Cos4Cloud

Co-designed Citizen Observatories Services for the EOS-Cloud

H2020 programme: Research and Innovation action

Deliverable 6.1 Identification of and Engagement with Projects of Interests - Report

31 January 2020, Version 1.0

Type		
R	Document, report excluding the periodic and final reports	X
DEM	Demonstrator, pilot, prototype, plan designs	
DEC	Websites, patents filing, press & media actions, videos, photos, etc.	
SOF	Software, technical diagramme, etc.	
OTHER	Flyers, etc.	

Dissemination level		
PU	Public, fully open	X
CO	Confidential, restricted under conditions set out in Model Grant Agreement	
CI	Classified	

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Executive Summary

This deliverable, produced within Work Package 6 (WP6) Task 6.1, identifies 78 citizen science (CS), citizen observatory (CO) projects, CO portals and other initiatives of interest (past, current and future) that may either contribute to or make use of the Cos4Cloud platform and services. The goal was to identify a group of projects and initiatives that we might productively work with across the duration of Cos4Cloud, not to produce a comprehensive list of projects[1].

In doing so, we are exploring a range of possible options, and refining a framework for the type of projects Cos4Cloud should engage with and how engagement should occur. We will also develop and contribute to work seeking to understand which activities can be considered to be citizen science, under which conditions, and how can they engage with and/or contribute to the Cos4Cloud services.

The overarching vision of Cos4Cloud is to integrate citizen science in the European Open Science Cloud (EOSC) through the co-design of innovative services that solve some of the challenges faced by COs. In doing so, Cos4Cloud will transform CS projects into services for the scientific community and society, as well as provide new data sources. Considering the scale of collaborations involved in the current COs in different research domains, this can easily reach several thousands of users in the immediate science and participant communities.

The fifth Objective of the Cos4Cloud project is to facilitate networking and CS knowledge management processes across organisations, people and initiatives. This objective is implemented through Work Package 6 (WP6) '*Networking, Training and Capacity Building*'. The main goal of WP6 is to demonstrate a new conceptual model for evidence-based knowledge exchange, capacity-building, learning and engagement with and for citizen science.

D6.1 is being implemented in two phases:

- Phase 1 is this report, which identifies projects of interest, summarises the engagement approach, creates criteria for inclusion and collates the initial inventory database of 8 CS projects, 14 CO projects, 35 CO portals and 21 other initiatives of direct relevance to Cos4Cloud (Section 4.4). This report also summarises the research conducted around the scale of COs, CS projects and other initiatives currently underway reflecting the state of play at the start of the grant.
- Phase 2 will see the database evolve, as a living document, updated and refined as the project progresses. We will embed outputs across WP6; implementing engagement strategies that reach projects identified, while integrating new projects of interest as they develop throughout Cos4Cloud's lifetime.

Both this Report and the database will also contribute to WP7 '*Project Dissemination and Exploitation*' and WP8 '*Communication, outreach and stakeholder engagement*'.

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[1] Section 2.3 references exhaustive lists of projects and initiatives in the Citizen Science area.

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1. Introduction

Citizen science, the involvement of the public in scientific research (whether community-driven research or global investigations), is growing rapidly and its scientific, societal, and political impacts increase substantially. Citizen science (CS) creates a nexus between science and education that, when coupled with emerging technologies, expands the frontiers of research and public engagement. Over a decade of activity in citizen science has resulted in an enormous range of approaches, tools, resources, projects and impacts in all scientific fields.

A significant development has seen CS infrastructure in Europe taking the form of Citizen Observatories (COs), characterised by their focus on observing the environment (rather than other phenomena), the scale of their activities (typically local) and their timeline (typically long term)[2]. The growth in the number and appreciation of COs has been supported in recent years with European funding[3]. This includes COs supported in dedicated calls in the last two H2020 framework programmes: FP7 (ENV.2012.6.5-1: Developing community-based environmental monitoring and information systems) and H2020 (SC5-17-2015: Demonstrating the concept of 'Citizen Observatories', H2020-EU.3.5.5.: Developing comprehensive and sustained global environmental observation and information systems, SC5-19-2017: Coordination of citizens' observatories initiatives).

COs are a means by which communities can monitor and report on their environment, access information that is easily understandable, and contribute to wider decision-making.[4] The overarching vision of Cos4Cloud is to integrate citizen science in the EOSC through the co-design of innovative services that solve the challenges faced by COs. In doing so, Cos4Cloud will bring CS projects as a service for both the scientific community and society, as well as provide new data sources. The purpose of D6.1 is to identify and engage projects of interest to facilitate this.

This report is part of the requirements of *Deliverable 6.1 (D6.1): Identification and engagement with projects of interest. OU will create a database (shared internally);* contributing to WP6, *'Networking, Training and Capacity Building'* led by The Open University (OU). The main objective of this WP is to demonstrate a new conceptual model for evidence-based knowledge exchange, capacity-building, learning and engagement with and for citizen science; and as part of the EOSC hub, to integrate observations and citizen science practice across Europe. It contributes directly to Task 6.1, 'Networking with other projects, initiatives and platforms'.

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[2] We Observe: An Ecosystem of Citizen Observatories for Environmental Monitoring. D2.1 EU Citizen Observatories Landscape Report - Frameworks for mapping existing CO initiatives and their relevant communities and interactions. (2018).

[3] We Observe, 2018.

[4] Rubio-Iglesias, J.M. (2013) Citizens' observatories for monitoring the environment: A commission perspective. In Proceedings of the Workshop on Citizen's Involvement in Environmental Governance, Arlon, Belgium, 7 October 2013; Directorate General Research and Innovation, European Commission: Brussels Belgium

As leader of WP6 the OU is implementing D6.1 in two phases: Phase 1 is this report, and a consortium-internal, initial project inventory database. Phase 2 will see the database evolve, as a living document, updated and refined as the project progresses. We will embed outputs across WP6; implementing engagement strategies that reach projects identified, while integrating new projects of interest as they develop throughout Cos4Cloud's lifetime. This was determined to be the best approach in WP6 delivery for effective communications and coordination with other European, international and national projects, related platforms and initiatives, which can add value during the project and after its completion.

Phase 1 involved research into and identification of a range of projects of interest to Cos4Cloud. A desk review was conducted to scope out COs and CS projects of interest, and an inventory framework was collaboratively drafted with the consortium, to collect the preliminary list of potential projects of interest. The tasks in Phase 1 included:

- a review of the landscape, identification and collation of information on relevant initiatives, including past, current and future
- the collection of a range of reports and other outputs, which collate relevant types of information, suggesting possibilities for collaboration
- the development of a draft framework identifying projects of interest, creating an inventory of projects contributed by Cos4Cloud partners

2. Background: Cos4Cloud and citizen observatories

2.1 Citizen observatory portals, Citizen science platforms and services

Citizen Observatories (COs) can be defined as "community-based monitoring and information systems, which build on innovative and novel observation applications embedded in portable or mobile personal devices. Owing to the vast array of ubiquitous information and data they can provide, COs can enable authorities to obtain evidence and inform environmental policy-making, complementing more authoritative in-situ observation and monitoring networks and systems with a very positive cost-benefit ratio." [5]

In addition to the programmes mentioned in the introduction above, other projects and initiatives have emerged - supported by different funding schemes - consolidating CO platforms and tools beyond the lifetime of most of the conventional projects or programmes. This is particularly common in biodiversity-monitoring platforms, such as:

- **Artportalen**: (https://www.artportalen.se/ - the Swedish Species Observations System) supported by the Swedish Environmental Protection Agency and the Swedish University of Agricultural Sciences (SLU) since 2000;

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[5] SC5-19-2017: Coordination of citizens' observatories initiatives call (https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/topic-details/sc5-19-2017)

- **iSpot**: (http://www.iSpotnature.org) developed and managed by The Open University (UK) and launched to the public since 2009;
- **Pl@ntNet**: (https://plantnet.org) funded by the French agencies Agropolis and ANRU since 2011; and
- **Natusfera**: (https://natusfera.gbif.es/) developed and managed by CSIC and Bineo Consulting[6]. Natusfera was adopted by the Global Biodiversity Information Facility (GBIF) Spanish node as its Citizen Science Portal in 2016.

Cos4Cloud refers to these existing biodiversity platforms as CO portals.

The scale of the contribution of the data and research from citizen science projects and initiatives is significant. They generate more than 50% of the data available through the Global Biodiversity Information Facility (GBIF), close to 349 million reports of occurrence data[7] with a significant number associated with environmental monitoring (air, water, noise, odours, climate, etc.).

Services and platforms which have been developed to report environmental-quality observations will also benefit through the scaling up of Cos4Cloud services applied in different contexts. Services and platforms already identified are:

- **FreshWater Watch**: (https://freshwaterwatch.thewaterhub.org) a global citizen scientist project, started in 2012, investigating the health of the world's freshwater ecosystems.
- **Odour Collect**: (https://odourcollect.socientize.eu) a project is based on a standardised European methodology to evaluate odour episodes through citizen observations.
- **iSPEX**: (http://ispex.nl/en) an innovative way to measure aerosols based on a mobile app and a small optical add-on containing a spectrometer and a polarizer.
- **KdUINO**: (http://www.citclops.eu/transparency/measuring-water-transparency) an open-source, low-cost mooring system to measure water transparency being developed for the European project Citclops. Citizens build their own buoy with its sensors and set it in the sea.
- **CanAir.io**: (http://canair.io) a citizen-science project for measuring air's particle material (PM 2.5) using low-cost sensors and smartphones.

Cos4Cloud responds to an identified need to provide innovative services in the EOSC for these types of citizen science communities, through related infrastructures in COs; and to widen the use of CS data among traditional scientists through the co-design of innovative services.

While some initiatives self-identify as being COs, many other initiatives could be defined as such since they closely fit the definition. However, many do not use this term or may not even be aware of the terminology. This report lays the groundwork by researching and identifying a subset of possible of projects of interest to Cos4Cloud. In doing so, we identify key stakeholders and define methods of engagement to reach and involve them throughout the

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[6] The mobile version of Natusfera is based on Naturapp developed, managed and licensed by Bineo Consulting.
[7] Chandler, M., See, L., Copas, K., Bonde, A. M. Z., López, B. C., Danielsen, F., ... Turak, E. (2016). Contribution of citizen science towards international biodiversity monitoring. Biological Conservation. https://doi.org/10.1016/j.biocon.2016.09.004

project's lifetime. It informs the development and implementation of novel methods and strategies for networking, education, training, capacity building and citizen engagement, which will be implemented.

2.2 Identifying CS and CO attributes of interest

A desire for better coordination of CS projects has led to collaborative working towards identification of core sets of attributes[8] revealing commonalities between projects and these types of models have been useful to help frame a criterion to help identify projects of interest. COs can be considered as the next phase in the growth of CS[9] and in Cos4Cloud. We identify seven key elements (layers) of COs that help determine projects of interest and how we might engage with them:

Participants: the people involved in providing observations (scientists and non-scientists). They can also play additional roles (e.g. project co-creation, data validation, data analysis).

Acquisition systems: any digital system that facilitates the process of acquiring an observation (usually provided with time and location stamps): examples include smartphones, tablets and sensors.

Observations: active acquisition of information from a primary source. These sources could be human observations or those captured digitally (e.g. DIY devices, camera traps, sensors, drones). The evidence could be occurrence data, photographs, videos, audio recordings, etc.

Projects: entry points (with unique identifiers, commonly a URL) that can be set up for scientists but also participants to assign observations for specific purposes. Many projects are not motivated for academic purposes: some are place-based, built on individual participation and motivated by a local agenda i.e. conservation. [10]

Data sets: sets of observations that are grouped for specific criteria, such as:
  1) belonging to a specific project
  2) observations labelled with the same criteria (e.g. taxonomic group, type of measurement)

Portals: web platforms[11] that allow participant interactions and project creation.

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[8] Bowser, A., Brenton, P., Stevenson, R., Newman, G., Schade, S., Bastin, L., Parker, A., Oliver, J. (2017) Citizen Science Association Data & Metadata Working Group: Report from CSA and Future Outlook." Workshop Report, Woodrow Wilson International Center for Scholars, Washington, DC.

[9] Grainger, A. (2017). Citizen Observatories and the New Earth Observation Science. Remote Sensing, 9(2), 153. doi:10.3390/rs9020153,

[10] Newman, G., Wiggins, A., Crall, A., Graham, E., Newman, S., & Crowston, K. (2012). The future of citizen science: emerging technologies and shifting paradigms. Frontiers in Ecology and the Environment, 10(6), 298-304.

[11] Portals and platforms may sometimes be used interchangeably.

Repositories: archives that manage the long-term storage and preservation of digital resources and provide a catalogue for discovery and access. Digital research data is best preserved and published using these.

Figure 1, shows how these layers sit alongside each other within Cos4Cloud:
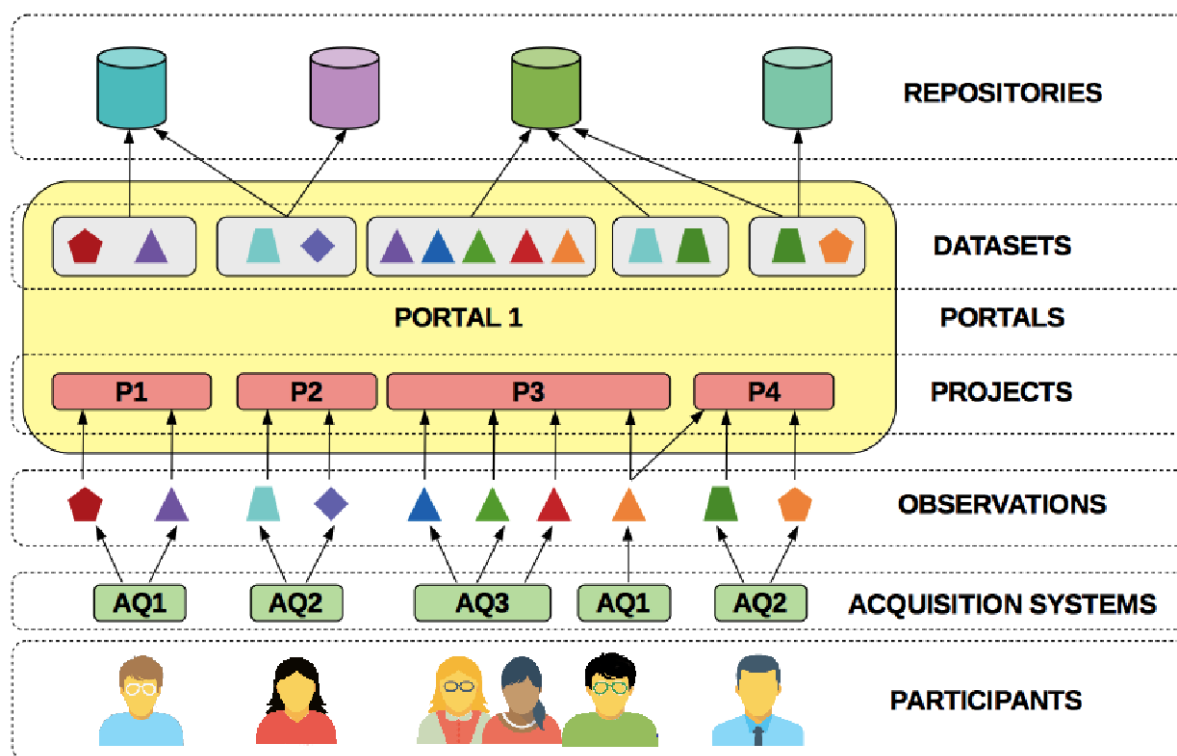

Figure 1. Cos4Cloud key elements of citizen observatories

From the research conducted, criteria to guide the development of a framework to identify projects of interest was constructed. Projects, Portals, and 'other initiatives' were the defining categories selected:

- 'Projects' were divided into categories to help identify:
  - CO projects (past, current and future)
  - other CS projects
- 'CO 'Portals' in two categories to differentiate:
  - biodiversity-monitoring platforms and environmental-quality services already identified by Cos4Cloud (see 2.1 above); and
  - other web-based platforms and services
- a final category collates any 'Other initiatives' of interest.

Section 4 breaks this down defining attributes within these categories. As the database continues to develop in Phase 2, criteria for other categories and attributes, based on the seven layers identified above, will evolve.

2.3 Evidence base: existing overviews of COs and CS projects

CS activity is dynamic and continues to grow at an exceptional rate with projects ending or going into hiatus for periods of time, and new ones being developed and implemented on a regular basis[12].

Our review of the landscape for potential projects of interest uncovered a range of comprehensive reports, research papers, website databases, etc: As part of the development of this report, we explored potential synergies with other relevant citizen science projects with an aim to reduce repetition and any duplication of effort. These were important considerations for the methodology adopted and the research conducted to meet this deliverable.

Existing databases lists and inventories of CS activity highlight hundreds[13] and thousands of initiatives[14]; operating at different scientific disciples, sizes, scales, focus, and geographic area. These categories were used to devise a rudimentary framework and criteria to engage consortium partners about potential projects of interest. This research also identified efforts underway to identify strategies and techniques to reach these types of stakeholders.

Support for these growing communities has also been established in the form of citizen science associations such as the European Citizen Science Association (ECSA)[15], the US-based Citizen Science Association (CSA)[16] and the Australian Citizen Science Association (ACSA)[17]. In Europe, different EU funded networking initiatives have emerged such as the COST Action Citizen Science[18] to promote creativity, scientific literacy, and innovation throughout Europe, to investigate and extend the impact of the scientific, educational, policy, and civic outcomes of CS. Another example is EU-Citizen.Science, which started in January 2019 and is aimed at building a central platform for citizen science in Europe[19].

The table below lists reports that have been particularly relevant for identifying CO and CS activities and developing a process for engagement with Cos4Cloud.

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[12] Efforts to capture a 'live' list of some of these activities are underway including a Wikipedia page of 'active' and 'completed or inactive' projects. See: https://en.wikipedia.org/wiki/List_of_citizen_science_projects .

[13] An inventory of Citizen Science activities' in 2018 collated over 500 initiatives across and beyond Europe. European Commission, Directorate-General for Environment; European Commission, Joint Research Centre; Bio Innovation Service(2018): An inventory of citizen science activities for environmental policies. European Commission, Joint Research Centre (JRC) [Dataset] PID: http://data.europa.eu/89h/jrc-citsci-10004. https://www.eea.europa.eu/about-us/who/epa-network

[14] SciStarter (www.scistarter.org), an online community aimed at improving CS experiences lists over 3,000 projects and events.

[15] https://ecsa.citizen-science.net/

[16] https://www.citizenscience.org/

[17] https://citizenscience.org.au/

[18] https://cs-eu.net/

[19] http://eu-citizen.science/

Project / Report Title	Summary Theme	Source / Link to resources
WeObserve: An Ecosystem of Citizen Observatories for Environmental Monitoring (2018). D2.1 EU Citizen Observatories Landscape Report - Frameworks for mapping existing CO initiatives and their relevant communities and interactions.	Citizen Observatories overview	https://www.weobserve.eu/wp-content/uploads/2019/02/D2.1-776740-WeObserve-EU-Citizen-Observatories-Landscape-Report-Frameworks.pdf
EU-Citizen.Science Consortium (2019). EU-Citizen.Science: D2.1: Stakeholders, Network & Community Mapping Report, ECSA, Berlin.	Stakeholder mapping	https://zenodo.org/record/3465726
European Commission, Directorate-General for Environment; European Commission, Joint Research Centre; Bio Innovation Service (2018). An inventory of citizen science activities for environmental policies. European Commission, Joint Research Centre (JRC)	Inventory of Citizen Science activities	http://data.europa.eu/89h/jrc-citsci-10004
Bowser, A., Brenton, P., Stevenson, R., Newman, G., Schade, S., Bastin, L., Parker, A., Oliver, J. (2017) Citizen Science Association Data & Metadata Working Group: Report from CSA and Future Outlook. Workshop Report, Woodrow Wilson International Center for Scholars, Washington, DC	Towards common standards and criteria for CS data and metadata	https://www.wilsoncenter.org/sites/default/files/wilson_171204_meta_data_f2.pdf

3. Methodology for networking: Cos4Cloud approaches

3.1 Codesign

Cos4Cloud adopts a methodology based on co-design, meaning that the requirements of end-users will form the basis for the development of services. This will include integrated stakeholder engagement with workshops to guide and validate concepts, and the effectiveness of activities. External communication and collaboration initiatives will also be implemented via a detailed engagement strategy. These requirements also guide the

framework for identifying, engaging and networking with projects of interest, consolidated from:

1) The co-design methodology designed for Cos4Cloud, incorporating stakeholder mapping; experience and documentation of user needs, carried out during several years of operation by the citizen observatories on biodiversity; and the platforms of environmental monitoring that are part of Cos4Cloud.
2) Requirements and challenges faced by citizen observatories, identified from the members of the consortium and from information generated by other projects such as We Observe and EU.Citizen.Science.

3.2 Engagement

D6.1 incorporates Cos4Cloud's novel approach to engagement, under a **formal framework,** to identify, recruit and engage with participants. D9.1 outlines this framework to reach stakeholders identified through the inventory of projects of interest aligning with the sustainability plan, stakeholder engagement, and network mapping. It combines the conceptual **'hook' model** proposed by Eyal (2014)[20] for creating habit-forming products with (b) the **layered model of social experience** proposed by Yamakami (2014)[21] in his study of citizen relationships with internet services and games.

The first phase in the **hook model** is the *trigger*. An iterative process begins with external triggers and, after a series of cycles, converts them into internal triggers. The second phase of the hook is the *action*. The easier it is to do something; the more users will do it. The third phase of the model consists in *rewarding* the triggered actions; and, critically, if these rewards are variable, the user is far more likely to get engaged. Finally, for the habit to really form, the user has to *invest* in it.

Cos4Cloud general procedures guiding the identification and recruitment of projects of interest as stakeholder / participants includes:

1. Mapping of the actors that will be involved in each activity, taking into account the communities that are linked to each of the citizen observatories and platforms that are already part of the Cos4Cloud consortium.
2. Prioritization of the actors according to the criteria established in these guidelines and those specified by the team that will develop the activity.
3. Design of an engagement and communication strategy taking into account the defined theoretical and methodological frameworks defined (i.e. Co-creation, co-design, Hook model)
4. Design of materials and methodological process of participation activities (i.e. survey models, co-creation templates and events)

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[20] Eyal, N. (2014). Hooked: How to build habit-forming products. Penguin.

[21] Yamakami, T. (2014). A layered view model of social experience design: Beyond single-user user experience. In Advances in Computer Science and its Applications (pp. 35-41). Springer, Berlin, Heidelberg.

5. Explanation and signature prior to the activity of the informed consent on the ethical guidelines of the project, which include a clear description of the scope and use of the results of the activity and the use of personal data, in case they are collected.
6. Evaluation and feedback of the process by the participants.
7. Internal incorporation by the consortium of lessons learned in involvement activities.

3.3 Channelling feedback: an agile approach

A detailed understanding of individual motivations, intentions from COs, their respective communities and scientists will add true value to Cos4Cloud. Throughout the project this kind of feedback will be very helpful to facilitate understanding of the problem domain in more detail.

Regular contact with existing COs, project communities and other stakeholders will be a core part of Cos4Cloud to review, refine or extend our mission within the project. We believe that transparency and being open minded will tease out people interested in citizen science and probably motivate others to participate. During the project that kind of input is essential to evaluating the effectiveness of our activities and enables us to adapt our approach when necessary. This will be one important element to apply an agile methodology to WP6 and other work packages.

In addition to this, through WP7 '*Project Dissemination and Exploitation*', we will involve potential end-users, businesses and institutional partners in our project development and product roll-out. Feedback from different input channels will be expected as it will be figured out from various activities like education, training and integration to EOSC actions. Involving participants who play a fundamental role in the project will also give very welcome input for the ongoing activities in the other work packages.

3.4 Communication

The communication plan during the project lifetime will be an essential tool to reach and engage the different target groups, maximizing the project's effort to create interest and understanding of the Cos4Cloud project. The communication plan strategy will create:

a) An appealing EOSC-Cos4Cloud brand
b) Innovative promotional and communications material and resources
c) A live website
d) Social media channels (i.e. LinkedIn and Twitter).

Work package 8 (WP8) '*Communication, Outreach, and Stakeholder Engagement*' will provide ongoing opportunities to keep all the target groups informed (among them the projects of interest), we will interact with them through our social channels and offer them a quality content through our website and newsletter.

3.5 Dissemination

The development of the exploitation roadmap (Task 7.6), dissemination plan and marketing strategy will be a key part of the process of creating dissemination approaches to engage with stakeholders derived from projects of interest. The Road map will scope emerging needs, future technological developments and trends in end-user requirements, including projects of interest, and this will be used to pre-assess the sustainability of Cos4Cloud products and make appropriate modifications during the project life. During the first year of Cos4Cloud engagement and consultation with projects of interest as stakeholders (i.e. end-users) will help to influence the development of appropriate Cos4Cloud services.

3.5 Dissemination

4. Creating a database: Projects of interest inventory

4.1 Data management

D6.1 refers to the collection of information about projects of interest and engagement with representatives about Cos4Cloud and is guided by Cos4Cloud principles and responsibilities on research ethics in Work Package 9 (WP9) '*Ethics Requirements*'. Guidelines set out in Deliverables 9.1 (Research participants), 9.2 (Protection of Personal Data) and 9.3 (Non-European Countries) data as well as the Cos4Cloud code of conduct are particularly relevant.

D9.1 details how the participants will be approached and the procedures that the consortium must follow to identify, recruit and engage participants. The creation and management of the database may involve the direct collection of personal data and, if so, this will be managed according to the informed consent guidelines outlined in D9.1 and technical and organisational procedures in D9.2; which includes operating in strict compliance to GDPR. The OU will be guided by internal procedures and guidelines, and be responsible for safeguarding the collection, storage and processing of any such personal information to ensure a GDPR compliant process.

The handling of any personal data collected, stored and / or processed will also be managed by processes and protocols to be defined in the Data Management plan to be delivered in April 2020.

4.2 Metadata about the database

The framework developed for the inventory collated as part of D6.1 was guided by developing data management protocols[22] and OU standards and principles[23]. The results collated emphasise the importance of identifying and using categories (i.e. name of project, delineation as a CS Project, CO Portal or other initiative, geographic location, etc); the metadata, to ensure that the data is "findable, trackable and (re)usable"[24].

As the database continues to be updated questions to be considered include:

- How is the information collected?
- Who is responsible for the database?
- How often is the database updated?

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[22] This was informed by current efforts to establish data and metadata standards for citizen science:
i Citizen Science Data and Metadata Working Group: Report from CSA and Future Outlook Workshop Report (cited earlier) https://www.wilsoncenter.org/sites/default/files/wilson_171204_meta_data_f2.pdf ;
ii. *PPSR Core*, https://github.com/CitSciAssoc/DMWG-PPSR-Core and
iii. *An inventory of citizen science activities for environmental policies*, European Commission, Joint Research Centre (JRC) (cited earlier).
[23] http://www.open.ac.uk/about/digital-governance/digital-standards-and-guidelines/metadata
[24] https://www.openaire.eu/what-is-metadata?rCH=2

- Where is the database stored?
- Who is responsible for backups of the database and how will this be managed?
- Who has access to the database? Who are the potential users?
- What personal information is collected? (i.e. contact information about project leader) How is this collected and protected?
- When is it going to be destroyed? or What is long-term information?

4.3 Project attributes

To build a process for identifying projects of interest, a framework for data collection was developed and a range of attributes assigned guided by developing standards for citizen science projects and their data.[25] Each Cos4Cloud consortium member was invited to identify projects of specific interest. From the contributions, comments and feedback received a framework was further revised.

The following table lists attributes used as criteria for selecting and describing projects of interest:

Category / Attribute	Summary description
Project Type description:	
Project Type	
CO Projects	Citizen Observatories (CO) projects
CS Projects	Citizen Science (CS) Projects of interest
CO-Portals (A)	Biodiversity platforms, tools and environmental services identified by Cos4Cloud - described as CO - portals
CO-Portals (B)	Suggestions of biodiversity platforms, tools and environmental services that could fit the Cos4Cloud description of CO - portals
Other initiatives	Other initiatives shaping / impacting on citizen science and CO infrastructure
Project Information:	
UID	Unique code for each project / portal / initiative
Name	Name of the project / portal / initiative
Description	Description of the project / portal / initiative
Website URL	Link to the website of the project / portal / initiative

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[25] This was informed by current efforts to establish data and metadata standards for citizen science. See 22 above.

Environmental Topic / Theme / area	Environmental topic / theme / area / data collection focus (please select)[26]: Air quality Biodiversity, nature and landscapes Climate Land Noise Sustainable consumption and production Waste Water Efficient use of resources Transport and energy use Animal welfare Environmental risks Environmental health Other (specify)
Other and cross-cutting areas	Specify / list other and cross-cutting theme
Contact name	Contact name for engagement purposes
Contact email	Contact email for engagement purposes
Partners / lead	Names of lead organisation and / or partners and funder
Timeline	Timeline including: start year, end year or ongoing
State	Active, Finished, Future
Geographic coverage	Specify country / region; whether national, international or regional etc
Social Media	Twitter / Facebook etc links to follow and use for future engagement
Registered by: Cos4Cloud Partner	Name / Acronym of Cos4Cloud partner organisation
Synergy with Cos4Cloud	Describe the potential synergy between Cos4Cloud and the project, initiative or platform. (i.e. Potential ally for development services, potential participant of hackathon, datathon or bioblitz, source of best practices about CO, etc)
Date of Entry	Date when the information was created / added. The date must be registered using the following standard: YYYMMDD
Date Updated	Date when the information was last updated. The date must be registered using the following standard: YYYMMDD

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[26] Environmental Theme / Topic/ Area attributes adapted from An inventory of citizen science activities for environmental policies, European Commission, Joint Research Centre (JRC) (cited earlier).

Contributions received from partners, tested and assured the suitability of the inventory database framework, with an initial list of 78 projects of interest identified.

Projects of Interest summary results: Project Type

Project Type (Attributes / categories)	Description of project type	Inventory count
CO Projects	Citizen Observatories (CO) projects	14
CS Projects	Citizen Science (CS) Projects of interest	8
CO-Portals (A)	Biodiversity platforms, tools and environmental services identified by Cos4Cloud - described as CO - portals	9
CO-Portals (B)	Suggestions of biodiversity platforms, tools and environmental services that could fit the Cos4Cloud description of CO - portals	26
Other initiatives	Other initiatives shaping / impacting on citizen science and CO infrastructure	21
	TOTAL	**78**

We will continue to work with Cos4Cloud partners to update, refine and expand this as a living database while engaging with stakeholder representatives through WP6 and other associated work packages. Standards for engaging with projects of interest will be further developed and implemented, approved via the Communication Plan (WP8) to be developed in March 2020. This will include standard text depending on the identified criteria. The aim is to inform and engage more and new target audiences of citizen scientists and users of the EOSC hub to ensure the greatest possible exploitation of the services and products to be developed by Cos4Cloud. The contacted representatives will be collated into stakeholder groups, following ethical guidelines, and invited to participate in relevant Cos4Cloud communication and dissemination activities.

4.4 Projects of Interest

The description of the projects in this section was mainly obtained directly from the respective websites and/or created by desk research.

4.4.1 Citizen Science projects

ACTION: Participatory science toolkit against pollution (https://actionproject.eu/)

Description. ACTION seeks to transform how citizen science is done today: from a predominantly scientist-led process to a more participatory, inclusive, citizen-led one, which acknowledges the diversity of the citizen science landscape and the different, evolving challenges citizen science teams must meet as their project develops. Key Focus: Bringing together and considering the needs of multiple stakeholders throughout the entire lifecycle of citizen science, creating methodologies, tools and guidelines that will democratise the scientific process, allowing anyone to design and realise a citizen science project, from the early stages of project ideation to validating and publishing the results and beyond. ACTION is looking for new and ongoing citizen science projects related to any form of pollution in Europe and worldwide. Successful applicants will receive Eur 20,000 to help deliver a six-month pilot with the help of the ACTION team.

BioBlitzBcn (http://bioblitzbcn.museuciencies.cat/)

Description. BioBlitz is an environmental education initiative aiming to gather scientists, educational experts, naturists and the general public to promote the exploration in open spaces and improve the biodiversity knowledge through a dynamic and collaborative learning. BioBlitzBcn consists in two open journeys of naturalist prospection, open to everybody. Participants are accompanied by experts in different biology topics. The obtained results enrich the census of the biological diversity of Barcelona.

Biodiversity GR (https://www.biodiversitygr.org/recording-projects-and-missions.html)

Description. Biodiversity GR is a CO project run by the Hellenic Biodiversity Center. It organises a range of missions that involve citizens throughout Greece in observing and recording Greek fauna and flora species with the use of Noah & iNaturalist platforms.

Planttes (http://www.planttes.com/?page_id=46&lang=en)

Description. Planttes is a citizen science project that aims to inform about the presence of allergenic plants in our environment and the level of allergy risk depending on their status. Its objective is to help to better understand the relationship between the environment and allergic diseases, contributing to improve the quality of life of people who suffer them.

Recosfa (http://www.recosfa.com/)

Description. RECOSFA (Colombian Network of Tracked Wildlife Trapping) is a citizen science initiative that, since 2014, made an effort between the scientific community and other citizens, to reduce the number of animal run overs on the roads of Colombia.

EU-Citizen.Science (http://eu-citizen.science/#the-project)

Description. The EU-Citizen.Science project is building the central platform for citizen science in Europe. Key Output: A place to share useful resources about citizen science, including tools and guidelines, best practices and training modules. This will make citizen science knowledge created in Europe accessible to all and enable people to initiate their own activities. It will also enable anyone involved with or interested in citizen science to learn more and get involved.

Engaging Environments (https://gtr.ukri.org/projects?ref=NE%2FS017437%2F1)

Description. The NERC Community for Engaging Environments project aims to engage a broad range of audiences, including those typically less represented in public engagement activities. The project takes an innovative approach that combines community development, storytelling and citizen science, enabling diverse communities to have a meaningful stake in discussing and tackling environmental science issues such as climate change and pollution. It aims to create lasting change in public engagement practice by providing learning opportunities while shaping future activities to equip NERC's research community and diverse communities with essential skills in public leadership.

Greenspaces (https://greenspaces.gr/)

Description. WWF-Greece has designed and runs a citizen science project allowing for identifying, recording and evaluating open green spaces in urban environments. This project is part of a wider capacity building project called "Better Life" also run by WWF-Freece. A free mobile app (https://apps.apple.com/gr/app/wwf-greenspaces/id1099344730) allows citizens to share information on where to find parks, green corners as well as spots in big cities, what is to find there and what to expect based on different people's needs and interests. They can also rate the environmental quality of these spaces on various criteria such as the amount of vegetation, the cleanliness of the place and the availability and state of any infrastructures in them; and claim for green urban space improvements.

4.4.2 Citizen Observatory projects

CitiES-Health (http://citieshealth.eu/)

Description. CitieS-Health aims to put citizens' concerns at the heart of research agenda on environmental epidemiology by tackling health issues that concern them. Groups of citizens in five cities in Europe will design and run experiments to explore how the pollution in their living environment is affecting their health. The project will create an interactive toolkit with customised tools and best practices for the replication of the studies in other locations by researchers, individuals and citizen groups.

Ciudadanos científicos (Scientific Citizens) (https://www.metropol.gov.co/ambiental/siata/Paginas/ciudadanos-cientificos.aspx)

Description. Ciudadanos cientificos is a local program of science, education and technology. The program started in 2015, when 100 citizens of the Metropolitan Area (Antioquia, Colombia) voluntarily offered their homes and workplaces to install a 'cloud', that is, a low-cost air quality measurement sensor that was developed by SIATA professionals and that allows to obtain punctual measurements, minute by minute, of temperature, relative humidity and PM2.5. Currently, Scientific Citizens has 250 monitoring points that constitute a network that has allowed the monitoring of the distribution of pollutants in the territory, both in critical episodes of air quality and day to day. The data provided by the clouds are available for consultation, in real time, at www.siata.gov.co and the SIATA and Scientific Citizens applications for mobile devices.

Citizen observatories (https://citizen-obs.eu/)

Description. Collaborative project website for H2020 EU-funded projects SCENT, GROW and Ground Truth 2.0 and LANDSENSE (https://citizen-obs.eu/#projects), funded under the topic SC5-17-2015 - Demonstrating the concept of 'Citizen Observatories' portal, to disseminate activity from four projects which make Citizen Observatories an integral part of environmental monitoring. Also builds on previous collective efforts of the pioneering Citizen Observatories projects COBWEB, Citclops, WeSenseIT, CITI-SENSE, OMNISCIENTIS (https://citizen-obs.nilu.no/ParticipatingProjects.aspx). Key focus: A common, interactive place to provide regular information on the progress and activities of the projects, to further promote citizen awareness regarding environmental policy issues, and to enable community engagement and active participation.

D-Noses: Distributed Network for Odour Sensing Empowerment and Sustainability (https://dnoses.eu/about-d-noses/)

Description. D-NOSES will reverse the way in which odour pollution is commonly tackled (i.e. a non-transparent, private process involving either the odour emitting industry or the local city council, with no citizen involvement and poor access to data and information) by applying a holistic approach to researching, building and suggesting an appropriate regulatory framework, which can act as a basis of the future odour pollution control efforts. D-NOSES will empower citizens to become a driving force for change through RRI, citizen science and co-creation tools to map and measure the problem, and co-design solutions with key quadruple helix stakeholders.

D-NOSES aims to kickstart a much-needed collaborative journey to tackle the problem of odours at a global scale by developing coordinated local case studies in 10 European and non-European countries.

Flamenco project Flanders Mobile Enacted Citizen Observatories (http://citizen-observatory.be/index.php/about/)

Description. FLAMENCO aims to deliver an open cloud-based software platform, designed for citizens to create and participate in citizen observatory campaigns. Citizen observatories are sets of ICT-tools to collect, analyse and visualise sensor data, with the aim of improving the quality of life of citizens. Key Focus: Today citizen observatories have to be developed from scratch for each application area, an enormous effort as witnessed by dedicated consortia for the topics of air quality, water quality, ocean monitoring and odour monitoring, under the 2012 EU-ENV-FP7 call. These first-generation citizen observatories prove the critical role of ICT in the evolution towards a sustainable society but deploying a new citizen observatory remains extremely difficult and labour-intensive. Despite an overwhelming demand for such platforms, they are thus beyond the reach of most societal stakeholders. This is the gap we aim to close through the FLAMENCO project.

groundtruth2.0: A new approach to citizen observatories (https://gt20.eu/)

Description. Ground Truth 2.0 is a 3-year EU funded project that is setting up and validating six citizen observatories in real conditions, in four European and two African demonstration cases. The project is demonstrating that such observatories are technologically feasible, can be implemented sustainably and that they have many societal and economic benefits. The ultimate objective is the global market uptake of the concept and the enabling technologies. The thematic focus of Ground Truth 2.0 is on flora and fauna, as well as water availability and water quality, for land and natural resources management. The project uses mobile apps and social media analytics to collect explicitly and implicitly-sensed citizen data.

MONOCLE: Multiscale Observation Networks for Optical monitoring of Coastal waters, Lakes and Estuaries (https://monocle-h2020.eu/About)

Description. MONOCLE brings together 12 partners from across Europe to create sustainable in situ observation solutions for Earth Observation (EO) of optical water quality in inland and transitional waters. Key Focus: Developing essential research and technology to lower the cost of acquisition, maintenance, and regular deployment of in situ sensors. Key Output: A sensor system which will establish firm links between operational Earth Observation (EO) and essential environmental monitoring in inland and transitional water bodies. These aquatic ecosystems, which are particularly vulnerable to direct human impacts, represent areas of the weakest performance in current EO capability, despite the major technological advances in recent decades. At the same time, these areas are of great economic importance and are crucial to sustainable food, energy, and clean water supply.

Mosquito Alert (http://www.mosquitoalert.com/en/)

Description. Mosquito Alert is a cooperative citizen science observatory coordinated by different public research institutions. Its main objective is to fight against the tiger mosquito and the yellow fever mosquito expansions, two invasive species vectors of global diseases like Zika, Dengue and Chikungunya. With the Mosquito Alert app anyone can report a possible finding of tiger mosquito or yellow fever mosquito and their breeding places on the public road by sending a photo. The photo collects the GPS position along with other detailed information. Afterwards, a team of expert entomologists validates the photos received. The result of the validation is sent directly to the participant and published in the observation map. In it you can consult and export all observations from 2014 to the present. This information complements the scientific work and allows public health managers to use this information to monitor and control the spread of mosquitoes in neighbourhoods and cities.

Scent (https://scent-project.eu/)

Description. Scent engages citizens in environmental monitoring and enable them to become the 'eyes' of the policy makers; supporting the monitoring of land-cover/use changes using their smartphones. The project demonstrates the huge potential of citizen observations and environmental monitoring. A people-led online observation movement capturing land-cover and land-use changes and other relevant environmental parameters through user-friendly tools and innovative technologies, the Scent Toolbox' complementing existing forms of monitoring such as satellite and remote sensing which are costly and less dynamic. Key Output: The Scent Toolbox includes low-cost and portable sensors, an innovative crowd sourcing platform, serious gaming applications for large-scale image collection, machine learning for image and text classification, numerical models for mapping land-cover changes to quantifiable impact on flood risks and a harmonization platform, consolidating data and adding it to GEOSS.

The GROW Observatory (https://growobservatory.org/)

Description. The GROW Observatory (GROW) was a European-wide project engaging thousands of growers, scientists and others passionate about the land. Partners aimed to discover together, using simple tools to better manage soil and grow food, while contributing to vital scientific environmental monitoring.

luftdaten.info (https://luftdaten.info)

Description. The luftdaten.info project is based on the approach of building low-cost sensors for monitoring parameters such as air quality (particulate matter) and noise. Besides guidance on how to build the necessary sensor hardware, it provides functionalities for collecting, storing and

managing the measured air quality data. Furthermore, functionality for data visualisation is available.

Observadores del mar (https://www.observadoresdelmar.es/)

Description. The Observadores del Mar citizen science platform collects visual data and citizen experiences on different phenomena that occur at sea, to promote research and create new knowledge together. In addition, it is composed of experts from different research centres, national and international, that analyse and validate the observations received, which represents an added value with respect to other existing initiatives.

Landsense: A Citizen Observatory and Innovation Marketplace for Land Use and Land Cover Monitoring (https://landsense.eu/)

Description. The overall aim of the LandSense project is to build an innovative citizen observatory in the field of LandUse LandCover(LULC). The LandSense Citizen Observatory aims to aggregate innovative EO technologies, mobile devices, community-based environmental monitoring, data collection, interpretation and information delivery systems to empower communities to monitor and report on their environment. Key output: Development of a LandSense Engagement Platform where communities will be able to actively participate through a variety of interactive tools and functions to facilitate information transfer, assessment, valuation, uptake and exploitation of environmental data and results. Will bring together and extend various pieces of technology including: Geo-Wiki, LACO-Wiki, Geopedia and Sentinel Hub.

WeObserve: An Ecosystem of Citizen Observatories for Environmental Monitoring (https://www.weobserve.eu/)

Description. WeObserve tackles three key challenges that Citizens Observatories (COs) face: awareness, acceptability and sustainability. The project aims to improve the coordination between existing Citizen Observatories and related regional, European and International activities. The WeObserve mission is to create a sustainable ecosystem of Citizen Observatories that can systematically address these identified challenges and help to move citizen science into the mainstream.

4.4.3 Citizen Observatory portals (A)

These Biodiversity platforms, tools and environmental services are described as Citizen Observatory portals identified by Cos4Cloud.

CanAir.io (https://github.com/kike-canaries/esp32-hpma115s0/wiki/Official-Guide-(EN))

Description. A guide to build a device to measure air quality by using a Honeywell HPMA115SO sensor, which measures PM 2.5 and PM 10 particles and then if you want, publish it to CanAirio cloud or a personal server using CanAirIO App.

Freshwater Watch (https://freshwaterwatch.thewaterhub.org/)

Description. An Earthwatch research project investigating the health of global freshwater ecosystem.

Artportalen (Swedish Species Observation System) (www.artportalen.se)

Description. Artportalen is a reporting platform for the biodiversity of Sweden. While there have been rapid developments in the field of citizen science Artportalen remains a model system recommended by the European Environmental Protection Agency. The platform was first developed in 2000 but has gone through several versions. Artportalen currently has over 73,000,000 geo-referenced observations gathered by the general public (~90%) as well as professionals (~10%). The database is now a corner stone in environmental management in Sweden where the County Administrations access data via their own GIS system, Artsök (Species Search), while town administrations may either use Artsök or Artportalen directly. Data from the authorities and agencies is uploaded via the Artportalen site. Data quality is maintained by a hierarchical structure of data observation rules written by expert validators, public examination of the open data and finally expert validation of individual observations. Data is harvested directly by the Global Biodiversity Information Facility (GBIF) and contributes with 6% of the observations in the total repository. Some 145 peer-reviewed articles have appeared using Artportalens data accessed via GBIF. Artportalens data can also be accessed by researchers via the Analysis portal service hosted by ArtDatabanken.

iSpot (https://www.ispotnature.org/)

Description. iSpot is a website aimed at helping anyone identify anything in nature. People upload their observations of wildlife, help each other identify it, and share and discuss what they've seen. One of the main distinguishing factors of this website is its reputation system that helps ensure the identifications produced are accurate.

KdUINO (http://kduino.weebly.com/)

Description. KdUINO, a low-cost buoy to measure the attenuation coefficient and determine phytoplankton chlorophyll concentration in water.

iSPEX (http://ispex.nl/en/)

Description. Measurements by thousands of citizen scientists in the Netherlands using their smartphones and the iSPEX add-on are delivering accurate data on dust particles in the atmosphere that add valuable information to professional measurements.

Natusfera (https://natusfera.gbif.es)

Description. Natusfera is an adaptation of iNaturalist developed by CREAF and Bineo Consulting. It is funded by the FECYT, Spanish Foundation for Science and Technology (www.fecyt.es), Obra Social 'La Caixa' (https://obrasociallacaixa.org/es/home), the National Biodiversity Node in Spain, GBIF.ES (www.gbif.es) and the Institute of Marine Sciences (www.icm.csic.es). The administration, coordination, maintenance and content management is done through CREAF, GBIF.ES and Bineo Consulting.

Odour Collect (https://odourcollect.eu/)

Description. OdourCollect is the open App to report odour observations. Have you perceived nice or bad smells in your neighbourhood? Are you affected by odour pollution? We have the best sensor to identify and measure odours, our sense of smell!

Pl@ntNet (https://plantnet.org/en/)

Description. Pl@ntNet is a citizen science project available as an app that helps you identify plants thanks to your pictures. It develops computer-based plant identification using large numbers of correctly identified plant images often of specific parts of the plant such as flowers or leaves.

4.4.4 Citizen Observatory portals (B)

Suggestions of biodiversity platforms, tools and environmental services that could fit the Cos4Cloud description of CO - portals.

Alerta Forestal (http://www.alertaforestal.com/es/)

Description. Alerta Forestal works to create an active community of citizens who help to study the state of health of the forests of Catalonia. To do so, citizens send photos of landscapes of rural areas for different disturbances such as: the processionary moth, the caterpillar of the boxwood, drought, gust of wind or snowfall. The project has a mobile application and a web application. All the photos received by the project are available on an alert map. From there one can consult both the geographical location and the degree of affectation (low, moderate, high and very high).

iRecord (https://www.brc.ac.uk/irecord/)

Description. An equivalent of iSpot for bulk uploading data from spreadsheets and lists of information rather than observation by observation. Can include images. Also has a system for verifying the information that has been uploaded based on automated rules-based checks and checks by expert verifiers from the areas where the data were collected.

BSBI (https://bsbi.org/)

Description. Botanical Society of the British Isles. Collects botanical data from botanists across the British Isles. The main organisation dealing with native plant data in British Isles. Also runs training courses, analyses the data and produces atlases.

BTO (https://www.bto.org/)

Description. British Trust for Ornithology. Collects bird data from across the British Isles. The main organisation dealing with bird data in British Isles. Also runs training courses, analyses the data and produces atlases.

National Biodiversity Network (https://nbn.org.uk/)

Description. Collects data from all groups of organisms and displays on maps. It is one centralised system that the majority of biological recording systems send their data to once it has been checked. UK and surrounding seas.

Eco-Navigation (https://archipelago.gr/en/ - https://archipelago.gr/en/eco-navigation/)

Description. Eco-Navigation is a citizen science platform having been developed by "Archipelagos - Institute of Marine Conservation' (a Greek non-profit, non-governmental organization) to allow the exchange of information with sea enthusiasts from all over the world. Among the data collected are the names of the marine species, the location in which a species was found and how many individuals of it live in an area. Images are also very welcome especially for marine mammals such as dolphins for photo identification of their dorsal fins. A citizen science community has been set up around this platform and a database is being created from sailors, sea enthusiasts and tourists' reports, based on a protocol, which is under construction, to enable citizens to provide observation data from the Aegean Sea and other parts of the Mediterranean.

enviroCar (https://envirocar.org)

Description. enviroCar is an open Citizen Science Platform for traffic monitoring and environment. Via the OBD II interface it is capable of logging different parameters measured by integrated car sensors. This comprises parameters such as speed, rpm, or mass air flow. Via an Android app the data is transmitted to a data management server which again published the collected information as open data. Based on the collected data, it is possible to derive further information such as traffic flow, traffic density, noise or fuel consumption. This can serve as input for tasks such as environmental protection or urban planning.

FloodUp (http://www.floodup.ub.edu/)

Description. Floodup aims to improve knowledge of floods and heavy rains and their impact, as well as to increase the information available to the scientific community. The citizens can download a mobile app or can register in the project website to share observations of recent and historical floods, rains and other phenomena. The tools also allow sharing observations of historic watermarks, places vulnerable to flooding or adaptation measures to these episodes.

Hamelin (https://hamelin.io)

Description. Hamelin is a citizen science platform whose main objective is the management of projects, activities and observations, mainly in the context of the world of tourism. It is a project managed by Bineo Consulting.

iNaturalist (https://www.inaturalist.org/)

Description. iNaturalist is an online social network of people sharing biodiversity information to help each other learn about nature It's also a crowdsourced species identification system and an organism occurrence recording tool. You can use it to record your own observations, get help with identifications, collaborate with others to collect this kind of information for a common purpose, or access the observational data collected by iNaturalist users.

Ritme Natura (http://www.ritmenatura.cat/ENG/objectius.htm)

Description. RitmeNatura.cat looks for Nature-lover citizens that are willing to learn how to collect phenological information and help scientists in studying the impact of climate changes on plants and animals.

Snapshot Safari (https://cbs.umn.edu/snapshot-safari/about)

Description. SnapshotSafari is an unprecedented collaborative network of camera-trap grids in wildlife parks and reserves throughout Botswana, Mozambique, South Africa, Swaziland, Tanzania

and Zimbabwe, with sites from Kenya, Malawi, and Rwanda (coming online soon). SnapshotSafari relies on online volunteers ('citizen scientists') to classify thousands of images of wildlife photographed by cameras uniformly dispersed throughout each protected area, providing a glimpse into the lives of endangered species and the distribution of wildlife across many landscapes.

iSea - SEAlly (https://isea.com.gr/seally/?lang=en)

Description. The aim of the 'Fishers, Sea turtles & Sharks: Alliance for Survival' project run by the iSea organisation is to study and mitigate the impacts of bycatch and ghostfishing on the sea turtle and shark populations in Greece, through awareness, capacity building and cooperation with stakeholders in the fisheries sector. SEAllyÂ© is a mobile application developed by this project, which allows multi-taxa recording and in particular species of which abundance is not well known. Both sea turtles and sharks have a long lifespan, slow growth rates and migrate large distances. Thus, data collection through this application aims to increase scientific knowledge about sea turtles and sharks. SEAlly allows fishers, port authorities, divers and all sea lovers to record sea turtle and/or shark sightings in the Mediterranean Sea.

Observatorio Cinegetico (https://observatoriocinegetico.org/)

Description. The Cinegetic Observatory is a digital platform designed with the aim of improving the knowledge of hunting species to improve their conservation and use. The OC consists of a mobile application: CENSDATA for preserve managers, which allows APP users to do citizen science by sending information taken in the field, to a web platform that is received by OC scientists. In the Cinegetic Observatory, the data provided generates information that helps the conservation of populations of hunting species. Technical reports come out of the OC to increase awareness of the status of hunting populations of the administrations of the Autonomous Communities and top-level scientific publications.

Bird Calender (FÃ¥gelkalendern) (https://www.naturenskalender.se/fagelkalendern.php)

Description. The FÃ¥gelkalender is aimed at the general public to report observations of a selected number of species to follow changes in phenology, primarily the timing of bird movements and migration. Observers observe for a period of 5 minutes. During this time, they tick of observed species from a predefined list of 36 species and report the list. After the five minutes is completed the list is reported to Artportalen, including the zero-observations.

Flora Guadians (Floraväkteri) (https://svenskbotanik.se/floravaktarna/)

Description. The Flora Guardians (Floraväkteriet) is a network of nature-interested people who help monitor and increase knowledge about our endangered plants, primarily vascular plants.

Knowledge of the state of the species is used in the conservation and management work. Compilations of the Flora Guardian's tasks are important basis for assessing which vascular plants should be red listed in Sweden, in order to follow developments in our nature in environmental monitoring, in order to assess whether we are approaching and can achieve environmental goals and for international reporting on the environmental state in Sweden. The Swedish Botanical Society is responsible for the coordination of the Flora ward at the national level. The regional botanical associations manage the coordination in the counties. What are we monitoring? Most of the vascular plants classified as endangered in Sweden's Red List are regularly monitored by the Flora Guardians, as well as some species that have been identified as closely endangered. The Flora Guardians species development at specific sites from year to year through regular visits. How often a site is visited depends on the plant species but varies between annually to once every five years. Data is reported to the Flora Guardians.

hackAIR (https://www.hackair.eu/)

Description. The hackAIR project aims at a better understanding of the air quality. For this purpose, it provides a technology platform (including smart phone apps, guidance on do-it-yourself sensors, etc.) that enables the collection of and access to air quality data.

The HCBM Scheme (http://www.ornithologiki.gr/page_in.php?tID=79443&slD=250)

Description. The Hellenic Common Bird Monitoring (HCBM) Scheme is the national program of common bird monitoring in Greece. It has been running since 2007 by the Hellenic Ornithological Society with a view to both collect data on population trends of common bird species and to provide data to the Pan-European Common Bird Monitoring Scheme (PECBMS), which is in progress in most European countries (27). The data obtained are used to generate the national Farmland Bird Index (FBI), an index that each EU country is required to incorporate to the national 'biodiversity indicators' and to the state of the wider environment. Data are also provided to the PECBMS programme to generate supra-national indices for individual species and European composite indices for groups of species (indicators, e.g. forest, farmland, etc.) on an annual basis. The scheme is long-term, based on the participation of volunteers who undertake monitoring in a specific area (a 2x2km square) every year. Observers visit their site twice per year and record all bird species in 15 pre-selected points. The methodology of the scheme is described in detail in the 'methodology' section of the scheme's webpage. At the end of each period, data are entered in the HCBM database and analysed using the TRIM software for the production of national indicators.

Observadores del mar (https://www.observadoresdelmar.es/)

Description. The Observadores del Mar citizen science platform collects visual data and citizen experiences on different phenomena that occur at sea, to promote research and create new knowledge together. In addition, it is composed of experts from different research centres,

national and international, that analyse and validate the observations received, which represents an added value with respect to other existing initiatives.

paratiro.gr (www.paratiro.gr)

Description. The "paratiro.gr" is a citizen science platform enabling the reporting and collecting of information on any incidents of dead or injured animals throughout Greece. It is based on a Greek initiative that aims to establish a nationwide, reliable recording and monitoring system for wildlife mortality due to anthropogenic causes based on citizen science participation. The collected information is grouped according to the animal type, cause of injury and/or death and the area in which it was found. Data analysis allows a better understanding of the threats wildlife faces due to human activities and the identification of measures and actions necessary to be taken to decrease animal mortality both locally or nationwide.

Zooniverse (https://www.zooniverse.org/)

Description. The Zooniverse enables everyone to take part in real cutting-edge research in many fields across the sciences, humanities, and more. The Zooniverse creates opportunities for you to unlock answers and contribute to real discoveries.

Hellenic Fauna Citizen Science Project (https://www.inaturalist.org/projects/hellenic-fauna-citizen-science-project?tab=about)

Description. This is a citizen science project run by the Zoological Museum of NKUA in Greece (@zmua). It aims at recording any animal occurrences with the view to enrich and expand knowledge about the Greek fauna. It asks for submissions of any kind of animal observations (e.g. alive, dead, traces, carcasses, etc.) accompanied by a georeferenced photo with the use of iNaturalist.

uBMS (urban Butterfly Monitoring Schemes) (http://ubms.creaf.cat/)

Description. uBMS is the citizen observatory of urban butterflies' uBMS is a collaborative network of volunteers who join forces to obtain data on butterfly populations in the cities of Barcelona and Madrid. In this way, relevant data will be obtained to assess and understand urban biodiversity, and with it, management tools that encourage its increase in our cities.

VigieNature (http://www.vigienature.fr/)

Description. Vigie-Nature is a participatory science programme founded and carried by the French National Museum of Natural History, a pioneer in participatory science for 20 years. Vigie-

Nature is run by associations and implemented through networks of volunteer observers. Based on simple and rigorous protocols, it offers everyone the opportunity to contribute to research by discovering biodiversity. Initiated more than 20 years ago with the Temporal Monitoring of Common Birds (STOC) created in 1989, the Vigie-Nature programme has since been strengthened with the monitoring of new groups: butterflies, bats, snails, pollinating insects, dragonflies, wild plants in towns, etc.

Treezilla (https://www.treezilla.org/)

Description. Website that calculates the ecosystem services provided by trees. It has over a million trees compiled from local authorities and the general public. It is UK based.

Marine LitterWatch / WISE (https://www.eea.europa.eu/themes/water/europes-seas-and-coasts/assessments/marine-litterwatch)

Description. WISE (Water Information System for Europe) is the European information gateway to water issues, run by the European Environment Agency (EEA). EEA developed Marine LitterWatch, which combines citizen engagement and technologies to help tackle marine litter. Marine LitterWatch offers tools - a mobile app, a web portal and a public database - to collect and share comparable data on marine litter on beaches. It also provides a platform for marine litter communities to come together, share their knowledge and co-create approaches to monitoring marine litter.

4.4.5 Other initiatives

COST Action on Citizen Science (https://cs-eu.net/)

Description. A Framework in Science and Technology to promote creativity, scientific literacy, and innovation throughout Europe.

ARCHELON (https://www.archelon.gr/index_eng.php)

Description. ARCHELON is the Sea Turtle Protection Society of Greece. Established in 1983, its primary goal is the protection of sea turtles and their habitats in Greece through monitoring and research, developing and implementing management plans, habitat restoration, raising public awareness and rehabilitating sick and injured turtles. ARCHELON is a Partner of the UNEP/Mediterranean Action Plan and a member of the European Union for the Conservation of the Coasts (EUCC). Members of the ARCHELON team participate in the IUCN/Marine Turtle Specialist Group and contribute to the formulation of the international strategy for the conservation of sea turtles. ARCHELON collaborates closely with state agencies, the local authorities, institutions, other NGOs, fishermen and local inhabitants in order to mitigate and

reverse population reduction of sea turtles. It also participates and contributes to the implementation of projects co-funded by the European Union.

Citizen Science Association (Citizen Science.org) (https://www.citizenscience.org/)

Description. CitizenScience.org is a US organization that aims to harness the knowledge gained by practitioners and researchers across the field of citizen science to build collaboration, community and credibility. They organise the bi-annual international conference CitSci (2017, 2019, 2021) and regular webinars. They are in charge of the scientific journal Citizen Science: Theory and Practice, an open-access, peer-reviewed journal published by Ubiquity Press on behalf of the Citizen Science Association.

CSEOL Citizen Science Earth Observation Lab (https://cseol.eu/)

Description. CSEOL (pronounced Sizzle) is an initiative funded by the European Space Agency (ESA) to find people and organizations with the energy, imagination and creative talent to help Europe's big Space data address some of our biggest problems. Key Focus: Ideas that provide opportunities for citizen scientists - or the wider public - to validate what satellites observe or to put those images to use. A CSEOL Call went out in 2019 around the world, with great ideas coming in from four continents. Now in the implementation phase - the four CSEOL pilot prepare and implement their projects.

EKBY - The Greek Biotope/Wetland Centre (http://www.ekby.gr/ekby/en/EKBY_home_en.html)

Description. EKBY is an offspring of the Goulandris Natural History Museum, a renowned non-profit institute for research, public awareness, information, and education on nature conservation. It was established in 1991 by the Natural History Museum with European Community funding and the support of the Worldwide Fund for Nature (WWF), following an application by the Greek Ministry of Environment, Physical Planning and Public Works. Based on its research activity EKBY has produced national information archives for several Greek nature areas and the sustainable development of renewable natural resources (such as inventories of Greek fauna and flora species and Greek vegetation, the mapping and monitoring of ecosystems, etc). It has several national and international collaborations with other research organisations. As for the Museum, its present premises include a large herbarium, zoological and geological collections, exhibition halls, a library, and laboratories (Entomology, Botany, Geology, Hydrobiology, Biotechnology, Herpetology, Ornithology, and Information) and an Environmental Education Exhibition Centre (the "Gaia Centre").

eMammal (https://emammal.si.edu/wasatch-wildlife-watch)

Description. eMammal is a data management system and archive for camera trap research projects. This cyber-tool is designed to not only be useful to scientists, but also to the citizen scientists who aid scientists in photo collection. Camera trappers use our software to look at pictures, identify animals and upload them for review and archive at the Smithsonian. These data then help address important conservation-related questions. The pictures provide a unique view into the secret world of wildlife.

Endemia (https://www.endemia.nc/)

Description. Endemia is a non-profit association whose aim is to contribute to the knowledge, promotion and enhancement of the native biodiversity (endemic and indigenous) of New Caledonia. Since 2001, Endemia has been running the internet portal www.endemia.nc, which is enriched and used by all, passionate naturalists and the scientific community. Supported by the local authorities (North and South provinces in particular), Endemia is an essential reference on the flora and fauna of New Caledonia.

LifeWatch Eric (https://www.lifewatch.eu/)

Description. European Infrastructure Consortium providing e-Science research facilities to scientists seeking to increase our knowledge and deepen our understanding of Biodiversity organisation and Ecosystem functions and services in order to support civil society in addressing key planetary challenges.

Extreme Citizen Science (ExCiteS) (https://www.geog.ucl.ac.uk/research/research-centres/excites)

Description. Extreme Citizen Science (ExCiteS) is a situated, bottom-up practice that takes into account local needs, practices and culture and works with broad networks of people to design and build new devices and knowledge creation processes that can transform the world.

GEO-BON (https://geobon.org/)

Description. GEO BON is the Biodiversity Observation Network of GEO, The Group on Earth Observations and represents biodiversity, one of GEO's nine Societal-Benefit-Areas. Key Focus: building up for the pathway to link biodiversity data and metadata to GEOSS, the Global Earth Observation System of Systems. GEOSS will provide decision-support tools to a wide variety of users. As with the Internet, GEOSS will be a global and flexible network of content providers allowing decision makers to access an extraordinary range of information at their desk.

GEO: Group   on   Earth   Observation   (GEOSS   Portal)
(https://www.earthobservations.org/geoss.php)

Description. GEO is a partnership of more than 100 national governments and in excess of 100 Participating Organizations that envisions a future where decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations. A global network connecting government institutions, academic and research institutions, data providers, businesses, engineers, scientists and experts to create innovative solutions to global challenges at a time of exponential data growth, human development and climate change that transcend national and disciplinary boundaries. The unprecedented global collaboration of experts helps identify gaps and reduce duplication in the areas of sustainable development and sound environmental management.

TRANSFORM: Territories as Responsive and Accountable Networks of S3 through new Forms of Open and Responsive decision-Making

Description. In TRANSFORM three European regions (Lombardy (IT), Brussels (BE) and Catalonia ES)) join forces and open up their R&I activities to co-create more responsible approaches to innovation. TRANSFORM brings them together to design, test and dissemination three sound co-creation methodological frameworks (participatory research agenda setting, design for social innovation and citizen science). The work in these three clusters will support and increase co-creation and participatory processes within their R&I ecosystems, both building on existing regional commitments towards transformative opportunities and strengthen the opening effect on the organisations involved. Regional governments involved in TRANSFORM will reflect on, experiment with, learn from and adopt RRI approaches to their R&I policies and actions.

MedPAN (https://medpan.org/about/)

Description. MedPAN is the network of Marine Protected Areas managers in the Mediterranean. It gathers today 120 institutions and NGOs that either have direct responsibility for managing Marine Protected Areas (MPA) or are involved in the development of MPAs in the Mediterranean. These players manage over 100 MPAS in 20 Mediterranean countries.

NEWSERA: Citizen Science as the new paradigm for Science Communication

Description. NEWSERA will analyse and evaluate the complex and multidirectional science communication strategies, including digital and non-digital ones, addressed to quadruple helix stakeholders in citizen science projects across Europe as the new paradigm for science communication. 4 pilot cases will be selected from ongoing EU projects mapped under the EU-Citizen.Science platform, taking into account not only the quantity, quality, reliability and effectiveness of the communication, but also psycho-social factors such as the perception and trust on science communication and, in consequence, on sciences.

OpenAIRE (https://www.openaire.eu/)

Description. OpenAIRE's mission is closely linked to the mission of the European Commission: to provide unlimited, barrier free, open access to research outputs financed by public funding in Europe. OpenAIRE fulfils the EOSC vision substantially, as its operations already provide the glue for many of the user and research driven functionalities, whether these come from the long tail of science (repositories and local support) or domain disciplined research communities or Research Infrastructures.

SciStarter (https://scistarter.org/)

Description. SciStarter is an online community dedicated to improving the citizen science experience for project managers and participants. Over 3,000 projects and events are searchable by location, scientific topic, and age level, and by joining SciStarter, members can track their contributions and provide valuable feedback. SciStarter also supports researchers in managing projects, including best practices for engaging participant partners.

Australian Citizen Science Association (https://citizenscience.org.au/)

Description. The Australian Citizen Science Association (ACSA) was formed to advance citizen science through the sharing of knowledge, collaboration, capacity building and advocacy. We are a member-based community that supports, informs and develops citizen science. ACSA membership is open to citizen science project managers, volunteers or anyone with an interest in citizen science.

ENVRI community (https://envri.eu/)

Description. The ENVRI community is a community of Environmental Research Infrastructures, projects, networks and other diverse stakeholders interested in environmental Research. Infrastructure matters. Although very diverse, all the Research Infrastructures share the same challenges, both in their constructions and operations. The ENVRI community thus encourages and facilitates a joint work to develop the synergies, to harmonise the Research Infrastructure landscape, products and services as well as to share the best practices.

European Open Science Cloud (EOSC) (https://www.eosc-portal.eu/)

Description. The EOSC will offer 1.7 million European researchers and 70 million professionals in science, technology, the humanities and social sciences a virtual environment with open and seamless services for storage, management, analysis and re-use of research data, across borders

and scientific disciplines by federating existing scientific data infrastructures, currently dispersed across disciplines and the EU Member States.

IAS - Institute of Agricultural Sciences (https://ige.gr/index.php/el/)

Description. The Institute of Agricultural Sciences is a governmental research and education institutional body established in 1901 and operating under the auspices of the Greek Ministry of Rural Development and Food and the Legacy of Iphigenia A. Syggrou. It conducts applied research and development projects aiming at the promotion of agricultural practices in Greece (such as beekeeping, viticulture - oenology, arboriculture, vegetable gardening, aromatic and medicinal herbs, etc.) through education. It is also active in the organization of thematic conferences and workshops of agricultural interest, and more recently in the design and implementation of environmental awareness activities for school students.

LEWA (https://www.lewa.org/)

Description. The Lewa Wildlife Conservancy and Borana Conservancy are wildlife sanctuaries based at the foothills of Mount Kenya. Conservation efforts on Lewa began in the early 1980s to protect the last of northern Kenya's black rhinos from extinction. From protecting rhinos, Lewa's work has expanded to the conservation of other species as well as catalysing community-centric conservation across northern Kenya and beyond. In 2015, Lewa and Borana took an unprecedented step by removing the fence separating them to create a larger landscape for the benefit of endangered species. Since 2019, LEWA works closely with the Pl@ntNet platform in order to set up a citizen observatory of the vegetal biodiversity of the park through the involvement of the visitors. The park has been inscribed into the UNESCO Mount Kenya World Heritage Site since 2013.

5. Next steps for engaging and networking

This report contributes to the overarching goal of WP6 to ensure that the Cos4Cloud model: (a) fulfils the needs of different stakeholders to demonstrate engagement of individual observatories; (b) provides the necessary engagement tools and training; and (c) results in a consistent approach to citizen science across a network of Cos4Cloud COs, with the purpose of scaling up across Europe. It is anticipated that the implementation of novel strategies for networking, education, training, capacity-building and citizen engagement will consist of:

1. Consolidation and expansion of existing citizen observatories and citizen science projects across Europe through networking and promoting Cos4Cloud
2. Recruitment of new citizen science observers from a range of stakeholder groups and wider society (with a focus on youth)
3. Networking with other ongoing, related projects and initiatives, facilitating mutual transfer of knowledge and information through an exchange of best practice and education, supported by training; this will be done using a coordinated approach and working within existing citizen observatories and citizen science projects
4. Development and implementation of case studies to demonstrate examples of best practice
5. Development and implementation of new citizen science educational learning activities and designs
6. Development of a citizen science toolbox and evidence hub, built within an ethos of co-designed and co-created sharing (e.g. contributing resources, etc.)

As part of WP6 we will:

- Continue to work with Cos4Cloud partners to refine the inventory of projects of interest and expand this as a living database with additional categories, user friendly search filters and tools etc
- Working with other relevant projects (i.e. EU-CitizenScience, WeObserve) identify and implement a process to integrate existing mapping and inventories of CS-CO initiatives in the database
- Finalise and implement engagement strategies
- develop engagement strategies to identify and target recent or potential new citizen observatories
- Establish collaborations with associated projects (i.e. [EU-CitizenScience](#)), to develop and contribute to work that better defines and fosters understanding of what should be considered as citizen science projects, to establish Cos4Cloud models for projects of interest
- Learn from efforts underway to map existing COs, their stakeholder communities and interactions (e.g., [WeObserve](#)) and refine a framework to reach projects that can engage with and/or contribute to Cos4Cloud services.

So created, the database will guide us as well as collate how we reach and involve a range projects of interest. This will inform the development and implementation of novel methods and strategies

for networking, education, training, capacity building and citizen engagement, which will also be delivered within WP6.