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Development of Sensor-based Citizens' Observatory Community for Improving Quality of Life in Cities
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Deliverable D 4.5

The CITI-SENSE Citizens' Observatories Web Portal

Work Package 4
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Executive summary

CITI-SENSE has been working for and with people to share objective and subjective information about air quality and acoustic and thermal comfort. The objective was to create Citizens' Observatories in different places in Europe where people could through their own observations and understanding of environmentally related information report and comments through a dedicated ICT platform.

This platform is the CITI-SENSE Citizens' Observatories Web Portal (COWP, http://co.citi-sense.eu). It provides access to all tools developed and tested in the project that have been used to engage with people. This includes for example mobile applications, web widgets, web pages and sensor based tools and questionnaires. Moreover, the COWP contains also information about the project outcomes and methods and tools to build a Citizens' Observatory or actively engage with people.

This document describes structure, content and functionality of the COWP. The COWP is the part of the project that will survive although the project has been finished.

Table of Contents

Abbreviations

Anonym	Full name
CMS	Content Management System
CO	Citizens' Observatories
COT	Citizens' Observatories Toolbox
COWP	Citizens' Observatories Web Portal
DNN	DotNetNuke
EKIs	Exploitable Knowledge Items
FAQs	Frequently Asked Questions
GEOSS	Global Earth Observation of System of Systems
KPIs	Key Performance Indicators
NGOs	Non-Governmental Organizations
WP	Work Package

1 Introduction

1.1 Background

The rise of relatively cheap, internet-connected, programmable, sensor-laden smart-phones and the explosive growth in ways to use personal communication devices vastly increases the potential for anthrocentric applications. As a result, the idea of participatory sensing emerged, in which both non-professionals and professional users participate in gathering and sharing local knowledge about various aspects of their environment. Participatory sensing provides the enabling technology to deploy so-called Citizen Observatories (CO), i.e., *a set of Information and Communication Technologies (ICT) that provide stakeholder organizations with the instruments to collect, analyse and visualise data such that it can be used as a policy making and evaluation instrument for improving the quality of life of citizens* (Castell et al., 2014, Liu et al., 2014, Zaman et al., 2014).

In recent years, the increase in the prevalence of CO globally has been mirrored by an increase in the number of variables that are monitored, the number of monitoring locations and the types and number of participating citizens (Liu et al., 2014). There are many aspects to a CO, such as one view is that its essence is a process that involves environmental monitoring, information gathering, data management and analysis, assessment, and reporting systems (Liu et al., 2014, Kobernus et al., 2015). Hence, it requires the development of novel monitoring technologies and advanced data management strategies to capture, analyse and survey the data, thus facilitating its exploitation for policy and society.

Practically, there are many challenges in implementing the CO approach, such as ensuring effective citizens' and other stakeholders' participation, dealing with data privacy, accounting for ethical and security requirements, and taking into account data standards, quality and reliability. These concerns all need to be addressed in a concerted way to provide a stable, reliable and scalable CO programme. On the other hand, the CO approach carries the promise of increasing the public's awareness to risks within their environment, which has a corollary economic value, by enhancing data acquisition at low or no cost (Castell et al., 2014, Liu et al., 2014).

COs are emerging as an increasingly essential tool that provides an approach for better observing, understanding, protecting and enhancing our environment (Liu et al., 2014). It can be interpreted as a means to establish interaction and co-participation amongst citizens, researchers and authorities to support and influence community and societal priorities and associated decision-making (Lanfranchi et al., 2013).

At present, the concept of COs has been implemented in various environmental monitoring fields, including water quality, air pollution, odour, biodiversity and climate change. All COs typically share a similar data flow chain or structure, and provide tools for data collection and visualization, and for information exchange. A common COs model (Figure 1-1-1) can be expressed as a combination of technologies and interaction with the public. The **technologies** include data collection tools and implementation of an Information and Communication Technologies (ICT) infrastructure that underlies the COs framework and supports effective citizens' participation. The **interaction with public** is done in a number of sequential steps: A) Identifying what citizens want and what citizens can offer; B)

Exploring what products and services a CO can provide for the citizens; C) Recruiting and retaining citizens to participate in and contribute to environmental governance; D) Providing tools that support citizens to report their observations, inferences and concerns; and E) Supplying tools to access/receive timely information on the environment in a manner that is both easily understood and useful (Liu et al., 2014). The essential features of an effective CO are (i) inclusion of observations from professionals, scientists and from citizens alike; and (ii) enabling a two-way communication between citizens and other stakeholders (including public authorities). This may potentially result in profound changes to local environmental management processes and, as such, engage in social innovation processes and outcomes (Wehn et al., 2015). The **data collection tools** include social media platforms and innovative monitoring technologies (e.g., smartphones, low-cost micro-sensors). These tools are used to both, engage citizens and to collect data. ICT infrastructure includes boundary services with sensors and apps, data management services, data storage support, and reusable visualization widgets used for both apps and web portals.

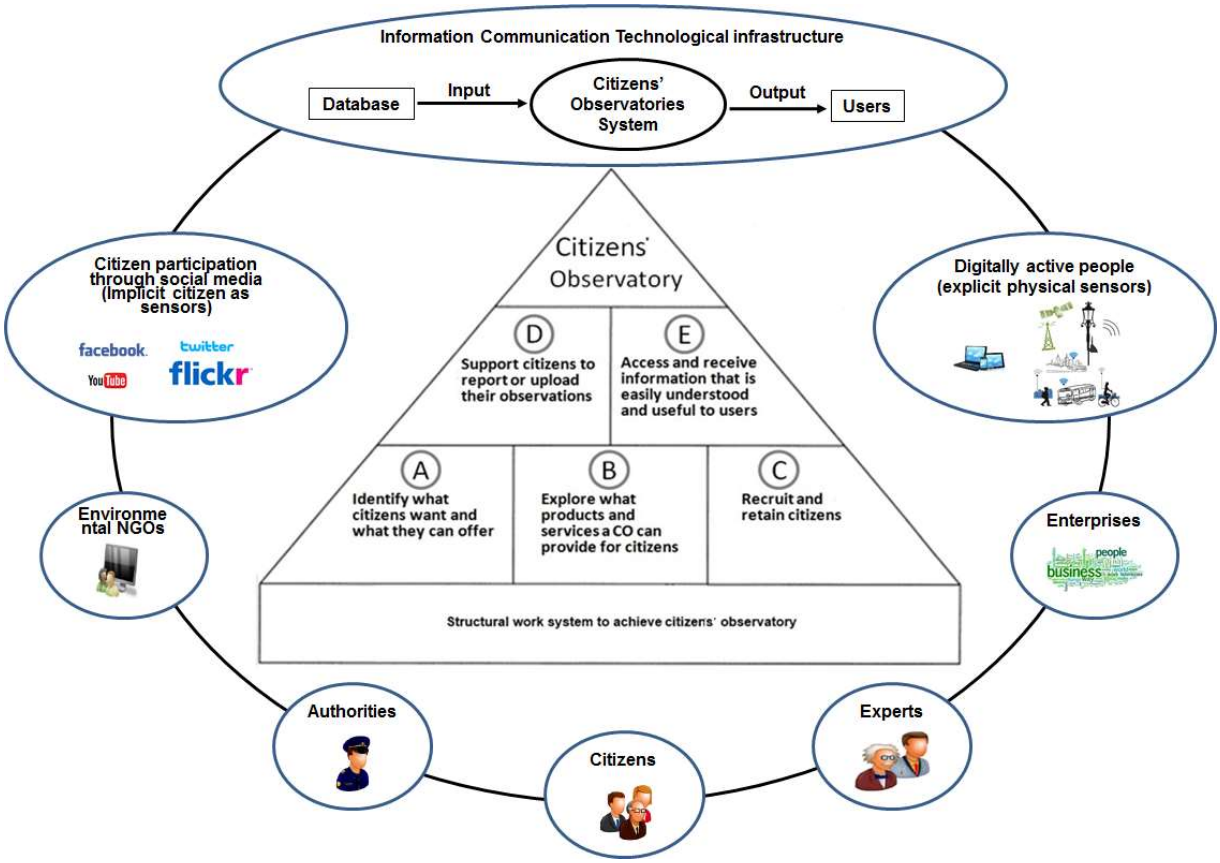

Figure 1-1-1. A common Citizens' Observatories model.

In a CO, all parties are preferrably active participants: creating knowledge about the situation in a participatory manner and contributing to dealing with the situation (Lanfranchi et al., 2013). In the

citizens' observatory, the main aspects are needed to effectively address citizens' participation. These include participation in data collection, data interpretation and information delivery.

Alternatively, this can be expressed as follows (Liu et al., 2014):

- Identifying what citizens want and what citizens can offer;
- Exploring what products and services a CO can provide for the citizens;
- Recruiting and retaining citizens to participate in and contribute to environmental governance;
- Providing tools that support citizens to report their observations, inference and concerns;
- Supplying tools to access/receive timely information on the environment in a manner that is both easily understood and useful.

1.2 About the CITI-SENSE Project

CITI-SENSE is an EU FP7 project (funded from 2012 to 2016), developing sensor-based Citizens' Observatory communities of urban air quality, noise and thermal comfort, and indoor air quality in schools (Castell et al., 2014, Engelken-Jorge et al., 2014, Liu et al., 2014). The goal of CITI-SENSE is to give citizens the tools to 'sense' and appraise their environment through new devices and resources, at the same time raise awareness about air pollution issues, and allow to communicate valuable environmental information between various stakeholders. The project wants to create products and tools that inspire people to relate to their natural environment in a systematic and scientifically defendable way, to motivate citizens so that they become active stewards of a good environment. To address this objective, CITI-SENSE initiated an intensive dialogue among the technical, scientific, and social aspects of environmental information, its production, and its use, thereby defining a framework in which researchers, authorities and citizens can cooperate in (Kobernus et al., 2015). Therefore, CITI-SENSE aims at:

- Raising environmental awareness in citizens;
- Enabling dialogue for citizens, communities and authorities;
- Gathering, sharing, exchanging and making use of data from a variety of sources.

Within the lifespan of the CITI-SENSE project a significant amount of work has been conducted with respect to the design, installation and testing of sensors and sensors platforms, development of CO infrastructure (e.g., web application, app application, questionnaire development, data flow model, etc.), engaging with citizens and other stakeholders, and the COs' full implementation.

1.3 The Role of Work Package Four in the CITI-SENSE Project

The aim of 'Work Package 4 (WP4) – Citizens' Observatories' is to provide a gateway to the products and services that are generated from various COs in this project (Figure 1-3-1). WP4 focusses on the development of the concept and strategy to support various CO in practice and to achieve the project objectives, as well as its implementation. To realize this, WP4 developed both a top-down and bottom-up approach to (i) link metadata generated by the various CO across the nine cities (Barcelona,

Belgrade, Edinburgh, Haifa, Ljubljana, Ostrava, Oslo, Vienna and Vitoria, WPs2 and 3), and (ii) to integrate methodologies and other products/services developed by the methods-oriented WPs (WPs5-8). The key components of the top-down CO approach are the standardization of the measurement protocols and the sampling designs and methodologies (D4.1, D2.1, D3.1), although the CO themselves may not have one identical purpose. Crucial to the bottom-up CO approach is the development of methodologies that will enable integration of the diverse data (e.g., air quality, thermal comfort, noise, etc.) and technologies (e.g., systems, platforms, sensor technologies, engagement methodologies, social IT networks, etc.). Together these two complementary approaches aim to minimize the differences and maximize the similarities among different COs activities.

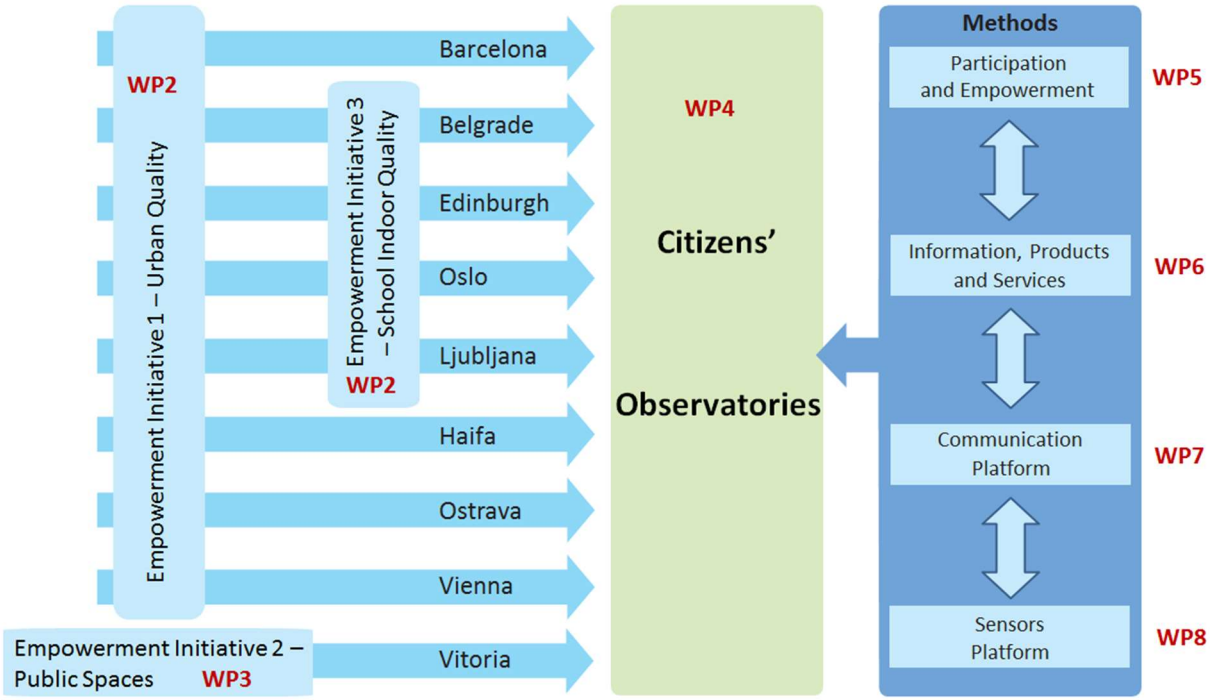

Figure 1-3-1. The interaction of the CITI-SENSE Work Packages.

1.4 About This Deliverable

The purpose of 'D4.5 – Citizens' Observatories Web Portal (COWP)' is to provide a gateway to access to the CITI-SENSE products and services. This document describes the developed and implemented COWP. This document comprises of six sections.

- The current section gives a general introduction of this deliverable.
- Section 2 describes the COWP in detail.
- Section 3 lists the anticipated COWP users.

- Section 4 provides the guideline on how to use the CITI-SENSE COWP.
- Section 5 presents the results of the COWP user assessment exercise carried out within the confines of the CITI-SENSE project.
- Finally, section 6 provides a summary and the conclusions of the deliverable.

2 What is the CITI-SENSE Citizens' Observatories Web Portal?

The CITI-SENSE COWP is a central hub designed to enable users to gain access to the wide array of information, data, services and functions that comprise the outcomes of the CITI-SENSE project. These are hosted on a number of databases, servers and web portals in various countries within Europe, and the near East (i.e., Haifa), so the CITI-SENSE COWP has a vital role as a gateway portal, ensuring easy and intuitive access to everything in a single 'one stop shop.' The data security in this COWP is very crucial.

In particular, the CITI-SENSE COWP provides an access point to the tools developed and used in the various CITI-SENSE COs. The tools include mobile phone apps, web widgets, web pages and sensor based tools and questionnaires which are detailed in the subsequent section of the report. The users can get information about how to acquire, install and use such tools. The users can also access the collected data by using such tools in various COs. For the technically minded, the users can get information about the sensing devices, and about how to use our data for their own applications. And of course, the users can learn about the project that brought this to the users, CITI-SENSE, and the various COs that have been implemented, i.e., outdoor air quality in eight cities, indoor air quality in 12 schools, and environmental quality in four public spaces, and links to various COs social media platforms as well as synergy and integration with GEOSS. The portal is structured into the following pages:

1) Home (Section 2.2, http://co.citi-sense.eu/UseExamples.aspx)
2) The project (Section 2.3, http://co.citi-sense.eu/TheProject.aspx)
3) COs Toolbox (Section 2.4, http://co.citi-sense.eu/CitizensObservatoriesToolbox.aspx)
4) Use Examples (Section 2.5, http://co.citi-sense.eu/UseExamples.aspx)
5) FAQs (Frequently Asked Questions) (Section 2.6, http://co.citi-sense.eu/FAQs.aspx)
6) Useful Links (Section 2.7, http://co.citi-sense.eu/UsefulLinks.aspx)
7) Contact Us (Section 2.8, http://co.citi-sense.eu/ContactUs.aspx)

The CITI-SENSE COWP was developed on an open source platform called DotNetNuke (DNN), which was created using a development language called C#. This Content Management System (CMS, computer application that supports the creation and modification of digital content using a common user interface and thus usually supporting multiple users working in a collaborative environment) is possibly the most widely supported of all CMS today, and it has a wide array of third party modules that can extend and customise the platform.

However, for the purposes of the CITI-SENSE project, a good deal of custom development was required such as products and services that can be used to engage citizens (D6.4). This was performed in Work Package 6 (WP6), but any modules that tie into DNN relate also to WP4. Consequently, close collaboration between the WPs was critical during the project.

2.1 Portal Address

The COWP can be found at http://co.citi-sense.eu/, which is a unique sub-domain name, and clearly affiliated with the CITI-SENSE project, which hosts and administrates website at the following address: www.citi-sense.eu.

Other related project portals use sub-domain names in the same manner. For example, the COs at Barcelona is http://barcelona.citi-sense.eu/, the COs at Ljubljana is http://ljubljana.citi-sense.eu/. This convention makes finding another CO easier, even if you do not remember the web address. This is discussed further in the Section related to project portals and various COs (Section 2.4.5).

2.2 Home Page

The starting point for the COWP is the main page (http://co.citi-sense.eu/Home.aspx), which provides a good overview of the project and its aims, and the overall objectives of the COWP in particular. This includes a dynamic header image, which changes automatically after a few seconds (See Figure 2-2-1). This uses a rotating banner function and was created with JavaScript code.

Figure 2-2-1. Banner section of COWP main page.

The main page, also known as the Landing Page, contains an overview of some of the major features of the project, such as the CityAir mobile app, near real-time data from eight cities, access to 12 schools and their indoor monitoring data, as well as access to environmental information to four public spaces in Vitoria-Gasteiz. These are key aspects of the project, but that is far from the whole picture. The home page contains links to allow visitors and users to search and access the following, which are discussed in more detail in the following Sections:

- The Citizens' Observatories of Air (Section 2.2.1)
- Air Pollution Perception Surveys (Section 2.2.2)
- Outdoor Air Quality in Cities (Section 2.2.3)
- Indoor Air Quality in Schools (Section 2.2.3)
- Environmental Quality in Public Spaces (Section 2.2.3)
- Your Voice and Your Observations (Section 2.2.4)
- Collaboration and Synergy with GEOSS (Section 2.2.5)
- Social Media Platform (Section 2.2.6)

2.2.1 The Citizens' Observatories of Air

On the COWP main page, within the first section 'The Citizens' Observatories of Air', we clearly address the key concept of the COs of air, the overall objectives of the COWP in particular, and put out our call to the public 'Be a citizen scientist and contribute to citizens observatories' (Figure 2-2-2).

Figure 2-2-2. Key components of the project – the citizens' observatories of air.

2.2.2 Air Pollution Perception Surveys

In CITI-SENSE, we developed two types of survey to allow participants to indicate their perception of air pollution in their immediate area. One is an online air quality perception questionnaire developed for users to describe how they see air quality issues in the eight participating cities (Figure 2-2-3). Another one is using the CityAir App to collect and display the users' individual perceptions of air quality, anytime, anywhere, and users can indicate the assumed source of the air pollution as well (Figure 2-2-4). Both surveys are accessible via the COWP main page (Figure 2-2-5).

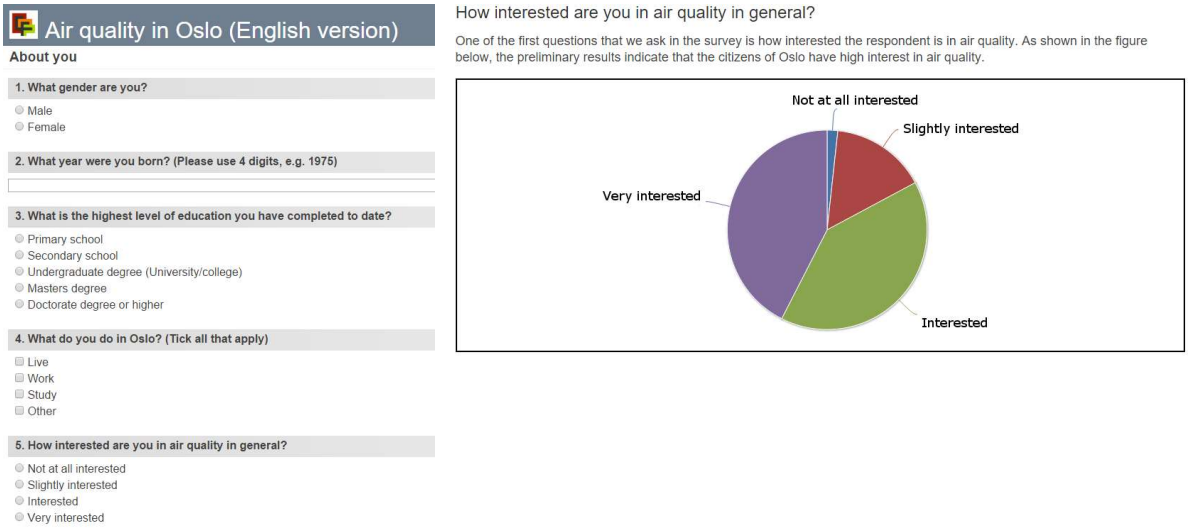

Figure 2-2-3. Screenshot of the first part of the online air quality perception questionnaire and its analysing results (An example from Oslo).

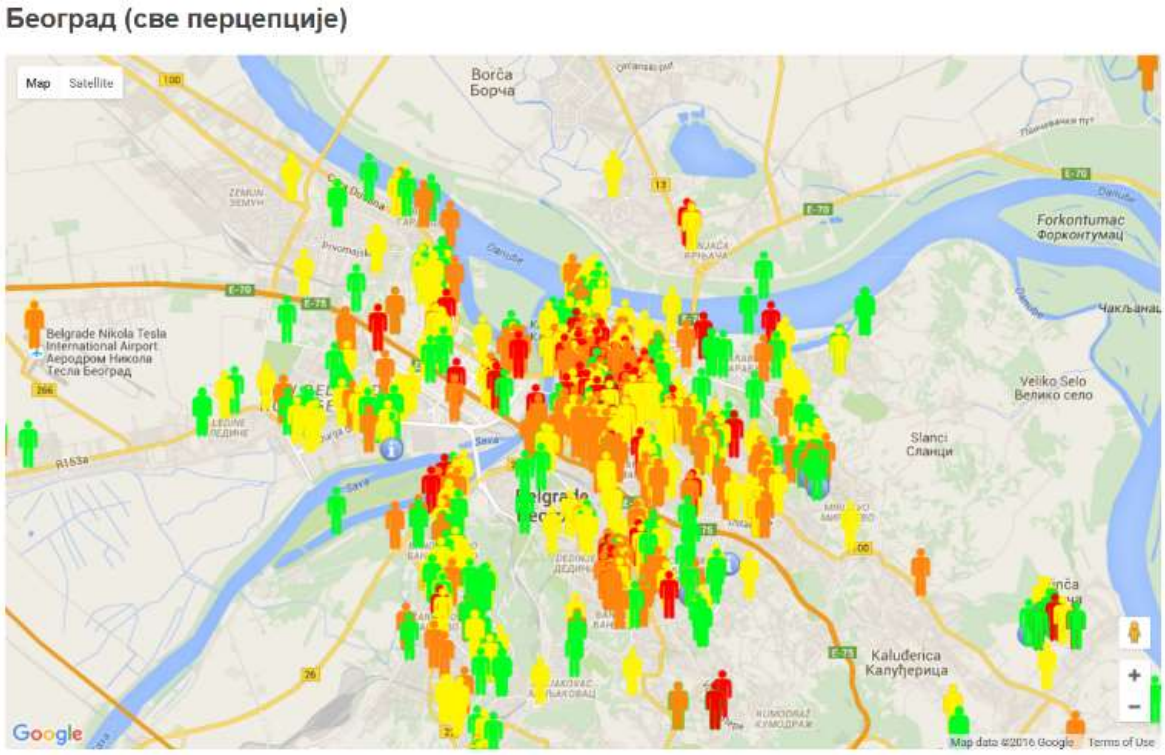

Figure 2-2-4. Screenshot of the air quality perception results by using CityAir App in Belgrade (The colour indicates the level of the air quality the participant has perceived in their surroundings).

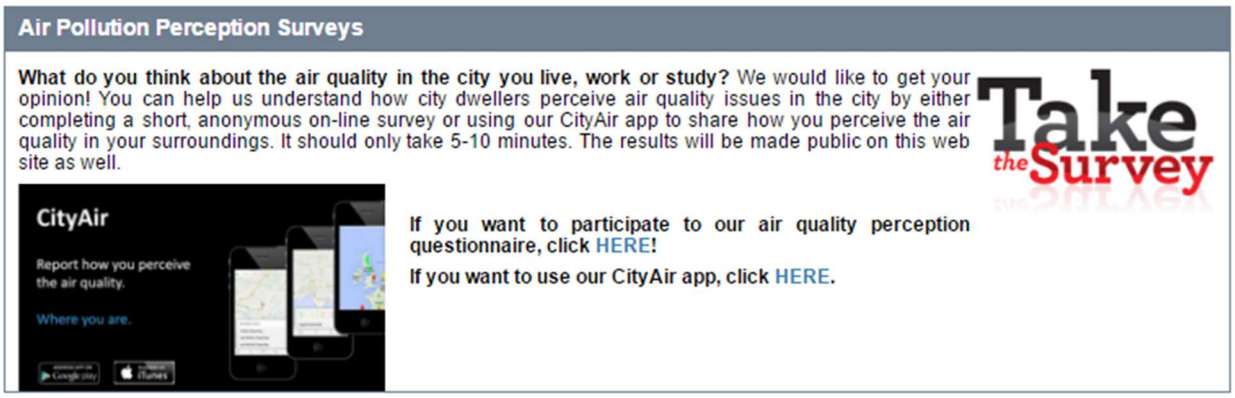

Figure 2-2-5. Key components of the project – air pollution perception surveys.

2.2.3 Citizens' Observatories in Cities, Schools and Public Spaces

In CITI-SENSE, three types of COs were developed and implemented in 9 cities, 12 schools and 4 public spaces. Including:

- Outdoor air quality in 8 cities
- Indoor air quality in 12 schools
- Environmental quality in 4 public spaces in Vitoria-Gasteiz

All three COs are accessible via COWP main page. Data from each of the COs are available, can be viewed and downloaded from relevant links here (Figure 2-2-6).

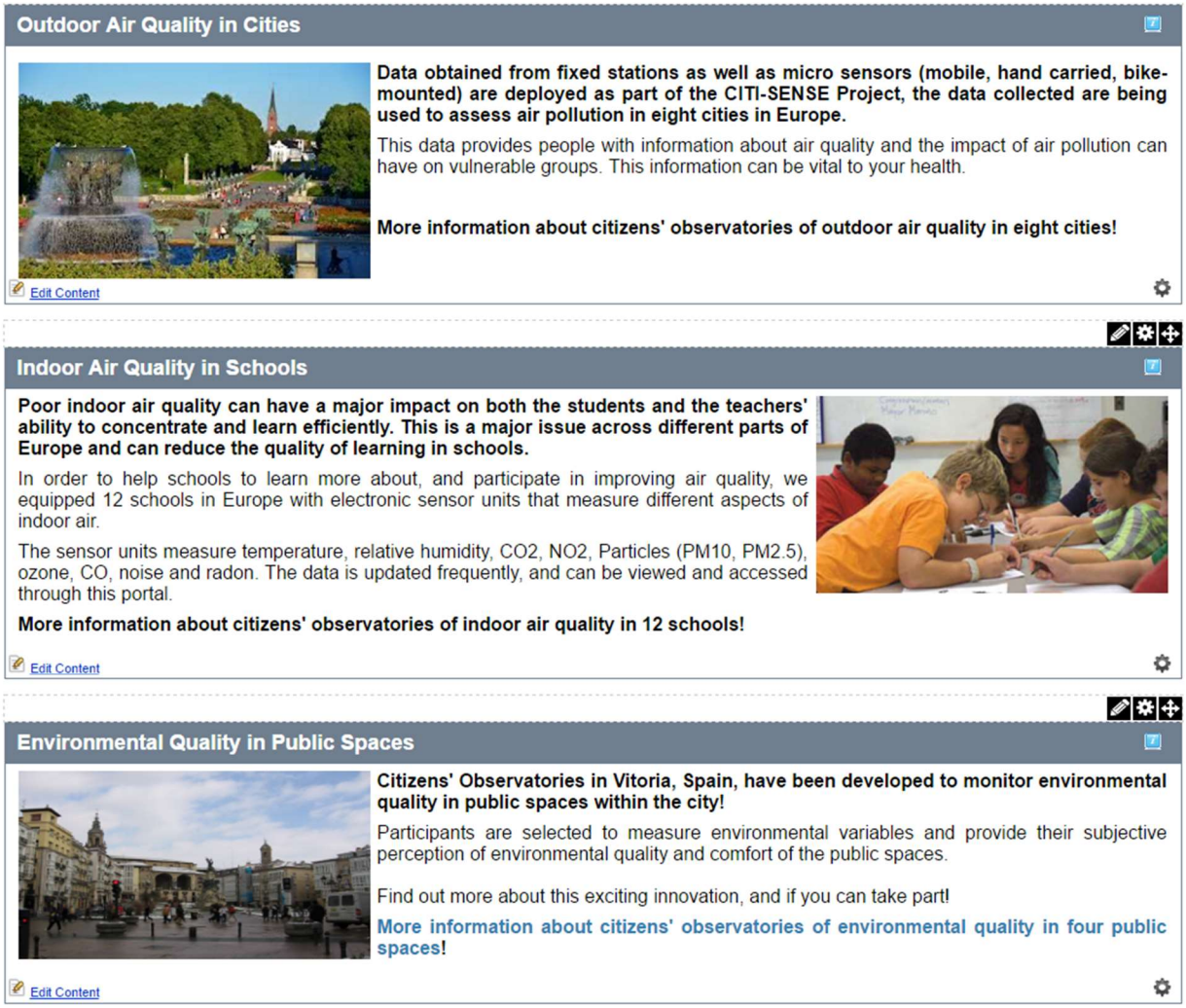

Figure 1-2-6. Key components of the project – three citizens' observatories.

2.2.4 Your Voice and Your Observations

In addition to providing tools to enable citizens to perceive the air quality of their environment in their surroundings objectively, in CITI-SENSE, we also developed tools that can facilitate citizens to do their subjective perceptions, e.g., is it too polluted, is it too hot, too noisy, can you breath properly, are you happy, sad, irritated, etc. The tools include a google map with uploading layer-based observations functionalities, a CityAir App, an outdoor air quality perception questionnaire, a environmental quality perception in public spaces questionnaire, and an indoor air quality in school perception questionnaire.

In addition, to upload observations and leave their comments, citizens can also discuss any issue related to air quality in their surroundings, and participate in other ongoing discussions. We developed a common forum where all participants can discuss with each other. The tools of 'Your Voices and Your

Observations' and the discussion forum are accessible via COWP main page by this link: http://co.citi-sense.eu/empowerment.aspx.

2.2.5 Collaboration and Synergy with GEOSS

A major aim of the project is to create a close affiliation, and integration, with GEOSS (Global Earth Observation of System of Systems, http://www.earthobservations.org/geoss.php). GEOSS is a set of coordinated, independent Earth observation, information and processing systems that interact and provide access to diverse information for a broad range of users in both public and private sectors. GEOSS links these systems to strengthen the monitoring of the state of the Earth. The GEOSS Portal (www.geoportal.org) offers a single internet access point for users seeking data, imagery and analytical software packages relevant to all parts of the globe. It connects users to existing databases and portals and provides up-to-date information.

In CITI-SENSE, collaboration and synergy with CITI-SENSE was achieved both by ensuring that project data/resources was submitted to the GEOSS database (Figure 2-2-7), but also inclusion in the Web Portal of the GEOSS search interface itself (Figure 2-2-8).

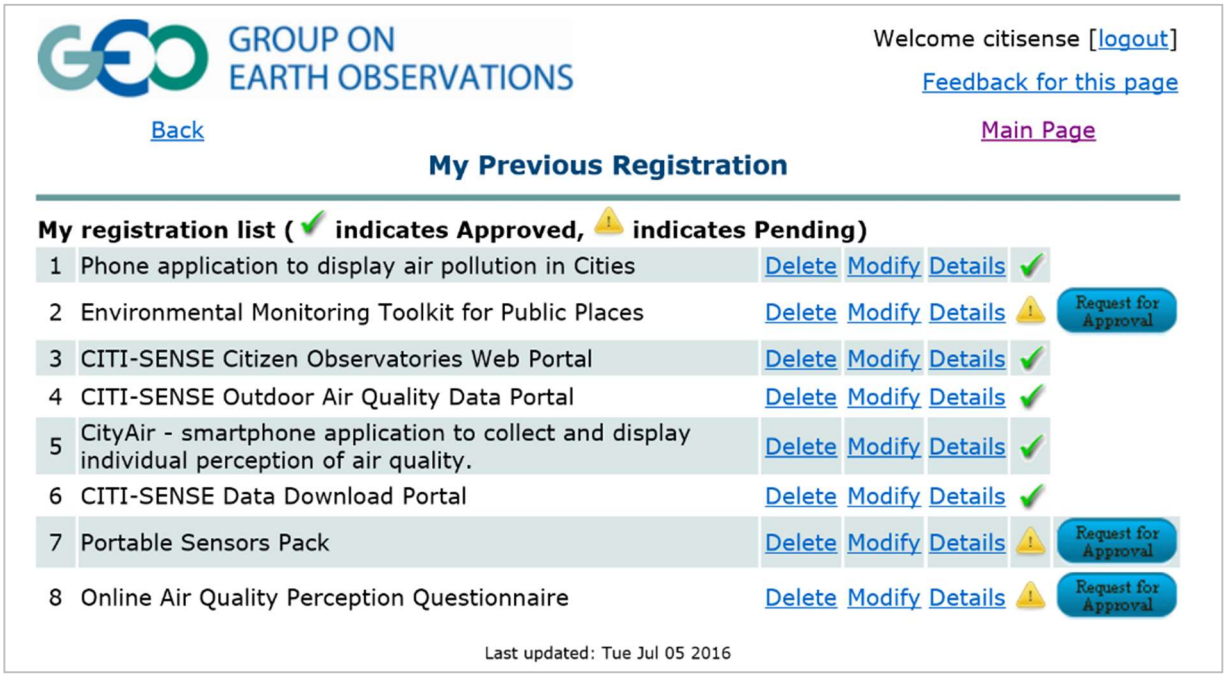

Figure 2-2-7. The registered CITI-SENSE resources on the GEOSS web portal.

WP4 created a schema to enable the project members to validate the compatibility of their data with the structure required by GEOSS. This enabled our members to input their data into the system, so that it is now both discoverable via the GEOSS search engine, but also linked to other relevant data and projects. To access to the data stored on GEOSS portal, users need to enter search word, specify

Themes, Country/Geography, Data Access Conditions, Earth Observation Catalogs, and Start Date and End Date (Figure 2-2-8).

Figure 2-2-8. GEOSS search interface embedded in the COWP main page.

2.2.6 Social Media Platforms

2.2.6.1 Multimedia

The CITI-SENSE project has generated a great deal of media interest during its lifespan, and some of these videos are available on the COWP main page (Figure 2-2-9). A number of these come from news outlets and interviews, others have been made by project members, or in some cases, users of the project's products.

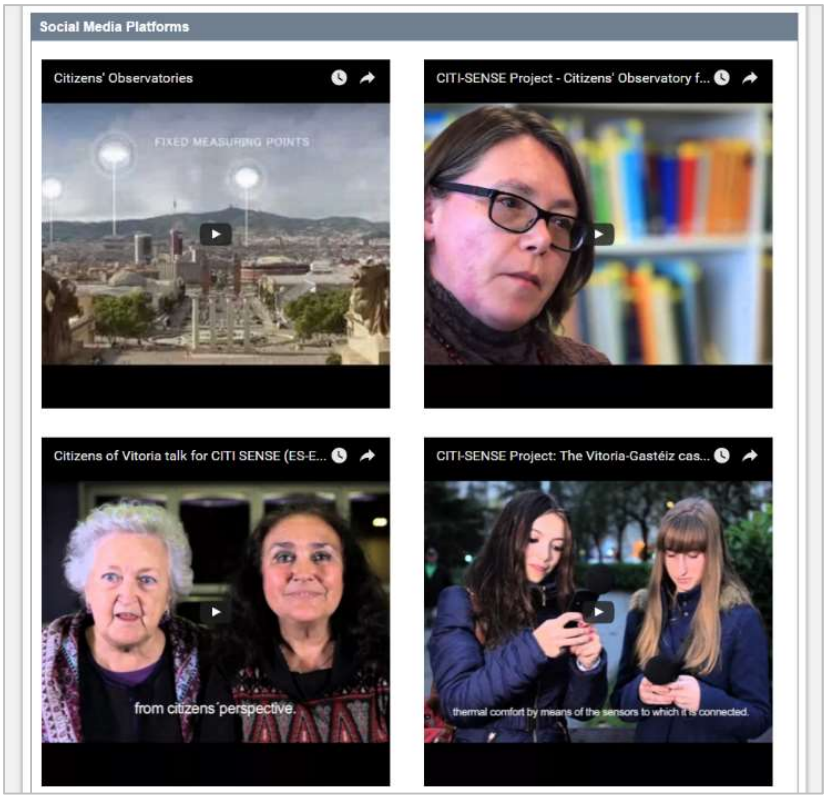

Figure 2-2-9. Screenshot of CITI-SENSE YouTube videos.

2.2.6.2 Social Media

Every COs project should take advantage of the social media channels available today. CITI-SENSE COs, in particular, focuses on ensuring cross promotion of relevant information, news and events across a range of different social media outlets (See Figure 2-2-10).

Figure 2-2-10. Screenshot of CITI-SENSE Citizens' Observatories social media platforms.

2.3 The Project Page

The project page (http://co.citi-sense.eu/TheProject.aspx) includes a good overview of the CITI-SENSE project, and its structure, including both images, as well as textual descriptions of the projects aims and objectives.

In addition, there are links to the participating members' organisations, as well as contact information for those interested in learning more about the project.

There is also the video with project coordinator giving the overview of the project. If interested people want a short snappy overview, this is the place to go.

2.4 Citizens' Observatories Toolbox Page

The Citizens' Observatory Toolbox, or COT (Figure 2-4-1), is the heart of the CITI-SENSE COWP, as it contains the largest body of data, access to services, and tools, applications and project outcomes.

Figure 2-4-1. The Citizens' Observatories Toolbox page, showing introduction text.

2.4.1 The Citizens' Observatories Toolbox Flower

The COT flower is a clickable interface to the various project outcomes. It uses a hotspot, assigned to each 'petal', which links to a page containing data (Figure 2-4-2).

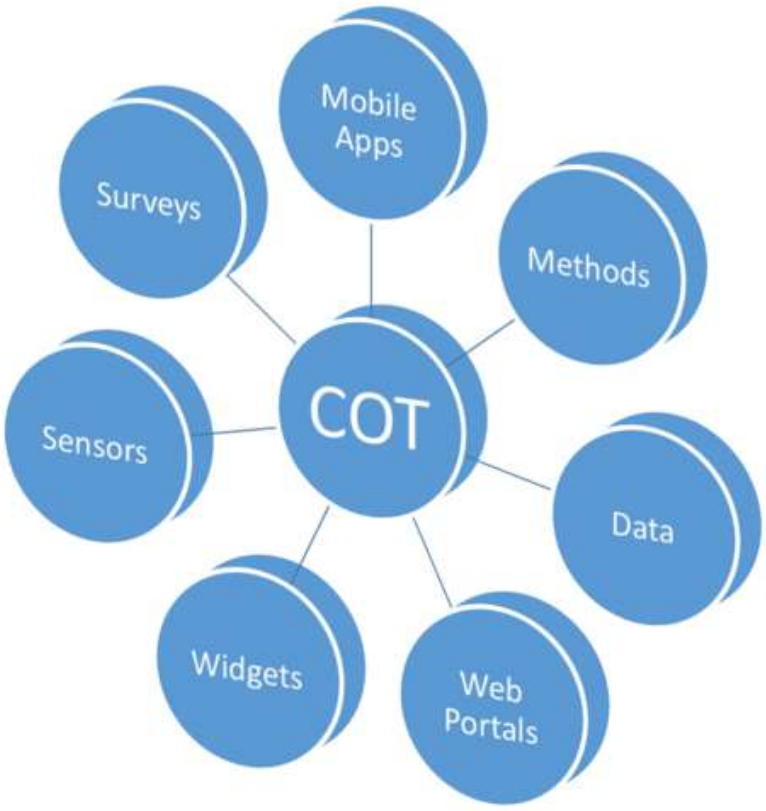

Figure 2-4-2. The Citizens' Observatories Toolbox flower.

On the 'The Citizen Observatory Toolbox Page', information is also provided for users on how to access the data, who can use it and so on. A special request is made to ensure that the project and the EU is credited, where and when any data, services, etc., are used (Figure 2-4-3).

Figure 2-4-3. Information page of the Citizens' Observatories Toolbox.

2.4.2 Citizens' Observatories Toolbox - Surveys

A number of online surveys had been developed, allowing users to describe how they perceive the air quality issues in the eight participating cities/locations. **The Long Perception Questionnaire for Outdoor Air Quality** can be answered by anybody anywhere, but at the moment, it is only meant for the participating localities. However, it can be implemented for any other city/location as well. For those who are outside the CITI-SENSE consortium, and want to use the surveys for their need, they can find the contact information on the 'Contact Us' page. The questionnaire has three parts: participants' personal information, specific questions on the participants' air quality perception, and feedback from the participants. The questionnaire has also an optional part asking what information on air quality the user would like to receive. The questionnaire is available in different languages for each city involved,

the answers from the participants being stored at CITI-SENSE SEPS (Spatial Environmental Platform Server), and the data privacy is protected. The user can answer the questionnaire on a webpage, mobile phone or tablet. These are accessible through the COWP on the 'Surveys Page' (Table 2-4-1). The feedback about this survey has been requested in the hope that COWP can be updated to account for this. For giving feedback on this survey, users can find the link within page 'Citizens' Observatories Toolbox'

Further, there are also surveys allowing students and teachers to perceive the classroom environmental condition (**Perception Questionnaire for Indoor Air Quality in Schools**), allowing citizens to describe how they perceive the environmental quality of public spaces and their importance in the perceived quality of life of citizens (**Perception Questionnaire for Environmental Quality in Public Spaces**).

Table 2-4-1. CITI-SENSE Citizens' Observatories surveys – questionnaires based.

Surveys

In this page, we present different types of survey with questionnaire tools developed and used within CITI-SENSE, including aim of the survey, target groups, where the survey implemented, where the survey data stored, how the data being visualized, etc.

Survey name	Aim of the survey	Target Groups	Where to find the survey	Where is the survey implemented	How is survey implemented
Outdoor AQ long perception questionnaire	To gauge the Level of knowledge of citizens and their interest for air quality in a respondent's urban environment	General citizens	Barcelona (Castellano) Barcelona (Català) Barcelona (English) Beograd Edinburgh Haifa Ljubljana (Slovene) Ljubljana (English) Oslo (English) Oslo (Norwegian) Ostrava Vienna	Barcelona Beograd Edinburgh Haifa Ljubljana Oslo Ostrava Vienna	Web and smartphone application from UHopper, done on the CivicFlow platform.
Indoor AQ in schools questionnaire	To explore the perceptions of the classroom conditions	Students Teachers	www.CivicFlow.com	12 schools in Oslo, Edinburgh, Beograd and Ljubljana	Web and smartphone application from UHopper, done on the CivicFlow platform.
Environmental quality in public spaces questionnaire	To get a broader view on the perception of the quality of public spaces and their importance in the perceived quality of life of citizens.	General citizens	Four public spaces in Vitoria	Four public spaces in Vitoria	Web and smartphone application from UHopper, done on the CivicFlow platform.

CITI-SENSE CityAir App can also be used by users to report how they perceive the air quality in their surroundings (Figure 2-4-4).

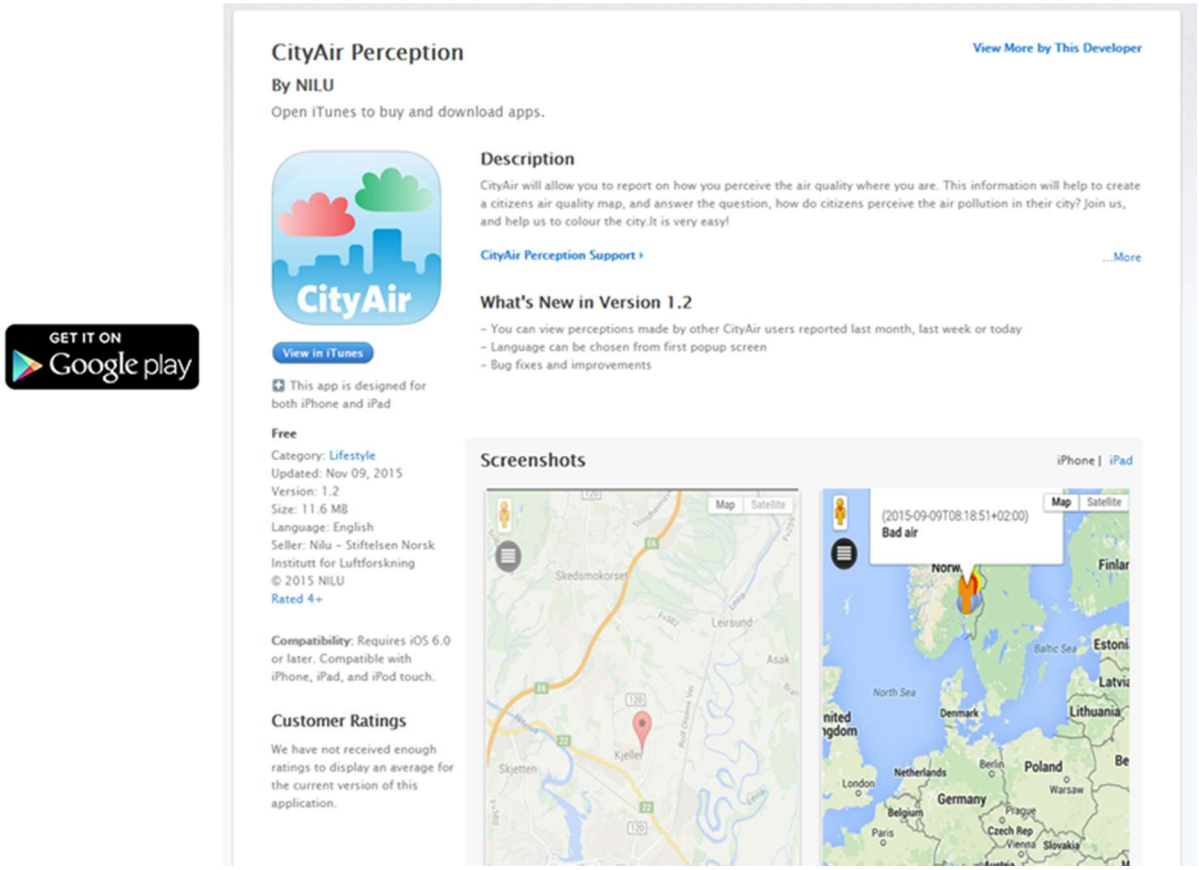

Figure 2-4-4. Screenshot of the CityApp Air for users to perceive the air quality in their surroundings.

2.4.3 Citizens' Observatories Toolbox – Sensors and Sensor Platforms

The sensors and sensor platforms used in the CITI-SENSE project underwent extensive testing and review, both prior to the implementation and during the lifetime of the project (See Figure 2-4-5). Brief information about each sensor and sensor platform is provided under 'Sensors and Sensor Platforms Page'.

Sensor platform	Name	Contact information	Detail Information
	Little Environmental Observatory (LEO)	**Name:** Ateknea Solutions **E-mail:** asqm@ateknea.com	The LEOs are portable sensor packs. It measures NO, NO2 and O3 using electrochemical sensors. The personal sensors together with the ExpoApp smartphone application from Ateknea Solutions. Documentation, links to video tutorials, PC application download and user guides can be found at **Here**.
	Obeo Radon sensor	**Name:** Bent Morten **E-mail:** bent.morten@liessem.no	The Obeo Radon sensor is easy to remotely monitor radon and/or CO2 levels in indoor areas and buildings. The MMA utilises the GSM/GPRS cellular network to relay the sensor data to a central server available from any PC/Mac/Ipad. For more information click this **Link**.
	Environmental Instruments (AQMesh)	**Name:** Amanda Randle **Email:** a.randle@aqmesh.com	AQMesh is the commercially available and proven low-cost system for monitoring air quality. The product combines a robust hardware platform with the latest sensor technology and GPRS communication, cloud-based data processing and secure online access. It measures gases NO, NO2, NOx, O3, CO, SO2, particulates PM1, PM2.5, PM10 and TPC and %RH, pod temperature, atmospheric pressure and noise. For more information, click this **Link**.
	Vitoria-Gasteiz Sensing Tools	**Name:** Itziar Aspuru Soloaga **E-mail:** itziar.aspuru@tecnalia.com	To monitor and assess environmental quality of public spaces in terms of noise and thermal comfort. A pack consists of: • Kestrel 4000 sensor device to monitor temperature, relative humidity • Smartphone Nexus and Microphone to monitor thermal and acoustic level • CityNoise smartphone android app • **SENSE-IT-NOW** smartphone android app • **Web portal** with results for thermal comfort and noise map
	Atmospheric Indoor Static Air monitor	**Name:** Mike Kellaway **Email:** mike.kellaway@atmosphericsensors.co.uk	Atmospheric Indoor Static Air monitor combines Alphasense's low cost and high sensitivity sensors linked with electronics, GPS, GSM and advanced data algorithms. It measures temperature, relative humidity, CO2, NO2, Particles (PM10, PM2.5), Ozone, CO. For more information, click this **Link**.
	Dunavnet	**Contact information:** Dejan Drajic **E-mail:** dejan.drajic@dunavnet.eu	**ekoNET** services are designed to provide a complete end-to-end solution for the environment monitoring following the concepts used within the IoT (Internet of Things) domain. The system comprises all necessary components, namely: measuring device, back-end infrastructure (i.e. cloud server) and client applications (web and mobile). The measuring device can be any chosen, while EB800 and RPi800 devices are available and preconfigured to work with ekoNET platform. **For more information, click this Link.**

Figure 2-4-5. The CITI-SENSE sensor page.

In addition to the information and links about sensors and sensor platforms used in the CITI-SENSE, the 'Sensors and Sensor Platform Page' also provides the information about various sensors-based server platforms and CITI-SENSE central platform including Ateknea, ATMOS, Civicflow, Envirologger, OBEO, SensApp and SEDS (Spatial and Environmental Data Server) data server for storing data from

different devices and sources. All data generated from the CITI-SENSE project are stored in the CITI-SENSE SEDS platform (Figure 2-4-6).

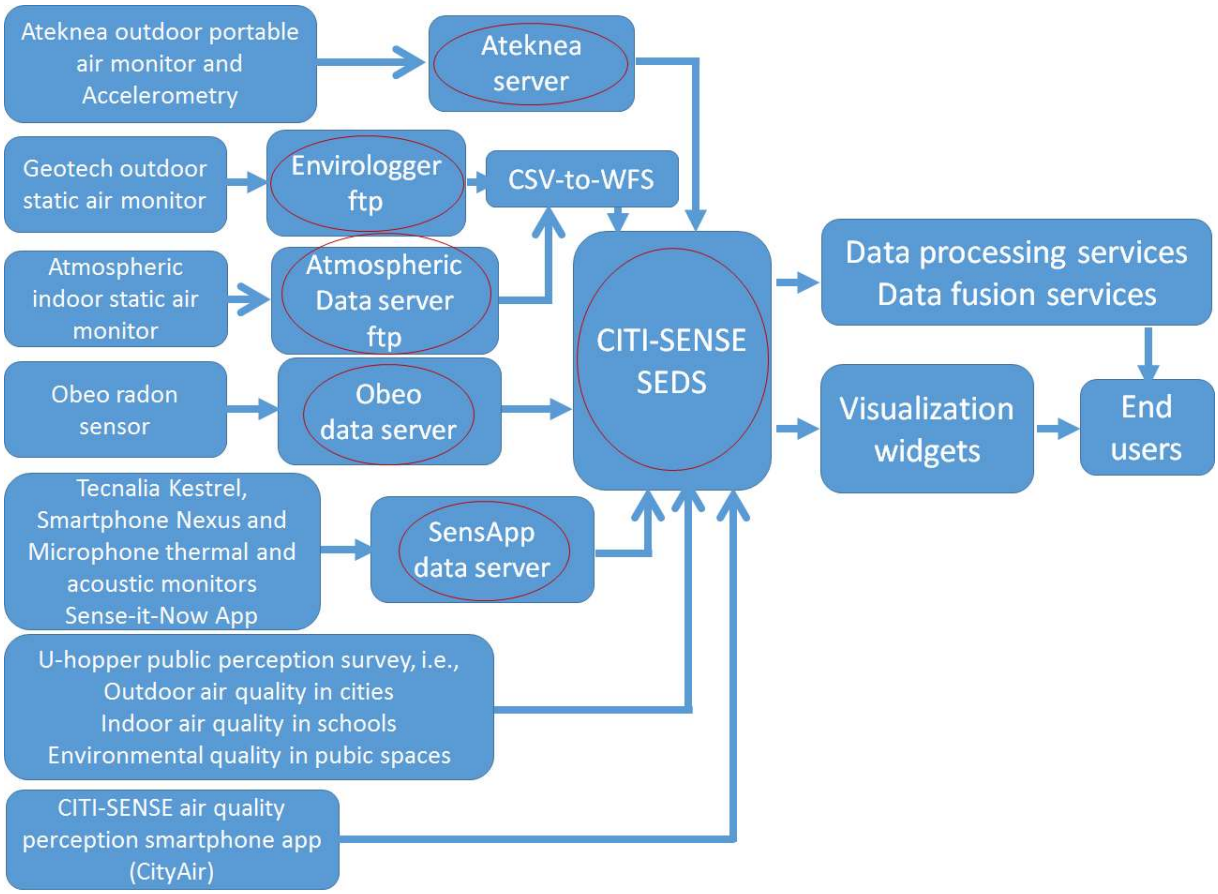

Figure 2-4-6. The CITI-SENSE data server platforms.

2.4.4 *Citizens' Observatories Toolbox – Visualization Widgets*

The COT widgets are applications designed to display data (Table 2-4-2). Details of these are provided along with links to the code to allow users to incorporate them within their own webpages should they wish. Visualisation of data in the project is handled in a variety of ways. Here, we present various graphs displaying data (Figures 2-4-7 and 2-4-8). These are created by getting data from the SensApp Platform, a database designed to contain sensor data.

Table 2-4-2. The CITI-SENSE visualization widgets.

CITI-SENSE Visualization Widgets

CITI-SENSE develop a set of reusable graphical components/widgets that could be easily configured for and deployed in various kinds of end user decision making applications and platforms (e.g., web portals, mobile). This table summarize various widgets for visualization of sensors and real-time data coming from different heterogeneous sources on maps, charts and plots in web portals and mobile devices.

Widget name	Storage platform	Code link	Usage description and link
Real-time sensor value	WFS	http://citisense.u-hopper.com/widgets/sensors/jquery.sensor.statistics.js	http://citisense.u-hopper.com/pilots/common/#tabs-realtime
Historical sensor values	WFS	http://citisense.u-hopper.com/widgets/sensors/jquery.sensor.statistics.js	http://citisense.u-hopper.com/pilots/common/#tabs-historic
Physical activity levels map	WFS	http://citisense.u-hopper.com/widgets/activities/jquery.activities.js	http://citisense.u-hopper.com/pilots/barcelona/#tabs-activity-map
Physical activity levels graphs	WFS	http://citisense.u-hopper.com/widgets/activities/jquery.activities.js	http://citisense.u-hopper.com/pilots/barcelona/#tabs-activity-graph
Real time graphs	SensApp	http://toolbox.citi-sense.eu/citisense.graph2.js	Widget Real Time Thermal Widget Real Time Acoustic
Results Acoustic & Thermal	SensApp	http://toolbox.citi-sense.eu/citisense.results.js	Widget Result Thermal & Acoustic
CivicFlow Web questionnaire	WFS	http://citisense.u-hopper.com/widgets/perceptions/jquery.questionnaire.js	http://citisense.u-hopper.com/pilots/schools/#tabs-questionnaire
CivicFlow Web questionnaire results	WFS	http://citisense.u-hopper.com/widgets/perceptions/jquery.questionnaire.statistics.js	http://citisense.u-hopper.com/pilots/schools/#tabs-questionnaire-results

Figure 2-4-7 is example of the visualization widgets for viewing collected air quality related data on the CITI-SENSE platform. Figure 2-4-8 is example of the visualization widgets for viewing real time wind speed. Visualisation of data in the project is handled in a variety of ways. Here, we can see various graphs displaying data. These are created by getting data from the SensApp Platform, a database designed to contain sensor data.

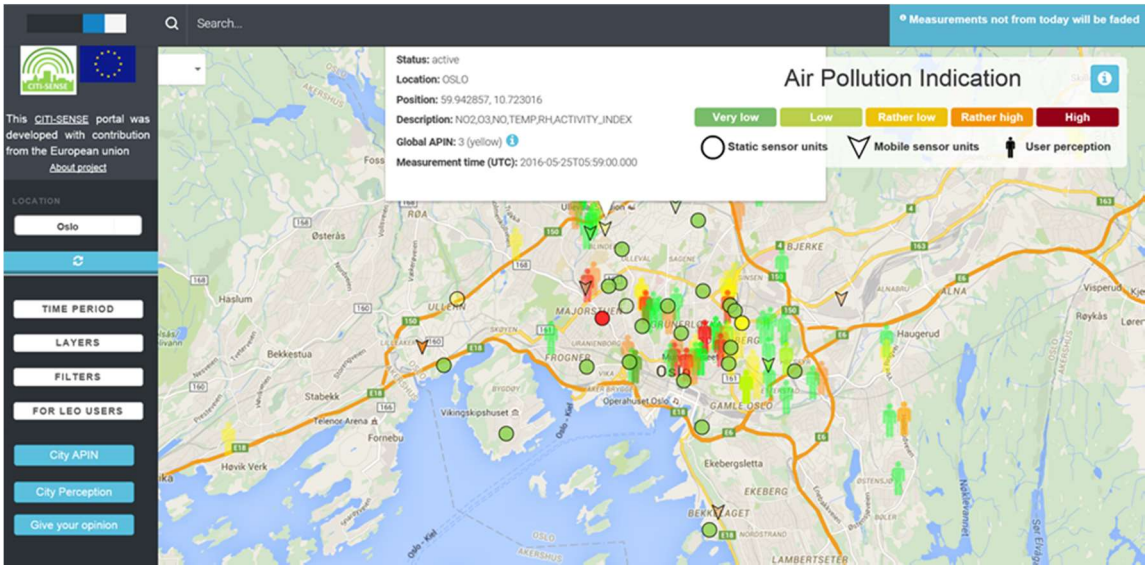

Figure 2-4-7. CITI-SENSE Citizens' Observatories visualization web portal.

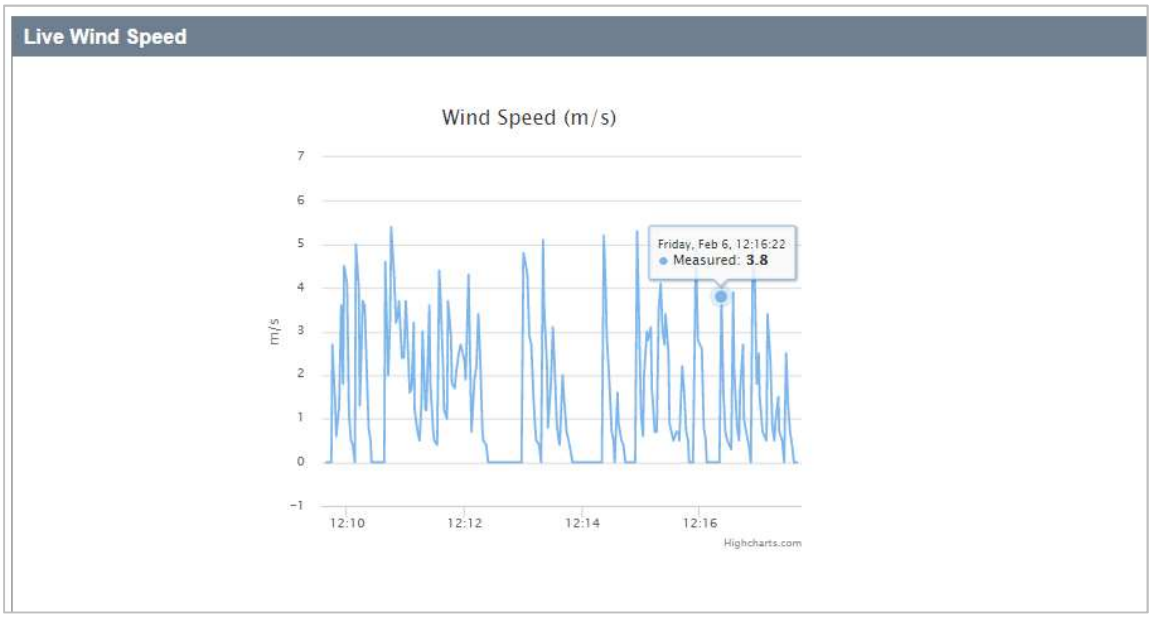

Figure 2-4-8. CITI-SENSE COs visualization – example for wind speed.

2.4.5 Citizens' Observatories Toolbox - Web Portals

The CITI-SENSE project promoted the creation and dissemination of COs in many of the participating member countries. WP4 worked closely with many of these initiatives. The result is a wide range of diverse COs that cover a number of topics, i.e., COs of outdoor air quality in eight cities, citizens'

observatories of indoor air quality in 12 schools, and citizens' observatories of environmental quality in 4 public spaces in vitoria.

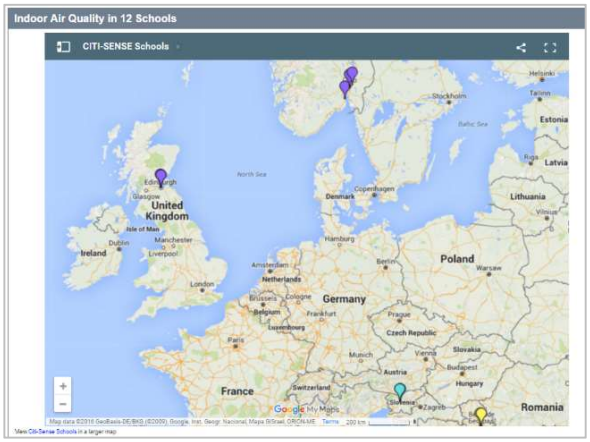

Figure 2-4-9. Indoor Air Quality in 12 Schools.

Figure 2-4-10. Location of Outdoor Air Quality in eight cities

The two maps above were created using the freely available Google maps tool. Each of the icons representing a location for one of the initiatives is clickable, linking directly to the location's COs information in brief.

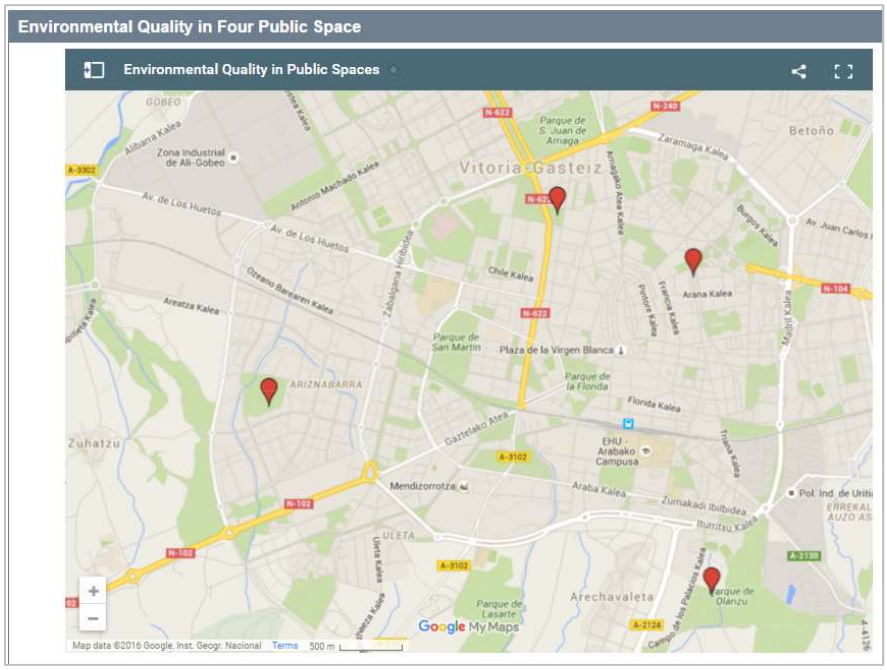

Figure 2-4-11. Map showing four test locations for environmental quality in public spaces.

CITI-SENSE has developed 16 location-based individual COs Web Portals. The full list of these web portals is as follows (See Chapter 8 in D6.4):

- Schools.citi-sense.eu (Citizens' Observatories of indoor air quality in 12 schools)
- 20.oktober.citi-sense.eu (Citizens' Observatory of Indoor Air Quality in 20. OKTOBAR School, Belgrade, Serbia)
- vigimnazija.citi-sense.eu (Citizens' Observatory of Indoor Air Quality in secondary school VI Belgrade's gymnasium, Belgrade, Serbia)
- ghmskola.citi-sense.eu (Citizens' Observatory of Indoor Air Quality in secondary school Geological and hydrometeorological school "Milutin Milankovic", Belgrade, Serbia)
- vitoria.citi-sense.eu (Citizens' Observatory of Environmental Quality in Four Public Space, Vitoria, Spain)
- ves.citi-sense.eu (Citizens' Observatory of Indoor Air Quality in VODMAT Elementary School, Ljubljana, Slovenia)
- vic.citi-sense.eu (Citizens' Observatory of Indoor Air Quality in Gimnazija Vič School, Ljubljana, Slovenia)
- spodnjasiska.citi-sense.eu (Citizens' Observatory of Indoor Air Quality in Spodnja Šiška elementary School, Ljubljana, Slovenia)
- barcelona.citi-sense.eu (Citizens' Observatory of Outdoor Air Quality in City, Barcelona, Spain)
- belgrade.citi-sense.eu (Citizens' Observatory of Outdoor Air Quality in City, Belgrade, Serbia)
- edinburgh.citi-sense.eu (Citizens' Observatories of Outdoor Air Quality in City, Indoor Air Quality in Three Schools and Scottish Case Study, Edinburgh, UK)
- air.net.technion.ac.il (Citizens' Observatory of Outdoor Air Quality in City, Haifa, Israel)
- ljubljana.citi-sense.eu (Citizens' Observatory of Outdoor Air Quality in City, Ljubljana, Slovenia)
- oslo.citi-sense.eu (Citizens' Observatory of Outdoor Air Quality in City, Oslo, Norway)
- ostrava.citi-sense.eu (Citizens' Observatory of Outdoor Air Quality in City, Ostrava, Czech Republic)
- vienna.citi-sense.eu (Citizens' Observatory of Outdoor Air Quality in City, Vienna, Austria)

For the location-based web portals the individual local partners were responsible for their content, hence they are presented in different styles and the amount of information. It is also important to note that the content within these web portals will probably not be updated after the completion of the project as there will be lack of funds to do so.

2.4.6 Citizens' Observatories Toolbox – Data

Currently, there are tools for users to browse and download data from the COs in schools and in cities available. A similar funtionality can be provided for the COs in public spaces.

- Portal for outdoor air quality data visualization (Outdoor air quality data in cities, see Figures 2-4-12): http://srv.dunavnet.eu/new/citisense/OutdoorDataPortal/#. There is a word document available on the COWP – Data page that details what is displayed on the outdoor air quality data visualization portal.
- Portals for indoor air quality data download and export to Excel (Indoor air quality data in schools)
    - For public: http://srv.dunavnet.eu/new/citisense/IndoorExport/
    - For CITI-SENSE participants: http://schools.citi-sense.eu/Browsedata.aspx (Figure 2-4-13)
- Portal for indoor radon data visualization: http://rad.obeo.no/radonis (Figure 2-4-14)

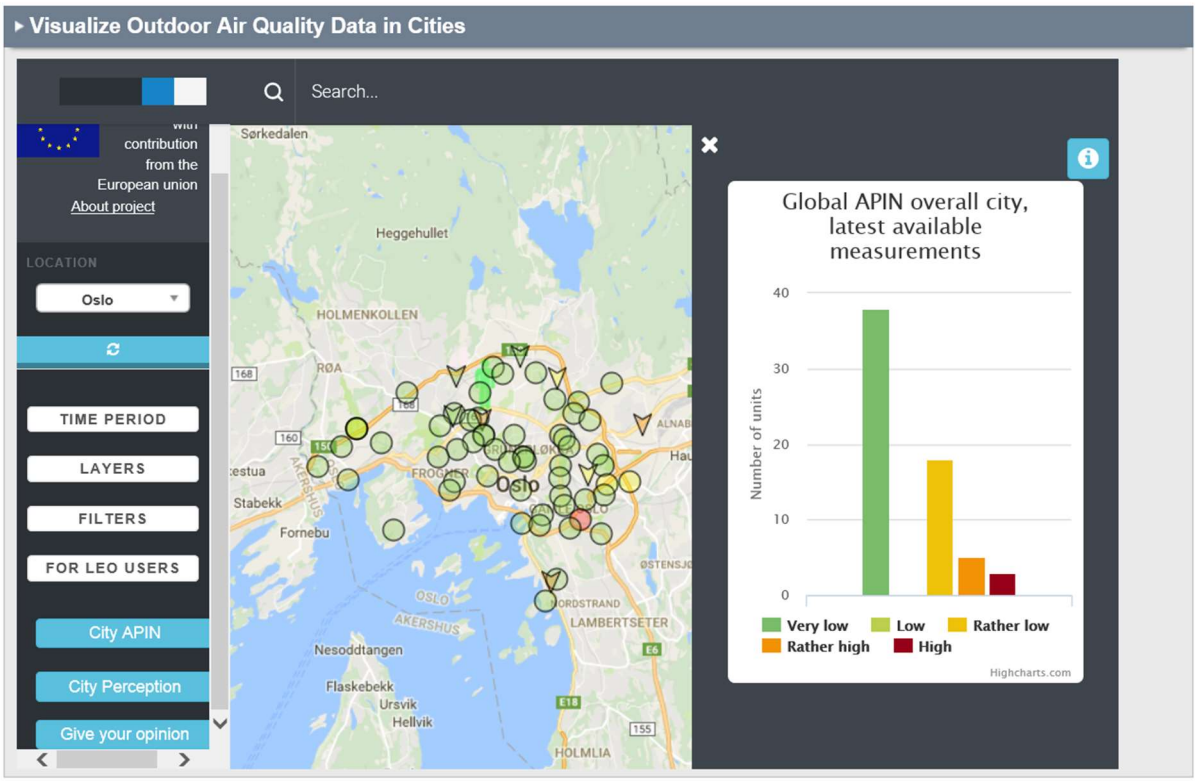

Figure 2-4-12. Data visualization of outdoor air quality data in Oslo.

For the visualization of outdoor air quality data in cities, the user can choose to look at different data types and to combine these in a simple map (http://srv.dunavnet.eu/new/citisense/OutdoorDataPortal/#). For example, the user starts by selecting a location from a predefined set of locations registered in our CITI-SENSE platform. When the location is chosen, the web page will uploaded as a default with the last measured values on the following sensors:

- Static sensors
- Mobile sensors
- User perceptions
- User comments
- Air quality map

Further, the user can choose to view data within a specific time period (i.e., latest observation, specific time period) and the individual sensor`s measurements by clicking filters (i.e., the pollution (global APIN (Air Pollution Index), $PM_{2.5}$, PM_{10}, NO_2), or the perception users want to see (one month, 7 days, 24 hours)). After clicking on a marker, the user will see more information about the sensor. Several options are available for removing layers, or viewing individual air quality parameters and perception markers. For mobile sensors, the user can fill in the individual user ID from the ExpoApp and track their measurements on the map. A summary graph is also provided for each city, indicating the air quality as measured by the sensor units. City APIN and City perception graphs are provided for each city, indicating the air quality level and the participants perception about air quality level in last month. Further, if users want, they can leave their opinion about this visualization portal as well (see D6.5).

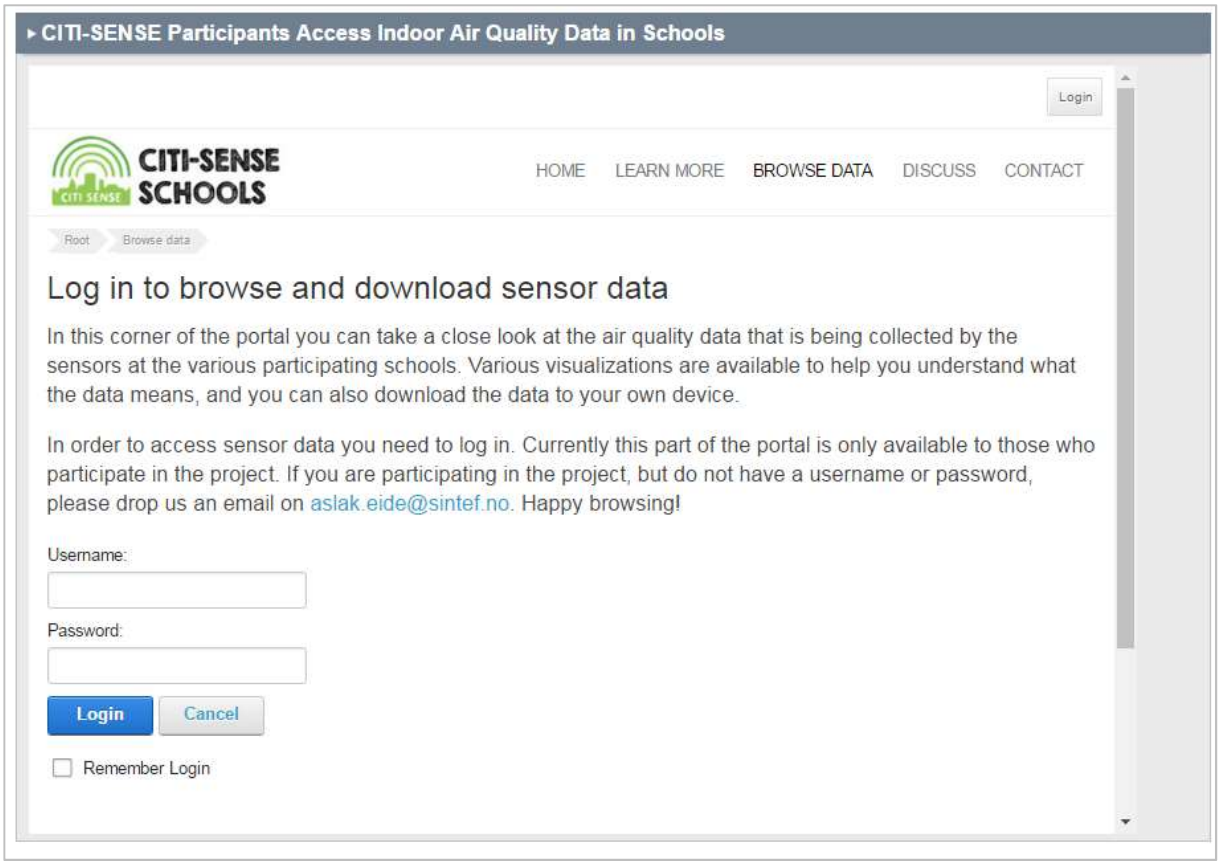

Figure 2-4-13. Browse and download sensor data for indoor air quality in schools.

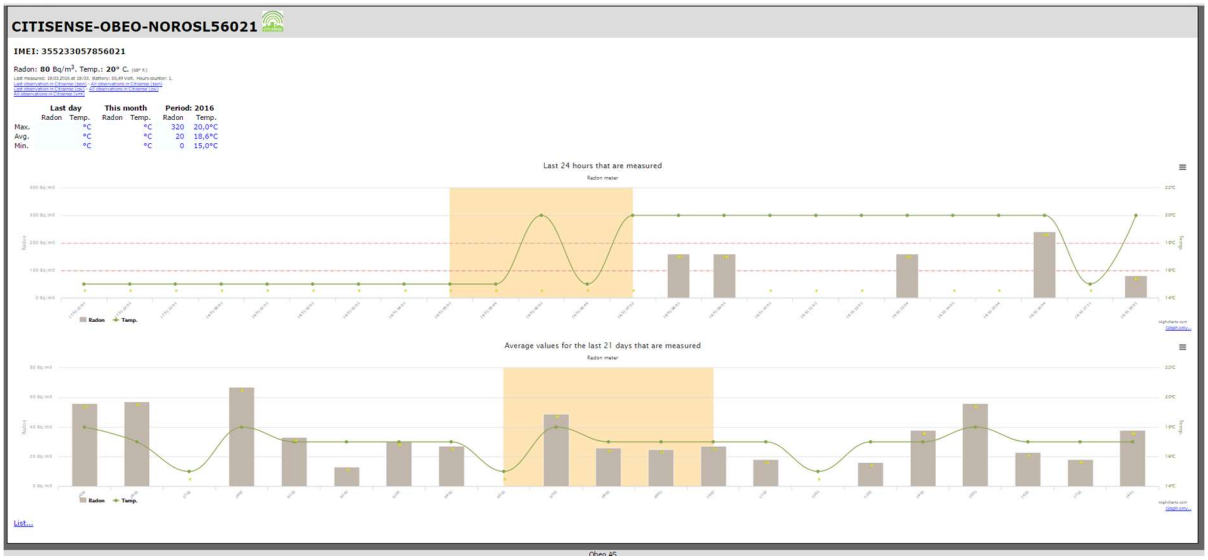

Figure 2-4-14. Data visualization of Radon data in schools.

2.4.7 Citizens' Observatories Toolbox – Methods

The concept of COs in CITI-SENSE rests on realizing the information chain 'sensors (physical and human)-platform-products-users'. Various categories of the methods (Figure 2-4-15) have been developed along the CITI-SENSE formation chain and implemented in various COs within CITI-SENSE project. It includes:

- Citizens' Observatories Concept
- Key Performance Indicators
- Co-Design
- Participation and Empowerment
- Sensor and Sensor Platforms
- Information, Products and Services
- Communication
- Dissemination
- Exploitation

Each of these methods are accessible via each bullet point in text with hyperlink in 'Methods' Subpage within COT main Page, and also from the drop-down menu in the COT page.

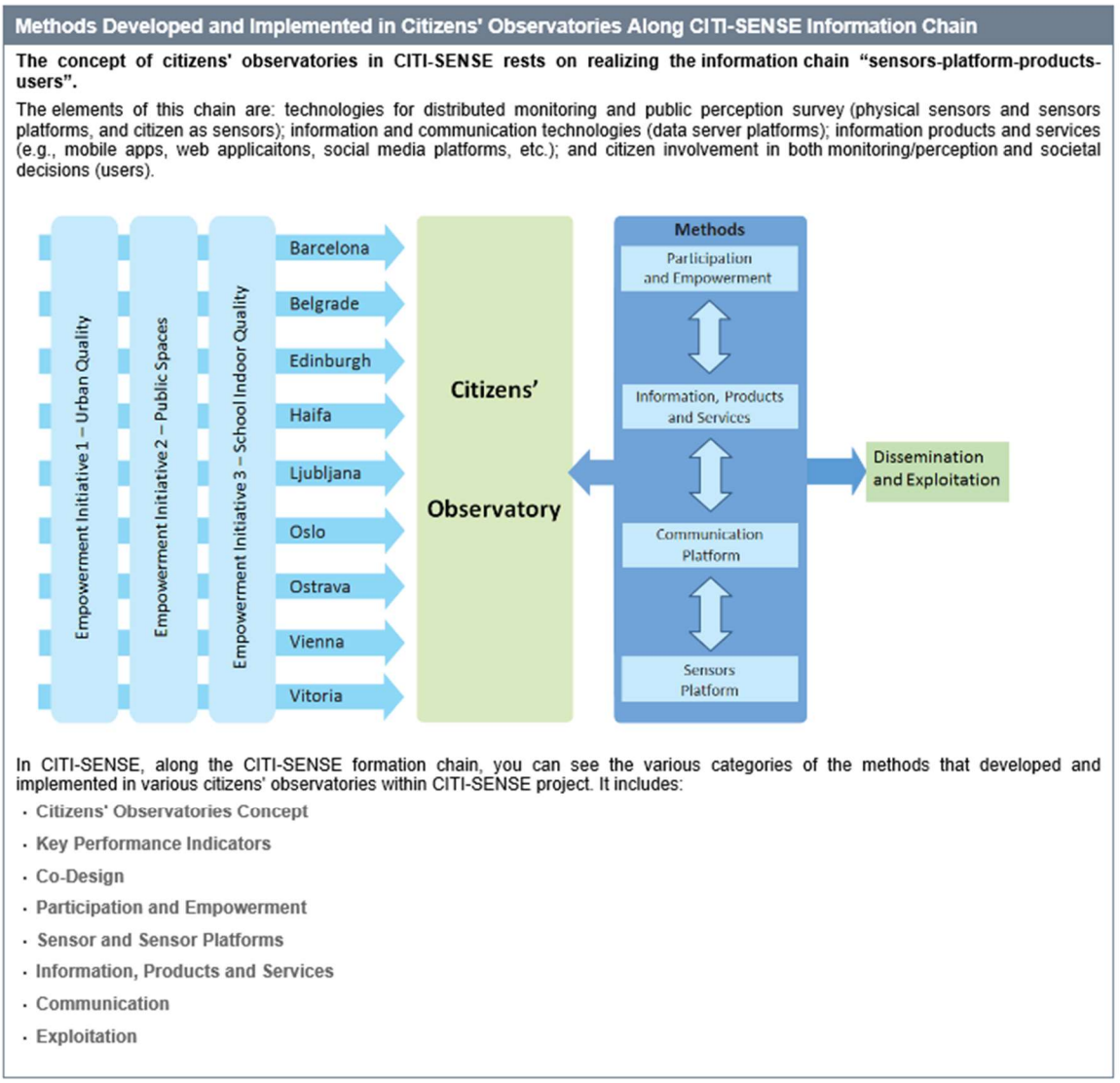

Figure 2-4-15. The overview of the CITI-SENSE COs methods.

2.4.8 Citizens' Observatories Toolbox – Mobile Apps

In CITI-SENSE, several mobile apps have been developed and tested in the various COs to enable citizens to report their perceived air quality in their surroundings (e.g., CityAir App (Figure 2-4-16), to facilitate citizens to monitor air quality by combining with various air monitors (e.g., SENSE-IT-NOW (Figure 2-4-17), Sense City Air (Figure 2-4-18), ExpoApp (Figure 2-4-18)), to transfer data to the CITI-SENSE data server (e.g., SensorLog (Figure 2-4-20), SensApp Gateway (Figure 2-4-21)), and to visualize data as well (e.g., CityAir and SENSE-IT-NOW). All these apps are accessible via 'Mobile Apps' subpage within COT Page. The CityAir App is available to download free from Google play or i-Tunes.

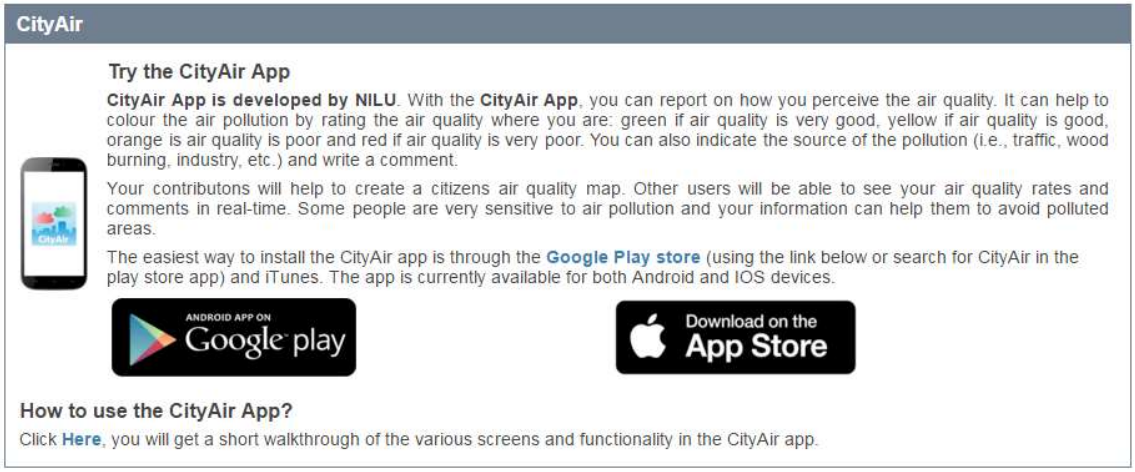

Figure 2-4-16. The CITI-SENSE COs Mobile Apps – CityAir.

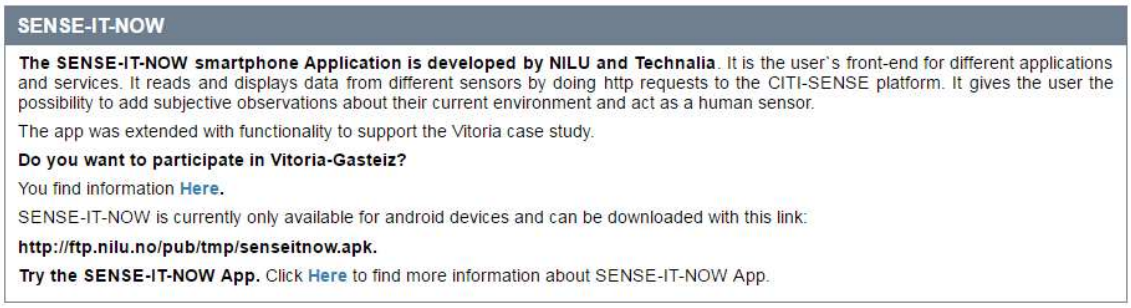

Figure 2-4-17. The CITI-SENSE COs Mobile Apps – SENSE-IT-NOW.

Figure 2-4-18. The CITI-SENSE COs Apps – Sense City Air.

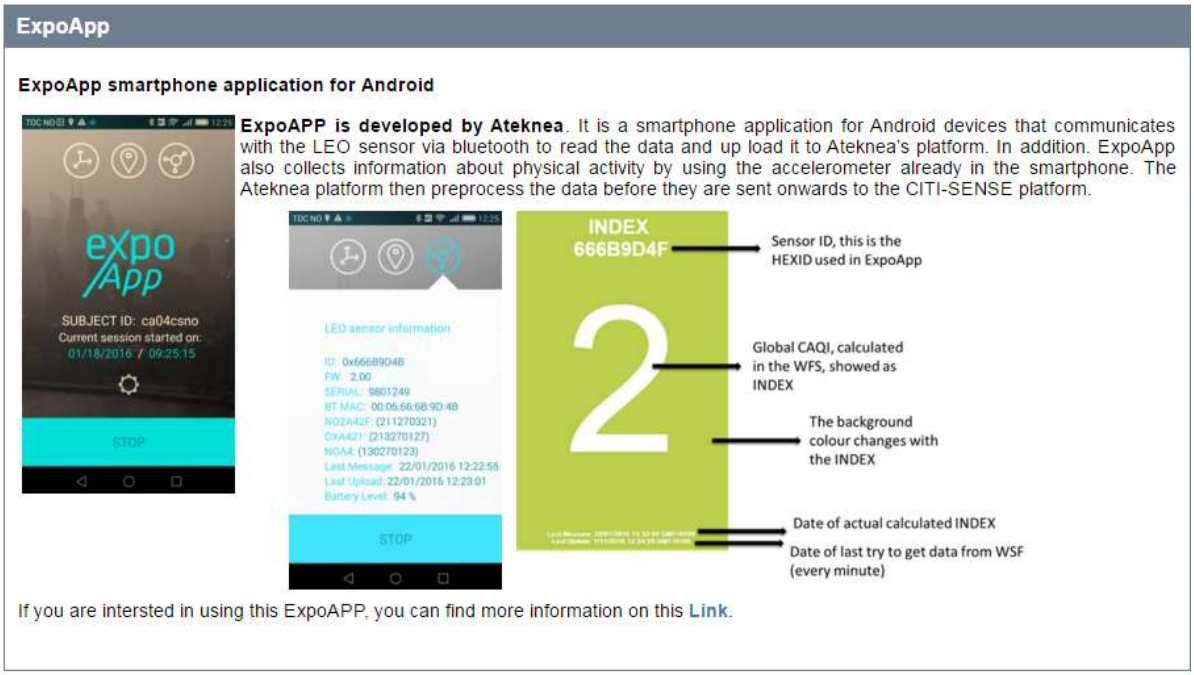

Figure 2-4-19. The CITI-SENSE COs ExpoAPP.

Figure 2-4-20. The CITI-SENSE COs SensorLog.

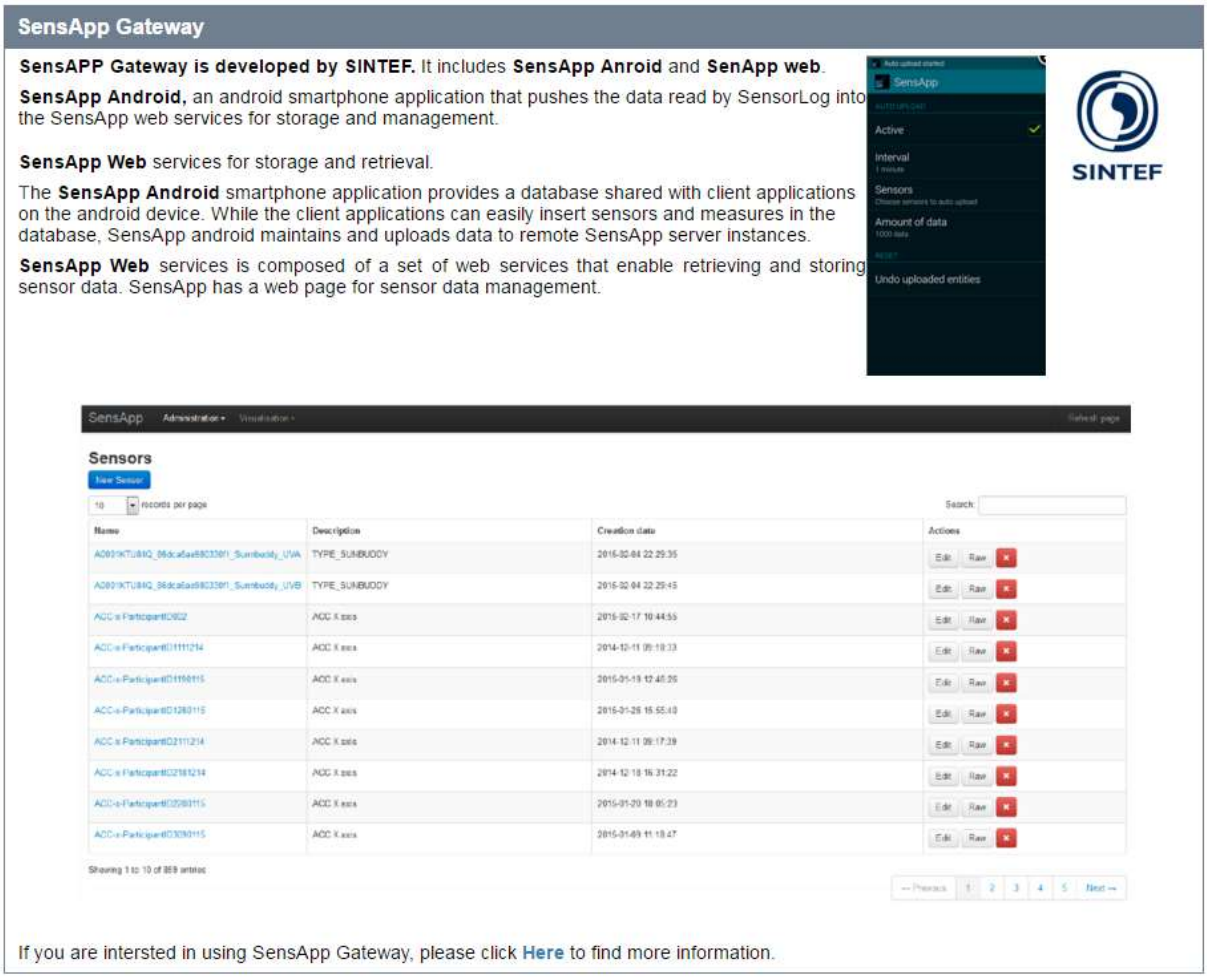

Figure 2-4-21. The CITI-SENSE COs SenseApp gateway.

2.5 Use Examples Page

The Use Examples page (http://co.citi-sense.eu/UseExamples.aspx) provides a short overview of the use of the tools developed in the CITI-SENSE project. The aim of these tools is to involve citizens in assessments of air and environmental quality to empower them to participate in environmental governance. In CITI-SENSE, we targeted people connected to our nine participating cities, i.e., Barcelona, Belgrade, Edinburgh, Haifa, Ljubljana, Ostrava, Oslo, Vienna and Vitoria, but most of the tools are available to everybody, everywhere, as long as the project infrastructure is in place.

This page provides the following nine toolkits as examples which have been tested and evaluated in real-life campaigns with users being cyclists, parents with children in kindergarten, students and teachers in schools, traffic wardens, and regular citizens:

- Personal air monitoring toolkit

- CityAir smartphone app
- Online air quality perception questionnaire
- Environmental monitoring toolkit for public spaces
- Data visualizaiton web page
- Data download web page
- COs web portal
- Social media platform
- Phone application to display air pollution in cities

Furthermore, on this page, we present some best use examples for each CITI-SENSE participating cities that can be adopted in future COs related activities. These are:

- Haifa - Raising Students' Awareness to Air Quality Concepts
- Ljubljana - Organizing Nature Days for Children
- Oslo - COs with Parents of Kindergarten Children and Other Citizens.

In addtion to the above listed use examples, this page also provides the location-based various campaigns outcomes from the CityAir App, including:

- Campaign in Berlin at the European Citizens Science Association conference, 16. May - 1. October 2016
- Campaign in Barcelona, 10. June - 20. July 2016
- Campaign at the Major Cities of Europe Conference, Florence, 30. May - 1. June 2016
- Campaign in Oslo, 29. April - 2. May 2016
- Campaign in Ostrava, 1. August - 30. September 2015
- Campaign in Ostrava, 1. October 2015 - 30. April 2016

The existing CITI-SENSE social media channles (i.e., Twitter account, Facebook page, LinkedIn group, Youtube) are presented on this page as well. At the bottom of the page, there is a link to access the usablity assessment for users to assess any tool tool or product developed by the CITI-SENSE project (Section 5).

2.6 FAQs Page

FAQs (Frequnetly Asked Questions) page (http://co.citi-sense.eu/FAQs.aspx) gathers all the questions we thought the users would ask and provides answers for each of the questions. The most FAQs are:

- Q1. If I want more information about CITI-SENSE, who shall I contact?
- Q2. What are the Citizens' Observatories projects?

- Q3. Is there any course about citizens' observatories?
- Q4. I am a web portal administrator. How can I visualise data from the observatory on my web pages?
- Q5. I am a web developer. Where do I find the API to use?
- Q6. I am a data provider. I have data that I would like to contribute with. How do I do that?
- Q7. I am interested in looking at the data. How can I view collected data?
- Q8. I am a sensor provider. How can I add my data into the observatory?
- Q9. I am a web developer. I would like to use your widgets. Where do I find technical information?
- Q10. I want to buy a sensor. Where can I buy one that is compatible with the observatory?

On the FAQs page, the answer will pop up by clicking on the relevant question.

2.7 Useful Links Page

Not only is the COWP a hub for CITI-SENSE, but also for many other COs initiatives. The Useful Links page (http://co.citi-sense.eu/UsefulLinks.aspx) provides links that directly connect to the existing and planned COs-related activities worldwide, including:

- Link about air quality related information
- Existing types of air monitors and platforms
- Collaboration and synergy with GEOSS
- Links to other similar projects world wide
- Links to the selected COs and smart cities projects in Europe
- Links to popular COs blogs.

2.8 Contact Us Page

The Contact Us Page (http://co.citi-sense.eu/ContactUs.aspx) provides the contact information for various tools developers:

- COWP web portal administrator
- COWP web portal technical support
- CITI-SENSE ICT (e.g., COs widgets, scirpts, Apps, data flow, etc.) support
- Location-based COs activities, including
    - Outdoor Air Quality in Eight Cities
        - ✓ Barcelona

- ✓ Belgrade
- ✓ Edinburgh
- ✓ Haifa
- ✓ Ljubljana
- ✓ Oslo
- ✓ Ostrava
- ✓ Vienna

- Indoor Air Quality in 12 Schools
  - ✓ Oslo
  - ✓ Edinburgh
  - ✓ Ljubljana
  - ✓ Beograd
- Environmental Quality in Four Public Spaces in Victoria

- For the general information about CITI-SENSE
  - Project coordinator
  - Project dissemination leader
  - Project web page
- COs-related social media platform
  - COs Facebook page
  - COs Twittter account
  - COs Linked group
  - Location-based COs Facebook page and Twitter account
    - ✓ Oslo
    - ✓ Barcelona
    - ✓ Lubljnana
    - ✓ Ostrava
    - ✓ Victoria.

3 Who Are the Citizens' Observatories Web Portal Users?

The tools in the CITI-SENSE Citizens' Observatories Toolbox can be used by different stakeholders and end users, e.g., citizens who are interested in air quality related environmental issues, environmental NGOs (Non-Governmental Organizations), authorities, industries, students, teachers, parents, school boards, etc., for different purpose, for example, research, urban planning, environmental sensing, education, citizens' observatories and citizen science related activities, etc.

According to google analytics, between 30 March 2015 and 28 September 2016, 4702 people have visited the COs web portal, of which 4083 became COWP users (Figure 3-1). Both page views and users are increasing gradually. Of 4342 session viewers, 4177 are new visitors and 165 are returning visitors (Figures 3-1, 3-2).

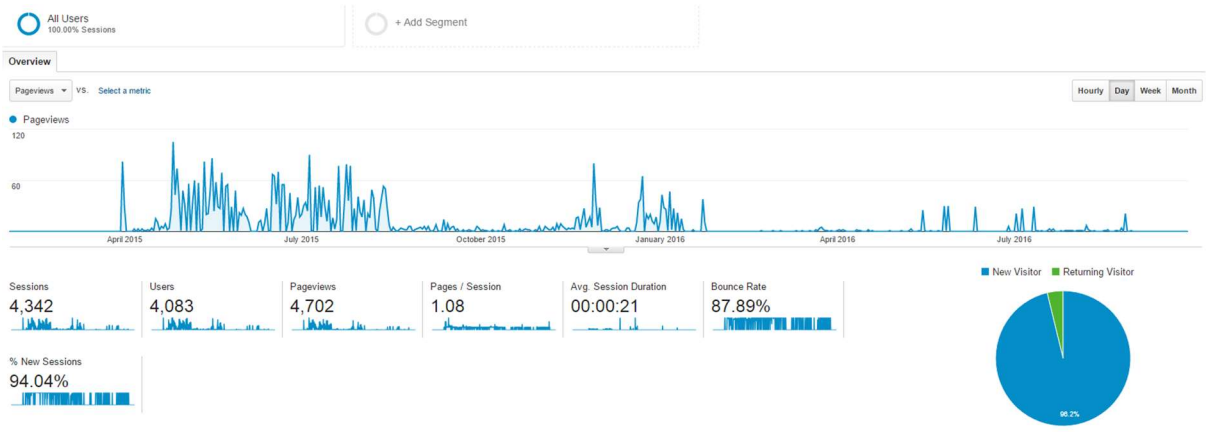

Figure 3-1. Overview of the COWP page views.

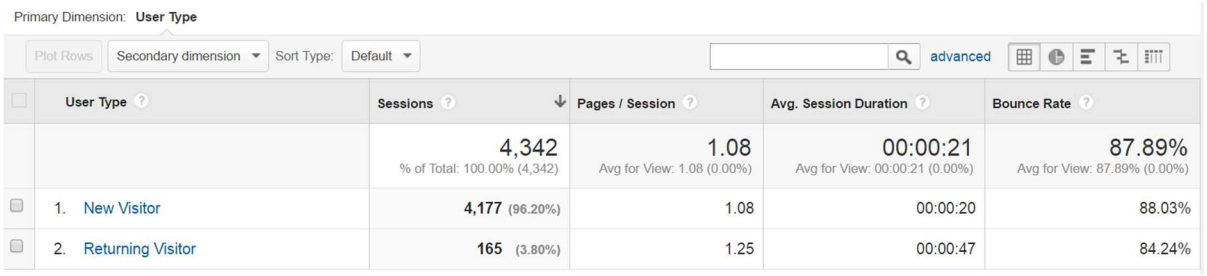

Figure 3-2. Overview of the COWP page user type.

Furthermore, Google Analytics gave an overview of active users per day, per week and per month (Figure 3-3).

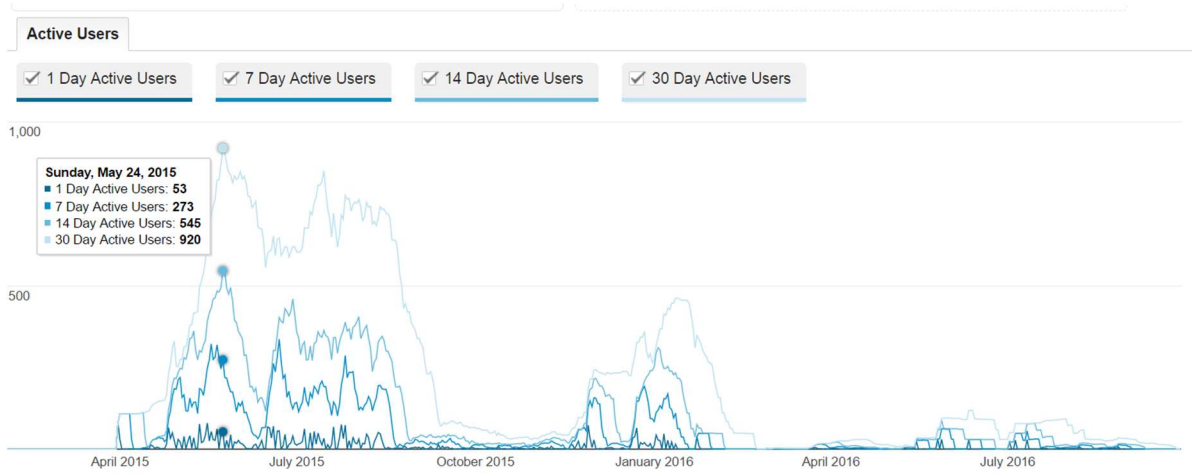

Figure 3-3. Overview of the COWP page active users.

Geo- targeting by location and country of both COWP page viewers and users (Figure 3-4, Figure 3-5) shows that many are from others countries (e.g., US, China, Japan, Russia, Germany, France, Brazil) than the CITI-SENSE consortium members' home countries.

Country	Acquisition			Behavior		
	Sessions ↓	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	4,342 % of Total: 100.00% (4,342)	96.20% Avg for View: 94.04% (2.30%)	4,177 % of Total: 102.30% (4,083)	87.89% Avg for View: 87.89% (0.00%)	1.08 Avg for View: 1.08 (0.00%)	00:00:21 Avg for View: 00:00:21 (0.00%)
1. United States	1,596 (36.76%)	99.25%	1,584 (37.92%)	84.96%	1.12	00:00:27
2. (not set)	965 (22.22%)	99.90%	964 (23.08%)	91.30%	1.07	00:00:18
3. United Kingdom	249 (5.73%)	99.20%	247 (5.91%)	94.78%	1.06	00:00:04
4. China	225 (5.18%)	98.22%	221 (5.29%)	85.33%	1.07	00:00:30
5. Japan	151 (3.48%)	98.68%	149 (3.57%)	84.77%	1.01	00:00:18
6. Russia	145 (3.34%)	26.90%	39 (0.93%)	84.83%	1.27	00:00:26
7. Germany	114 (2.63%)	95.61%	109 (2.61%)	89.47%	1.09	00:00:38
8. South Korea	74 (1.70%)	100.00%	74 (1.77%)	86.49%	0.95	00:00:08
9. France	55 (1.27%)	94.55%	52 (1.24%)	87.27%	1.05	00:00:10
10. Brazil	53 (1.22%)	100.00%	53 (1.27%)	84.91%	1.04	00:00:26

Figure 3-4. Overview of the COWP page viewers' geo-targeting by country.

City	Acquisition			Behavior		
	Sessions ↓	% New Sessions	New Users	Bounce Rate	Pages / Session	Avg. Session Duration
	4,342 % of Total: 100.00% (4,342)	96.20% Avg for View: 94.04% (2.30%)	4,177 % of Total: 102.30% (4,083)	87.89% Avg for View: 87.89% (0.00%)	1.08 Avg for View: 1.08 (0.00%)	00:00:21 Avg for View: 00:00:21 (0.00%)
1. (not set)	2,030 (46.75%)	99.56%	2,021 (48.38%)	87.00%	1.12	00:00:24
2. New York	77 (1.77%)	100.00%	77 (1.84%)	94.81%	1.00	00:00:05
3. Samara	43 (0.99%)	0.00%	0 (0.00%)	65.12%	1.72	00:00:10
4. Chicago	37 (0.85%)	100.00%	37 (0.89%)	86.49%	1.14	00:00:19
5. Beijing	30 (0.69%)	86.67%	26 (0.62%)	80.00%	1.13	00:01:26
6. London	28 (0.64%)	100.00%	28 (0.67%)	89.29%	1.04	00:00:32
7. Hull	27 (0.62%)	100.00%	27 (0.65%)	100.00%	1.00	00:00:00
8. Seoul	26 (0.60%)	100.00%	26 (0.62%)	76.92%	0.85	00:00:04
9. Los Angeles	25 (0.58%)	84.00%	21 (0.50%)	88.00%	1.12	00:00:28
10. Denver	25 (0.58%)	100.00%	25 (0.60%)	64.00%	1.36	00:01:53

Figure 3-5. Overview of the COWP page viewers' geo-targeting by location.

Demographics of the COWP page viewers (Figure 3-6) indicates that the largest partition (33.50%) of the page viewers are in the age between 35-44 and that there are more male viewers than female.

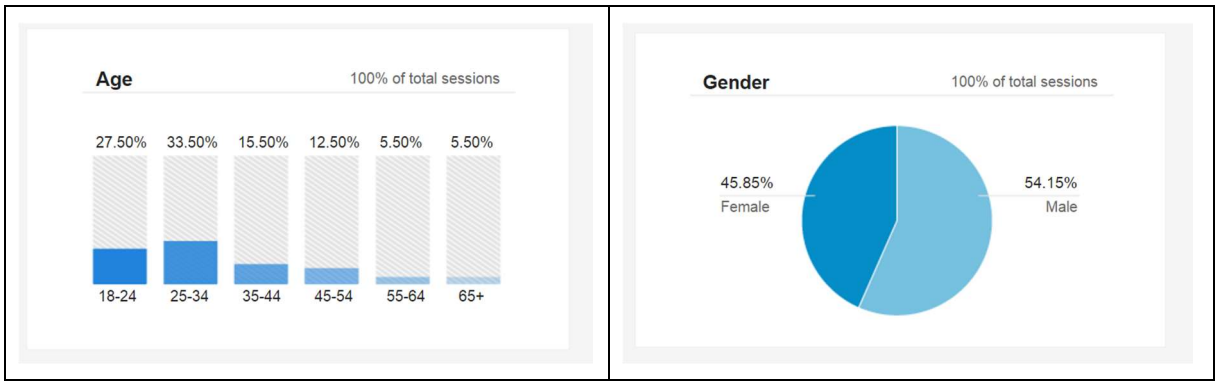

Figure 3-6. Overview of the COWP page viewers' demographics.

4 How to Use the Citizens' Observatories Web Portal?

In general, the user can go to the portal front page (Home page) to get an overview of what the portal is about. Further options include:

- Joining the air pollution perception surveys (either to participate to air quality perception questionnaire, or to use CityAir app, or both).
- Link to access and view the information and data from three specified COs in the project.
- Access to the data shared from CITI-SENSE via GEOSS, and existing data on GEOSS.
- Various videos developed by the CITI-SENSE
- Following CITI-SENSE on various social media channels for updates on the projects.

'The Project' page contains general information about the CITI-SENSE project. In order to view and access to the different type of the products and services developed by CITI-SENSE, the user should go to 'Citizens' Observatories Toolbox'. The COT can be used from two perspectives: the users' perspective and the developers' perspective. From a user perspective, the CITI-SENSE COT contains a number of elements that together provide the foundations of a complete Citizens' Observatory, which includes support for collection of data and observations through sensors, mobile apps and surveys, and elements for analysis and visualisation of observations through widgets and web portals. In the CITI-SENSE project, the focus is on air quality with the following elements:

- **Sensors** – a set of sensor platforms has been developed for both static and mobile air quality sensors, including monitoring of CO/CO_2, NO, SO, PM, Radon, Temperature, Humidity etc. They are providing their observations into a common data server.
- **Mobile Apps** – a set of mobile apps has been developed to support user perceptions and user answers to surveys and questionnaires, with a focus on air quality questions.
- A tool is being used for the creation of web- and smartphone-based **Surveys** and questionnaires.
- Reusable **Widgets** have been developed to visualise the collected observations in different ways, typically based on time-based and location-based queries.
- **Web Portals** include URLs for the web portals of each of the nine participating locations.
- **Methods** includes guidelines for how to use sensors (For LEOs), mobile apps and portals in order to support citizens' involvement and empowerment in environmental monitoring of air quality.
- **Data** collected and generated from CITI-SENSE and the way to access the raw data and the visualized data for each of the COs cross nine cities.

We include the following terms of use: 'If users use any toolkit from CITI-SENSEN COT, please refer it to the toolkit developer and their references, as well as to the CITI-SENSE project as follows: The toolkit was partly developed by the CITI-SENSE project. CITI-SENSE is a Collaborative Project partly funded by the EU FP7-ENV-2012 under grant agreement no. 308524.'

The page 'Use Examples' provides a short overview over use examples from the CITI-SENSE COT from nine cities including real-life campaigns. The 'FAQ' page provides frequently asked questions and the answers. 'Useful Links' page provides links to other similar projects in the world, existing types of air monitors, collaboration and synergy with GEOSS, air quality related information, etc. In the 'Contact Us' page, all contact information regarding each specific toolkit is available.

5 Assessing the Citizens' Observatories Web Portal

We have developed different methods to evaluate the COWP. They include:

- **Self-assessment: Key Performance Indicators (KPIs):** From WP4's perspective, we developed a set of KPIs to evaluate the project progress towards its planned objectives including indicators that should be used to evaluate the COWP. The KPIs were developed by covering the CITI-SENSE information flow 'citizens – sensors & platforms – data servers – products & services'. The KPI score was obtained through a questionnaire, and it included five levels of completion (Table 5-1; for detail about KPIs and its evaluation methods, please see D4.2 and D4.3). The COWP KPIs were developed and used for self-assessment by the CITI-SENSE consortium, especially by WP4. The COWP KPIs and their evaluation results are shown in Table 5-2.

Table 5-1. The KPIs evaluation score and completion scale.

Flag colours	Successful level	Score (%)	Completion scale
Blue	Excellent or complete success	90-100	5
Green	Very good or very effective success	80-90	4
Yellow	Good or effective success	70-80	3
Orange	Fair or moderate achievement of goals defined	60-70	2
Red	Low or relatively poor achievement of the objectives defined	<60	1

Table 5-2. The KPIs of COWP and its evaluation results.

The KPIs	Level of success	Evaluation score (%)	Completion scale	Flag colour
Is COWP established and function well as it is planned?	Very good or very effective success	80-90	4	Green
Is COWP function well as a gateway to access to the CITI-SENSE products & services?	Excellent or complete success (e.g., access to the integrated Citizens' Observatories Toolbox)	90-100	5	
Are stakeholders and users involved in the COWP design process?	Good or effective success (e.g., CITI-SENSE consortium are involved in the COWP design, and users are involved in the COWP usability assessment and their feedback are used to further revised the COWP)	70-80	3	
Is COWP synergized with GEOSS, other useful information and links (e.g., other COs-related projects and programmes)	Good or effective success (e.g., have registered CITI-SENSE resources at GOESS web portal, links with established COs-related social media platform, and has set up 'useful links' page on COWP)	70-80	3	

- **User assessment: CITI-SENSE Usability Evaluation:** A CITI-SENSE usability evaluation form has been developed, which aimed to collect users' feedback on the tools or products developed by the CITI-SENSE project including COWP. The COWP usability questionnaire and users' evaluation results are presented in Tables 5-3, 5-4 and 5-5. The COWP was also evaluated regarding its empowerment potential in the work done by WP5. The results will be available in D5.6.

Table 5-3. COWP usability evaluation – users' basic information (N/A: not answered).

Participant No.	Gender (Female=F; Male=M)	Year of birth	Highest education level	In which city did participant evaluate the COWP?	What is participant connection to the city in which participant evaluated the COWP?	In general, how interested are participant in air quality?
1	F	1957	PhD	Belgrade	Live and work	N/A
2	N/A	N/A	N/A	N/A	N/A	N/A
3	M	1971	Master	Oslo	Other	Interested
4	M	1962	PhD	Haifa	Work	Very interested
5	F	1986	Master	Barcelona	Work	Interested
6	M	1975	PhD	Haifa	Work	Very interested
7	M	1985	Master	Oslo	Live and work	Interested
8	M	1977	PhD	Ljubljana	Work	Interested
9	M	1969	University	Oslo	Other	Interested

Table 5-4. COWP usability evaluation – users' feedback – quantified (1 = strongly disagree; 2 = disagree; 3 = neither disagree nor agree; 4 = agree; 5 = strongly agree; N/A: not answered).

COWP usability questions	Participant No.								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
I would like to use this tool frequently	5	4	4	3	2	3	3	3	5
The tool unnecessary complex	1	3	1	3	4	4	2	3	3
The tool was easy to use	5	3	4	3	2	2	4	4	4
I need the support of a technical person to be able to use this tool	1	3	1	2	1	3	1	2	4
The various functions in this tool were well integrated	5	4	4	2	2	2	3	3	3
I thought there were too much inconsistency in this system	3	2	1	3	2	5	2	1	2
It easy to learn how to use this tool	N/A	2	4	2	2	2	3	1	1
I felt very confident using the tool	N/A	4	4	3	2	2	3	3	2
I needed to learn a lot of things before I could get going with this tool	1	4	2	4	1	3	2	2	5
I have learned something useful by using this tool	5	4	4	4	3	4	3	3	5
I would recommend this tool to my friends and family	5	3	4	4	2	3	2	4	3
I do not see any reason to use this tool in the future	1	2	1	3	1	1	2	1	1
I was satisfied with the tool as a whole	5	4	4	3	3	2	3	4	3
I have used this tool many times	5	2	4	2	2	1	2	1	1

Table 5-5. COWP usability evaluation – users' feedback – free comments (N/A: not answered).

Participant No.	Questions	
	What aspect of this product has been most useful/satisfying?	**What aspect of this product has been most disappointing?**
1	N/A	N/A
2	Very good source of information, a bit not organised.	Methods are a bit too complex, not sure it should be open, might "frighten" people.
3	N/A	N/A
4	Accessibility.	Not final/operating yet in many aspects.
5	The potential to integrate all the information/data for future use/research.	It is not easy to navigate and find what you want. To have a clearer goal of this website not only to be a data source.
6	I think this portal has a great potential to become a worldwide Mecca for anyone who is interested to build COs, rather than a website that encompasses all COs in the world.	Its scope is too wide and the target audience is not well defined.
7	It makes it easier to find the right information.	N/A
8	Design	N/A
9	N/A	N/A

- **Analysis and Qualification of Exploitable Knowledge Items (EKIs):** In the CITI-SENSE exploitation plan (See D9.15), the CITI-SENSE consortium has selected EKIs (i.e., those knowledge items generated by the project with business potential, for which possible business models can be worked out, see D9.15), generated by the project, including COWP and developed methods to analyse the EKIs from both research and commercial perspectives. The analysis and qualification of the COWP are presented in Table 5-6.

Table 5-6. Analysis and qualification of COWP (For more detail, see D9.15).

Exploitable knowledge	Owner (Partner's acronym)	Category	R&D context	Commercial setting
Citizens' Observatories Web Portal	NILU	Information Products and Services: Application/Services	Yes, direct use for research activities	No

For more evaluation results of the COWP, from both users' and developers' perspective, please see Chapters 4.1.8 and 4.2.8 in D4.4 and Chapter 8 in D6.5.

6 Conclusions

The CITI-SENSE COWP is available at http://co.citi-sense.eu/. Currently, it is functioning as a gateway to access the project products and services.

The members of the CITI-SENSE consortium and location-based users are invited to test the COWP's functionalities. A co-design and co-development approach have been applied for both members from the CITI-SENSE consortium and location-based users, by using KPIs and usability assessment, respectively. Currently, such a co-creation approach is still ongoing and the feedback from the users and other stakeholders are implemented continually in the COWP.

Integration with GEOSS via COWP is ongoing. So far, we have registered various CITI-SENSE resources on the GEOSS web portal (Section 2-2-5). To ensure that CITI-SENSE data will be submitted to the GEOSS database, the CITI-SENSE WP7 is working with COBWEB project (https://cobwebproject.eu) to develop formats/technology to transfer various types of data to GEOSS. In return, we can re-use their results.

The CITI-SENSE COWP is run by NILU and it is planned to be remained active after the project finished. The consortium is exploring potential ways to keep the COWP alive.

7 References

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