Citizen Science and conventional Earth Observation interaction

Joan Masó

Status

- Despite the proliferation of citizen science campaigns, only few projects really have succeeded in **connecting citizen science data with conventional in-situ or remote sensing sources**.

- Reasons:

  - the different nature of **sensors** used,

  - the lack of data **continuity**,

  - the difficulty in discovering and **accessing** data

  - the different methodologies for **data quality** assurance.

The goal of this two sessions today

- To explore **success stories** where citizen science data are combined with conventional sources of Earth observation data, including both remote sensing and in-situ.
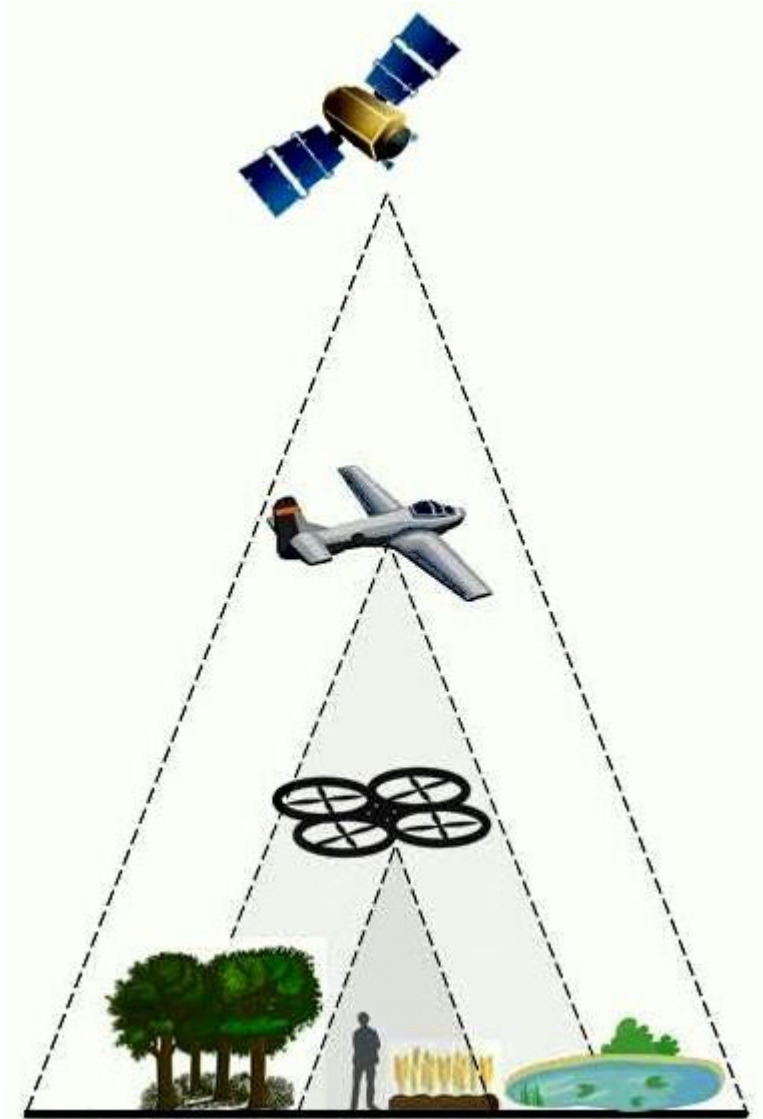
Kinds of Earth Observation

Remote sensing

Airborne

Drone

In-situ

Cases where Citizen Science is comparable or even better that professional in-situ:

- Land use classification

- Phenology

- Net primary productivity & Habitat structure

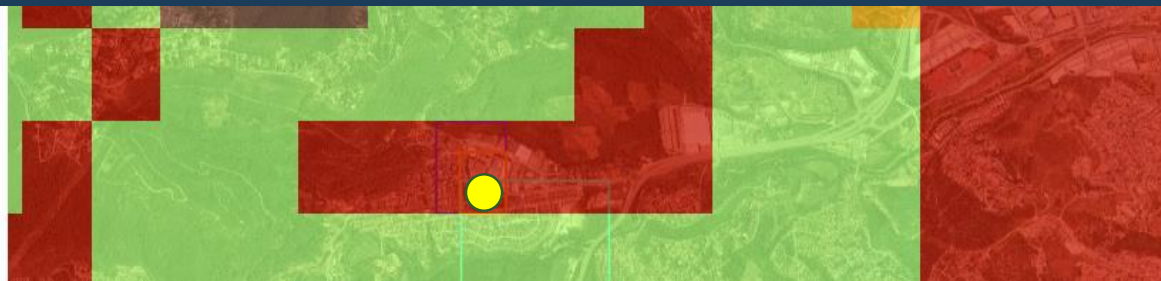# Validating Remote Sensing classifications

Phenology by remote sensing

	Ocean No Data
	Jan-1 - Jan-17
	Jan-17 - Feb-2
	Feb-2 - Feb-18
	Feb-18 - Mar-6
	Mar-6 - Mar-22
	Mar-22 - Apr-7
	Apr-7 - Apr-23
	Apr-23 - May-9
	May-9 - May-25
	May-25 - Jun-10
	Jun-10 - Jun-26
	Jun-26 - Jul-12
	Jul-12 - Jul-28
	Jul-28 - Aug-13
	Aug-13 - Aug-29
	Aug-29 - Sep-14
	Sep-14 - Sep-30
	Sep-30 - Oct-16
	Oct-16 - Nov-1
	Nov-1 - Nov-17
	Nov-17 - Dec-3
	Dec-3 - Dec-19
	Dec-19 - Dec-31

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Location	Robins first seen	Shadbush in bloom	Peach in bloom	Currants in bloom	Plum in bloom	Cherry in bloom	Apple in bloom
NYS Mean	**19-Mar**	**1-May**	**2-May**	**4-May**	**6-May**	**7-May**	**15-May**
Albany	23-Mar		11-May	2-May	4-May	2-May	
Auburn	20-Mar	26-Apr	4-May	3-May		28-Apr	11-May
Aurora		4-May	2-May	30-Apr	2-May	27-Apr	8-May
Belville	19-Mar	7-May		12-May	10-May	23-May	19-May
Bridgewater	31-Mar	4-May		13-May	9-May	22-May	21-May

Elmore A.J. (2016) Synergistic Use of Citizen Science and Remote Sensing for Continental-Scale Measurements of Forest Tree Phenology

How to combine...

Start of Season
End of Season
Length of Season
Date of Peak
Rate of Greening
Rate of Senecense
Cumulative VI
Average VI
Max VI
Rank

with...

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Essential Biodiversity Variables

- The 22 EBVs represent the minimum set of measurements needed to capture major dimensions of biodiversity change; now being used for global monitoring of biodiversity. Only 2 combine RS and CS.

| EBV class	EBV	Scale of CS/CBM measurement	Feasibility	Examples from Global CS database	Examples from CBM database
Ecosystem function	**Net primary productivity**	Global, regional, local	**Generally observed through remote sensing, but also measured by some citizen science projects**	FreshWater Watch; GLOBE; many volunteer lake monitoring projects	Monitoring of quality and quantity of vegetation (Roba and Oba, 2009); aboveground forest biomass in REDD+ programs (Brofeldt et al., 2014
Ecosystem structure	**Habitat structure**	Global, regional, local	**Primarily collected through remote sensing and professional monitoring, but some CS and CBM programs**	GLOBE, National Plant Monitoring Scheme (UK)	Bering Sea Sub–Network; monitoring of percentage of hard coral/sand in reefs (Uychiaoco et al. 2005); historical records of snow properties to inform pasture availability, (Eira et al., 2013)

Chandler M. et al. (2017) Contribution of citizen science towards international biodiversity monitoring

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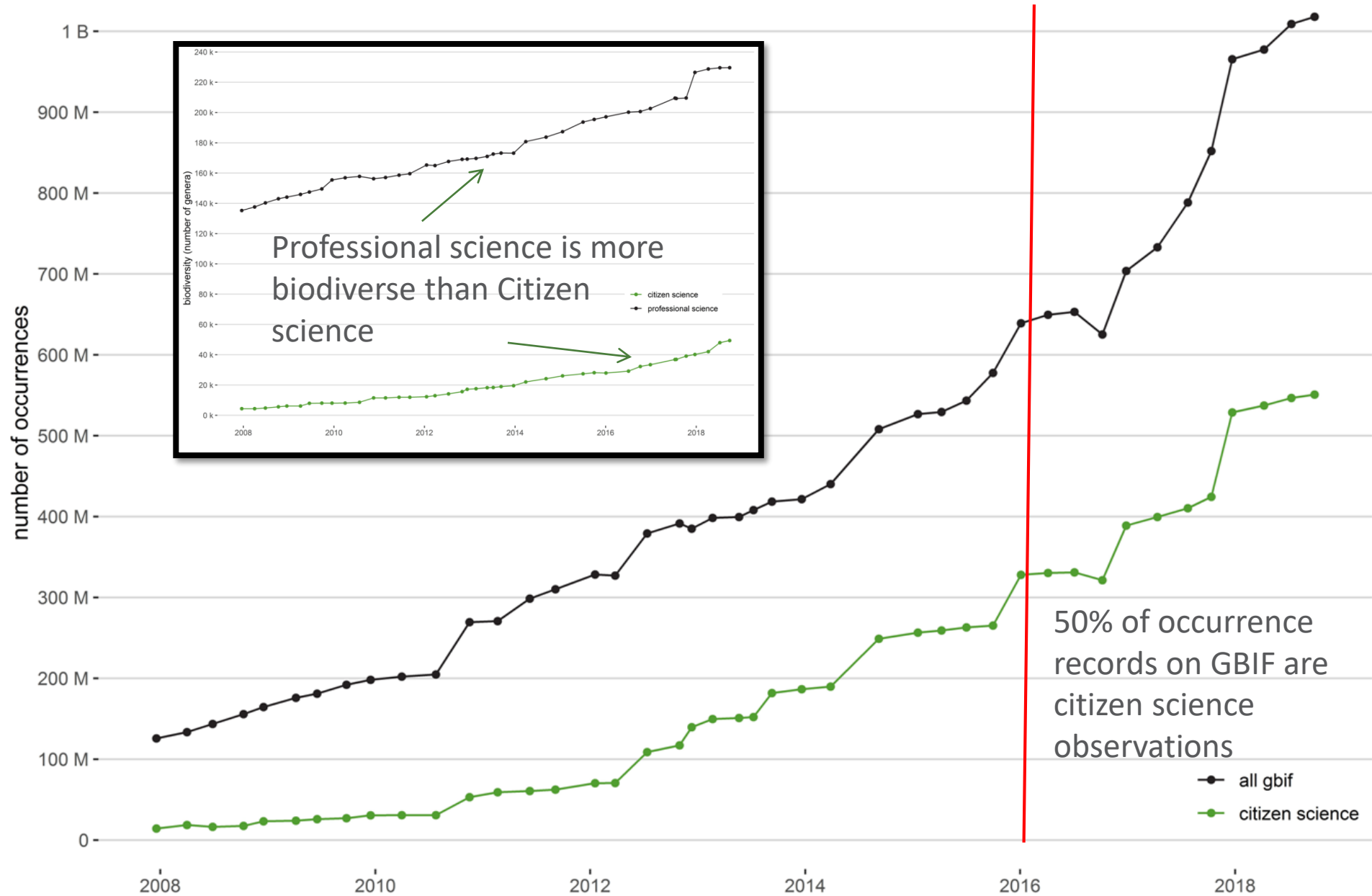Cases where Citizen Science is comparable or even better that professional in-situ:

- Biodiversity observations

- Bird observation

- Phenology observations
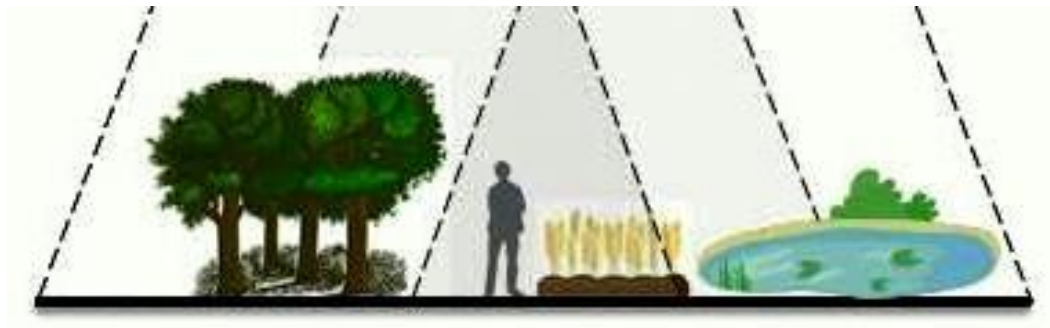
Case 1: Global Biodiversity Information Facility (GBIF)

- In 2016 CS programs accounted for 349 million records (50%9
    - 70% of animals
    - 87% of birds (300 million records)
    - over 1 million plants, insects (27%), and fungi (47%)
    - over 500,000 mammal records

- GBIF encourage citizen scientists interested in sharing their tim
  and their observations to get involved by:
    - Recording observations
    - Transcribing records from museum specimens or literature
    - Finding BioBlitzes near where you live
    - Joining other like-minded volunteers
    - Connecting your other interests and passions for activities like hiking or diving to projects

Chandlera M et al. (2017) Contribution of citizen science towards international biodiversity monitoring. Biolgial Conservation 213 280-294

Professional science is more biodiverse than Citizen science

50% of occurrence records on GBIF are citizen science observations

Case 2: Bird watching

- CS can be used in decision making

  - Bird population monitoring schemes are used to measure how well biodiversity targets and sustainable development goals are being met. In Europe, the farmland bird index produced by the EBCC/BirdLife Pan-European Common Bird Monitoring Scheme (PECBMS) has been adopted by the EU as an official indicator of sustainable rural development, and is used to help inform agri-environment **payments to farmers**

- Gap filling

  - Tropical countries have no history of bird monitoring but…

  - Starting in 2009 volunteers have been established successfully in Botswana, Kenya and Uganda through a project involving RSPB, BirdLife Botswana, Nature Kenya and Nature Uganda, Twice a year trained volunteers in each country set out to record as many birds as possible along a fixed 2-kilometre transect, reporting their data to the national Partner.

Case 3: Phenology

- Plant phenology networks of citizen scientists have a long history and have recently contributed to our understanding of climate change effects on ecosystems

- It is essential for observers to be properly trained in recognition of species and phases

- Our analysis suggests that even data from one-time reporters are unbiased and precise

Beaubien E.G. (2011) Plant phenology networks of citizen scientists: recommendations from two decades of experience in Canada
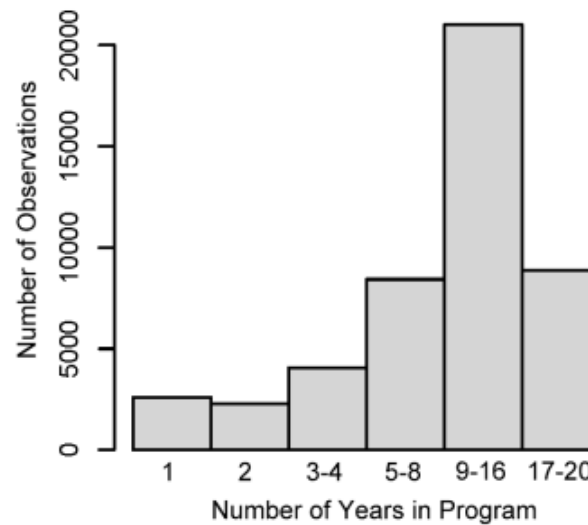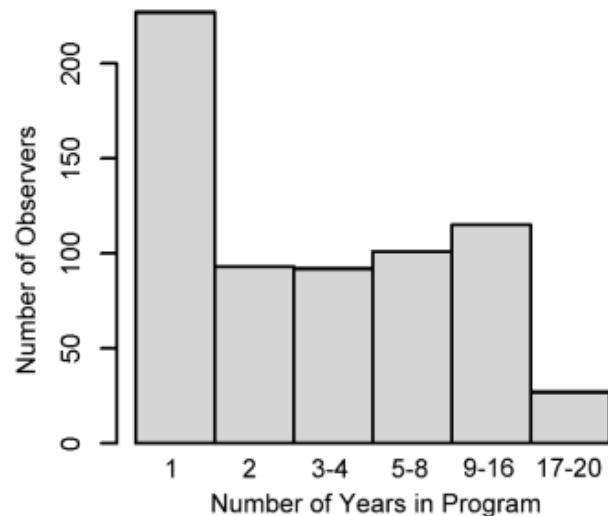
Cases where Citizen Science complements professional in-situ:

- •Air Quality

- •Mosquitos

- •Weather WoW
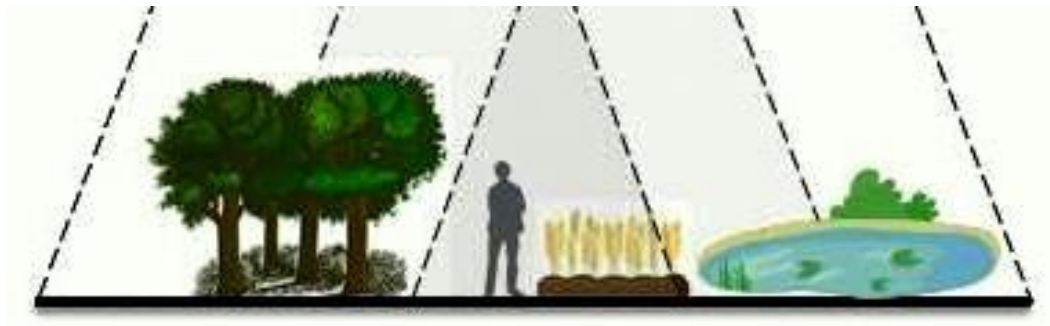
Air Quality: Spatial resolution can be much better

- Cit Sci can reveal "structures" and "patterns" that will not be visible with conventional density of in-situ official sources.

- Ground Truth 2.0 Belgium Citizen Observatory. It might be that the measures are note well calibrated but still some conclusions can be extracted.

Critical interseccions where black carbon is higher
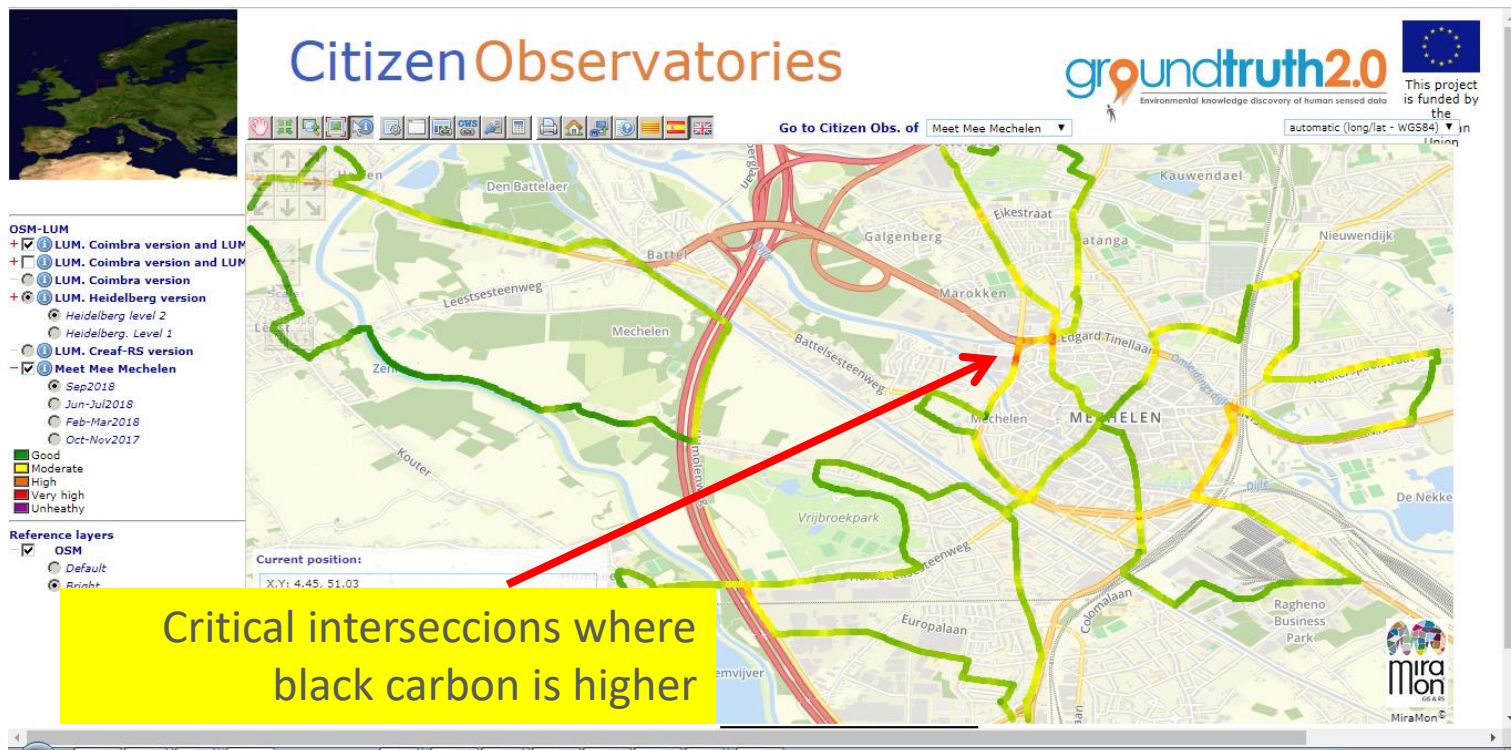
Mosquito distribution

- Citizens observing the mosquito tiger (*Aedes albopictus)* with unprecedented level of detail vital for public health services
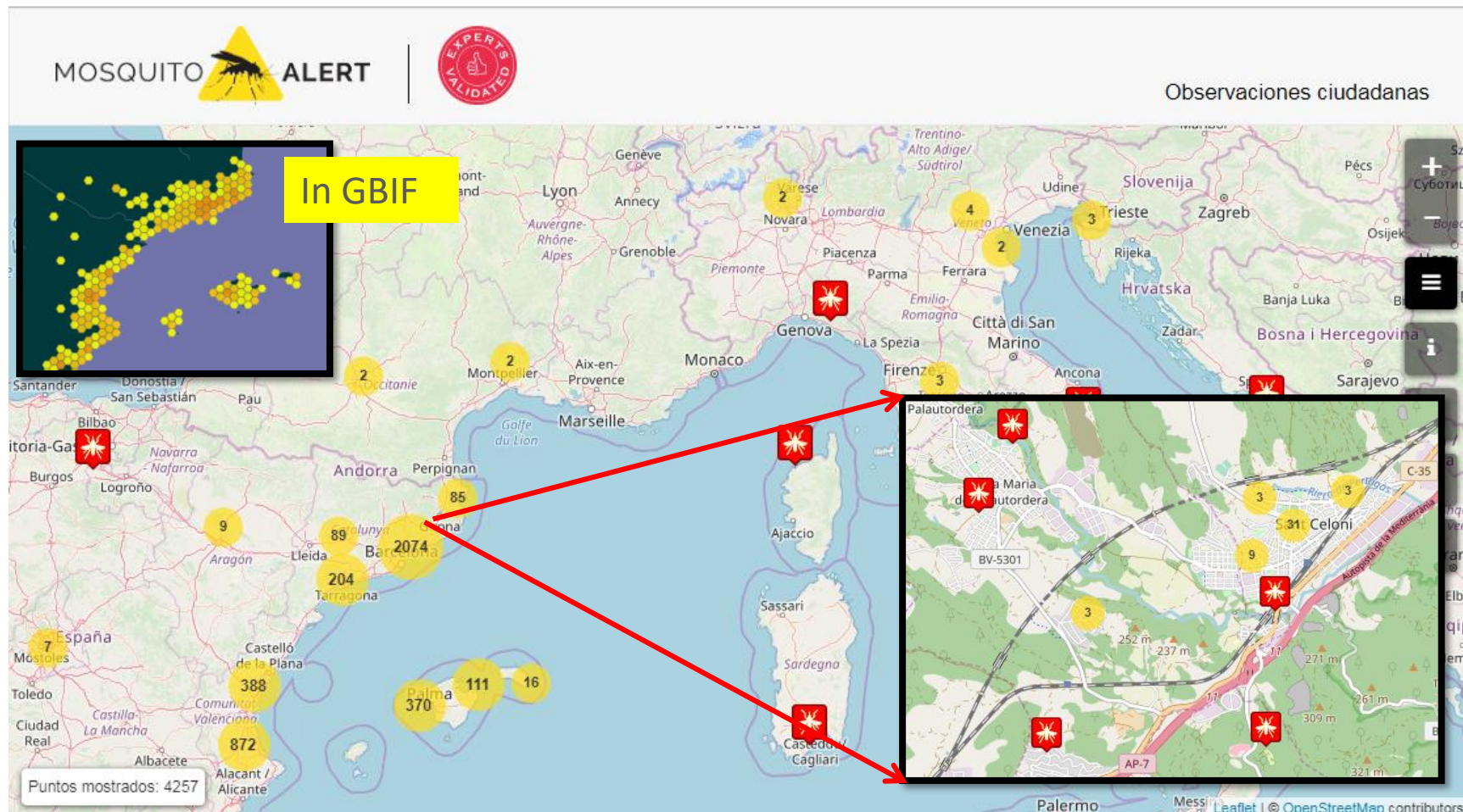
Comparison with traditional methods

- Traditional tiger mosquito surveillance generally involves trapping the mosquito's eggs using ovitraps: small containers of water that must be set and recursively checked by experts in the field.
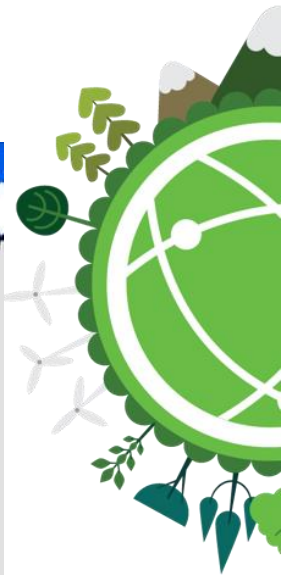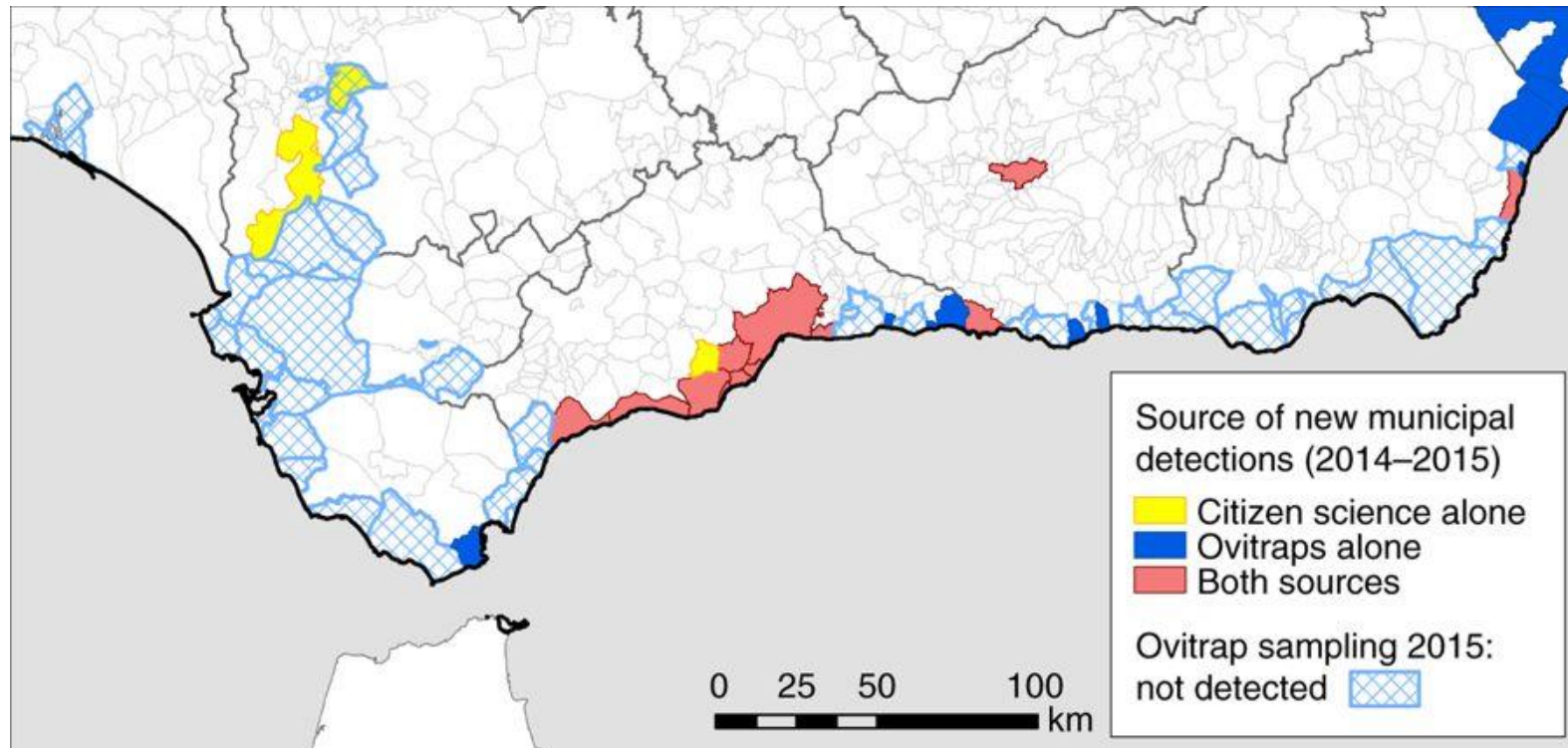
Palmer J.R.B (2017) Citizen science provides a reliable and scalable tool to track disease-carrying mosquitoes

Can we build a Global Mosquito Alert?

- Germany: The "Mückenatlas" (mosquito atlas)
- UK: Mosquito Reporting Scheme/Mosquito Watch
- The Netherlands: The "Muggenradar" (mosquito radar)
- Spain: AtrapaelTigre.com (hunting the tiger)
- France: iMoustique®
- Portugal: MosquitoWEB

- Two methods:
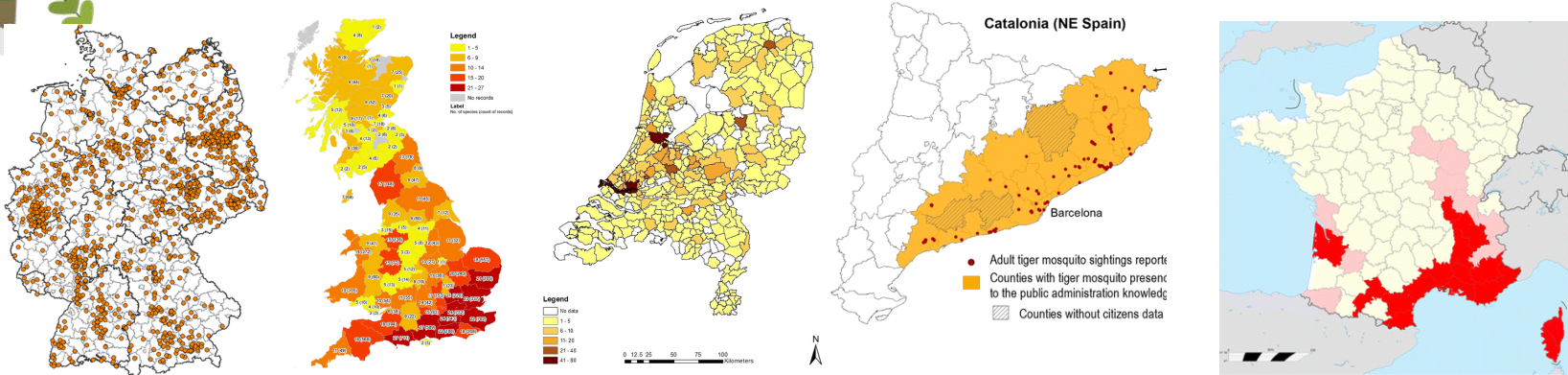 - rely on notifications of observations only,
  - the participants submit mosquito material for further scientific analysis.

- Later cases, species identification was eventually performed by the scientists resulting in better quality

Kampen H. (2015) Approaches to ~~passive mosquito surveillance~~ in the EU

Can we use Citizen Science data in weather prediction?

- In December 2018, the Danish Meteorological Institute organised an international meeting on the subject of citizen science data in numerical weather prediction (NWP) and weather forecasting.

- Subjects include data from vehicles, smartphones, and private weather stations.

- A **global platform** for sharing expertise, data, and results would help crowdsourced data realise this potential.
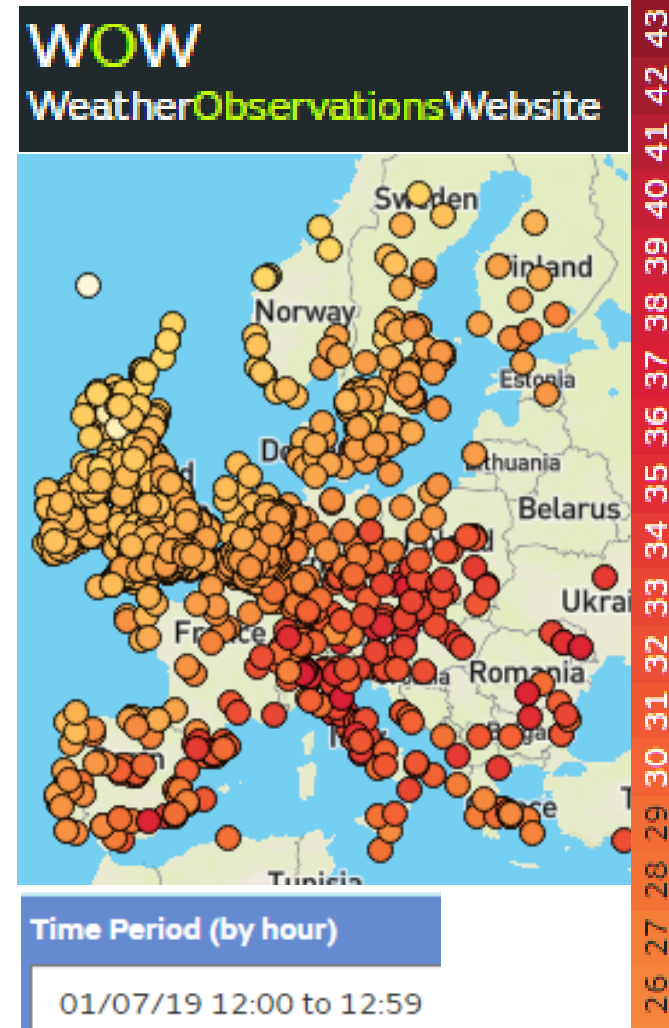

Hintz (2019) Collecting and utilising crowdsourced data for numerical weather prediction: Propositions from the meeting held in Copenhagen, 4–5 December 2018

Institution	Current activities	Activity status	Considerations	Contact persons
KNMI	WOW-NL	Half operational	Pollution measurements	Marijn De Haij
Met Office	WOW-UK, social media, cars, voluntary observations	Half perational	User reports, 5G network	Katharine O'Boyle
DMI	SPO, PWS	Research	User reports, webcam	Kasper Hintz
FMI	User reports	Operational	SPO	Juhana Hyrkkanen
Mètèo France	Cars, PWS, user reports	Research		Èmilie mallet
U.of Reading	Cars, CCTV, WOW	Research	Buses	Sarah Dance
ECMWF	Monitoring Progress	Research		Mohamed Dahoui
DWD	Cars, PWS	Research	SPO, user reports	Alexander cress
Met Èireann	Voluntary observations	Half Operational	PWS	Ronan Darcy
ESTEA	App in development			Ivar Ansper
University of Washington	SPO	Research		Conor McNicholas
ZAMG	Trusted spotter network, Austrian weather observer	Operational		Thomas Krennert
Met Norway	PWS (Netatmo)	Half,operational		Roger Randriamampianina

Can we use Citizen Science data in weather prediction?

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- Subjects include data from vehicles, smartphones, and private weather stations.

- A **global platform** for sharing expertise, data, and results would help crowdsourced data realise this potential.

- **Conclusion:** *NO*: **There is still much work to do before Citizen Science observations can widely be ingested into NWP models**.

WOW
WeatherObservationsWebsite

Time Period (by hour)

01/07/19 12:00 to 12:59

Hintz (2019) Collecting and utilising crowdsourced data for numerical weather prediction: Propositions from the meeting held in Copenhagen, 4–5 December 2018

Why not?. Interesting conclusions of the workshop

- **Terminology** is not agreed upon in the community: Citizen-science, Crowdsourced, Opportunistic data, Third-party data

- Obtaining useful crowdsourced data may involve collaboration with commercial entities, such as **manufacturers** (sensors)

- Law based restrictions on storage of **personal data** lead to a need to de-personalise which can lead to "black boxes" (GDPR)

- New data sources can potentially produce more observations than current NWP models **can realistically handle** (big data)

- Data quality could be enhanced by prioritising the collection of **accurate metadata** (data management)

Hintz (2019) Collecting and utilising crowdsourced data for numerical weather prediction: Propositions from the meeting held in Copenhagen, 4–5 December 2018

Data management and standards.

- The European Commission's Joint Research Centre (JRC) in 2014, identified the management of citizen-collected data as a major barrier to the re-usability and integration of these contributions into other data-sharing infrastructures across borders.

JRC TECHNICAL REPORTS

citizen science

Survey report: data management in Citizen Science projects
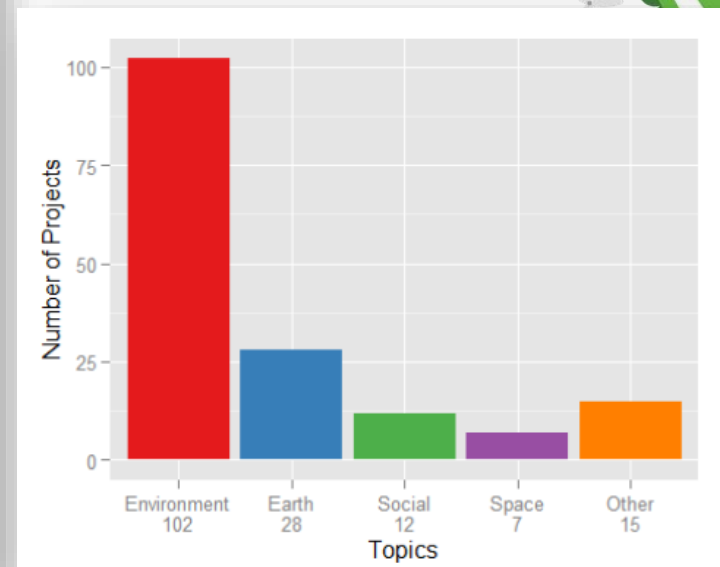
Data sharing and metadata in standard way?

Based on responses to questionaires

- 60% have a data management plan
- 47% discoverable through catalogues and search engines
- 28% have persistent identifiers
- 63% access to raw data
- 62% access to aggregates
- 63% access to WMS
- 24% bulk download
- 36% user-customizable downloads (e.g. WFS)
- 28% computational capacities.
- 20% immediate access, 58% after embargo
- 80% data quality control
- 55% open standards
- 58% behond the end of the project

WeObserve

- In WeObserve we believe that Citizen Science need to adopt equivalment level of quality standards to be regnized by the remote sensings and in-situ professional comunity.

- That is why we organize a Comunity of Practice about Interoperability on Cit Sci.

- We are closing the first Interoperability Experiment.

Thanks to the initiators and supporters

UAB
Universitat Autònoma de Barcelona

CREAF

IIASA

JRC
EUROPEAN COMMISSION

esa

Wilson Center

Initiators

We Observe — CoP3

NEXTGEOSS

OGC

Support

DIGITAL | EARTH | OBSERVATION
01-04 July 2019 Department of Geoinformatics - Z_GIS, University of Salzburg
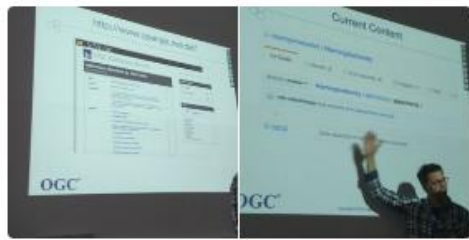
Stuttgart   Kyoto   Venice   Vienna

Joan Masó Pau
@joanma747

Contribution to the #CitSciIE: @opengeospatial definitions server to store the concepts. Extended to the ones used by the projects.

Sep 14, 2018

Joan Masó Pau
@joanma747

Contribution to the #CitSciIE: @LandSense engagement platform and single sign on.

Sep 14, 2018

Joan Masó Pau
@joanma747

nne is presenting the architecture of the data cloud at will support the Earth challenge 2020. GEOWeek18 . She mentioned the opengeospatial as partner and the #CitSciIE teroperability experiment we are doing in WeObserveEU

Oct 29, 2018

Joan Masó Pau
@joanma747

We detected and issue on the position of a moving sensor (common in citsci) versus the position of the observation in SOS O&M. How to link observations with sensors and procedures? Discussed in the #CitSciIE @FiveTwoN @opengeospatial @COWM2018 @CREAF_ecologia @WeObserveEU

Nov 28, 2018

Uta Wehn
@UtaWehn

@joanma747 presents the @GroundTruth20 data quality tool during @WeObserveEU #interoperability #CoP at #EGU19, applied to @MeetMeeMechelen & @hack_air data. @EU_H2020

Apr 11, 2019

• and 10 telecons

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FRIDAY SEPTEMBER 14TH

OGC CITIZEN SCIENCE IE KICK-OFF

9-15h Kick-off in Stuttgart

- **Vocabularies for** Citizen Science in particular **project metadata** standards implementation in **catalogues** of CitSci projects.

- The use of OGC standards or (e.g. Sensor Web Enablement (SWE)) to support **data sharing and integration** among CS projects, and with other sources, esp. authoritative data (e.g by following SWE4CS);

- The integration of CS projects/campaigns in **Single Sign-On** system (SSO) federation;

- How to **document** critical metadata, including **data quality** aspects, and generate a data quality label.
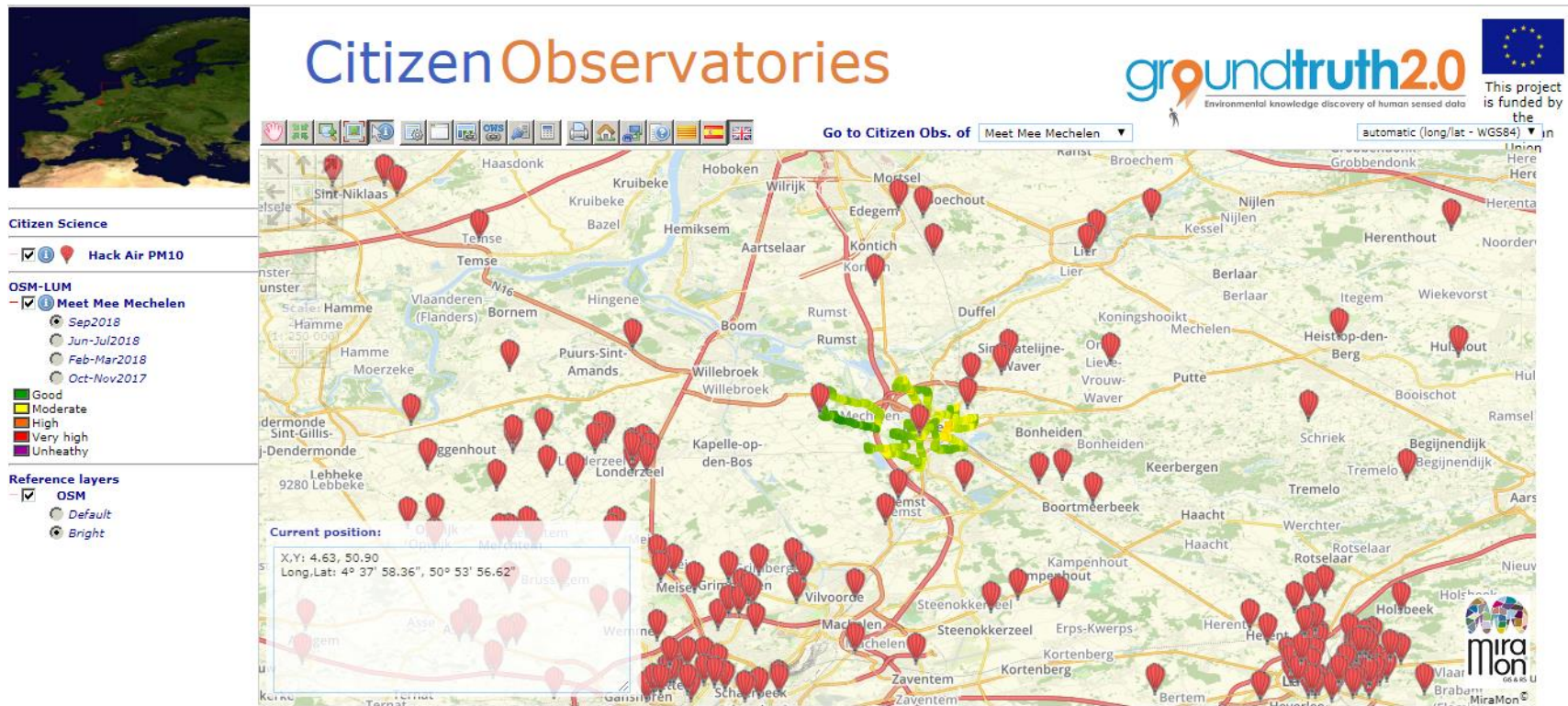
Initiators

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JRC — EUROPEAN COMMISSION

eesa

Wilson Center

NEXTGEOSS

CoP-Interop

WeObserve

OGC

Support

D: Data sharing using OGC standards such as O&M and SOS

- We have 4 instances of SOS services
  - GROW Hydrologic SOS
  - istSOS (http://istsos.org/) in DLR hackAir
  - 52North SOS
  - MiraMon SOS

- We have a client the MiraMon Javascript client and the Hergoland client from 52 North.

- WE would like to produces a set of **instruction** on how a CS project can easily setup a SOS service
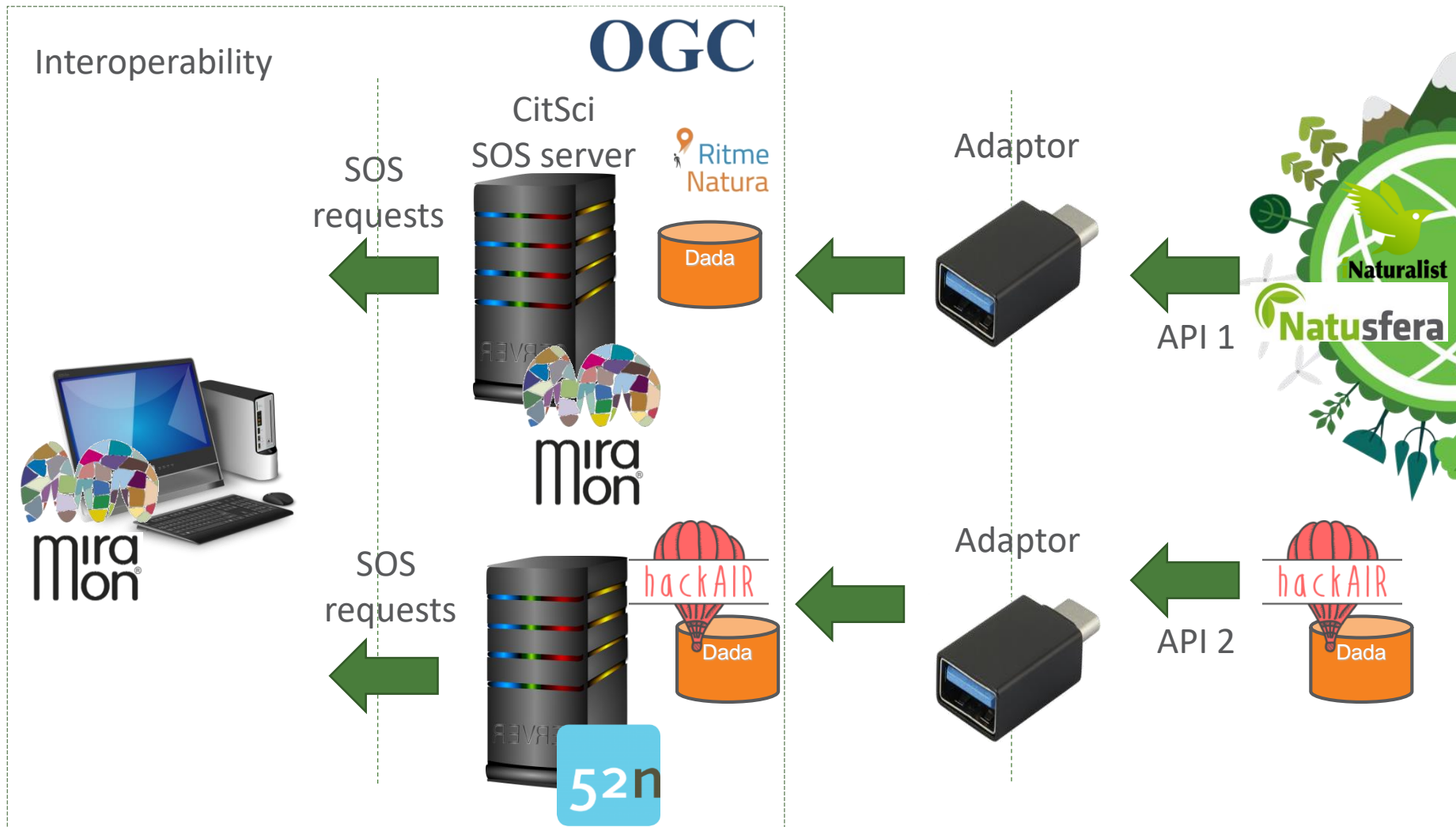
- Integration of SOS in GEOSS discussion

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Some results SOS in action

http://www.ogc3.uab.cat/gt20/?config=hackair.json

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Geospatial Consortium

Tested architectures for data integration

Conclusion

- There are multiple examples where Citizen Science can complement Remote Sensing and in-situ official data

- In some exemplary cases Cit Sci already integrated with in-situ (rarely with Remote Sensing)

- Citizen Science needs to adopt equivalment level of quality standards to be regnized by the remote sensings and in-situ professional comunity.

- The following presentations in this double bill about Citizen Science will illustrate other examples in more detail

Thanks
Joan Masó