groundtruth2.0

Environmental knowledge discovery of human sensed data

Deliverable D4.7

Training materials

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Deliverable lead	IHE Delft
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Internal reviewer(s)	Hans van der Kwast (IHE), Ester Prat (CREAF)
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Abstract of deliverable	This report is part of the work undertaken in WP4 of the Ground Truth 2.0 project which is dedicated to dissemination and communication activities of the project. More specifically, this report describes the process of producing and delivering Ground Truth 2.0 training materials.

Versions and Contribution History

Version	Date	Modified by	Modification details
v0.1	12-12-2019	Dorothee Baur	First version of deliverable
v0.2	13-12-2019	Uta Wehn	Additions throughout document
v0.3	16-12-2019	Hans van der Kwast, Ester Prat	Review
v0.4	17-12-2019	Dorothee Baur	Final edits

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Executive Summary

Ground Truth 2.0 delivers the demonstration and validation of 6 scaled-up citizen observatories in real, operational conditions, with four European and two African demonstration cases. Ground Truth 2.0 demonstrates 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.

This report is part of the work undertaken in WP4 of the Ground Truth 2.0 project which is dedicated to dissemination and communication activities of the project to the widest possible range of key stakeholders in Africa and Europe. This report describes part of the networking and awareness raising activities and, specifically, the process of producing and delivering Ground Truth 2.0 training materials. Training activities and materials described in this document include lectures and webinars, mapathons, contributions to a MOOC on Citizen Science, guidance on the Ground Truth 2.0 data quality tool and educational materials on citizen science and citizen observatories for schools.

1 Introduction

1.1 Background

Citizen science, enabled by ICTs, is on the increase. Using their own observations and mobile devices, citizens can provide a new data stream that provides localized information about the environmental situation on the ground, complementing existing data systems and surveys. However, many efforts to successfully implement citizen observatories are facing problems with the sustained engagement by citizens, limited scalability and limited impact on governance processes.

Ground Truth 2.0 delivers the demonstration and validation of 6 scaled-up citizen observatories in real, operational conditions, with four European and two African demonstration cases. Ground Truth 2.0 demonstrates 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.

1.2 Purpose

This report is part of the work undertaken in WP4 of the Ground Truth 2.0 project which is dedicated to dissemination and communication activities of the project. More specifically, this report describes part of the work undertaken by task T4.4 'Networking and awareness raising activities'. The purpose of this report is to present the process of producing and delivering Ground Truth 2.0 training materials.

1.3 Structure

This report is structured as follows: section 2 summarizes the educational lectures and webinars that were held by the Ground Truth 2.0 project partners, section 3 describes the mapathons that were organized during the project duration and section 4 introduces guidance on the Ground Truth 2.0 data quality tool. Section 5 outlines the contributions of Ground Truth to the WeObserve MOOC and section 6 describes the educational materials that are offered through TAHMO's 'School-2-School' program.

2 Lectures and webinars

2.1 Lectures

During the course of the Ground Truth 2.0 project, Dr. Uta Wehn (IHE Delft) held several lectures on the topics of co-designing citizen observatories for sustainability, citizen science and participation in decision making (see table 1). For the PowerPoint slides of the presentations, please see Annex 1.

Table 1 Overview of lectures and keynotes

Date	Topic	Location	Number of attendees
12 September 2019	Co-designing citizen science for participatory environmental governance	Ghent University, Belgium *IMETE Summer School 2019 on Circular Cities*	45 MSc students
27-29 August 2019	Citizen science & participation in decision making in African contexts	Wageningen University & Research, The Netherlands *4th International EVOCA Workshop*	50 PhD students, various WUR staff members and project representatives
10-12 June 2018	Co-designing citizen observatories for sustainability	Lappeenranta University of Technology, Finland *Pervasive computing and communications for sustainable development Summer school*	65 MSc students, various project representatives

2.2 Webinars

During the Ground Truth 2.0 Week 2019, several webinars were streamed, which covered topics such as the Ground Truth 2.0 co-design methodology, data quality and interoperability (see table 2). After the initial screening of the webinars during the Ground Truth 2.0 Week, all webinars were made available on the Ground Truth 2.0 vimeo account and are featured on the Ground Truth 2.0 website.

Table 2 Overview of webinars

Webinar	Topic	GT2.0 partner
Webinar 1	GT2.0 Week 2019 Overview – How to impact decision making with citizen observatories	Dr. Uta Wehn (IHE Delft)
Webinar 2	GT2.0 Co-design methodology and citizen observatories	Dr. Uta Wehn (IHE Delft)
Webinar 3.1	Tool matching	Alberto Masa (Altran)
Webinar 3.2	Data quality and interoperability	Dr. Joan Masó (CREAF)
Webinar 3.3	Land Use Mapper	Dr. Hans van der Kwast (IHE Delft)

Figure 1 Speakers at the first Ground Truth 2.0 webinar

3 Mapathons

IHE Delft, Upande and Maasai Mara University (MMU) organised several mapathons (see Table 3) during the project. Mapathons are coordinated online mapping events to improve coverage in vulnerable place. Good mapping material is essential for strengthening vulnerable places around the world that are suffering from epidemics, conflicts, natural disasters, poverty or environmental problems. Mapping helps governments to make better (policy) decisions and aid organizations to offer better assistance because they have more knowledge in advance about medical activities and the distribution of needed relief supplies. The mapathons organised for the Mara also contribute to the availability of data for the stakeholders in the Maasai Mara Citizen Observatory.

Based on satellite images, volunteers mapped features such as roads and buildings in the Mara River Basin on OpenStreetMap, a detailed, open-access map of the world (see figure 1). For an overview of the mapathon events, please see table 3. The maps produced during the mapathons (see figure 2), combined with knowledge, tools, and data from the MaMaSe program and Ground Truth 2.0, help to improve Integrated Water Resources Management in the Mara River Basin. In order to join the mapathons as an online volunteer, no specialist technical knowledge was required and trained experts (IHE Delft, Upande and MMU staff, Volunteers from the Red Cross and Youth Mappers) were available to guide the volunteers. Furthermore, instructions on how to join a mapathon were made available online on youtube here by Dr. Hans van der Kwast from IHE Delft.

Table 3 Overview of Ground Truth 2.0 Mapathons

Date	Location	Details
13 February 2017	IHE Delft, Wageningen University & Research, UT-ITC, Upande, various locations: IHE Delft alumni	200 participants
15 November 2018	Maasai Mara University, Upande, Map-Kibera, Youth Mappers, IHE Delft	2413 edits: 2061 buildings, 138 km roads
28 November 2018	IHE Delft and alumni in Uganda	150 participants
13 March 2019	Nelson Mandela African Institution for Science and Technology, Arusha (Tanzania)	Mini mapathon at the community of practice workshop Open Water Network event
28 March 2019	IHE Delft and Maasai Mara University	Online mapping for Cyclone Idai
18 November 2019	Maasai Mara University	30 participants
11 December 2019	IHE Delft	Land use and land cover (LULC) mapping

Figure 2 Volunteers at Masaai Mara University and IHE Delft, Mapathon November 2018

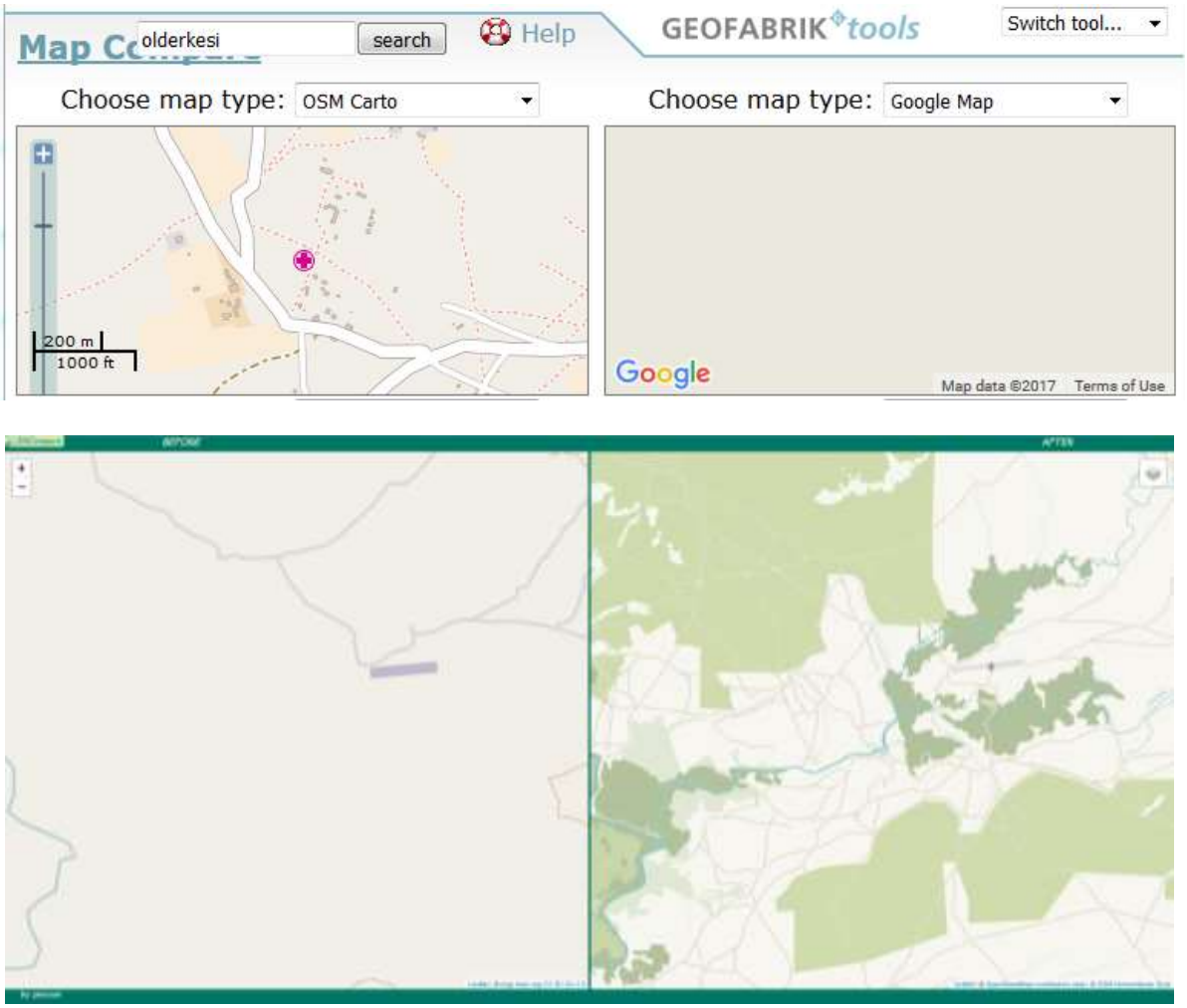


Figure 3 Examples of Mapathon before and after maps

4 Ground Truth 2.0 data quality tool

One of the main concerns in using and adopting citizen science based data is the quality of observations. Citizen observatories (and, by extension, citizen science) are particularly sensible to data quality because the number of contributors is bigger and more heterogeneous than in a traditional data survey campaign. An additional difficulty is that active citizen observatories are receiving continuous inputs and updates from citizens. Ground Truth 2.0 partner CREAF developed a tool to document the quality of datasets in order to increase the trust on information collected by citizens integrated in the MiraMon Map browser. Furthermore, the tool is used to assess the accuracy of products from the Ground Truth 2.0 Land Use Mapper. CREAF has developed some guidance for this data quality tool, which is presented in Annex 2.

5 GT2.0 contribution to the WeObserve MOOC

Ground Truth 2.0 has contributed substantially to the MOOC "Citizen Science Projects: How to Make a Difference", which has been organized by the WeObserve project. The course illustrated different types of citizen science projects available around the world and covered topics such as how to lead a citizen science project, including the best practices for community building, question forming and data collection. Next to the Ground Truth 2.0 project serving as an example of a citizen science project, the consortium partners IHE Delft (Uta Wehn) and CREAF (Joan Maso and Ester Prat) contributed content to topics such as co-designing citizen observatories, data analysis, open data sources and examining impact and change (see table 4).

The WeObserve MOOC started on 18 November 2019 and ran for four weeks. It is accessible free of charge through the FutureLearn platform here.

Table 4 Contribution to the WeObserve MOOC per week

Week	Activity	Content	Contribution	GT2.0 partner
1	Introducing WeObserve (and you!)	• Video introduction to citizen observatories and the WeObserve project. • Learning objectives	Writer/creator	IHE
	Glossary	• Glossary of commonly used terms	Writer/creator	IHE
	Types of observatories and campaigns	• Different types of observatories. • Open data for building new services and change. • Co-design vs top-down approach • Different types of campaigns	Writer/creator	IHE
	Discovering and mapping the issues	• Presenting of the observatories and discussion on how they tried to understand the issue.	Writer/creator/speaker	IHE
	Action spotlight: Community-based Environmental Monitoring	• Examples of community activities/collaboration from the observatories (Ground Truth 2.0, GROW sensing mission/places, LandSense Campaigner, SCENT Explore, SCENT Campaign Manager)	Writer/creator	IHE
	Choosing a question	• Example(s) from COs • What your questions were and why we chose them.	Writer/creator	IHE
	How we did it - forming teams	• Example(s) from COs • How did the different COs differ in their approaches? • Ways to get involved in CS/COs if you struggle to find a team	Writer/creator	IHE
	Moderation	• Tailored responses to participants based on Ground Truth 2.0 results	Forum moderation	IHE

2	Action spotlight: land use and land cover	• Examples of how observatories, campaigns, tools are working on this issue. • Ground Truth 2.0 Land Use Mapper	Writer/creator	IHE
	How do you know what data you need?	• Revisiting the question • Deciding what kind of data is appropriate to gather • Deciding how data will be collected and stored	Writer/creator	CREAF
	How we did it - Training for data collection	• Choosing data points, developing protocols and training for data collection	Writer/creator	IHE
	Moderation	Tailored responses to participants based on Ground Truth 2.0 results	Forum moderation	IHE
3	Action spotlight: biodiversity	• Illustration of how observatories, campaigns, tools are working on this issue. • Ground Truth 2.0 example: natusfera, natura alert	Writer/creator	CREAF
	Options for data analysis - tools & tips	• Explanation of data analysis options: simple ways incl. google spreadsheets, survey analytics as well as more complex data packages.	Writer/creator	CREAF
	How we did it - Analysing data	• How to manage understand and analyse data	Writer/creator	IHE
	How we did it - Visualising data	• Showcase of visualisations from Cos and related projects	Writer/creator	CREAF
4	How we did it: sharing data	• Examples from various projects: Edible Plant database (GROW), crowdsourced land map/engagement platform (LandSense), land use mapping (GroundTruth), Scent Harmonisation Platform (Scent)	Writer/creator	IHE
	Opening access to data	• Open data sources and their benefits and challenges. • Explore open data/share interesting datasets.	Writer/creator	CREAF
	COs and service innovation	• AAWA Case Study: Water Governance	Writer/creator	IHE
	Examining impact and change	• Social & political impacts of CO activities • Way forward of COs	Writer/creator/speaker	IHE

6 School-2-School educational material

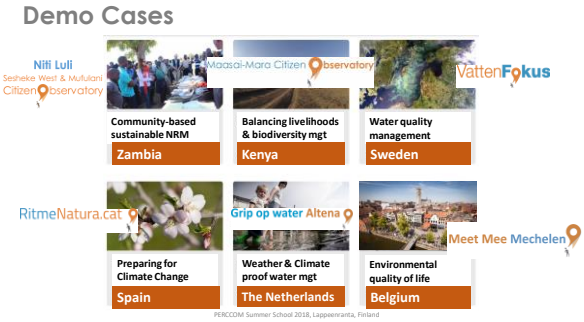
Ground Truth 2.0 partner TAHMO is in charge of the educational program 'School-2-School' (S2). S2S's mission is to foster international school partnerships and science and technology education utilizing on-site climate monitoring to analyse local weather and compare local school environments to partner schools around the world. Installing TAHMO weather stations in schools gives teachers and students of all levels the unique opportunity to connect science curriculum with real weather data for both educational and research purposes. S2S hopes to engage students and increase interest in science by S2S activities such as taking readings from the weather station, creating graphs and interpreting data to identify trends, make weather predictions, compare different climates and weather in different regions, and understand how the weather sensors work.

In June 2019, the Ground Truth 2.0 consortium held a dedicated workshop session during its plenary F2F meeting on how citizen science could be included in the S2S curriculum. Working in thematic groups, the partners composed specific inputs in alignment with the S2S educational format. Together with other materials of the S2S program, these newly created lesson materials were discussed during a training in Ghana organised by TAHMO in collaboration with ETH Zürich and the Oregon State University (USA) in August 2019 and further reviewed by the Kivulini Trust, a non-profit institution aimed at reconnecting pastoralist and other minority groups in Northern Kenya. Overall, the materials were well received. In order to enhance the understanding and use of the TAHMO S2S materials for primary school students (aged between 6-12 years), feedback included to simplify some of the S2S materials. Once the new academic year will start in January 2020, the materials will be available to over 400 schools and over 4000 students across Africa. In order to continuously improve the S2S materials, monitoring and evaluation will be done.

For an overview of the educational materials, please see Annex 3. The materials will be made available on the TAHMO school2school.net website.

Figure 4 Overview of TAHMO partner schools

Annex 1 – PowerPoint presentations



Co-designing Citizen Observatories METHOD

COs ≠ plug & play solutions for data collection

Framing COs: more than just *more data* and not *just* about science!

Stakeholder participation & knowledge co-production

Co-design METHOD

- ✓ Not pushing a concept & technology but creating **value** by understanding *stakeholder* needs & motivations
- ✓ **'Blank page'** re. purpose & scope of future CO
- ✓ Involving **all** (local) stakeholders every step of the way
- ✓ Feasibility & benefits of CO differ per community -> flexible, useful, adaptable method
  - geogr. contexts
  - social settings
  - thematic issues
- ✓ **Community building** as important as co-designing platform & tools

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Co-designing Citizen Observatories FINDINGS

Purpose & shape of COs differ significantly from initial expectations

- one off consultation is **not** enough; iterative process
- **balanced** co-design: stakeholder control & facilitator role [COs as tools for positive change]

Value of co-design: starts *before* delivery of platforms, apps, tools

- social movement
- social learning

Project dynamics

- *Technical partners* – lock in
- *Funders* – ex ante determination of outcomes vs. results of stakeholder consultation & co-design
- Implications for **impact**

Photo: Luigi Cesaroni

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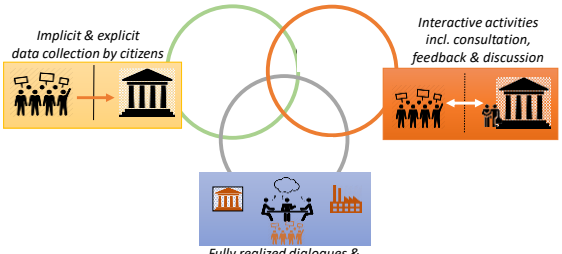
Thank you!

Project Director: Dr. Uta Wehn, Associate Professor, IHE Delft, u.wehn@un-ihe.org

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

Citizen Observatory **Domains**



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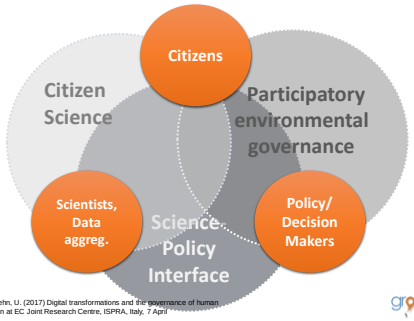

Source: based on Wehn, U. (2017) Digital transformations and the governance of human societies, presentation at EC Joint Research Centre, ISPRA, Italy, 7 April

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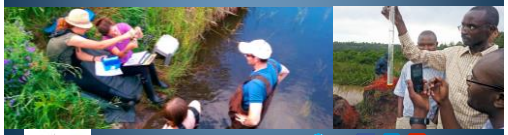
Citizen science & participation in decision making in African contexts

Dr. Uta Wehn, Associate Professor, IHE Delft Institute for Water Education

4th International EVOCA Workshop
27-29 August 2019



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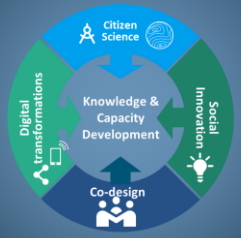
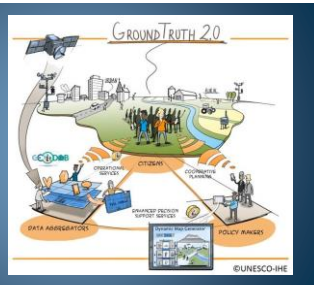
Citizen Science and Social Innovation Team at IHE Delft



Citizen Science and Social Innovation Team at IHE Delft

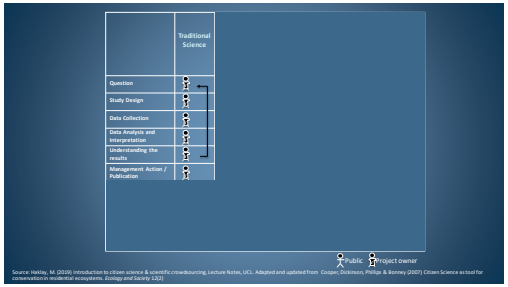
groundtruth2.0 — Environmental knowledge discovery of human sensed data
We observe
afrialliance — Africa-EU Innovation Alliance for Water and Climate
CSEOL — Citizen Science Earth Observation Lab
MICS — Measuring Impact of Citizen Science
KidronNar
Women & Water — Net Changes in Transformation
wwcc.wetlandsforum.net

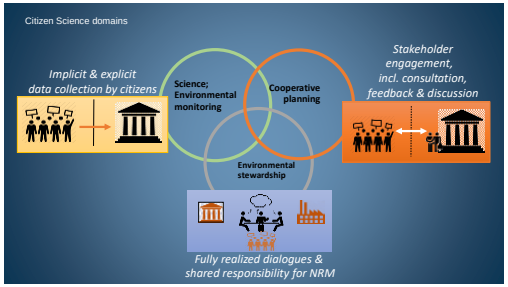
Citizen Science
- Volunteered geographic information
- Crowdsourcing geospatial data
- People-centric sensing
- Participatory sensing
- Public Participatory GIS
- eParticipation
- Environmental Virtual Observatories
- Citizen Observatories
- Community-based Monitoring & Information Systems
- …



Current issues in Citizen Science (in African contexts)

- **Under / overestimation of Citizen Science**
- **Participation in Citizen Science and decision making**
- **Governance implications 'by design'**


Traditional Science
Question
Study Design
Data Collection
Data Analysis and Interpretation
Understanding the results
Management Action / Publication
Public
Project owner
Source: Haklay, M. (2010) Introduction to citizen science & scientific crowdsourcing, Lecture Notes, UCL. Adapted and updated from Cooper, Dickinson, Phillips & Bonney (2007) Citizen Science as tool for conservation in residential ecosystems. Ecology and Society 12(2)


Citizen Science domains
Implicit & explicit data collection by citizens
Science; Environmental monitoring
Cooperative planning
Stakeholder engagement, incl. consultation, feedback & discussion
Environmental stewardship
Fully realized dialogues & shared responsibility for NRM


GroundTruth 2.0
Citizen Observatories
Dedicated communities of citizens, scientists & decision makers
relying on ICT-based platform and tools
to actively collaborate in the collection, exchange and use of information & knowledge for a shared purpose.
IHE DELFT
Starlab
vito
Gavagai
akvo.org
EARTHWATCH INSTITUTE
CREAF
altran
HydroLogic RESEARCH
WWF
Stockholm University
Upande
TYGRON
TAHMO
This project has received funding from the European Union's Horizon 2020 Research and Innovation Programme under grant agreement No. 689744.


Co-design of 6 demand-driven Citizen Observatories
6 countries
6 topics
6 scales
1 approach
groundtruth2.0
@Ground Truth 2.0 consortium


Ground Truth 2.0 Citizen Observatories
Niti Luli
Sesheke West & Mufulani CBNRM Observatory
Maasai Mara Citizen Observatory
VattenFokus
Community-based sustainable NRM
Zambia
Balancing livelihoods & biodiversity mgt
Kenya
Water quality management
Sweden
RitmeNatura.cat
Grip op water Altena
Meet Mee Mechelen
Preparing for Climate Change
Spain
Weather & Climate proof water mgt
The Netherlands
Environmental quality of life
Belgium


Kenya Demo Case
Balancing sustainable livelihoods & biodiversity management
Maasai Mara Citizen Observatory
Web-platform
App
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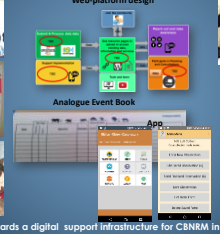
Zambia Demo Case

Community-based sustainable Natural Resources Management

Web-platform design



Analogue Event Book

App

Nifi Luli

Sesheke West & Mufulani

Citizen observatory

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Evolving towards a digital support infrastructure for CBNRM in Zambia

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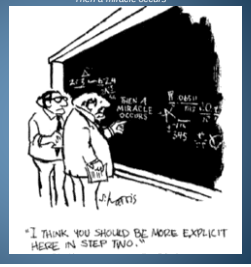
Lessons learned

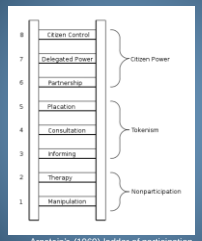
- Co-design for impact (approach)
- Embedding in (local) decision making
- One off consultation is **not** enough; iterative process
- Attention to incentives & barriers of all stakeholders & tailored engagement strategies
- Responsibility to offer continuity and be responsive
- Community building as important as co-designing CS, platform & tools

Participation in decision making

"Then a miracle occurs"



Participation in decision making



Arnstein's (1969) ladder of participation

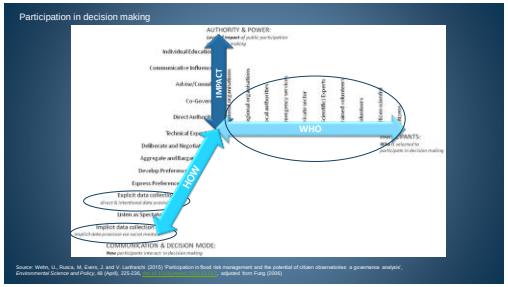
Participation in decision making

Core questions (Ahlers, 2006)

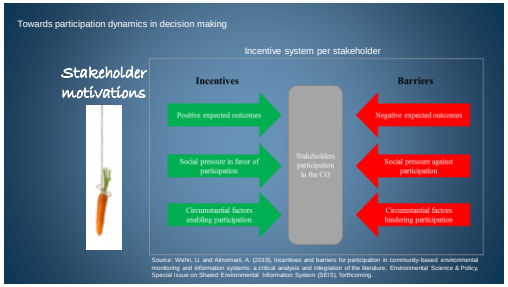
- Who sits at the table?
- Who can speak at the table?
- Who is listened to at the table?
- At which table are decisions actually made?

Participation in decision making

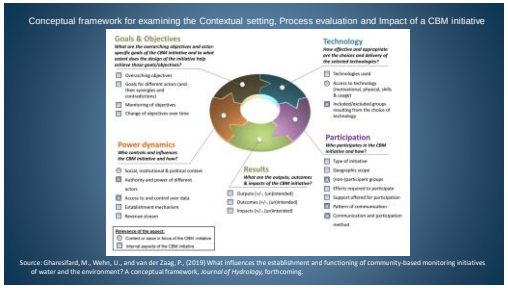
- **Who sits at the table?**
  - Right to participate: entitlement, obligation, or chance?
  - Motivation, time, and financial resources
  - Empowerment versus efficiency
- **Who can speak at the table?**
  - Social position and power
  - Trust and confidence
  - Knowledge and skills (incl. language and vocabulary)



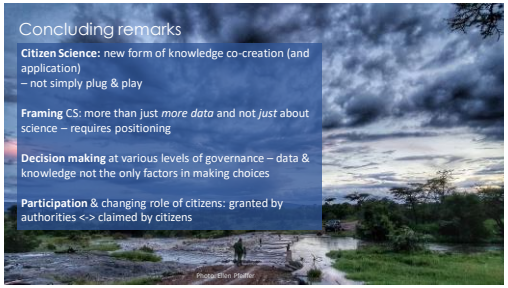
Source: Wehn, U., Rusca, M, Evers, J. and V. Lanfranchi (2015) Participation in flood risk management and the potential of citizen observatories: a governance analysis, *Environmental Science and Policy*, 48 (April), 225-236, adjusted from Fung (2006)



Source: 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.



Source: 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*, forthcoming.



Thank you

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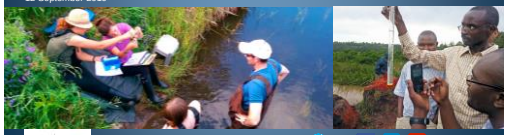
Co-designing citizen science for participatory environmental governance

Dr. Uta Wehn, Associate Professor, IHE Delft Institute for Water Education
Circular Cities summer school, Erasmus+ programme IMETE, Ghent University
12 September 2019



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MICS — Measuring Impact of Citizen Science
KidronNar
Women & Water — wwcc.wetlandsforum.net

Learning objectives

Participants will be able to:

- Describe citizen science
- Describe the links between citizen science and participatory governance
- Describe the need for co-designing citizen science activities for participatory governance

Structure of the session

1. Forms of Citizen Science
2. Citizen Science and participatory governance
3. Case studies: co-designing citizen science for participatory governance

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1. Forms of Citizen Science

Citizen Science – What is it?

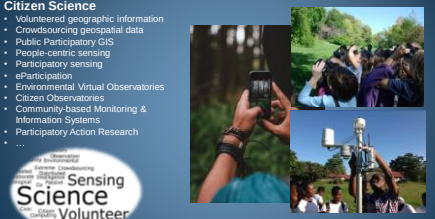
Citizens participate in **science**.

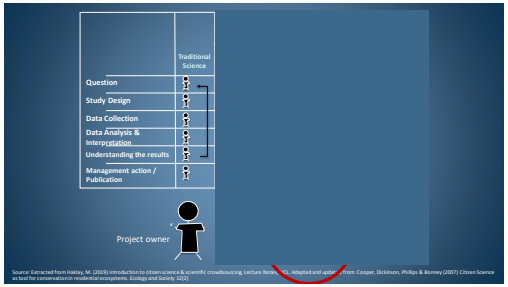
amateurs
non-professionals

researchers, scientists, trained professionals
e.g. water management institutions

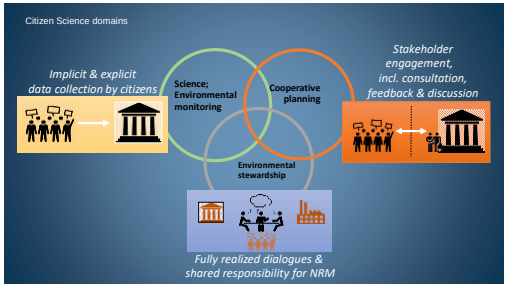
Citizen Science

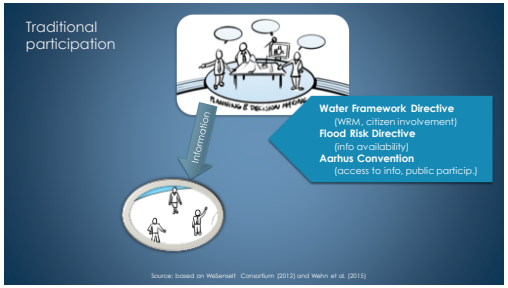
- Volunteered geographic information
- Crowdsourcing geospatial data
- Public Participatory GIS
- People-centric sensing
- Participatory sensing
- eParticipation
- Environmental Virtual Observatories
- Citizen Observatories
- Community-based Monitoring & Information Systems
- Participatory Action Research
- …

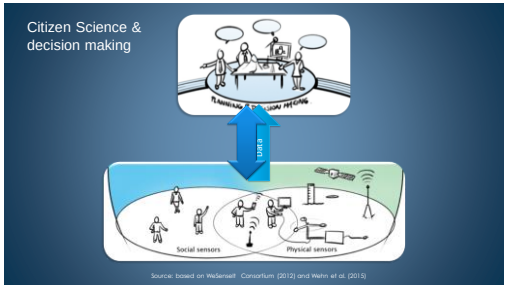


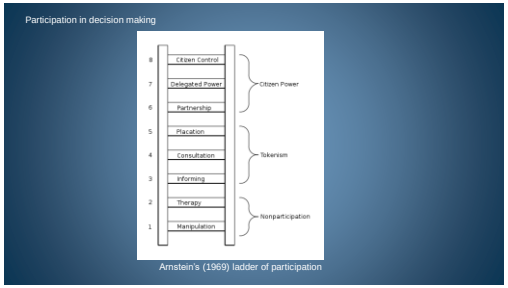


2. Citizen Science & participatory governance

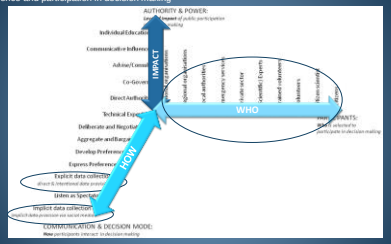








Citizen Science and participation in decision making



Source: Wehn, U., Rauca, M, Evers, J. and V. Lanfranchi (2015) 'Participation in flood risk management and the potential of citizen observatories: a governance analysis', *Environmental Science and Policy*, 48 (April), 225-236, http://dx.doi.org/10.1016/j.envsci.2014.12.017 , adjusted from Fung (2006)

3. Co-designing Citizen Science for participatory governance

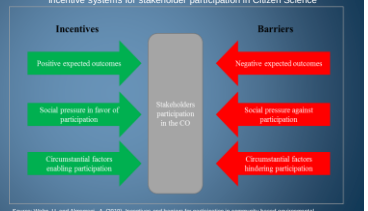
3. Co-designing Citizen Science for participatory governance

…why?

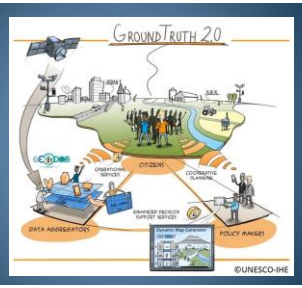
Engaging stakeholders in Citizen Science isn't [always] easy.
"Open the gates and here they come"

Stakeholder motivations

Incentive systems for stakeholder participation in Citizen Science



Source: Wehn, U. and Almomani, A. (2018). 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.



Citizen Science and participation in decision making

"What gets measured, gets managed."

Who decides what gets measured?
What counts as evidence?
How does evidence count?
Who decides how evidence counts?

"Empowerment" & meaningful participation:

- changing role of citizens
- needs to be granted & claimed

Citizen Science isn't plug & play.
Technologies are key but we need to know what we need in each case.

Innovative technologies for Citizen Science & smart catchment monitoring

Setting up Citizen Science initiatives

Co-design

- Identify & invite all stakeholders (citizens, scientists, decision makers)
- Hold stakeholder workshop(s)
- Define the goals
- Foster the community that runs the CS initiative

Technical components

- Review existing technical components
- Select the components to meet identified needs & capabilityes
  - incl. considerations for data quality and interoperability
- Tailor and configure the components

Case Studies: co-designing citizen science for participatory governance

Citizen observatories

- specific form of **knowledge co-production** initiatives
- typically implemented **at local scale**
- with a **long term** focus
- link to policy

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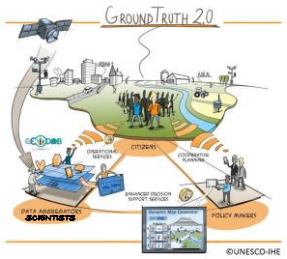
Environmental knowledge discovery of human sensed data



Citizen Observatories

Dedicated **communities** of *citizens, scientists & decision makers*

relying on **ICT-based** platform and tools

to actively **collaborate** in the *collection, exchange and use* of information & knowledge for a shared purpose.

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Swedish Demonstration Case

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Issues:

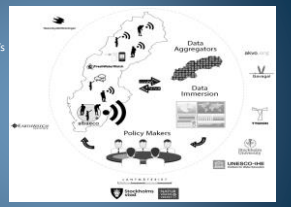
- Deteriorating **Water Quality** for land and natural resources management
  - Eutrophication, Biodiversity loss – Algal blooms
  - Land Use – Agriculture, Industry, Municipal Wastewater
- Disconnected Data Sources
- Citizen capabilities largely ignored within the policy debates

Two pilot areas : Stockholm and Flen

Stockholm University | Akvo | EarthWatch Institute | Gavagai | IHE Delft | egovlab

Stakeholders

- **Citizens:** Naturskyddsforeningen (Swedish Society for Nature Conservation), Communes: Skarpnäck, Nacka. (+Scaling up via Stockholm Stad's involvement)
- **Policy**: Lantmäteriet, Naturvårdsverket (EPA), Stockholm Stad, Vattenmyndigheterna
- **Data Aggregators & Visualizers**: Akvo, EarthWatch, Gavagai, Tygron
- **Scientific Expertise**: IHE Delft, SU



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Swedish Demo Case

Stakeholders' needs and motivations

*What is missing is a **platform and engagement process** to tackle pressures on natural resources.*

- **Citizen Science** as a first step toward a platform for collaborative governance and action.
- **Sharing knowledge** and making **data** more **accessible and open**
- **Enable citizens** to make sense of the data and **influence policy makers**

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Objectives

VattenFokus

1. To **group the community** by watershed and get citizen inputs (**observations, data**, from for instance WaterBlitz) on the water health of Båven and Mälarden and get these inputs verified by expert groups.

2. To **include existing water data platforms** in order to make those more visible and accessible and, by so doing, generating incentives to innovate with data.

3. To **provide visualization** of the existing **data platforms** and the new data to make the gathered data more accessible

4. Helping to count on a **physical space** for citizen to discuss, plan and engage in actions toward the open monitoring and stewardship of water quality and causes of stress visualized in the CO.

5. To **raise a**To **raise awareness** of water quality issues and how lifestyle choices impact upon the aquatic environment. **wareness** of water quality issues and how lifestyle choices impact upon the aquatic environment.

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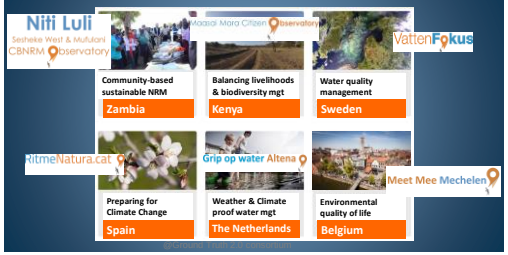
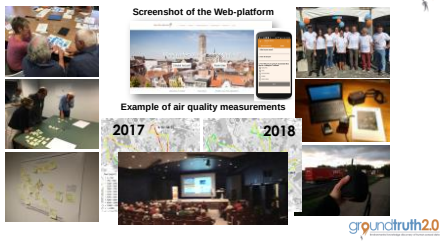
Ground Truth 2.0 Citizen Observatories



Belgium Demo Case

Environmental quality of life

Meet Mee Mechelen



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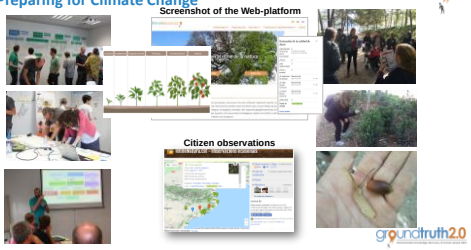
Spanish Demo Case

Preparing for Climate Change

RitmeNatura.cat



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Dutch Demo Case

Weather & Climate proof water management

Grip op water Altena

Screenshot of the Web-platform

Example of information about water storage areas

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Kenyan Demo Case

Balancing sustainable livelihoods & biodiversity management

Maasai Mara Citizen Observatory

Screenshot of the Web-platform

Screenshot of the App

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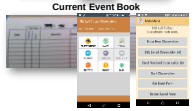
Zambian Demo Case

Community-based sustainable natural resources management

Niti Luli
Sesheke West & Mufulani
CBNRM Observatory

Web-platform design

Current Event Book



Evolving towards a digital support infrastructure for CBNRM in Zambia

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Citizen Science domains & knowledge co-production

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Co-designing citizen science for participatory environmental governance

Framing CS: **not** plug & play solutions for data collection, more than just *more data*, and not *just* about science!
Stakeholder participation, knowledge co-production & trigger for sustainable behaviour

Community building as important as co-designing platform & tools:
- fostering a sustainable community of relevant actors to achieve collectively agreed *sustainability* goals in their local environment

Purpose & shape of COs differ significantly from initial expectations
- one off consultation is **not** enough; iterative process
- **balanced** co-design: stakeholder contributions, control & facilitator role

- ✓ Not pushing a concept & technology <u>but</u> creating **value** by understanding *stakeholder* needs & motivations
- ✓ **'Blank page'** re. purpose & scope of future CO
- ✓ Engagement: involving **all** (local) stakeholders every step of the way
- ✓ **Value of co-design:** starts *before* delivery of platforms, apps, tools
  - social movement
  - social learning
- ✓ Feasibility, scope & benefits of CO differ per community
  -> flexible, useful, adaptable method
    - geogr. contexts
    - social settings
    - thematic issues

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Learning objectives

Participants will be able to:
- Describe citizen science
- Describe the links between citizen science and participatory governance
- Describe the need for co-designing citizen science activities for participatory governance

Wrapping up

What is Citizen science?
<choose 1 answer>

1. Citizen Science involves only non-professionals in science
2. Citizen Science involves non-professionals in only data collection
3. Citizen Science involves non-professionals and trained professionals in any step of the scientific methods

Wrapping up

What are the links between Citizen science and participatory governance?
<choose 1 answer>

1. The role of Citizen Science in decision making is limited to providing data for better decisions
2. The technologies co-designed for Citizen Science activities determine the level of public participation in governance
3. Various stakeholders determine the role of citizen scientists in decision making

Thank you

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Environmental knowledge discovery of human sensed data

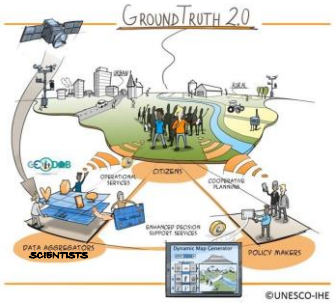
Co-designing citizen observatories for sustainability

Uta Wehn (IHE Delft)

Ellen Pfeiffer & Kim Anema (IHE Delft), Stijn Vrancks (VITO), Rianne Giesen (HR), Camille Pelloquin (Starlab), Tessy Cerratto Pargman (SU), Hans van der Kwast (IHE Delft), Mwape Sichilongo (WWF Zambia)

PERCCOM Summer School 2018, June 2018, Lappeenranta University of Technology

Project Director: Dr. Uta Wehn, Associate Professor, IHE Delft



PERCCOM Summer School 2018, Lappeenranta, Finland

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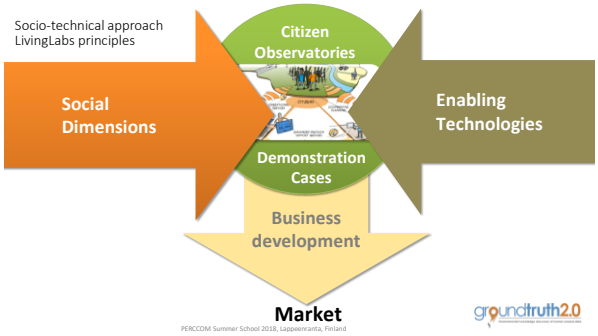
Environmental knowledge discovery of human sensed data

Socio-technical approach
LivingLabs principles



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PERCCOM Summer School 2018, Lappeenranta, Finland

Co-design of 6 demand-driven Citizen Observatories

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LivingLabs guiding principles
for the co-design process

- Create value for you by understanding your needs and motivations
- Give you - as future users - **influence** on the decisions of the Citizen Observatory
- Aim for **sustainability** in economic, environmental and social terms
- Involve multiple perspectives and collaborate widely for **openness**
- Carry out activities in the **real-life context**

Source: Adapted from Ståhlbröst & Holst (2012)

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PERCCOM Summer School 2018, Lappeenranta, Finland

Belgium Demo Case
Environmental quality of life

Meet Mee Mechelen

Screenshot of the Web-platform

Example of air quality measurements

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PERCCOM Summer School 2018, Lappeenranta, Finland

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Environmental knowledge discovery of human sensed data

#gt20week

Ground Truth 2.0 Week

Outputs

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

#gt20week

Thank you

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Ground Truth 2.0 Week 2019

"How to impact decision making with citizen observatories"

30 Sept - 2 Oct 2019

Parallel events in **Kenya, Zambia, Spain, Sweden, Belgium and The Netherlands**

- Data collection campaigns
- On-site demonstrations
- Workshops
- Panel discussions
- Webinars

3 - 4 Oct 2019

Face-to-Face workshops at IHE Delft in Delft, The Netherlands.

Participate in interactive sessions on the six citizen observatories and learn about the Ground Truth 2.0 co-design methodology.

Find out more: www.gt20.eu gt20@un-ihe.org @GroundTruth20 #gt20week

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 Week 2019

"How to impact decision making with citizen observatories"

Online Programme

See below the full programme of activities throughout the week, as well as how to key into the various activities remotely by joining a webinar or viewing a video once it has been launched.

Ground Truth 2.0 Week 2019 Programme

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Environmental knowledge discovery of human sensed data

#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 2

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Scientific method

- Question
- Study Design
- Data Collection
- Data Analysis & Interpretation
- Understanding the results
- Management action / Publication

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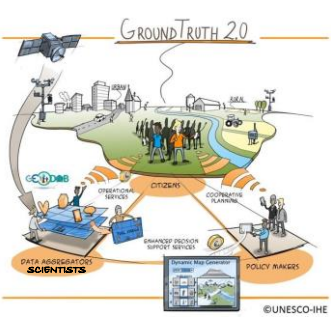

Citizen observatories

- innovative form of **monitoring, knowledge co-production & engagement** initiatives
- typically implemented **at local scale**
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- link to **policy & action**

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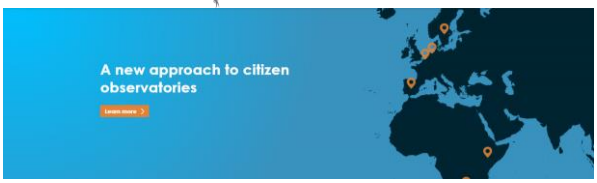
Environmental knowledge discovery of human sensed data



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Co-design METHODOLOGY

- serves to bring together dedicated communities of **citizens, scientists and policy makers**,
- takes their **individual and collective needs** as a starting point
- carefully guides them through a process of co-designing, implementing and evolving a CO that has a **shared purpose**
- and is enabled by suitable and **tailored ICT-based tools**
- in order to achieve **agreed impacts**, and which is sustainable in the long run.

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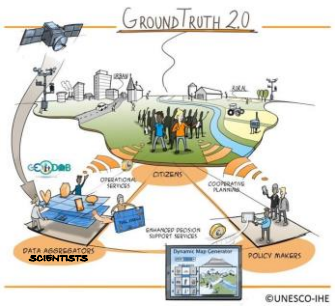

Citizen observatories

- all shapes & sizes

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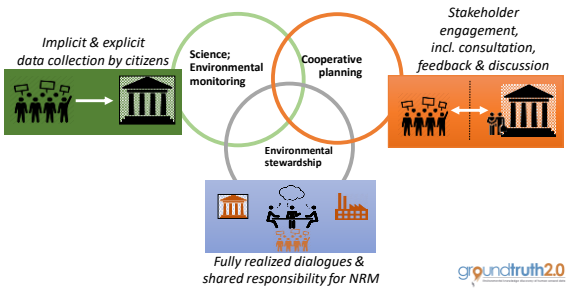
Citizen observatory domains



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- Hold stakeholder workshop(s)
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Technical components

- Review existing technical components
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- Tailor and configure the components

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Co-design of 6 demand-driven Citizen Observatories

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6 countries
6 topics
6 scales
1 approach

@Ground Truth 2.0 consortium

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Niti Luli
Sesheke West & Mutulani CBNRM observatory

Community-based sustainable NRM
Zambia

Maasai Mara Citizen observatory

Balancing livelihoods &
Kenya

VattenFokus

Water quality management
Sweden

RitmeNatura.cat

Preparing for Climate Change
Spain

Grip op water Altena

Weather & Climate proof water mgt
The Netherlands

Meet Mee Mechelen

Environmental quality of life
Belgium

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Citizen Observatory **domains**

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Ground Truth 2.0 Week 2019

"How to impact decision making with citizen observatories"

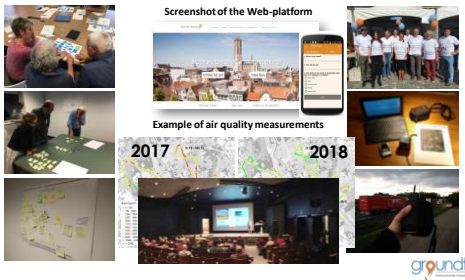
Ground Truth 2.0 Week 2019

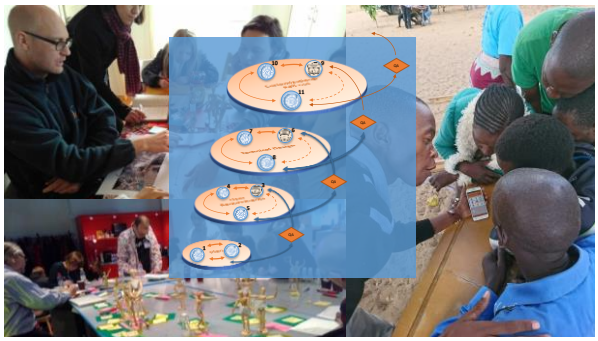
"How to impact decision making with citizen observatories"

Belgium Demo Case

Environmental quality of life

Meet Mee Mechelen





Swedish Demo Case

Water quality management

VattenFokus

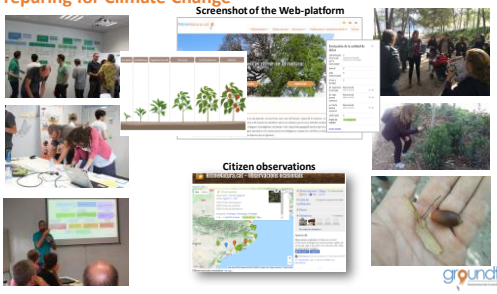
Screenshot of the Web-platform

Spanish Demo Case

Preparing for Climate Change

RitmeNatura.cat

Screenshot of the Web-platform



Dutch Demo Case

Weather & Climate proof water management

Grip op water Altena

Screenshot of the Web-platform

Kenyan Demo Case

Balancing sustainable livelihoods & biodiversity management

Maasai Mara Citizen Observatory

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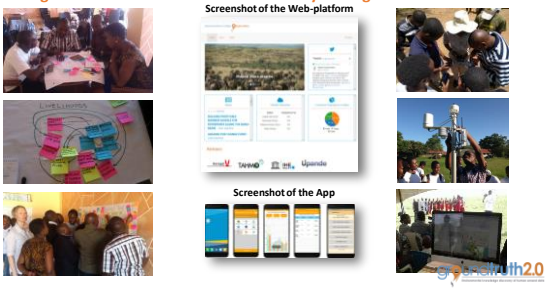


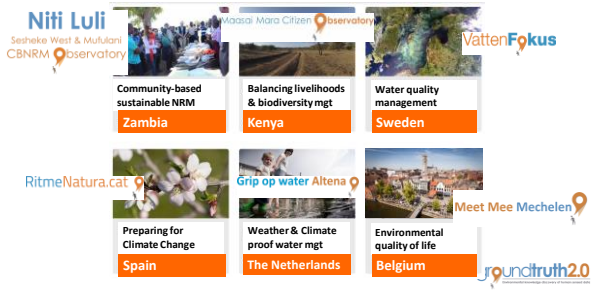
Zambian Demo Case

Community-based sustainable natural resources management

Niti Luli

Sesheke West & Mululani CBNRM Observatory

Web-platform design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Belgium
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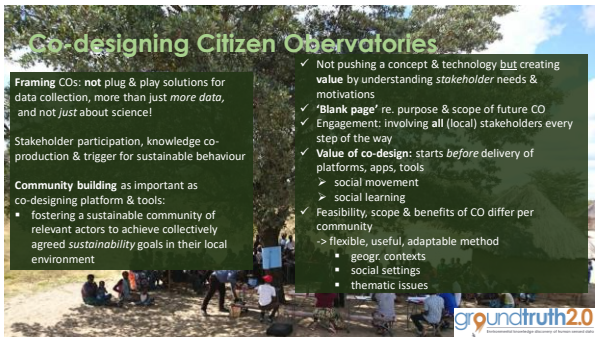
Co-designing Citizen Observatories
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Feasibility, scope & benefits of CO differ per community
-> flexible, useful, adaptable method
geogr. contexts
social settings
thematic issues
groundtruth2.0


Co-designing Citizen Observatories
METHODOLOGY IMPLEMENTATION
Purpose & shape of COs differ significantly from initial expectations
one off consultation is not enough; iterative process
balanced co-design: stakeholder contributions, control & facilitator role
Photo: Ellen Pfeiffer
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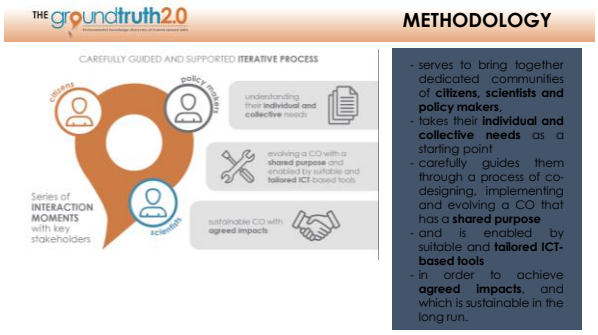
THE groundtruth2.0
METHODOLOGY
CAREFULLY GUIDED AND SUPPORTED ITERATIVE PROCESS
citizens
policy makers
scientists
Series of INTERACTION MOMENTS with key stakeholders
understanding their individual and collective needs
evolving a CO with a shared purpose and enabled by suitable and tailored ICT-based tools
sustainable CO with agreed impacts
- serves to bring together dedicated communities of citizens, scientists and policy makers,
- takes their individual and collective needs as a starting point
- carefully guides them through a process of co-designing, implementing and evolving a CO that has a shared purpose
- and is enabled by suitable and tailored ICT-based tools
- in order to achieve agreed impacts, and which is sustainable in the long run.

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Environmental knowledge discovery of human sensed data

#gt20week

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 Week 2019

#gt20week

"How to impact decision making with citizen observatories"

#gt20week

30 Sept - 2 Oct 2019

Parallel events in **Kenya, Zambia, Spain, Sweden, Belgium and The Netherlands**

- Data collection campaigns
- On-site demonstrations
- Workshops
- Panel discussions
- Webinars

3 - 4 Oct 2019

Face-to-Face workshops at IHE Delft in Delft, The Netherlands.

Participate in interactive sessions on the six citizen observatories and learn about the Ground Truth 2.0 co-design methodology.

Find out more: www.gt20.eu gt20@un-ihe.org @GroundTruth20 #gt20week

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

#gt20week

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Citizen observatories

- specific form of **monitoring, knowledge co-production & engagement** initiatives
- typically implemented **at local scale**
- with a **long term** focus
- link to **policy & action**

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Citizen observatories

- Dedicated **communities** of citizens, scientists & decision makers
- Relying on **digital technologies**
- To actively **collaborate** in the collection, exchange and use of information & knowledge for a shared **purpose.**

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Citizen Observatories domains

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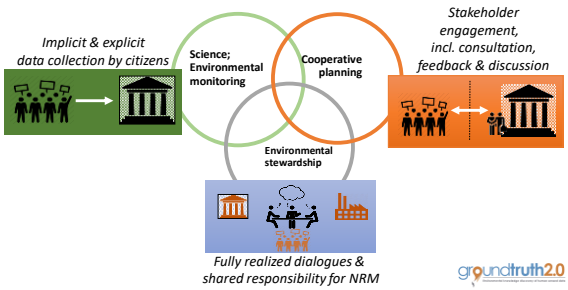

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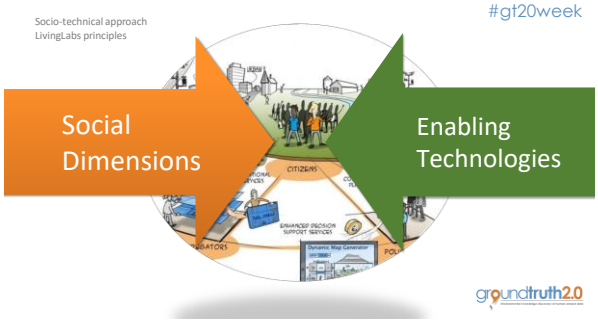
Socio-technical approach
LivingLabs principles

#gt20week



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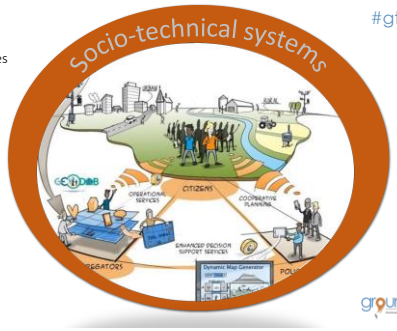
Citizen Observatories

#gt20week



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Niti Luli
Sesheke West & Mufulani CBNRM Observatory

Community-based sustainable NRM
Zambia

Maasai Mara Citizen Observatory

Balancing livelihoods & biodiversity mgt
Kenya

VattenFokus

Water quality management
Sweden

RitmeNatura.cat

Preparing for Climate Change
Spain

Grip op water Altena

Weather & Climate proof water mgt
The Netherlands

Meet Mee Mechelen

Environmental quality of life
Belgium

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Ground Truth 2.0 Week 2019 Programme

#gt20week

	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 (Biodiffi Campaign)	Local workshop/panel			Face-to-Face event of IHE Delft. Delft, The Netherlands (all day)	Face-to-Face event of IHE Delft. Delft, The Netherlands (all day)
		Local workshop on healthess 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 (2 hour) & exhibition (IHE Delft)	Webinar about GT2.0 outputs (1 hour) & exhibition (IHE Delft)		

Find out more: www.gt20.eu gt20@un-ihe.org @GroundTruth20 #gt20week

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

Ground Truth 2.0 Week 2019

#gt20week

"How to impact decision making with citizen observatories"

Webinars from IHE Delft

Webinar 1: Ground Truth 2.0 Overview - 30 Sep 2019
Language: English
Time: 11:00 - 12:00 (GMT+2, AMS)
A general overview of the Ground Truth 2.0 project and the Ground Truth Week 2019.
Register for the Webinar "Ground Truth 2.0 Overview"

Webinar 2: Ground Truth 2.0 Methodology and Citizen Observatories - 1 Oct 2019
Language: English
Time: 11:00 - 12:00 (GMT+2, AMS)
A presentation and discussion of the Ground Truth 2.0 methodology, and the Citizen Observatories that emerged from the co-design project was active in.
Register for the Webinar "Ground Truth 2.0 Methodology and Citizen Observatories"

Webinar: Ground Truth 2.0 Outputs - 2 Oct 2019
Language: English
Time: 11:00 - 12:00 (GMT+2, AMS)
An overview and discussion of the various Ground Truth 2.0 (GT2.0) outputs, including the Tool Matching, Data Quality tool and the Land Use Mapper.
Register for the Webinar "Ground Truth 2.0 Outputs"

KlimaatRobuust St. Andries

KlimaatRobuust St. Andries Webinar (Antwerp, Belgium)
Webinar: Hitwelven in Antwerpen: Resultaten Meetcampagne
Language: English
Time: 19:00 - 20:00 (GMT+2, AMS)
Register now de Webinar

Meet Mee Mechelen

Meet Mee Mechelen Webinars (Mechelen, Belgium)

Webinar: Meet Mee Mechelen Interactief Outdoor - Buitenwat is Luchtkwa Mechelen
Language: English
Time: 19:00 - 20:00 (GMT+2, AMS)
Register now de Webinar

Webinar: Voorstelling Meet Mee Mechelen Vlaamsch "Mechelen Lucht" en Samenwerking Meet Mee Mechelen-Klimaan
Language: English
Time: 19:00 - 20:00 (GMT+2, AMS)
Register now de Webinar

REGISTER here: gt20.eu/gt20week/online-programme/

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GT2.0 Week 2019 Face-to-Face Programme

Thursday 03 October		Friday 04 October	
09:00 - 09:30	Introduction and overview of Ground Truth 2.0	09:00 - 09:15	Opening of the GT2.0 market place and pitches
09:30 - 11:00	The Ground Truth 2.0 Citizen Observatories	09:15 - 10:30	Ground Truth 2.0 Tools and outputs market
11:00 - 11:30	Coffee Break	10:30 - 11:00	Coffee Break
11:30 - 12:30	Context matters	11:00 - 12:00	Passing the Torch - Panel and Closing remarks
12:30 - 13:30	Lunch	12:00 - 13:00	Lunch
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		

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groundtruth2.0 consortium

Research & Academia
IHE DELFT
Stockholm University
CREAF
vito

SMEs & Industry
altran
Gavagai
Starlab
Upande
TYGRON
HydroLogic RESEARCH

CSOs & non-profit
TAHMO
EARTHWATCH INSTITUTE
Akvo.
WWF

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groundtruth2.0 advisory board

ECTP-CEU — Henk van der Kamp	Independent environment consultant — Clairie Papazoglou
ArtDatabanken — Liselott Sjödin Skarp	Université de Genève — Gregory Giuliani
ICLEI Local Governments for Sustainability — Barbara Anton	

Ground Truth 2.0 Week 2019

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"How to impact decision making with citizen observatories"

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Thank you

#gt20week

Dr. Uta Wehn, Ground Truth 2.0 Project Coordinator, Associate Professor, IHE Delft
u.wehn@un-ihe.org

www.gt20.eu
gt20@unesco-ihe.org
@groundtruth20

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LivingLabs guiding principles
for the co-design process

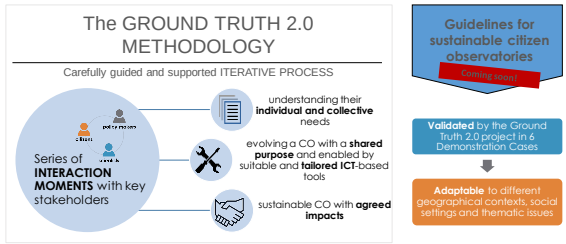
- Create value for you by understanding your needs and motivations
- Give you - as future users - **influence** on the decisions of the Citizen Observatory
- Aim for **sustainability** in economic, environmental and social terms
- Involve multiple perspectives and collaborate widely for **openness**
- Carry out activities in the **real-life context**

Source: Adapted from Ståhlbröst & Holst (2012)

Co-design methodology

Co-design
- Identify & invite stakeholders (citizens, scientists, decision makers)
- Hold stakeholder workshop(s)
- Define the goals
- Foster the community that runs the CBM initiative

Technical components
- Review existing technical components
- Select the components to meet identified needs & capabilities
  - incl. considerations for data quality and interoperability
- Tailor and configure the components



Co-designing citizen observatories for sustainability

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Kenyan Demo Case

Balancing sustainable livelihoods & biodiversity management

Maasai Mara Citizen Observatory

Screenshot of the Web-platform

Screenshot of the App

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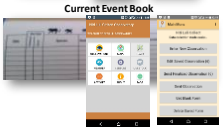
Zambian Demo Case

Community-based sustainable natural resources management

Niti Luli
Sesheke West & Mufulani CBNRM Observatory

Web-platform design

Current Event Book



Evolving towards a digital support infrastructure for CBNRM in Zambia

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Niti Luli
Sesheke West & Mufulani CBNRM Observatory

Maasai Mara Citizen Observatory

VattenFokus

Community-based sustainable NRM
Zambia

Balancing livelihoods & biodiversity mgt
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RitmeNatura.cat

Grip op water Altena

Meet Mee Mechelen

Preparing for Climate Change
Spain

Weather & Climate proof water mgt
The Netherlands

Environmental quality of life
Belgium

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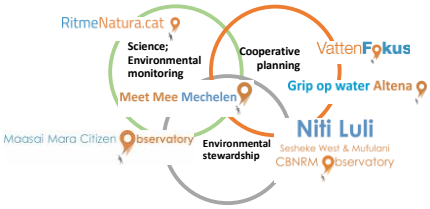
Citizen Science domains & knowledge co-production



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groundtruth2.0 data collection

Apps, platforms, sensors & social media

akvoflow

#FenoDato
CREAF

Virtual KENYA

HydroLogic

altran

FreshWaterWatch

SOCIAL MEDIA

Gavagai

groundtruth2.0 data processing

Integration platforms to gather, analyse & fuse data from heterogeneous sources & integrate with GEOSS

HydroLogic

Land Use Mapper

UNESCO-IHE

CREAF

GEOSS

Enhanced services & stakeholder interactions

Visualisation & community

Serious gaming

Co-designing local knowledge co-production for sustainability

Framing COs: **not** plug & play solutions for data collection, more than just *more data,* and not *just* about science!

Stakeholder participation, knowledge co-production & trigger for sustainable behaviour

Community building as important as co-designing platform & tools:

- fostering a sustainable community of relevant actors to achieve collectively agreed *sustainability* goals in their local environment

- ✓ Not pushing a concept & technology but creating **value** by understanding *stakeholder* needs & motivations
- ✓ **'Blank page'** re. purpose & scope of future CO
- ✓ Engagement: involving **all** (local) stakeholders every step of the way
- ✓ **Value of co-design:** starts *before* delivery of platforms, apps, tools
  - ➢ social movement
  - ➢ social learning
- ✓ Feasibility, scope & benefits of CO differ per community
  - -> flexible, useful, adaptable method
    - geogr. contexts
    - social settings
    - thematic issues

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Co-designing local knowledge co-production METHODOLOGY IMPLEMENTATION

Purpose & shape of COs differ significantly from initial expectations

- ➢ one off consultation is **not** enough; iterative process
- ➢ **balanced** co-design: stakeholder contributions, control & facilitator role

Project dynamics

- ➢ *Capacity of partners*
- ➢ *Technical partners* – lock in
- ➢ *Funders* – ex ante determination of outcomes vs. results of stakeholder consultation & co-design
- ➢ Implications for **impact**

Photo: Ellen Pfeiffer

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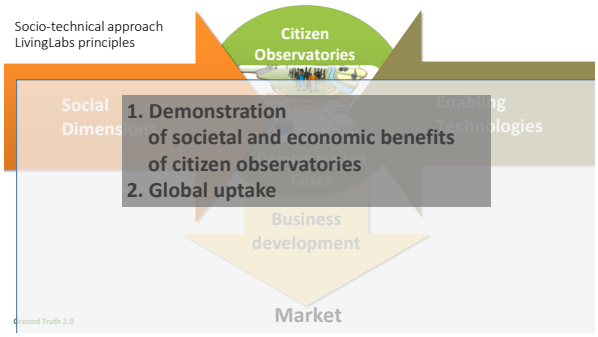


1. Demonstration of societal and economic benefits of citizen observatories
2. Global uptake

groundtruth2.0 project details

- 3-year project: 2016 - 2019
- Funding by EU H2020: 5m mil EUR
- Project coordinator: Dr. Uta Wehn

IHE Delft Institute for Water Education, The Netherlands

Impacting decision making with COs

- GT Week objectives here
- learn about the thematic focus, purpose and achievements of each observatory.
- Ground Truth 2.0 co-design methodology that was developed and applied to set up these observatories – and how it can be adapted to different geographical contexts, social settings and thematic issues.
- Impact stories from the Ground Truth 2.0 observatories
- Try out the platforms, apps and data quality tools that are supporting these observatories.
- And engage in discussions with the Ground Truth 2.0 team and other enthusiasts about what can help the uptake of citizen observatories in other regions, settings and topics.

Annex 2 – 'Data quality estimations in the client side'

This chapter was published here: https://github.com/opengeospatial/CitSciIE/blob/master/09-data-quality-with-SOS.adoc

One of the main concerns in using and adopting citizen science based data is the quality of observations. Citizen Observatories (and, by extension, Citizen Science) are particularly sensible to data quality because the number of contributors is bigger and more heterogeneous than in a traditional data survey campaign. An additional difficulty is that active Citizen Observatories are receiving continuous inputs and updates from citizens. GroundTruth 2.0 has developed a tool to document well the quality of datasets in order to increase the trust on the information collected by citizens integrated in the MiraMon Map browser.

The tool requires that data is exposed in the Web as a service using Sensor Observation Service (SOS). It presents a set of tests like positional accuracy, attribute consistency or confusion matrix that can be applied to a complete dataset or to an area the user is visualizing. Results include an overall quality indicator for the dataset.

The Ground Truth 2.0 Data Quality tool uses an interoperable approach based on QualityML that allows to parametrize the different statistics that are used to assess the quality of the data, and it focus on data quality indicators for Citizen Science datasets from the QualityML list. The quality module is encoded in JavaScript and has been made available as part of the web based MiraMon Map Browser (https://github.com/joanma747/MiraMonMapBrowser).

Quality estimation on vector data

The SOS protocol and the GetObservation operation enables a client to retrieve all the information about the results of the observations. With this data, the client can perform all sorts of analysis on the observations including to apply some quality checks. This section will discuss a pilot that was done in the GroundTruth 2.0 project that demonstrates this capability in some practical cases.

The selected cases and its implementation is based on the QualityML vocabulary. The scenario of rapidly growing geodata catalogues requires tools focused on facilitate users the choice of products. QualityML is a dictionary that contains hierarchically structured concepts to precisely define and relate quality levels: from quality classes to quality measurements. These levels are used to encode quality semantics for geospatial data by mapping them to the corresponding metadata schemas. The benefits of having encoded quality semantics, in the case of data producers, are related with improvements in their product discovery and better transmission of their characteristics. In the case of data users, they would better compare quality and uncertainty measures to take the best selection of data as well as to perform dataset intercomparison. Also it allows other components (such as visualization, discovery, or comparison tools) to be quality-aware and interoperable. On one hand, the QualityML is a profile of the ISO geospatial metadata standards (e.g. ISO 19157) providing a set of rules for precisely documenting quality measure parameters that is structured in 5 levels. On the other hand, QualityML includes semantics and vocabularies for the quality concepts. Whenever possible, it uses statistic expressions from the UncertML dictionary (http://www.uncertml.org) encoding. However it also extends UncertML to provide a list of alternative metrics that are commonly used to quantify quality beyond the uncertainty concept.

How data quality is presented

Datasets can have precomputed data quality indicators associated. This is part of the metadata of the datasets, but in the MiraMon Map Browser it has a prominent place in the *quality* option in the context menu of the layer name in the legend.

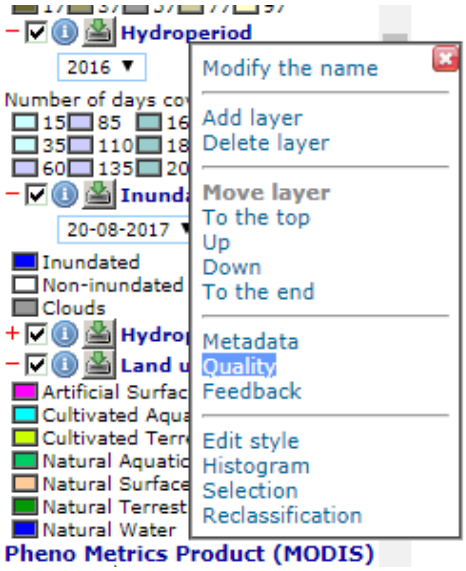


Figure 1. Data Quality context menu

Data quality indicators are presented following the QualityML model. For a quality class (in the Figure 2 "Thematic classification correctness"), there could be one or more quality measures (in the Figure 2 "Misclassification"), that are done by applying some metrics (in the Figure 2 "MeanAbsolute and StandardDeviation") over a domain (in the first entry of Figure 2 "Omission Error" over the categories "water" and "no water").

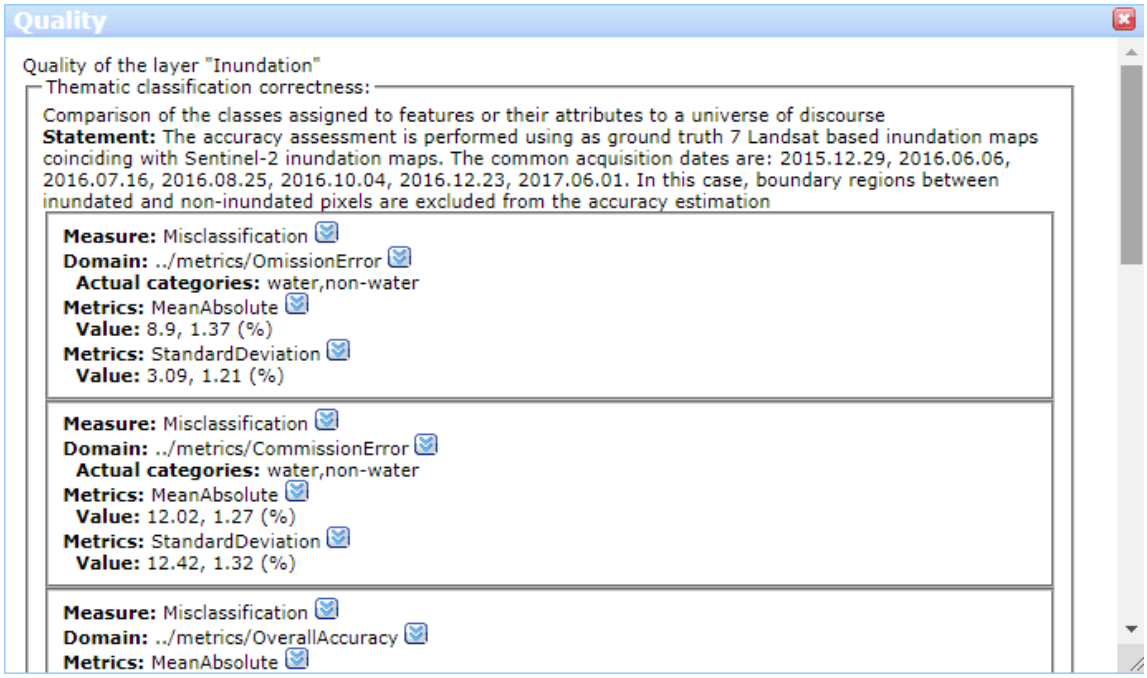


Figure 2. Data Quality indicators presented following the QualityML data model.

Every concept used here is connected to the QualityML vocabulary to know more details about it (figure 3).

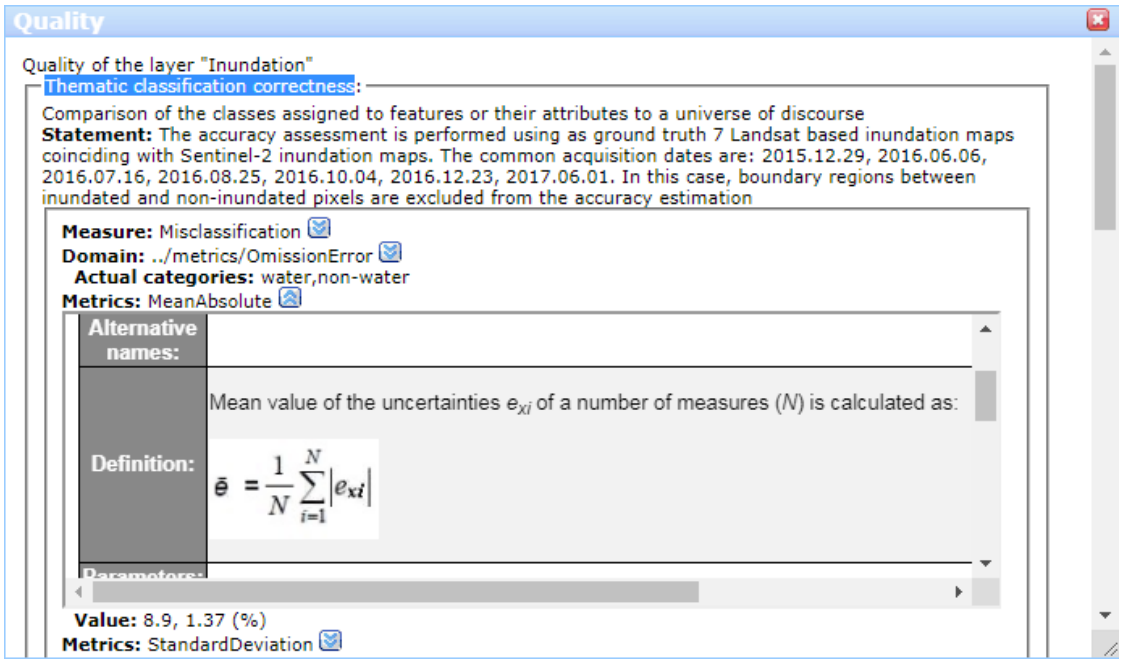


Figure 3. Connection to the QualityML dictionary

How to start computing data quality

The MiraMon Map Browser described in the section [SOS_Client] allows for computing some data quality indicators. To start the process, we should select the right option in the context menu by clicking in the layer name in the legend.

Figure 4. Data Quality compute context menu

This option opens a dialog box that offers a short list of four quality indicators that will grow with new tests.

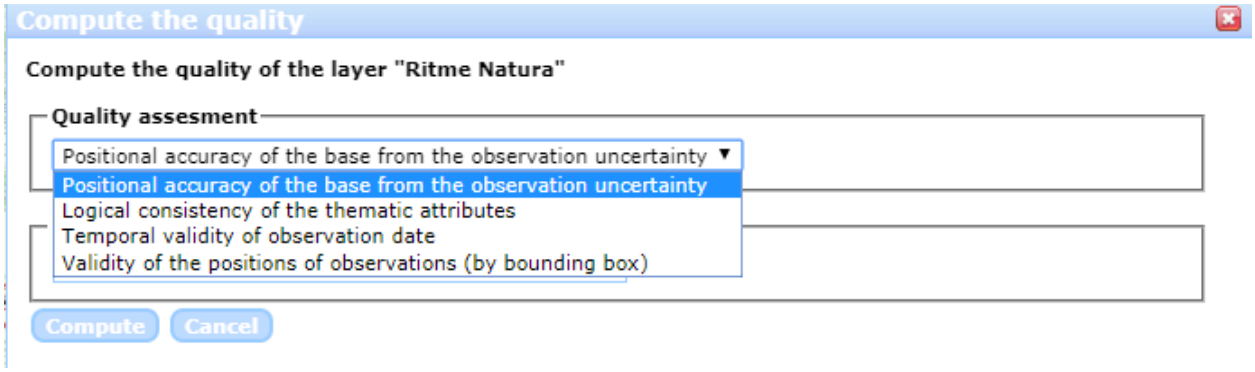


Figure 5. Data Quality indicator list

Case 1: Positional accuracy of the layer from observation uncertainties

Many citizen Science projects, use a mobile phone to get observations. In this process they use the location capabilities of the phone, including GPS, 3G triangulation, Wi-Fi antenna location or IP address registration. Each of this methods has different known positional accuracies and the phone is able to estimate that at the same time as it estimates the position. In this case we will assume that the individual observations have got a position and some estimation of the positional uncertainty and these are recorded by the service and offered as properties of the observation.

To compute this indicator we should select the property associated with the observation that contains the positional uncertainty.

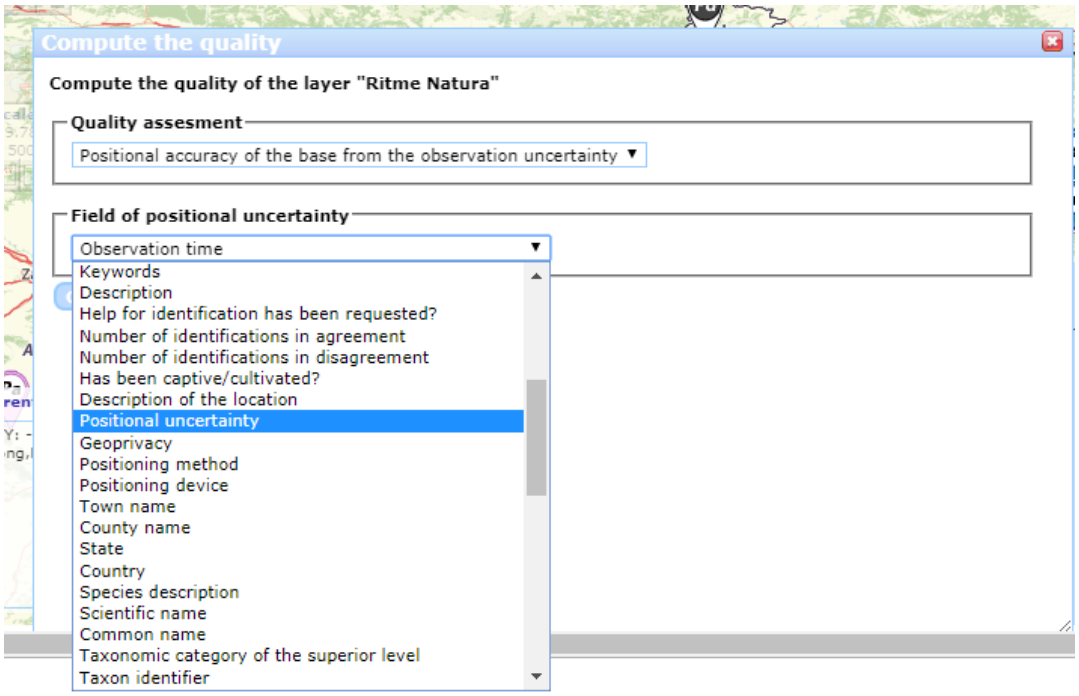


Figure 6. Selection of the positional uncertainty field

The calculated data quality parameter is not shown immediately but added to the previous recorded data quality indicators.

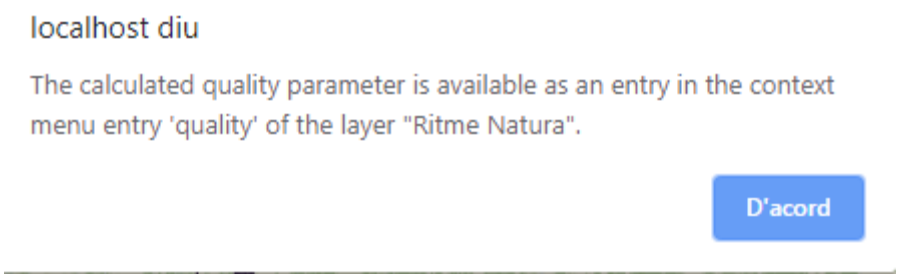


Figure 7. Calculation complete message

The result is a quality report that can be found in the quality option in the context menu by clicking in the layer name in the legend.

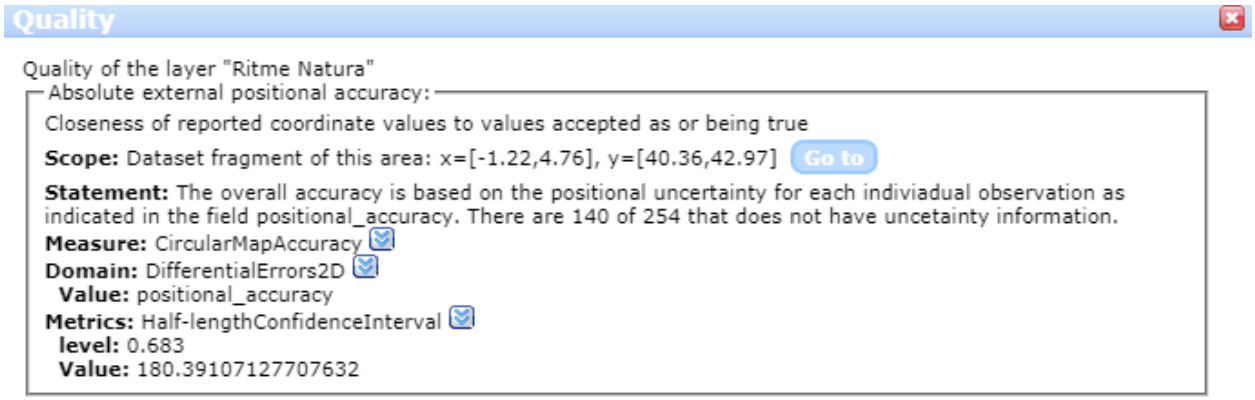


Figure 8. Calculated positional accuracy

Several things can be commented here. The first one indicates that the scope is not the full dataset but the view used for calculating the quality indicator: "Dataset fragment of this area: x=[-1.22,4.76], y=[40.36,42.97]". Secondly, the statement reports that not all observations has have positional uncertainties: "There are 140 of 254 that does not have uncertainty information". The accuracy is reported as a *half-length confidence interval* with a confidence *level* of 0.683. An uncertainty of 180.39m is not particularly good indicating the heterogeneity of the methods used to calculate the positions of the observations, some of them with big uncertainties.

Case 2: Logical consistency of the thematic attributes

Many Citizen Science projects provide the citizens with comprehensive instructions on how to conduct some observational tasks. In some cases observations are limited to a set of possibilities for a list. In cases more complex, once selected an option in the first list, only some values are possible in a second list. Sometimes apps control user inputs preventing citizens to input a value that is not listed in the instructions, but in some cases (such as bulk input form a csv) there might be no controls and unwanted values or incompatible value combinations could end up in the database.

In the case of the Ground Truth 2.0 RitmeNatura citizen observatory, we rely on Natusfera software that is designed for biodiversity in general allowing any possible scientific name while RitmeNatura is asking

for a limited set of species. Obviously, if nobody filters them, there is a chance that observations report on species not contemplated by the RitmeNatura subset.

The logical consistency test can count how many observations are not consistent with a controlled list of possibilities. To compute this indicator we should select the property (or properties) associated with the observation that are affected by a controlled list of possibilities and list the possible combinations of attributes. In this simple case, we will test if the scientific name is compatible with the list of possibilities described in the legend.

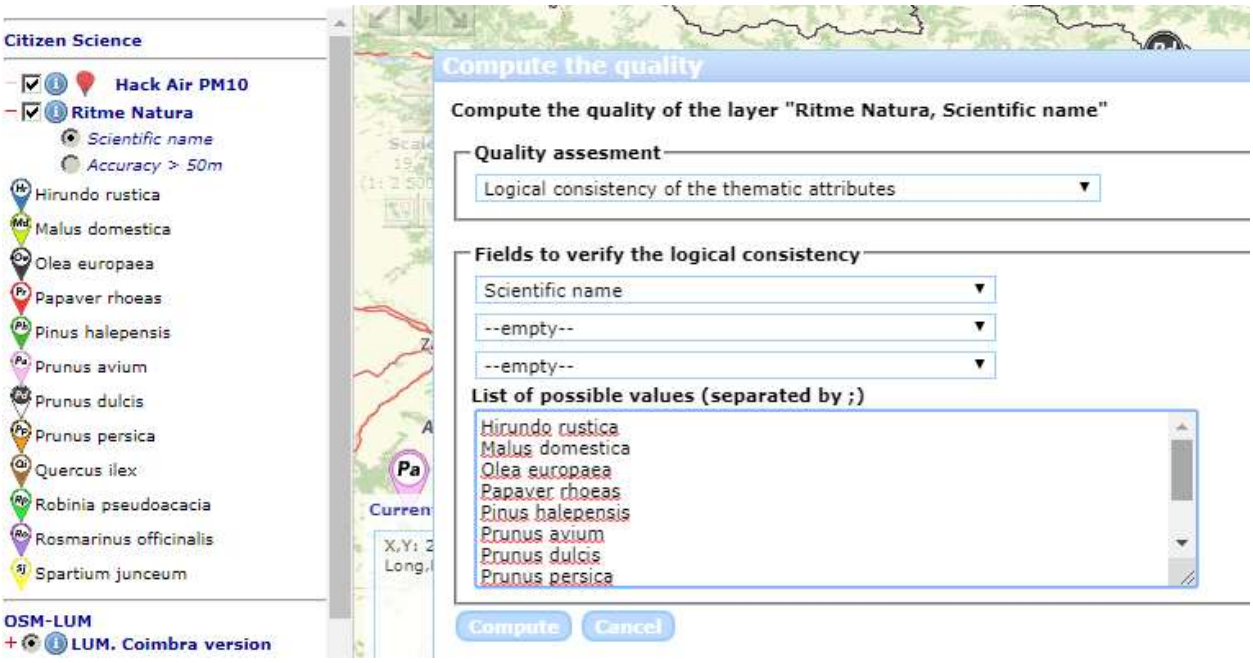


Figure 9. Computation of logical consistency

A new quality indicator will be added to the list of quality indicators related to this layer.

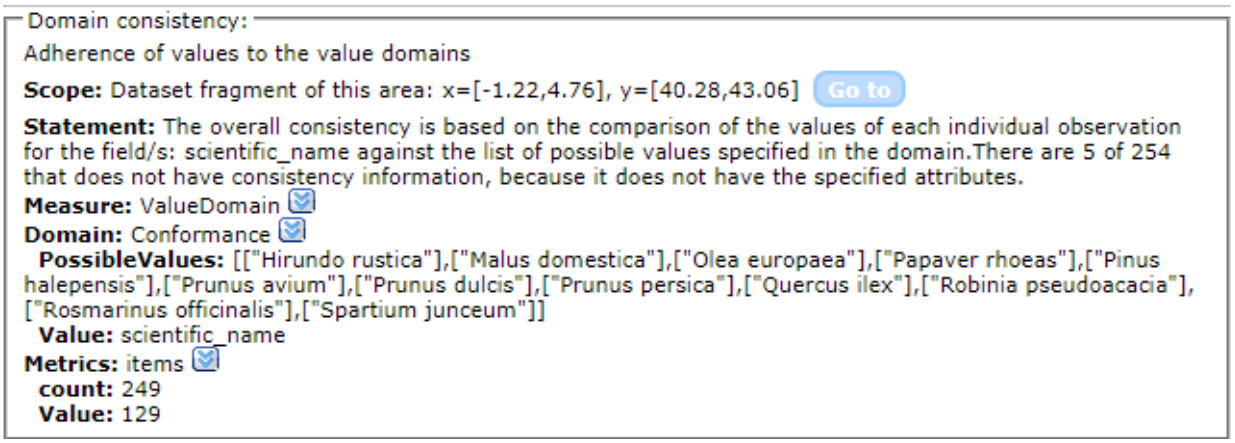


Figure 10. Domain consistency result

Only 129 of the 249 species scientific name are consistent with the legend. In addition, 5 observations have no scientific name (probably because the observer did not know it).

Case 3: Temporal validity of the observation date

One very simple quality control that can be performed is to check if the observations have an associated date, if the date is in the right format and if the date is in a range of plausible values.

In this example, we test if the observations where done after the year 2000 because we know there should not be observations before this date.

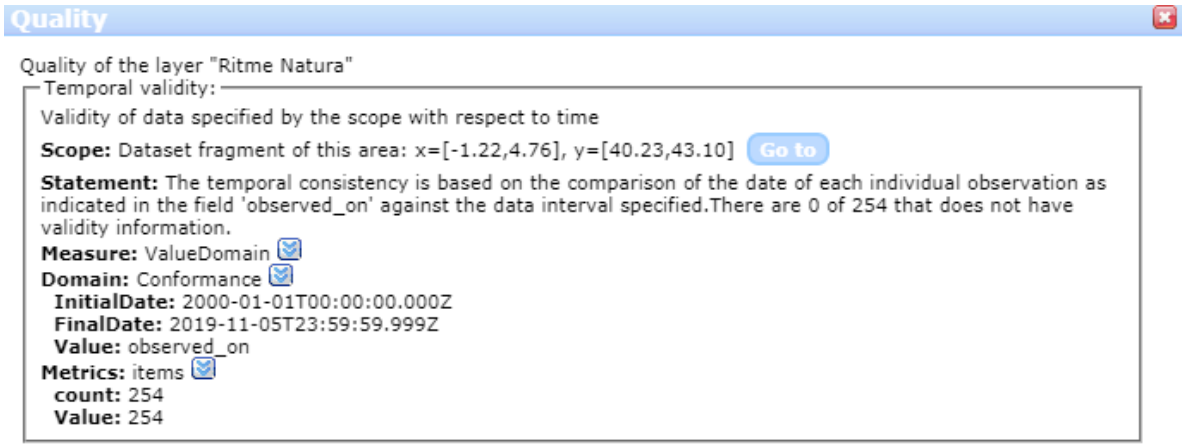


Figure 12. Temporal validity result

In this case we see that all the observations have passed the test.

Case 4: Validity of the positions of observations (by bounding box)

One very common mistake in data gathering projects is the presence of observations in places that do not have much sense. Typical mistakes are swap of latitude and longitude values or simply have them in the middle of the Atlantic ocean at the 0,0 position.

In this cases we are going to run a test to find how many observations are in the Catalonian bounding box.

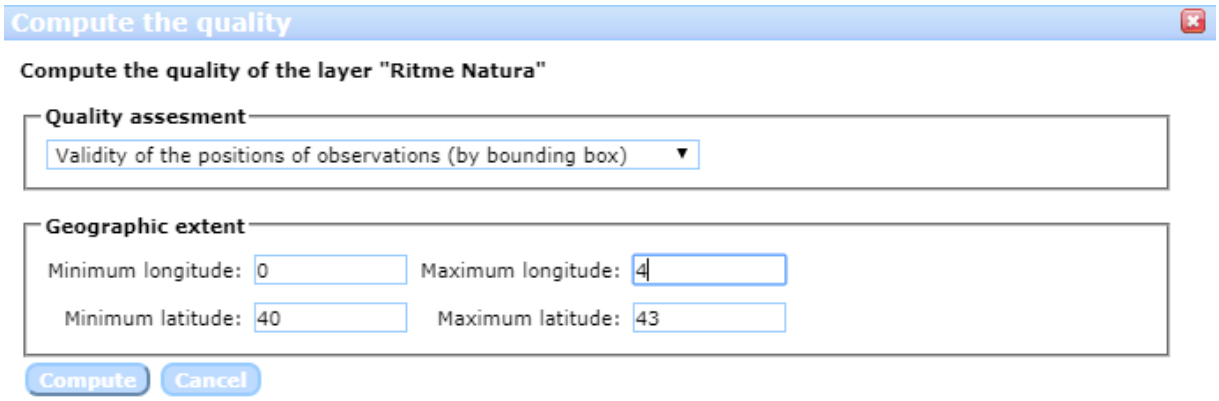


Figure 13. Computation of positional validity

A new quality indicator will be added to the list of quality indicators related to this layer.

Domain consistency:

Adherence of values to the value domains

Scope: Dataset fragment of this area: x=[-4.22,7.76], y=[38.79,44.54] Go to

Statement: The domain consistency is based on the localization of each individual observation present in the actual view against the envelope specified.

Measure: ValueDomain

Domain: Conformance

BBOX: {"MinX":"0","MaxX":"4","MinY":"40","MaxY":"43"}

Value: coordinates

Metrics: items

count: 287

Value: 252

Figure 14. Positional validity result

The result identifies 35 observations in this view that are clearly outside the boundaries of Catalonia.

Quality estimation on raster data

As explained before, the WMS protocol can be used to transport binary arrays instead of pictures. During this interoperability experiment, we have implemented a comparison functionality that can be used to compare two categorical maps with the same legend. This comparison results in a new map with all combinations of the two maps categories allowing us to discover changes in these maps.

This can be used to compare maps but also to quality control maps if we assume that one map represents the truth.

Confusion matrix

In this exercise we will combine one land-cover map created from OpenStreetMap (Coimbra version) with another one created by remote sensing.

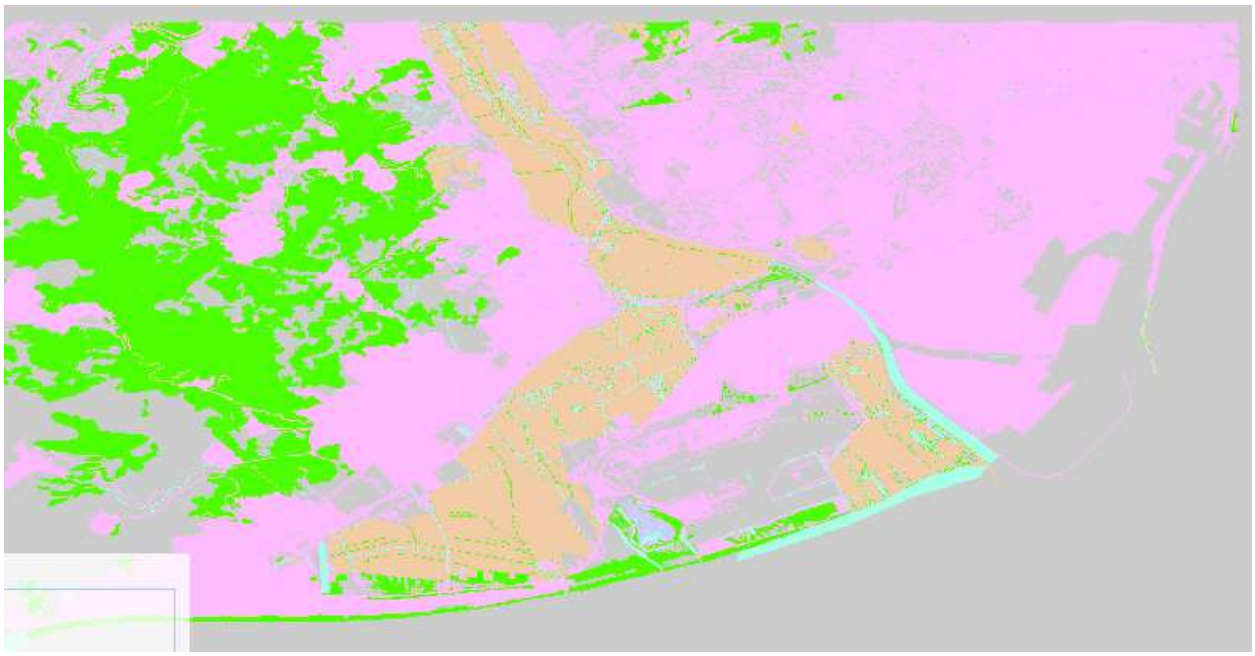


Figure 15. OpenStreetMap version of the land-use map

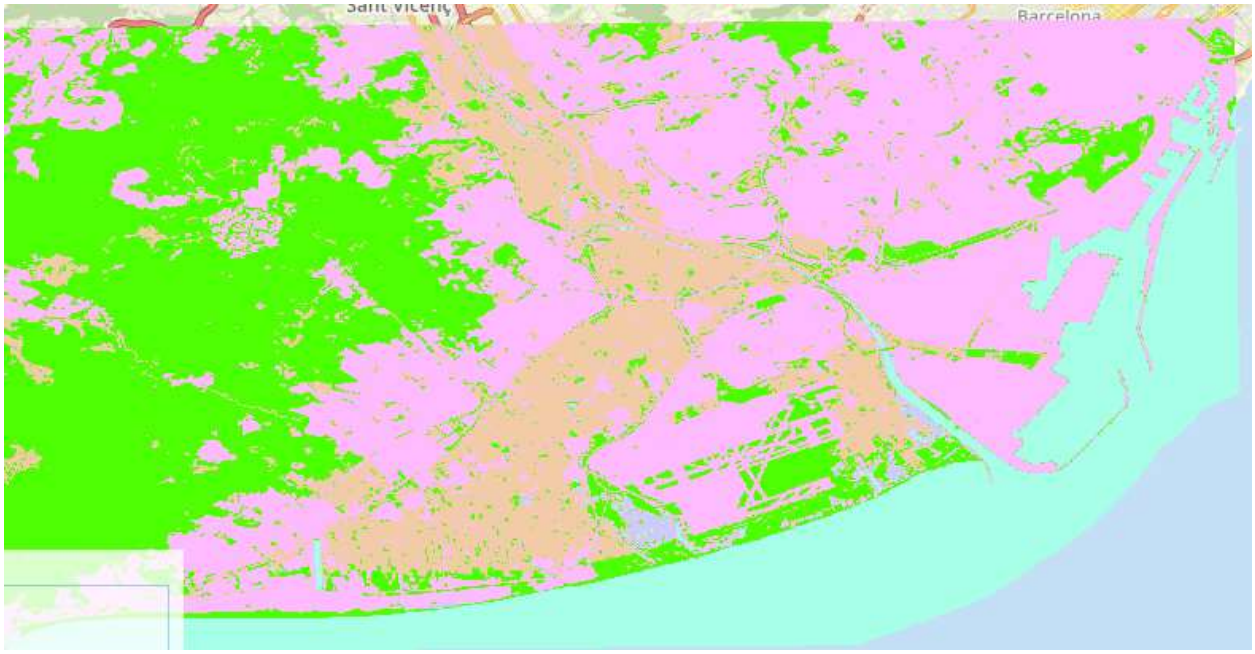


Figure 16. Remote sensing version of the land-use map

- Artificial surfaces
- Agricultural areas
- Forest and semi natural areas
- Wetlands
- Water bodies

Figure 17. Land-use map legend

The process of creating a confusion matrix starts by requesting the combination of both maps in a single layer those pixels will contain classes that are all possible permutations of the legend. In the Figure 18 the Coimbra version is the one generated from OSM while the CREAF-RS version is the one created by remote sensing. The result of the combination is shown in Figure 18. In principle even the number of combinations is 25, there are only 5 many colours present, corresponding to the classes that are the same in both maps.

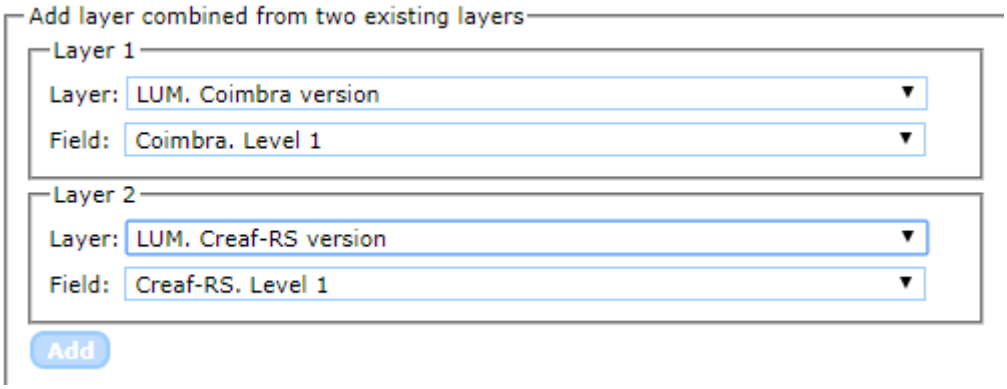


Figure 18. Request for a layer combination of both land use maps

Now we can request the confusion matrix as a statistical summary of the combination by selecting the option in the context menu.

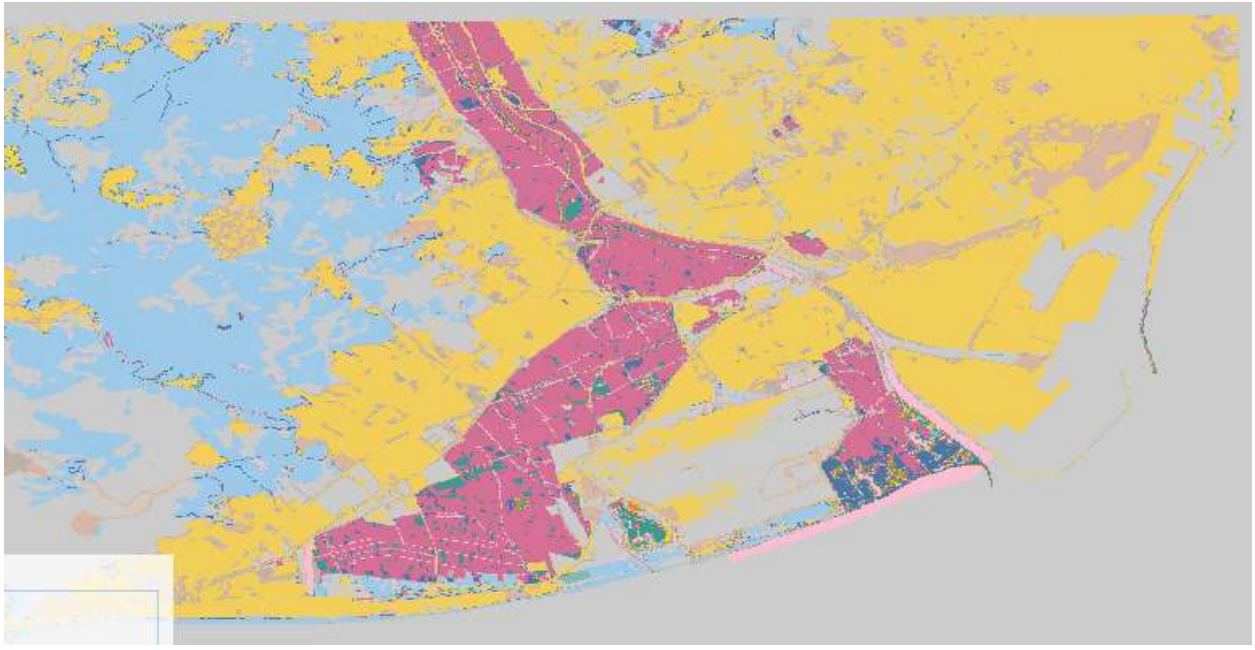


Figure 19. Layer combination of both land use maps

The diagonal values of the matrix (represented in green) correspond to the pixels that have the same value in both maps. The non-diagonal values are the pixels that have different classes in both maps. We can also see some information about the most similar classes (artificial surfaces and forest and semi-natural areas) as well as the Kappa coefficient that is 0.81 (the closer to 1 the better).

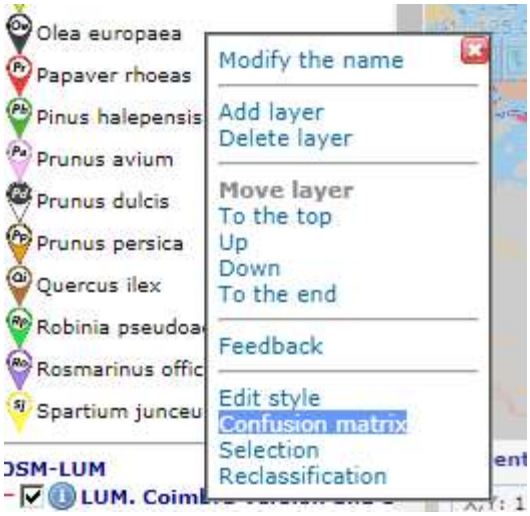


Figure 20. Request for the confusion matrix

A manual exploration of the dataset allows to discover a big purple area that is artificial surfaces from the OSM derived and forest and semi-natural areas from the RS derived map.

Confusion matrix 1, Combination of OSM Land Use Map. Coimbra version and Re

Remote Sensing Land Use Map. Creaf version Creaf-

OSM Land Use Map. Coimbra version Coimbra. Level 1 (m²) (Kappa: 0.8125659829491821)

	Artificial surfaces	Agricultural areas	Forest and semi natural	Wetlands	Water bodies	Total	Similarity
Artificial surfaces	103122830	2986301	1701599	111904	413606	108336240	95.2%
Agricultural areas	11627045	27234362	3482189	223808	648385	43215790	63.0%
Forest and semi natural areas	18083467	5074079	74057411	122875	1360402	98698233	75.0%
Wetlands	285245	484917	436645	405926	365334	1978068	20.5%
Water bodies	170050	78991	165662	8777	2563918	2987398	85.8%
Total	133288638	35858650	79843506	873290	5351644	255215728	
Similarity	77.4%	75.9%	92.8%	46.5%	47.9%		81.3%

Figure 21. Request for the confusion matrix result

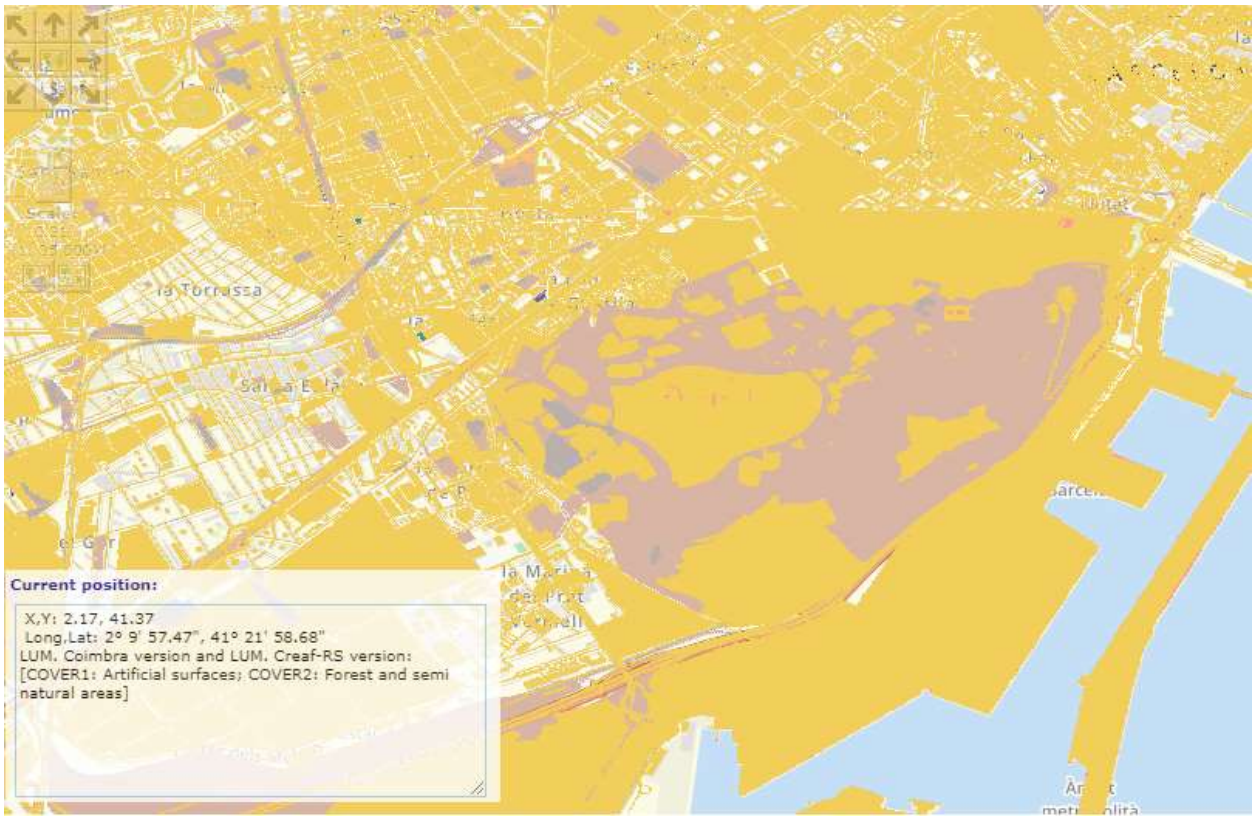


Figure 22. Zoom to an area of discrepancies

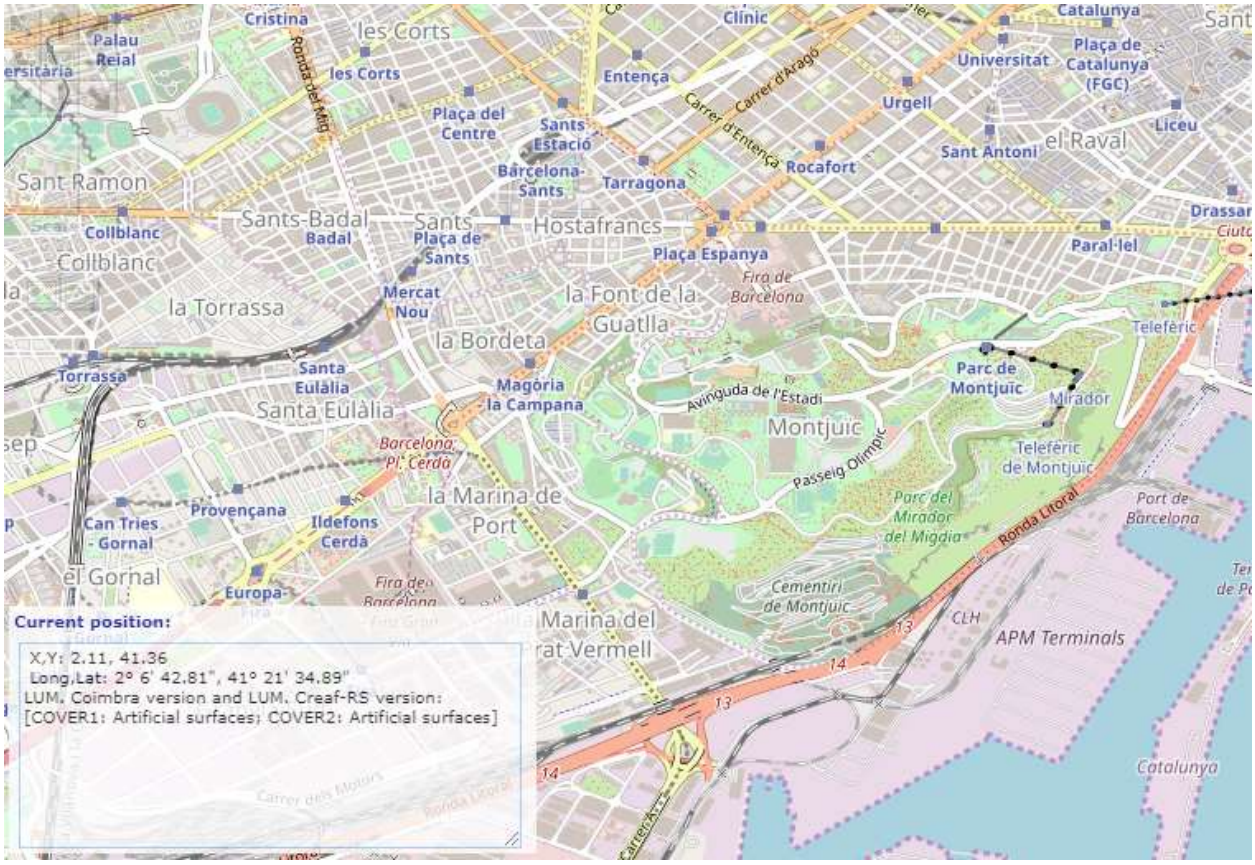


Figure 23. Reason for the discrepancies

The discrepancy makes sense. A big park in the city is identified as artificial in the OSM version that is more focused on land use while it is seen as a forest area from remote sensing due to its green land cover.

Future work

There are some points the authors of this chapter believe it is worth to further develop or explore.

- In the implementation of the confusion matrix there is no connection to the QualityML. It should be done.
- Highlight the observations that were detected as less accurate could be an interesting feature to have.
- We would like to be able to share the quality assessments with other users. One possibility is using the OGC Geospatial user feedback to report data quality assessments and share them with other users. Saving the quality report in the NiMMbus database (www.opengis.uab.cat/nimm-bus) implemented in the NextGEOSS project will allow that.
- The computations done in the MiraMon Map Browser are just a small subset of the QualityML vocabulary. We would like to extend the implementation to cover a better range of possibilities.
- QualityML is a vocabulary for data quality. The OGC definitions server presented in [DefinitionServer] is a generic tool to share vocabularies. Translating QualityML into a format that can be ingested by the Definitions Server should be a priority of the next interoperability experiment.

Annex 3 – School-2-School educational materials

Citizen Science: Teacher Guide

Level: Beginner

Subject: Geography

Duration: 1h

Type: Classroom discussion

Learning Goals:

Students are able to

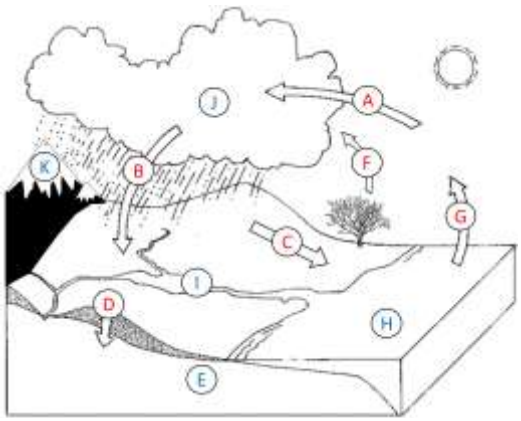
- illustrate the gathering of data about the water cycle
- define citizen science
- relate TAHMO station activities to Citizen Science and monitoring and forecasting

Background:

- Water cycle models need data to be reliable.
- Water cycle models can be used to e.g. provide forecasts.
- The data that water cycle models build on must be acquired somehow.
- This traditionally means trained experts or professionals, monitoring stations, and remote sensors etc.
- Citizen Science is another method to do so which involves local non-professionals in data collection, among many other things.
- The activities involved in working with a TAHMO station is Citizen Science and the students are now Citizen Scientists.

Discussion:

Use the diagram in the Water Cycle Guide and insert people: including experts, population, and citizen scientists. First with a very small number of experts; then with a large number of citizen scientists which means that the observations are of greater coverage and value.



Citizen Science: Teacher Guide

Level: Beginner

Subject: Geography/ Environmental Science

Duration: 30 minutes

Type: Classroom discussion

Learning Goals:

Students are able to

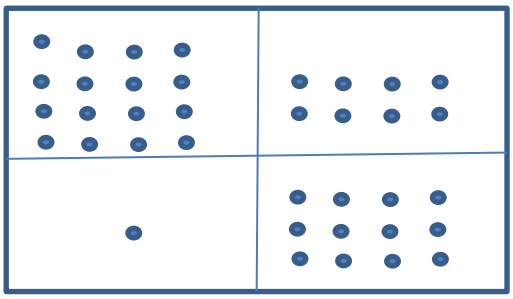
- define the concept of citizen science
- understand the benefits of citizen science
- relate sensor network, data collection and citizen science

Background:

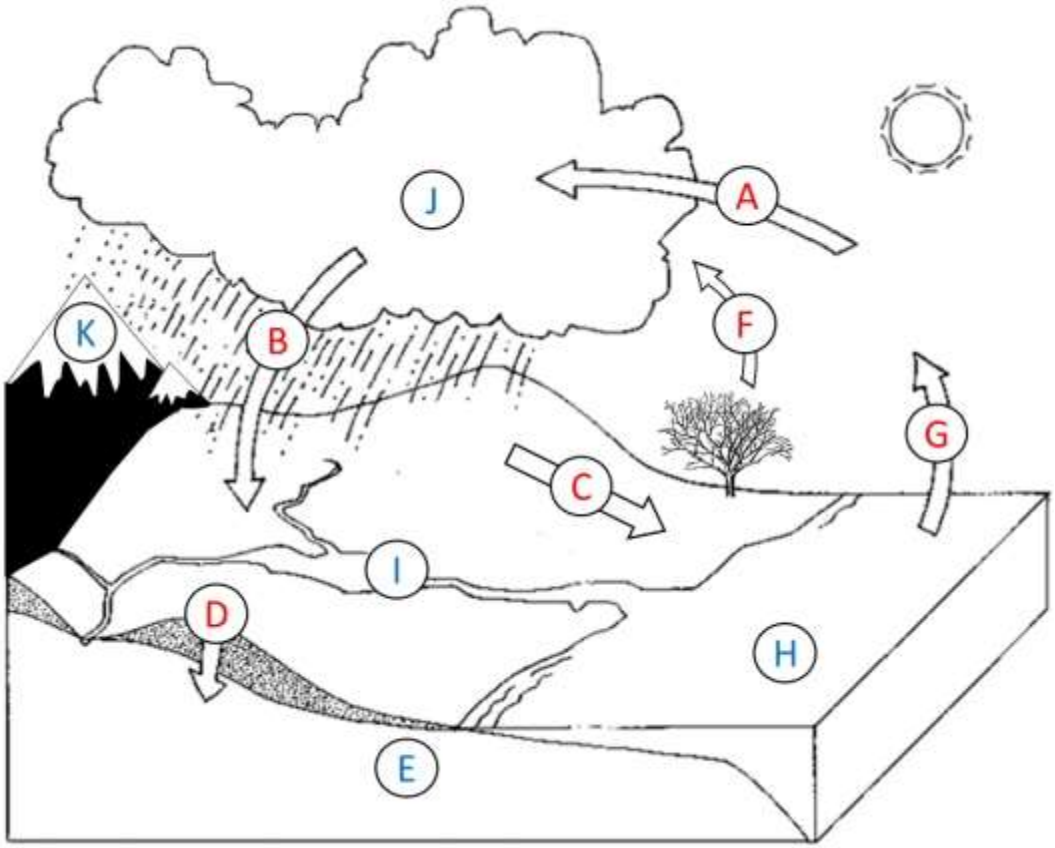
- Masaai Mara citizen observatory.
- Citizen science can complement traditional data collection methods.
- The student's role as citizen scientists.
- Strengths & limitations.

Discussions/Illustrations

- Build rain gauges with bottles / Build Wind Vanes
- Record data at various locations and try to understand why the variations
- Report the data via Smart phone and give the phone back to the teacher
- Prepare a wind map and how that contributes to hydrological and ecological processes (e.g. pollination)
- Identify a problem with lack of data
- How citizens (or they can contribute) to solving the problem
- Every Citizen can have his or her own sensor
- Explain that more data (points) will also eliminate biases (errors). E.g

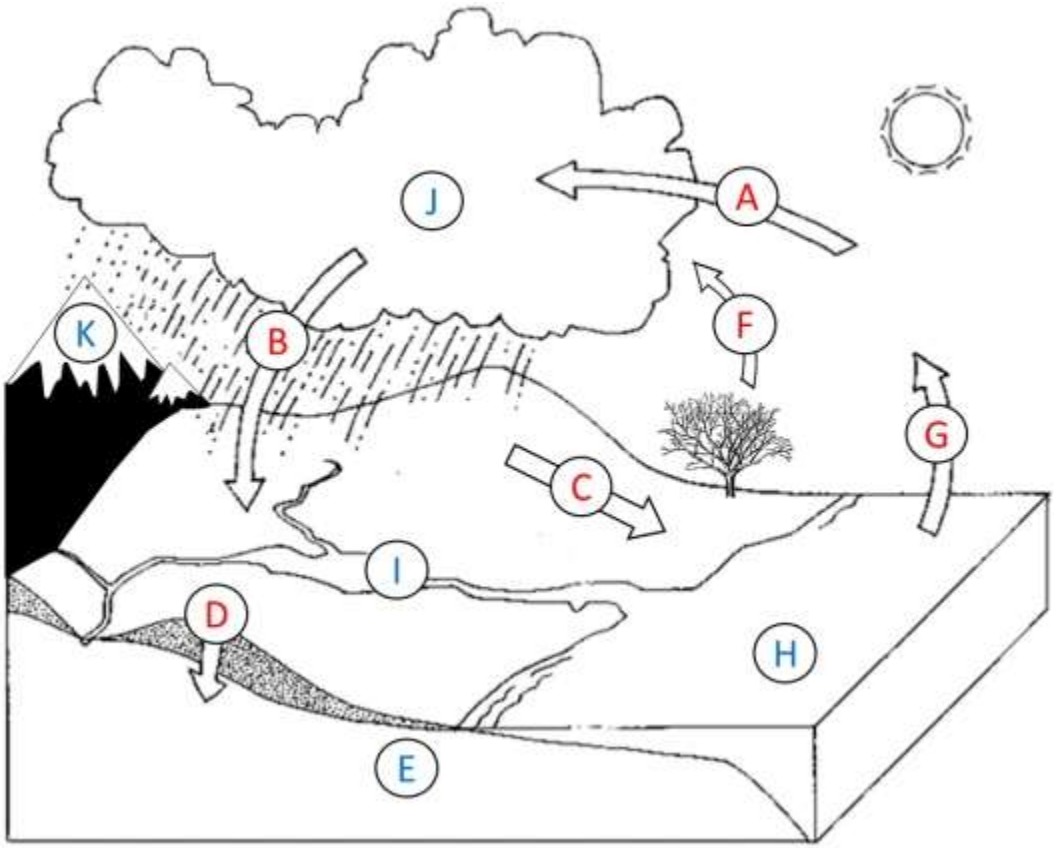


Discussion:



- Start by asking the class what the water cycle is, be sure to let multiple students give their interpretations. [Answer: The water cycle, also known as the hydrological cycle or the hydrologic cycle, describes the continuous movement of water on, above and below the surface of the Earth.]
- In small groups, ask students to come up with a list of places that we find water on the Earth. You may want to mention that water can be in the form of a gas (water vapor), a liquid (water), and a solid (ice) and that students should include all of the forms of water. [Answer: Clouds and atmosphere (liquid water and water vapor), river and lakes (liquid water), oceans (liquid water), glaciers and icebergs (ice), and groundwater (liquid water).]
- Identify the water sources on the water cycle plot. [Answer: H is Ocean, J is atmospheric water, I is surface water, K is snowpack, E is groundwater]
- Of these sources of water, which do you think there is the most of? [Answer: 96.5% Ocean, 1.7% glaciers/icebergs, 1.7% groundwater, 0.1% rivers/lakes, 0.01% clouds/atmosphere]
- What are the processes that move water between the different sources of water? These processes are shown with arrows in the water cycle diagram, ask the class think about each of these arrows and decide what sort of things are happening at each arrow. [Answer: at G the water is evaporating from the oceans and changing state from liquid to gas; at A the water is condensing and changing state from gas to liquid; in B the water is falling from the cloud to the land surface as precipitation; at C the excess water is flowing on the surface as runoff; at D the precipitation is being infiltrated into the soil and groundwater]

The Water Cycle: Student Worksheet



Match the letters in the diagram above to the correct term in the list below:

1. Condensation _____
2. Groundwater _____
3. Infiltration _____
4. Evaporation _____
5. Transpiration _____
6. Rivers and Lakes _____
7. Precipitation _____
8. Snow and Glaciers _____
9. Clouds _____
10. Runoff _____
11. Ocean _____

Which stages of the water cycle require solar radiation?

_____

Which stages of the water cycle are driven by the force of gravity?

_____

Describe at least two different paths that water can take in the water cycle using the figure above. Start in the ocean.

_____

_____

_____