relevance of continuing the Grip op Water platform. The connections that Grip op Water has created between decision makers and (organized) citizens was perceived as a clear added value of the observatory. As was evident from the campaign results, the topic of climate proof water management is deemed very important. The local agriculture and nature association stepped forward to take over the secretary role for Grip op Water and both, the municipality and the water board Rivierenland, committed to making funds available to sustain the observatory. Together with the citizens who have been and will continue to be active in Grip op Water, the future of Grip op Water was secured on that very night, which was a special outcome of celebrating Ground Truth Week.



In Mechelen, the Meet Mee Mechelen citizen observatory kicked off their celebration of Ground Truth Week by hosting an evening of talks on noise pollution in the city, focussing on the noise being emitted by the local catering industry and live outdoor events. Four different talks were given, two focussed on Mechelen, while two speakers shared their experience in other cities in Vlaanderen. The speakers from Mechelen were the chair of the neighbourhood centre for the central neighbourhood in Mechelen and representatives from the city talking about the policy on controlling noise levels in the city of Mechelen. The external speakers were from Akron, a company specialising in noise pollution solutions who has assisted with the plan for the city of Leuven, and from the province of Oost Vlaanderen who shared how they had tackled the problem of noise pollution in the city of Gent. The debate got heated, especially when the local city representatives were speaking, as local residents still believe the policies are too limited – residents are experiencing high noise levels. Some members from the local catering industry also expressed their frustration that even though they do not use loudspeakers and maintain low noise levels, they are denied permits because they cannot afford the hefty costs of a noise level inspection on their premises. The key message of the day was that a noisy city is different from a lively and vibrant city, and to work towards policy measures that can benefit everyone in the city of Mechelen.





### Ground Truth Week 2019 – Day 3

The third day of the Ground Truth Week started with the third and final webinar in the Ground Truth 2.0 Webinar series, in which some of the tools and outputs of GT2.0 were highlighted and discussed. The webinar started with the tool matching approach that was developed and applied by the project. Alberto Masa from Altran explained how this approach served to match the functional needs identified in each co-design group with existing tools or to indicate gaps and needs for further technical development. Dr. Joan Maso from CREAM then focused on the issue of data quality and how GT2.0 has ensured this across the seven citizen observatories. He explained that the approach starts by making the data available through OGC standard web services initially designed for automatic sensors. By doing so, the first result is that an integrated web map portal is then able to show data of the seven observatories in a single view. Taking advantage of this, the portal is able to estimate the overall quality of the datasets collected by the Ground Truth 2.0 directly in the portal making this process easy, transparent and reproducible. Dr. Hans van der Kwast from IHE Delft introduced the concept of the Ground Truth 2.0 land use mapper which, using a layered approach, combines various open access data streams (originally derived from the Open Street Map) and provides the ability to map land use on a global level. This nicely connected with the previous presentation that also described an approach from comparing land use datasets done with different algorithms and estimate commission or omission errors in them.

Recordings of the presentations, in English, can be found [here](#).



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## Ground Truth 2.0 Week Outputs

### Tool matching

Alberto Masa, Altran

Ground Truth Week 30 September – 4 October 2019 – Webinar 3



This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 689744. © Ground Truth 2.0



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## Ground Truth 2.0 Week Outputs

### Data quality and interoperability

Joan Masó, Researcher, CREAM

Ground Truth Week 30 September – 4 October 2019 – Webinar 3



This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 689744. © Ground Truth 2.0



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## Ground Truth 2.0 Week Outputs

### “How to impact decision making with citizen observatories”

Dr. Hans van der Kwast, Senior Lecturer, IHE Delft

Ground Truth Week 30 September – 4 October 2019 – Webinar 3

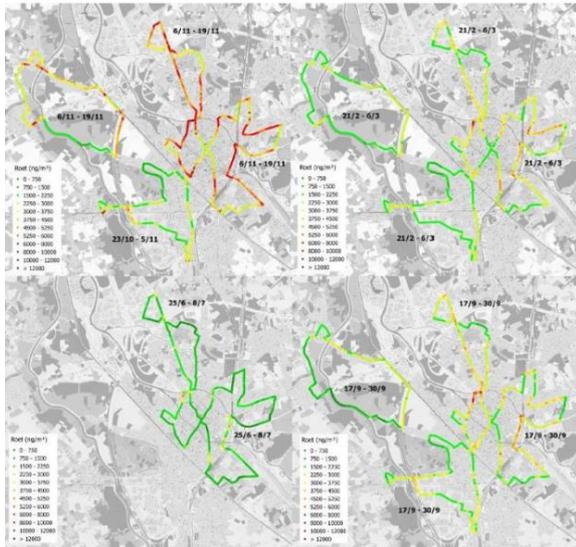


This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 689744. © Ground Truth 2.0

The Meet Mee Mechelen citizen observatory organized a second event on Wednesday to celebrate Ground Truth Week. On Tuesday, the topic of debate had been noise pollution in the city, on Wednesday the focus shifted to air quality. Meet Mee Mechelen finalized a round of air quality campaigns in the end of 2018. The results show the strong impact of road traffic on local air quality and triggered discussions on actions needed to improve urban air quality which resulted in Meet Mee Mechelen's 'Visie op de Mechelse Lucht' (Vision on air quality in the city of Mechelen). This vision was presented on Wednesday evening. It is made up of a list of 22 necessary actions focusing on mobility, spatial planning, behavioral change, residential heating, urban green and air quality measurements. With the feedback obtained during this Wednesday's event, the vision will be finalized and presented to local policy makers. The evening also marked the first joined event of Meet Mee Mechelen and Klimaan. Klimaan is a civic movement committed to a sustainable and climate-neutral society, without losing sight of the social aspect. Together with residents of Mechelen and the surrounding communities, Klimaan wants to think and act on the themes of energy, soil, water and air. As of fall 2019, Meet Mee Mechelen will join and strengthen the Klimaan family.

## Visie op de Mechelse Lucht

### Aanbevelingen Meet Mee Mechelen



In Sweden, the Vatten Fokus citizen observatory organised activities in Dunkern, located two hours from Stockholm. The area belongs to the Södermanland county and the lake belongs to two municipalities: Flen and Gnesta. Its geographical characteristics make it ideal for water testing, as there are approximately 170 lakes in the surroundings. Perhaps more important is the fact that some residents have shown a great level of commitment to environmental monitoring, water quality and of course, to VattenFokus. In Dunkern, we shadowed a 'local hero', a person who represents a community of 300 members, and interviewed him and a limnology expert. VattenFokus day was also joined by a representative of an 'Eco Village' nearby.

## Ground Truth Week 2019 – Day 4

On Thursday, 4 October 2019, the Ground Truth Week celebrations transitioned from the earlier virtual tour to a Face-to-Face conference at the premises of IHE Delft, The Netherlands. Dr. Uta Wehn, Project Coordinator of Ground Truth 2.0, opened the program with a short introduction to the Ground Truth 2.0 Project, to the co-design methodology and the seven citizen observatories that Ground Truth had helped to set up over the past 3 years. This session also marked the launch of the official Ground Truth 2.0 project video, which will be made available online shortly.

During the day, participants followed the Ground Truth 2.0 journey that the seven citizen observatories had taken. The first session explored the contexts in which the Ground Truth 2.0 team had worked with local communities and stakeholders to develop meaningful citizen observatories in six countries in Europe and Africa. These contexts differed not only in terms of climatic conditions and environmental challenges, but also technical infrastructure and the extent of public participation ‘readiness’ by authorities as well as citizens. The session also served to highlight that the Ground Truth 2.0 co-design methodology can accommodate differing real world conditions in which to embed citizen observatories.





Continuing the journey, the second session featured the citizen observatories now up and running. At a market place of the seven citizen observatories, participants could get to know the thematic focus, purpose and achievements of each citizen observatory; in what ways they differ from ‘normal Citizen Science’; and how they allow communities of citizens, scientists and policy makers to jointly monitor and manage their environment. This session sparked lively discussion by participants with both, the CO stakeholders and the Ground Truth team supporting each citizen observatory.





After lunch, participants convened in a ‘fishbowl’ setting to discuss the impact of each citizen observatory from the different stakeholders’ perspective. In the first round, the representatives of different authorities discussed the connection of the citizen observatories to the daily activities of the decision makers. The authority representatives from the Kenya and the Zambia citizen observatories both mentioned the devolution of power and the lack of data for spatial planning or natural resource management in the face of deforestation, poaching etc. Digital data helps a lot with the speed of reporting and reacting to the situations. The representative from the waterboard in Altena explained that in the Grip of Water Altena citizen observatory in the Netherlands, there was actually a lot of data available, but this was not shared with citizens. In the same line, there is also an awareness gap about the measures taken by the waterboard and the problems that exist, or what citizens can do to help. She mentioned that the citizen observatory can help with information sharing, allow the authorities to reach out to citizens for help and thereby contribute to problem solving. The representative of the authorities in the Spanish citizen observatory RitmeNatura.cat mentioned that, in the case of Spain, where data is openly accessible to everyone, decision makers do not always ‘listen’ to the data. Others illustrated that some authorities would like to retain the power to decide what data is shared publicly and what is not. Participants agreed that raising awareness among politicians is a common point across the citizen observatories.

In the second round of fishbowl discussion, the citizens representing the different observatories discussed the value of their citizen observatory was for them. A citizen involved in the Zambian demo case described the introduction of the citizen observatory as a game changer since the digitization of their log books has helped in speeding up the reporting of incidents to the authorities. The citizen representatives from the Belgian and Swedish citizen observatories agreed that data – and especially good quality and open data – is needed in order to communicate with authorities and decision makers. Open data means their evidence cannot be put away and ignored. A Maasai from the Kenyan Maasai Mara Citizen Observatory mentioned that not many people in his community have smartphones. In his area, human-wildlife conflicts are an issue and compensation is often not being paid to local citizens; the citizen observatory will help them us record and report incidents and make a case to the government, with hopefully faster response and compensation. Overall, all citizens involved in this discussion agreed that their citizen observatories were of great value to their communities.

Ground Truth 2.0 Deliverable D4.5 Report on standardisation contributions and interactions with relevant initiatives (GEOSS, INSPIRE, other CO projects)



In the last round of the fishbowl, scientists and data aggregators of the Ground Truth 2.0 team discussed how the quality of citizen observatory data can be ensured. It was agreed that in most cases, time is needed for instruction or training, but that after that, data is usually of good quality. Additionally, sometimes there is simply no better alternative to citizen science data, as for example in the case of open street maps. Therefore, it was suggested that it is always better to share the data and to let the user judge whether it is perceived as good enough to use or not.

In the last session of the day, the journey of citizen observatories beyond the Ground Truth 2.0 project was explored. In small groups, each citizen observatory team discussed sustainability challenges, what kind of lessons they learned and their concrete plans for the future. There was agreement among most observatories that keeping both the citizens and authorities involved was difficult, but that finding and encouraging 'champions' was helpful in this regard. Nevertheless, all citizen observatories had plans to continue their future work.





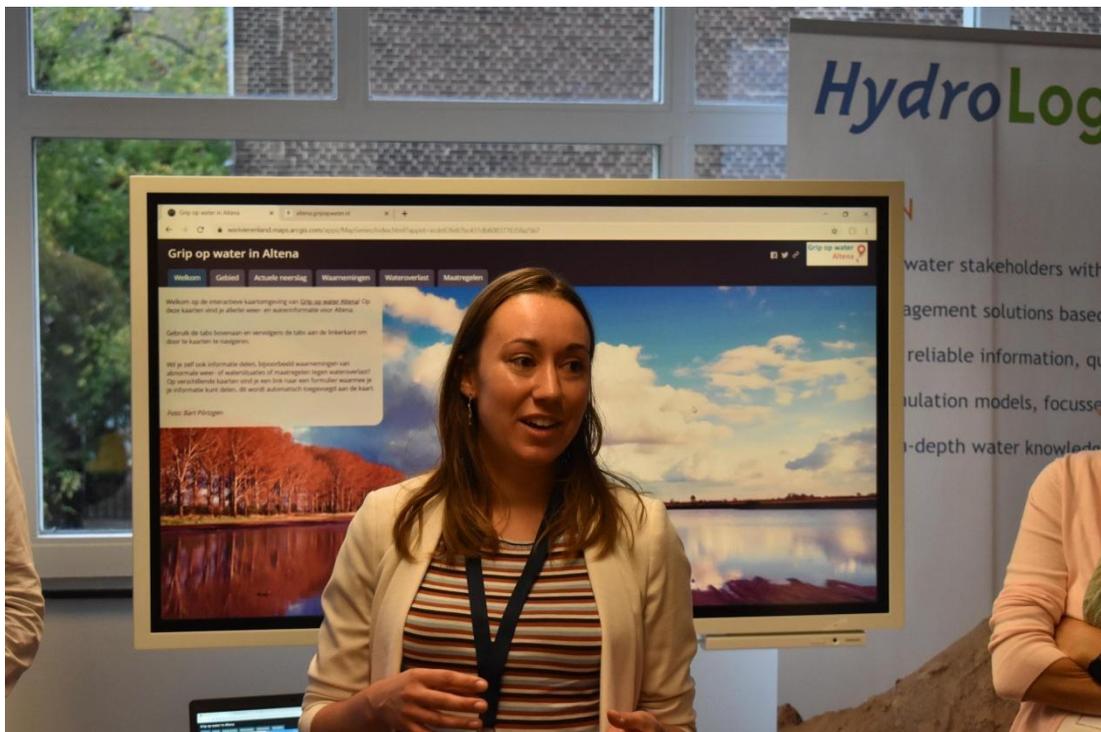
The day ended with an outdoor, hands on activity and a conference dinner. On the way to the restaurant, participants had the opportunity to try out the different Citizen Science tools and apps of the Ground Truth observatories.





## Ground Truth Week 2019 – Day 5

The last day of the Ground Truth 2.0 Week 2019 started with a market place, featuring the Ground Truth 2.0 tools and outputs. The Ground truth 2.0 partners were available at dedicated stations to introduce the participants to the tools and outputs, such as the Ground Truth 2.0 co-design methodology, the data quality module, citizen observatory tools and apps, the Gavagai monitor and many more.





After a short coffee break, the Ground Truth 2.0 week was closed with a panel discussion ‘Passing the torch’. Eight panellists shared their respective perspective on the uptake of specific Ground Truth 2.0 results in their respective project, activity, or field as well as the conditions for uptake.

Prof. Nick van de Giesen (TU Delft), coordinator of the [TWIGA](#) project, explained that while it may seem obvious how to involve people in Citizen Science, the Ground Truth 2.0 project highlights the importance of the involvement of citizens in the co-design of citizen science, as well as the fact that there is no “one size fits all” approach to citizen science. Dr. Luigi Ceccaroni, [ECSA](#) vice chair and innovation lead at Earthwatch, added that in the H2020 [MICS](#) project that he is coordinating, the Ground Truth 2.0 methodology is taken up in a “light” version to co-design citizen science activities in the four case studies in Europe. Mark Noort from the [Africultures](#) project, described how he received inspiration on how to involve citizens with the aim of tapping into the experience of citizens, such as farmers who could contribute lots of data.





Dr. Claire Papazoglou, an independent environment expert, mentioned that she perceives citizen science as of great value for advocacy work, but also stressed the importance of not only gathering data, but also to analyze it, and to feed this back to the citizens in order to keep them engaged and motivated. The same thought was picked up by Dr. Luis Velazquez, who emphasized the importance of adjusting the ways in which one communicates about citizen science data to the target audience. He also stressed that the links between citizen observatories and health should be explored in more detail. The Ground Truth team added that there is a clear connection between health and the citizen observatories in Belgium: in Antwerp, KlimaatRobuust is directly linked with a project about care for the elderly as cool spots are mapped throughout the city that can help alleviate heat stress. For Meet Mee Mechelen, there is a very clear link with the health implications of bad air quality.

Prof. Charlotte de Fraiture, the Vice Rector of IHE Delft, talked about what IHE as an institute can do to take up the results of Ground Truth 2.0 in its research, education and capacity development activities. She suggested to integrate citizen science in the curriculum of the MSs programs at IHE, and expose the students to the richness of citizen science as more than just data collection illustrated by the Ground Truth 2.0 citizen observatories. Prof. Richard Hawkins added that we need to “enlarge our ranks” as there is a crisis in science when it comes to communication with policy makers. Everyone can contribute to knowledge and tools should be passed on to citizens in order to do so. He perceived Ground Truth 2.0 as a great example of this empowerment. Izabela Freytag from EASME at the European Commission touched upon the funding of citizen science projects. Since the outcomes of co-design processes are less predictable than more traditional approaches, flexibility is required when funding such projects.



### Annex 3 - Participant List

No.	Name	Organisation
1	Alfonso, Leonardo	IHE Delft
2	Almomani, Abeer	IHE Delft
3	Anema, Kim	IHE Delft
4	Annor, Frank	TAHMO
5	Banda, Isaac	Zambia Community Resources Board Association
6	Baur, Dorothee	IHE Delft
7	Beloff, Natalia	University of Sussex
8	Bhambhani, Anurag	
9	Bilbao Erezkano, Ane	IHE Delft
10	Bjelkeman-Pettersson, Thomas	Akvo
11	Bremer, Karin	
12	Busto, Montserrat	Meteorological Service of Barcelona
13	Carl-åke Anders Lindsten	Vattenfokus Citizen Observatory
14	Ceccaroni, Luigi	CERT
15	Colardyn, Jo	Citizen Observatory Meet Mee Mechelen
16	Costa, Nina	NDCConsult
17	Dalmases, Carles	
18	de Blois, Mark	Upande
19	Fehri, Raed	UCLouvain
20	Freytag, Izabela	EASME
21	Geidel, Teresa	CEU School of Public Policy
22	Gharesifard, Mohammad	IHE Delft
23	Giller, Onno	IHE Delft
24	Gil-Roldán, Elizabeth	Starlab
25	Gold, Margaret	ECSA
26	Hawkins, Richard	University of Calgary
27	Hooghiemstra, Hansje	Tygron
28	Kabanda, Bwendo	WWF Zambia
29	Karbolu, Mark	Masaai Mara Citizen Observatory
30	Karlgren, Jussi	Gavagai

31	Kersbergen, Annemarleen	HydroLogic
32	Liekens, Inge	VITO
33	Luis Velazquez Contreras	University of Sonora
34	Mabwoga, Samson	Demo Case Kenya
35	Masa, Alberto	Altran
36	Masó, Joan	CREAF
37	Matokwani, Musiwa	Sesheke Town Council
38	Merton, Hans	Akvo
39	Mokrane, Kadir	UC Louvain
40	Nairuko, Anne	Demo Case Kenya
41	Noort, Mark	HCP international
42	Nooteboom, Aron	IHE Delft
43	Nora Munguia	University of Sonora
44	Papazoglou, Foteini	Consultant
45	Pfeiffer, Ellen	IHE Delft
46	Portilla, Karina	Colombian Geological Survey
47	Prat, Ester	CREAF
48	Sanson, Gonzalo	Gent University
49	Schepers, Mon	Citizen Observatory Meet Mee Mechelen
50	Schmitz, Tobias	Global Institute for Water, Environment and Health
51	Tejada Skoglund, Silvina	Stockholm University
52	Thijs, Jos	Citizen Observatory Antwerp
53	van de Giesen, Nick	Delft University of Technology, The Netherlands
54	van der Kwast, Hans	IHE Delft
55	Van Lint, Sylvia	Citizen Observatory Antwerp
56	Vanbrabant, Johan	Citizen Observatory Meet Mee Mechelen
57	Vicente, Maria	Leiden University
58	Visser-Kieboom, Hannie	Grip op Water
59	Vranckx, Stijn	VITO
60	Wehn, Uta	IHE Delft
61	Wewer, Manuel	TU Dresden / TU Delft
62	Xin, Tian	Delft University of Technology

#### Annex 4 Twitter Statistics (raw data)

MONTH	Tweets	Retweets	Likes	Tweet impressions	New Followers
Aug 2016	0				3
Sep 2016	14	70	31	8,980	66
Oct 2016	3	8	4	2,597	31
Nov 2016	6	19	13	4,160	45
Dec 2016	12	34	16	6,576	10
<b>2016</b>	<b>35</b>	<b>131</b>	<b>64</b>	<b>22,313</b>	<b>155</b>
Jan 2017	7	31	26	10.2K	30
Feb 2017	5	20	13	7,619	12
Mar 2017	5	12	11	3,047	24
Apr 2017	11	11	11	2,820	21
May 2017	15	39	24	8,837	317
Jun 2017	0	65	29	13.9K	37
Jul 2017	2	7	4	4,594	15
Aug 2017	0	0	0	2,028	8
Sep 2017	6	24	27	5,675	32
Oct 2017	8	55	54	12.7K	25
Nov 2017	20	72	81	15.6K	33
Dec 2017	7	17	31	8,541	17
<b>2017</b>	<b>86</b>	<b>353</b>	<b>311</b>	<b>43,161</b>	<b>571</b>
Jan 2018	7	38	45	12.6K	22
Feb 2018	7	19	32	11.3K	19
Mar 2018	6	20	35	12.1K	26
Apr 2018	3	16	10	5,727	18
May 2018	11	46	64	19.1K	39
Jun 2018	14	48	72	20.7K	25

Jul 2018	11	40	56	24.2K	18
Aug 2018	14	57	96	22.3K	26
Sep 2018	6	9	16	7,910	18
Oct 2018	14	49	57	15.2K	13
Nov 2018	7	28	25	15.1K	25
Dec 2018	4	36	58	13.4K	14
<b>2018</b>	<b>104</b>	<b>406</b>	<b>566</b>	<b>13,637</b>	<b>263</b>
Jan 2019	5	28	45	15.7K	27
Feb 2019	0	3	8	3,842	22
Mar 2019	4	15	34	5,328	30
Apr 2019	1	5	7	2,692	23
May 2019	4	16	29	6,388	11
Jun 2019	6	18	27	9,589	23
Jul 2019	5	20	31	11.2K	13
Aug 2019	1	8	8	3,504	9
Sep 2019	13	55	72	18.5K	24
Oct 2019	83	173	261	50K	26
<b>2019</b>	<b>122</b>	<b>341</b>	<b>522</b>	<b>31,343</b>	<b>208</b>
<b>TOTAL</b>	<b>347</b>	<b>1231</b>	<b>1463</b>	<b>110,454</b>	<b>1197</b>