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Collective Awareness Platform for Tropospheric Ozone Pollution

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List of Abbreviations

API	Application Programming Interface
BSD	Berkeley Software Distribution
CSS	Cascading Style Sheets
EU	European Union
HTML	HyperText Markup Language
HTTP	HyperText Transport Protocol
OS	Operating System
OWL	Ontology Web Language
RDF	Resource Description Framework
REST	Representational State Transfer
SDK	Software Development Kit
SQL	Structured Query Language
SSL	Secure Session Layer
URL	Uniform Resource Locator
WHO	World Health Organization

Executive Summary

Description of the work

This deliverable describes AirAct, a web application that displays pollution data taken from the CommSensum platform.[1]. This data is obtained from reference stations and from the deployed CAPTOR nodes in the testbeds. The app may also display data from other geographical areas if data from these is stored in the CommSensum platform. The app allows users to display pollutants and to share this data with other users through several social networks, arising then awareness.

Objectives

The main objectives of this deliverable are:

- Describe how the AirAct application works
- Show which technologies are involved in the design of application
- Describe the front-end of the application and how users can arise awareness with the application

[1] CAPTOR Deliverable D2.4, "Open Linked Data repository development".

1. Research Context

The purpose of this deliverable is to describe a web application called **AirAct** that displays data from the repository CommSensum[2]. The information displayed will be environmental pollution data obtained from official sources of the countries in which the project deploys testbeds and data captured by CAPTOR nodes[3] developed in the project. However, the application can easily extend and include other geographical areas or countries. It will be fully accessible on three platforms (computer, tablet and smartphone) and be translated into the languages in which the testbeds are deployed (Spanish, Catalan, German and Italian) and in English. The reason of having the application in several languages is that the users are citizens of Catalonia, Austria and Italy and in general, they could be no fluent in English. For that purpose, the first version will first develop the interface in Spanish, following versions in Catalan, English, German and Italian.

Moreover, each time that a user see information related to the pollutants and is interested in sharing this information with other users or colleagues, the application allows them to create awareness and interact using social networks such as Facebook and Twitter.

The AirAct software is available in the URL https://airact.org

2. Technological Context

In this section all the technologies used in the application and the relevant concepts for the understanding in the design of the platform are briefly described. Figure 1 presents the system architecture for AirAct and the technologies that have been used in the development of the platform. These technologies are briefly described in the following subsections.

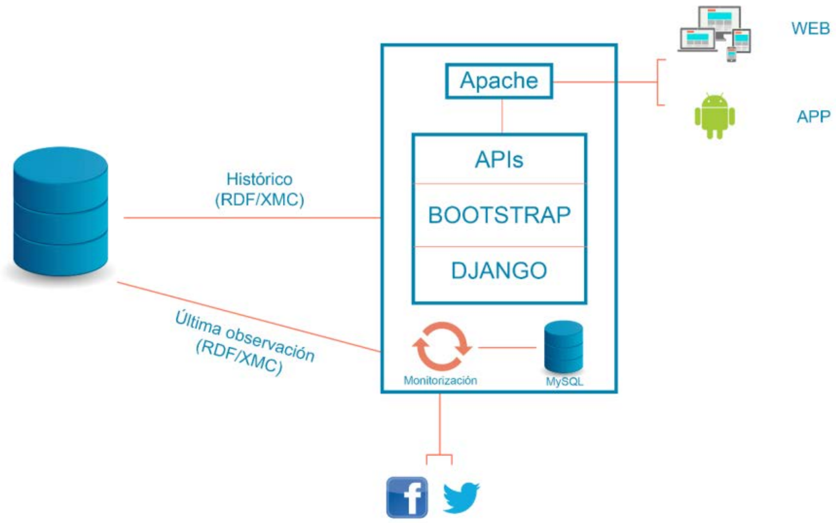


Figure 1. AirAct system Architecture

[2] CAPTOR Deliverable D2.4, "Open Linked Data repository development".
[3] CAPTOR Deliverable D2.2, "Node design".

2.1 Django

Django is a high-level Python Web framework that promotes the development of a fast, clean and pragmatic design. One major paradigm Django follows is the model-view-controller design pattern. In other words, the view part accesses the data through the model and serves it to the template. The templates are written in HTML which is rendered by the views.

This framework has a file called urls that allows you to assign friendly links, without extensions of files, and you pair it with a view to passing the parameters of the link. Django is used as a framework that enables you to develop web applications quickly and to be secure and scalable. In regard to security, by default Django provides security anti SQL injection and Protection of falsification of requests in cross-site.

Django is licensed in BSD, as this license is very permissive it serves both for proprietary and free environments. In addition, Python offers an infinite number of libraries that may be useful and contribute to a fast development of the platform.

2.2 Bootstrap

Bootstrap is a front-end framework of HTML, CSS and JavaScript code that enables you to develop websites and web applications designed for all types of devices[4]. It contains templates for many typical objects which are used in web pages, e.g. forms, buttons or menus, among others.

This framework allows you to easily define the behaviour of objects for different screen sizes. One of the most important objects in this regard is the menu: while in large screens it remains horizontal and deployed on the top, on a smartphone we find it hidden and when it is deployed it appears from side to side, resembling a lot to a native application.

In addition, each object is defined in twelve divisions, i.e. an object can be nested within another and if the interior object occupies twelve parts, it will occupy the 100% of the parent whereas if we define it with a six it will take the 50%. But this is not all, bootstrap allows you to define a value depending on the size of the screen, i.e. if an object in a set of objects can be defined with a six, it will appear two objects for each line, while in a mobile device, we would have to define twelve parts in order to view the contents well, therefore appearing only an object per line.

As has been described above, bootstrap enables the use of multiple predefined templates and to edit them at high speed for multiple devices in a very intuitive way. Bootstrap will make a nice page for the view and makes it accessible in a short time.

2.3 Apache HTTP server and SSL certificates

The Apache HTTP Server is an open source HTTP web server for different platforms[5]. This server is developed and maintained by a community of users under the supervision of the Apache Software Foundation. The objective of this project is to provide a secure, efficient and extensible server that provides HTTP services in synchronization with the current HTTP standards.

This web server is characterised by being very modular, the different modules available can be downloaded and enabled to add new functionalities. One of them is the wsgi module, which provides an interface between the Apache server and the programming framework of Django. In addition, has another module that allows working with SSL certificates.

The addition of an SSL Certificate allows to sign with an identity key the web page and to encrypt

[4] Bootstrap: http://getbootstrap.com

[5] Apache HTTP Server: https://httpd.apache.org

connections between server and client. The current certificate has been signed by Let's Encsypt, certification agency sponsored by companies very recognized as Cisco or Akamai that offers free certificates recognized by the majority of the browsers[6]. The need arises to use this certificate by the imposition of the Google Maps API for Geo-localize a client, the geolocation is not permitted without a secure connection[7].

2.4 Semantic Web

The Semantic Web is developed by the World Wide Web Consortium (W3C) and its main function is to facilitate the creation of technologies to publish data that can be used for other applications[8]. The Semantic Web technology allows people to create repositories of data on the Web, build vocabularies and write rules to control the data. This linked data is composed of different technologies such as RDF, OWL and SPARQL.

Resource Description Framework or RDF is a standard model for exchanging data on the Web. RDF provides a general method and is flexible to break down any knowledge in small parts, called triple, with some rules of semantics[9]. RDF breaks the knowledge in a graph directed labelling. Each ridge on the graph represents a fact, or relationship between two things. A judgment represented in this way has three parts: a subject, a predicate and an object (s,p,o). The subject is what is at the beginning of the ridge and describes what object the triple is describing. The predicate is the type of edge and defines the piece of data in the object we are giving a value to and the object at the end of the edge is the actual value. The most used syntax for the exchange of information defined by the model RDF is XML.

Web Ontology Language or OWL allows you to extend the functionality of the Semantic Web, adding new classes and properties to describe the resources[10]. The ontologies serve to define the terms used to represent an area of knowledge. SPARQL Protocol and RDF Query Language or SPARQL is a standardized language to perform queries on graphs RDF made by the W3C[11]. This language allows you to do searches on the resources of the Semantic Web filtering through the different fields of the triplets.

The CAPTOR sampled data is stored in the Commsensum[12] platform. CommSensum uses Semantic Web to share information generated by sensors of different projects. The REST API in the repository allows you to access the data in RDF/XML format that is structured by the Semantic Sensor Network (SSN) Ontology[13]. In Figure 2 you can see the extended ontology model in the repository based on the previous ontology. For more information on the data types and the extended ontology and how the data is stored in the CommSensum platform we refer to CAPTOR Deliverable D25.

Listing 1 shows a request to Commsensum ozone data for a reference station. The geolocation data, the type of data that is displayed, the moment in which they were taken, the amount and unit of measurement are marked for an easy understanding.

[6] Let's Encrypt: https://letsencrypt.org

[7] Geolocation API removed from unsecured origins in Chrome 50. Google developers. https://developers.google.com/web/updates/2016/04/geolocation-on-secure-contexts-only

[8] Semantic Web. W3C: https://www.w3.org/standards/semanticweb

[9] Resource Description Framework. W3C: https://www.w3.org/RDF

[10] Web Ontology Language. W3C: https://www.w3.org/OWL

[11] SPARQL. W3C: https://www.w3.org/OWL

[12] CAPTOR Deliverable D2.4, “Open Link Data repository development”

[13] Semantic Sensor Network Ontology. W3C: https://www.w3.org/2005/Incubator/ssn/ssnx/ssn

```
<?xml version="1.0"?>
<rdf:RDF xmlns:rdf="http://www.w3.org/1999/02/22-rdf-syntax-ns#"
xmlns:rdfs="http://www.w3.org/2000/01/rdf-schema#"
xmlns:ssn="http://purl.oclc.org/NET/ssnx/ssn#"
xmlns:dct="http://purl.org/dc/terms/"
xmlns:foaf="http://xmlns.com/foaf/0.1#"
xmlns:dc="http://purl.org/dc/elements/1.1/"
xmlns:xsd="http://www.w3.org/2001/XMLSchema#" xmlns:DUL="http://www.loa-cnr.it/ontologies/DUL.owl#">
 <rdf:Bag
rdf:about="http://localhost/observations/sensors/6756/samplingTimes/20160617T000000::20160617T001000/observedpropertie
s/O3r/projects/17/geo/41.389065;2.113082;1">
  <rdf:li>
   <ssn:Observation rdf:about="http://localhost/observations/248357118">
    <rdfs:label>O3r observation from the sensor 6756.</rdfs:label>
    <ssn:observationResultTime
rdf:datatype="http://www.w3.org/2001/XMLSchema#string">20160617T000025Z</ssn:observationResultTime>
    <ssn:observedProperty rdf:resource="http://localhost/properties/33"/>
    <ssn:observationResult>
     <ssn:SensorOutput>
      <ssn:isProducedBy rdf:resource="http://localhost/sensors/6756"/>
      <ssn:hasValue>
       <DUL:Amount>
        <DUL:hasDataValue rdf:datatype="http://www.w3.org/2001/XMLSchema#double">482.555</DUL:hasDataValue>
        <DUL:isClassifiedBy rdf:resource="http://localhost/unitsofmeasure/33"/>
       </DUL:Amount>
      </ssn:hasValue>
     </ssn:SensorOutput>
    </ssn:observationResult>
   </ssn:Observation>
  </rdf:li>
 </rdf:Bag>
 <ssn:Property rdf:about="http://localhost/properties/33">
  <rdfs:label>O3r</rdfs:label>
  <rdfs:comment>raw resistance value measured by O3 sensor</rdfs:comment>
  <DUL:UnitOfMeasure>KOhms</DUL:UnitOfMeasure>
 </ssn:Property>
 <DUL:UnitOfMeasure rdf:about="http://localhost/unitsofmeasure/33">
  <rdfs:comment>raw resistance value measured by O3 sensor</rdfs:comment>
  <rdfs:label>KOhms</rdfs:label>
 </DUL:UnitOfMeasure>
</rdf:RDF>
```

Listing 1. RDF request to the CommSensum platform. Description of the data types used by the CommSensum ontology may be found in CAPTOR Deliverable D24.

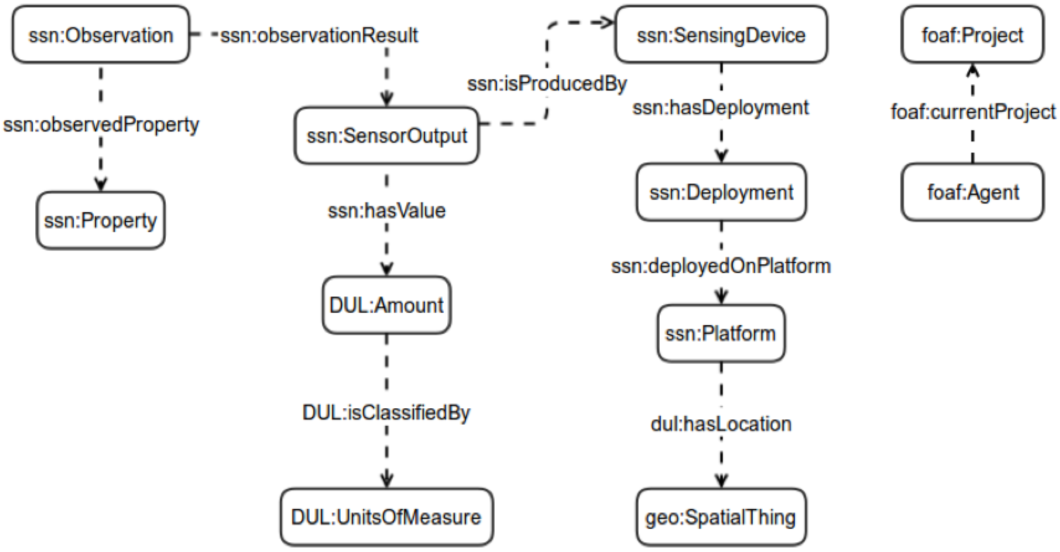


Figure 2. Ontology used in CommSensum platform

2.5 APIs

In the course of the application development, several Application Programming Interfaces or APIs have been used to facilitate tasks such as the use of maps, graphs or social networks. The used APIs are described below:

2.5.1 Google Maps API

The Google Maps API is the most complete API for the use of maps in spite of not being of free use. Google Maps restricts the amount of maps loaded to 25,000 per day, which is sufficient for the present project. One of the arguments for Google Maps API is the high amount of documentation and the great community that uses it. Another aspect it allows to the project is to show the areas of influence in a very simple way, only with a function that lets you paint polygons on the map and customize the colour and transparency of the same. In addition to these utilities, the API provides geolocation functionalities in order to provide the user with information on his/her nearest station.

2.5.2 Google Graphics API

The Google API of graphs is free and it allows creating graphs that combine linear data with others represented in areas.

2.5.3 Facebook and Twitter API

The Facebook and Twitter APIs are free also and they are supported in Python and JavaScript. In Python the APIs have been used for monitoring automatic alerts while in JavaScript they have been used to share information of the platform.

2.5.4 Android SDK

For mobile devices with Android OS, the official android SDK has been used. The app is not a purely native application. The mobile application is composed of a custom web container that extends the permissions of geolocation and network usage. In turn, it creates a number of alerts to improve the user experience, as e.g. to verify the geolocation in a transparent manner and in the case it is not obtained, keep the user informed of why this has not been obtained.

3. Application functionalities

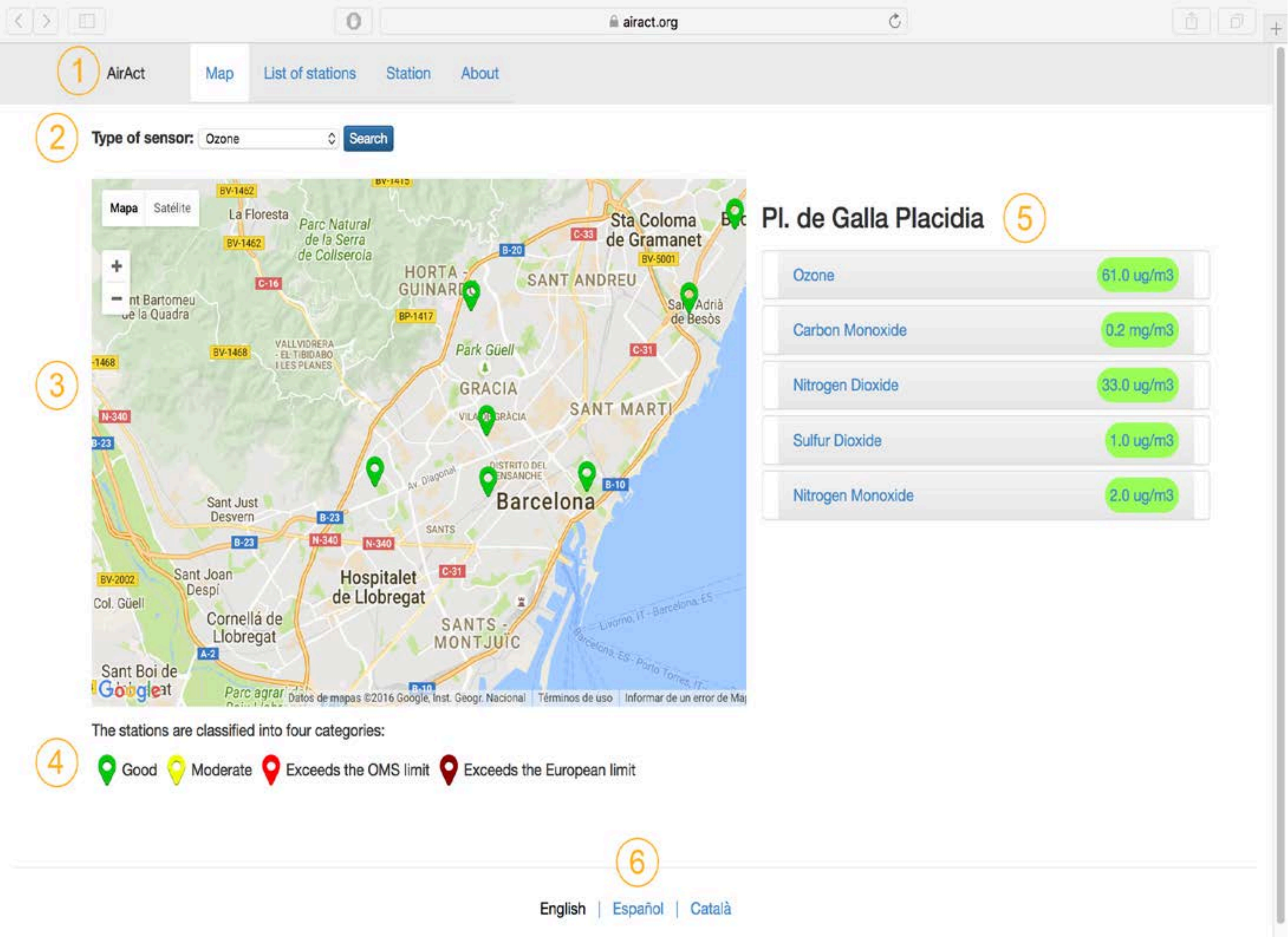
The application provides the following functionalities:

- Display Data on a map. The data will be shown on a map, in which the specific points, where measurements of contamination are obtained, are marked with an associated colour according to its quality. The data displayed correspond to official reference stations and to CAPTOR nodes.
- Filter map by compound. The map must be updated with the actions of a single compound when the filter is applied.
- List the stations: allow users to access the different nodes and stations from a listing of the same.
- Show the measures of the sensors in a station/node. For each station/node, the last measure of each of its sensors, with is shown with an associated colour and a value.
- Display a chart with the history of a compound. Make a chart that by default displays the last 24 hours of a sensor of a station.
- Show the last measure of a compound next to the limits of the WHO and the EU.
- Give information about the polluting compounds.
- Give recommendations to improve the quality of the air.
- Automatically publish alerts in the social networks.
- Allow sharing measures of a station/node in social networks.

3.1 Application platform

Screen shots showing how the platform works are displayed below, listing the different elements of each of the templates.

Figure 3 shows the main menu (Map, List of Stations, Station and About) and the possibility to change the language (in this version Spanish, Catalan and English, in a following version in addition German and Italian). Clicking on “Map” in the main menu, Figure 3, a map with the reference stations or captor nodes in that area is shown. The stations are flagged in green, yellow, red or brown depending on the levels of pollution and clicking on a station, more specific information appears.



Type of sensor: Ozone Search

Pl. de Galla Placidia

Ozone	61.0 ug/m3
Carbon Monoxide	0.2 mg/m3
Nitrogen Dioxide	33.0 ug/m3
Sulfur Dioxide	1.0 ug/m3
Nitrogen Monoxide	2.0 ug/m3

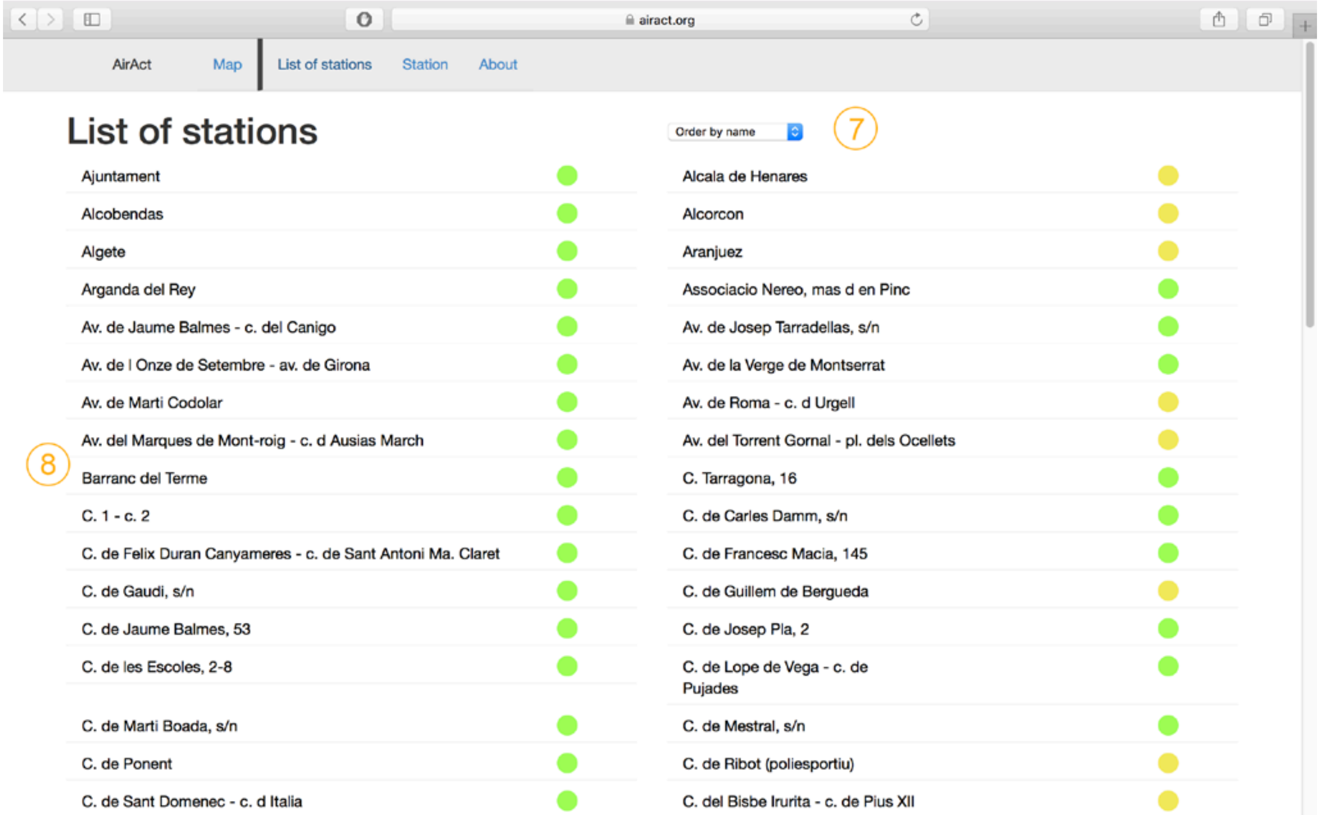
The stations are classified into four categories:

🟩 Good 🟨 Moderate 🟥 Exceeds the OMS limit 🟥 Exceeds the European limit

English | Español | Català

Figure 3. Map button.

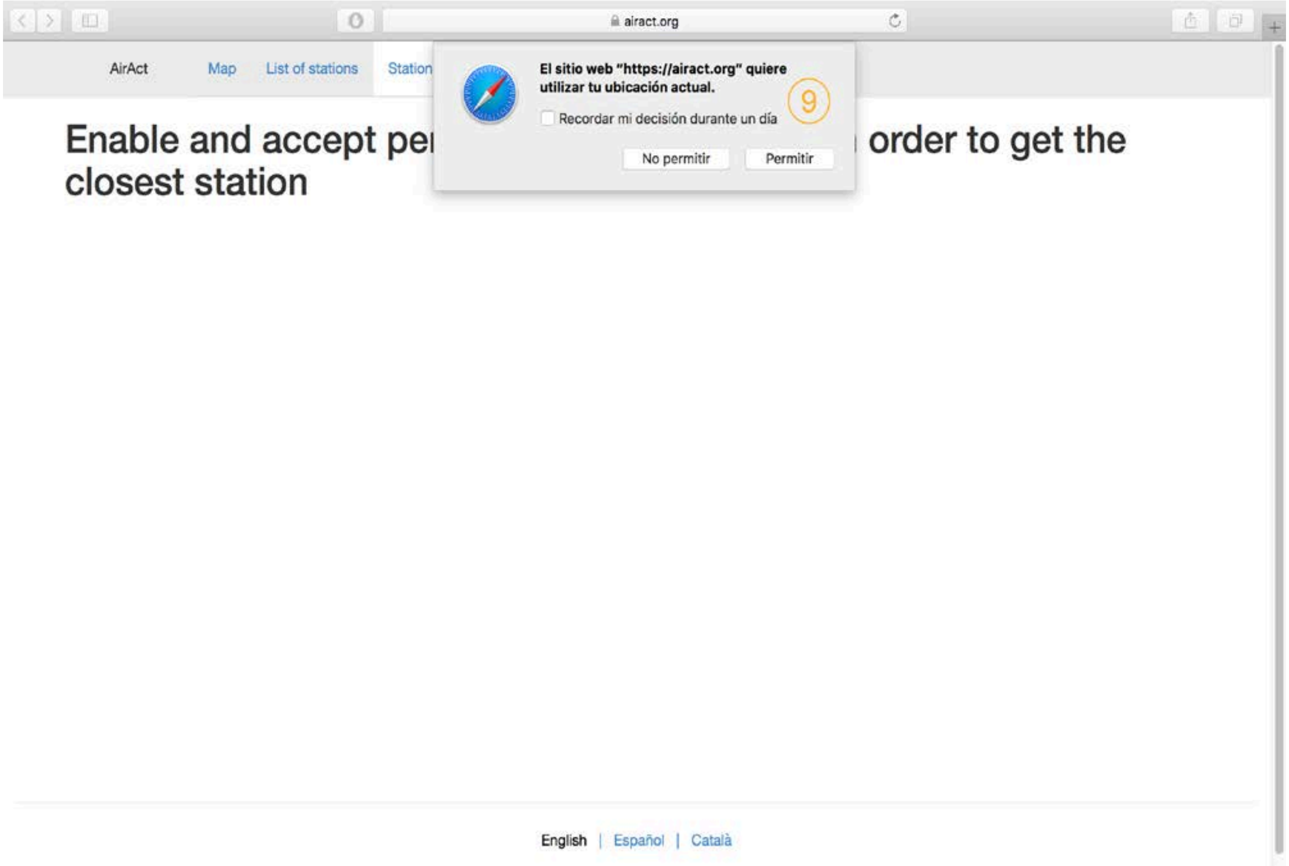
Figure 4 shows the “List of stations”. Here a list with all the stations that may be checked are listed, in this case “by order of name”. Clicking on the station, specific information about the values of that station or node appears. Moreover, it is possible to enable “location services”, Figure 5, e.g., if the session is made from a smart-phone or a device with location services. In this case, the map shows the stations or nodes near the users’ current location.



List of stations

Ajuntament	🟢	Alcala de Henares	🟡
Alcobendas	🟢	Alcorcon	🟡
Algete	🟢	Aranjuez	🟡
Arganda del Rey	🟢	Associacio Nereo, mas d en Pinc	🟢
Av. de Jaume Balmes - c. del Canigo	🟢	Av. de Josep Tarradellas, s/n	🟢
Av. de l Onze de Setembre - av. de Girona	🟢	Av. de la Verge de Montserrat	🟢
Av. de Marti Codolar	🟢	Av. de Roma - c. d Urgell	🟡
Av. del Marques de Mont-roig - c. d Ausias March	🟢	Av. del Torrent Gornal - pl. dels Ocellets	🟡
Barranc del Terme	🟢	C. Tarragona, 16	🟢
C. 1 - c. 2	🟢	C. de Carles Damm, s/n	🟢
C. de Felix Duran Canyameres - c. de Sant Antoni Ma. Claret	🟢	C. de Francesc Macia, 145	🟢
C. de Gaudi, s/n	🟢	C. de Guillem de Bergueda	🟡
C. de Jaume Balmes, 53	🟢	C. de Josep Pla, 2	🟢
C. de les Escoles, 2-8	🟢	C. de Lope de Vega - c. de Pujades	🟢
C. de Marti Boada, s/n	🟢	C. de Mestral, s/n	🟢
C. de Ponent	🟢	C. de Ribot (poliesportiu)	🟡
C. de Sant Domenec - c. d Italia	🟢	C. del Bisbe Irurita - c. de Pius XII	🟡

Figure 4. List of Stations



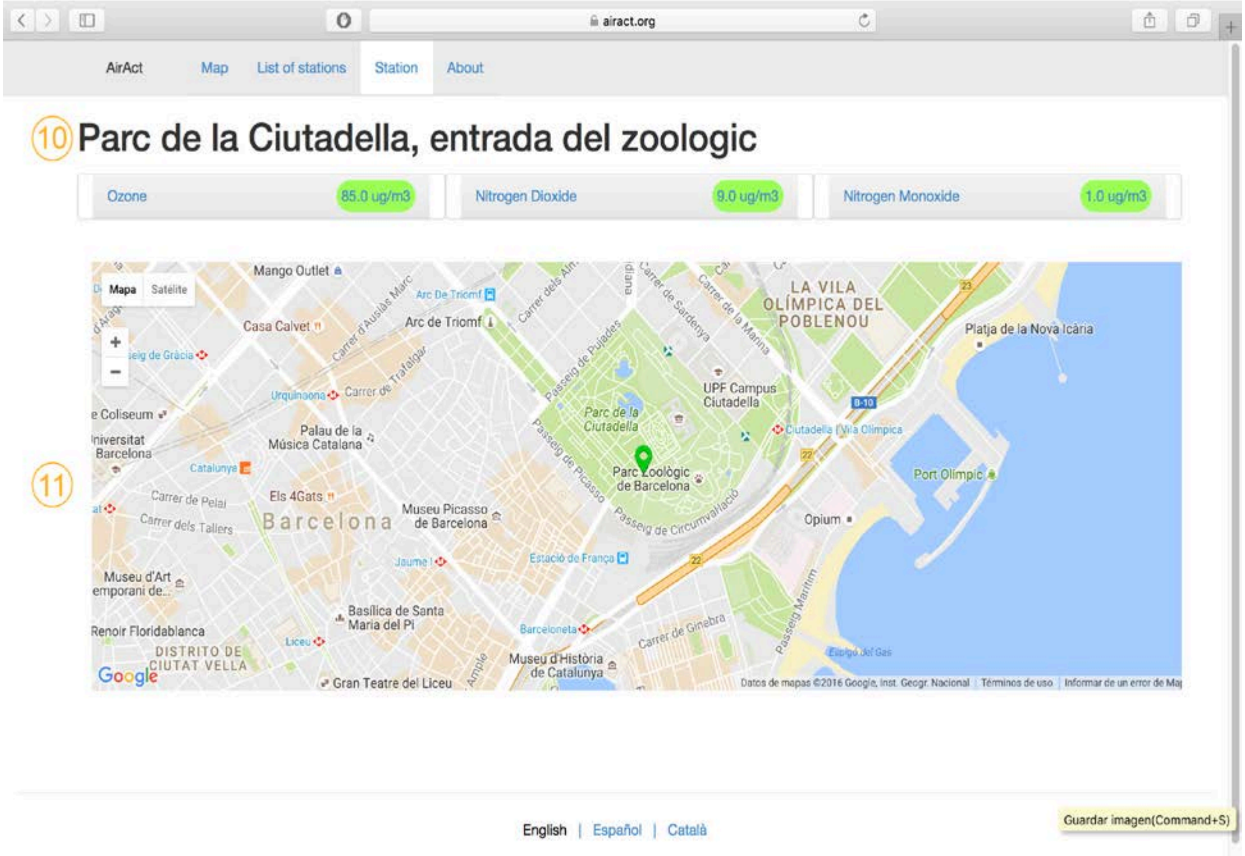
Enable and accept pe[...] order to get the closest station

El sitio web "https://airact.org" quiere utilizar tu ubicación actual.

□ Recordar mi decisión durante un día

Figure 5. Allow location services.

Figure 6 and 7 shows the “Station” button that allows selecting specific information about any station in the area. It is possible to select intervals of time in which the data may be viewed. The data shown is in values and in a weekly graph.



airact.org

AirAct | Map | List of stations | Station | About

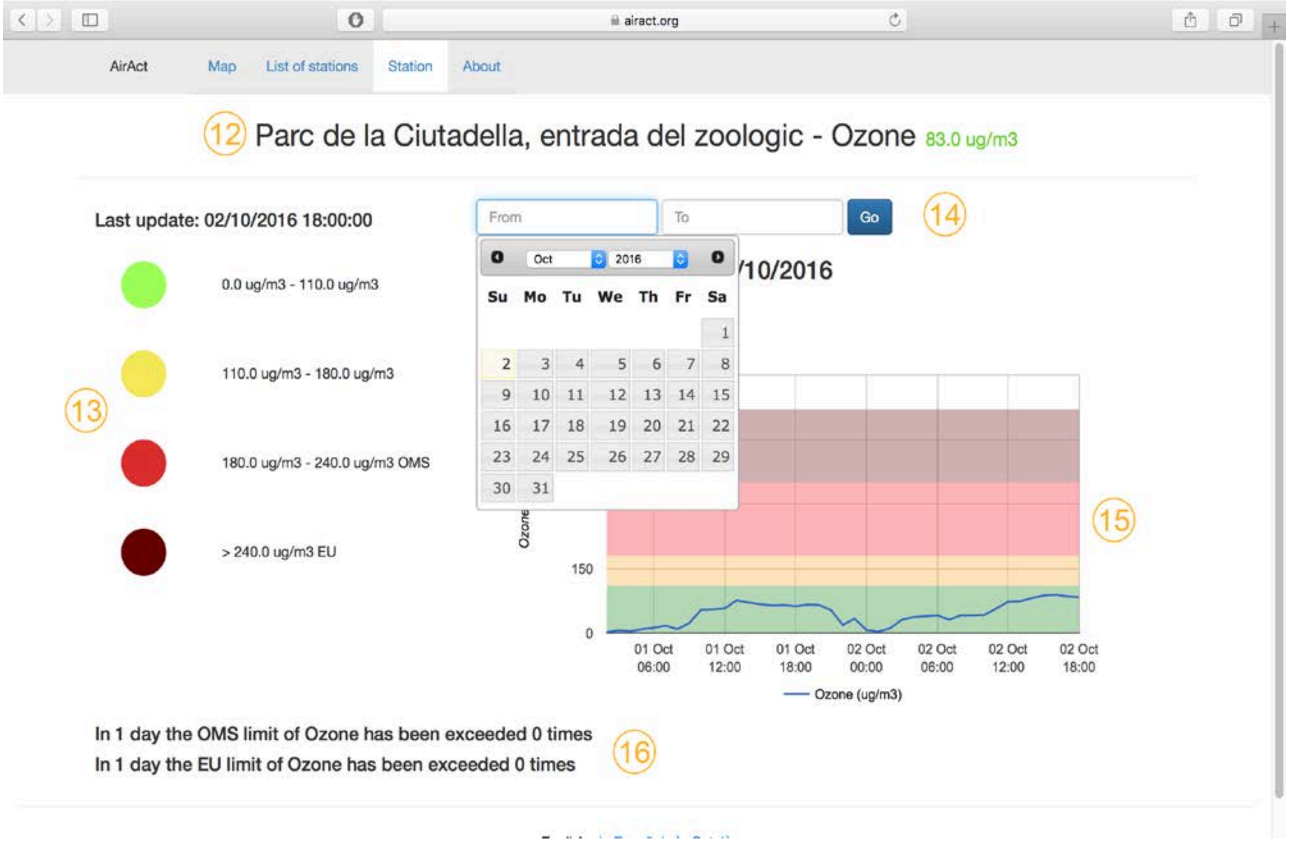
10 Parc de la Ciutadella, entrada del zoologic

Ozone	85.0 ug/m3	Nitrogen Dioxide	9.0 ug/m3	Nitrogen Monoxide	1.0 ug/m3

English | Español | Català

11
Mapa
Satélite
+
−
Mango Outlet
Casa Calvet
Arc de Triomf
Arc De Triomf
LA VILA OLÍMPICA DEL POBLENOU
Platja de la Nova Icària
UPF Campus Ciutadella
Parc de la Ciutadella
Parc Zoològic de Barcelona
Ciutadella | Vila Olímpica
Port Olímpic
Opium
e Coliseum
Universitat Barcelona
Palau de la Música Catalana
Urquinaona
Catalunya
Els 4Gats
Museu Picasso de Barcelona
Barcelona
Jaume I
Estació de França
Museu d'Art Contemporani de...
Basílica de Santa Maria del Pi
Renoir Floridablanca
DISTRITO DE CIUTAT VELLA
Liceu
Gran Teatre del Liceu
Barceloneta
Museu d'Història de Catalunya
Google
Datos de mapas ©2016 Google, Inst. Geogr. Nacional | Términos de uso | Informar de un error de Ma
Guardar imagen(Command+S)

Figure 6. Specific station is selected.



Parc de la Ciutadella, entrada del zoologic - Ozone 83.0 ug/m3

Last update: 02/10/2016 18:00:00

● 0.0 ug/m3 - 110.0 ug/m3

● 110.0 ug/m3 - 180.0 ug/m3

● 180.0 ug/m3 - 240.0 ug/m3 OMS

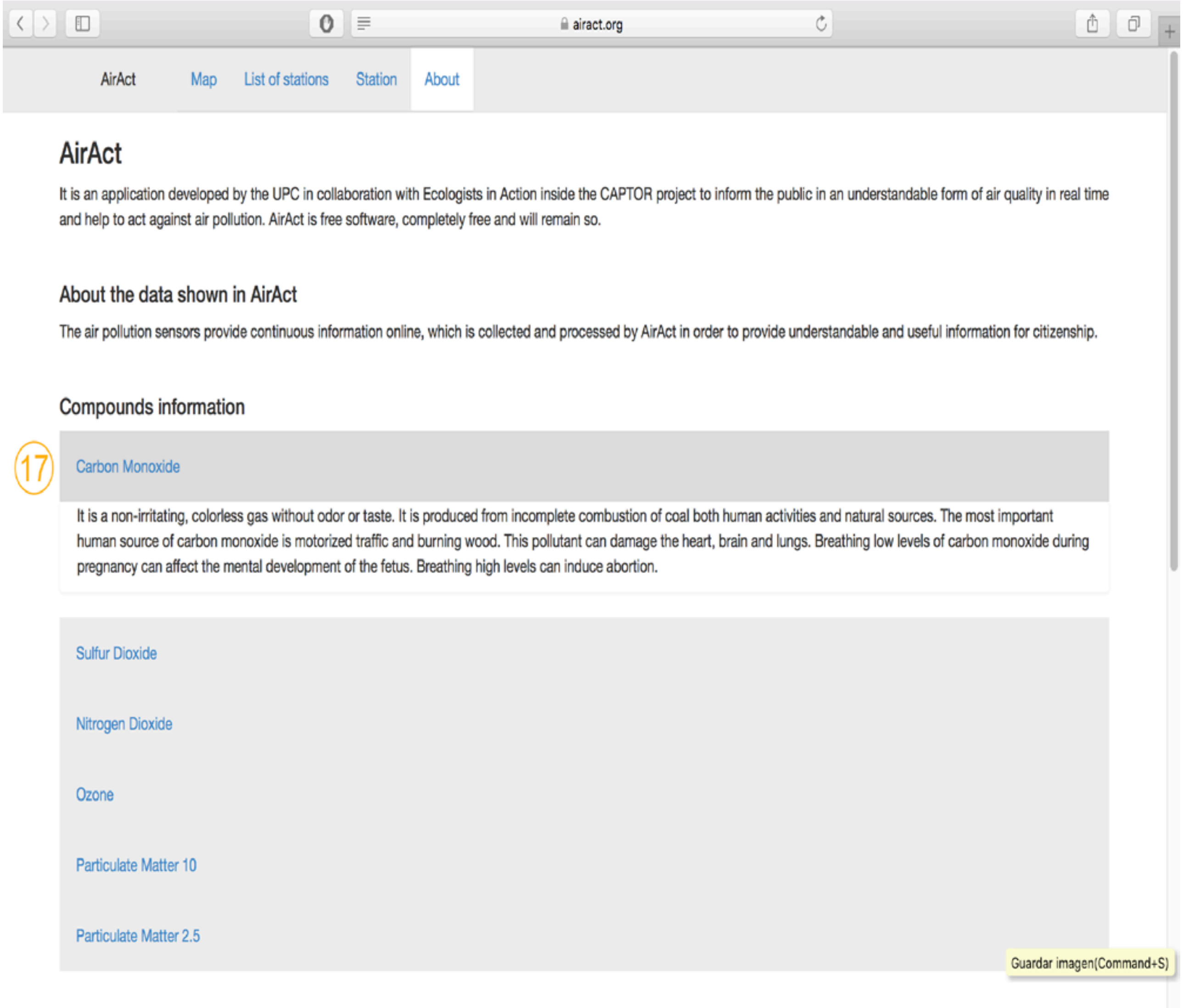
● > 240.0 ug/m3 EU

In 1 day the OMS limit of Ozone has been exceeded 0 times

In 1 day the EU limit of Ozone has been exceeded 0 times

Figure 7. Choosing the dates in which data is going to be visualized.

Finally, Figure 8 and 9 displays the "About" button, general information about the application, pollutants, etcetera, is shown. It also allows to interact with other users of the platform or even with people that do not use it but is reachable via social networks such Facebook or Twitter, arising awareness and reaching a larger number of people.



AirAct

It is an application developed by the UPC in collaboration with Ecologists in Action inside the CAPTOR project to inform the public in an understandable form of air quality in real time and help to act against air pollution. AirAct is free software, completely free and will remain so.

About the data shown in AirAct

The air pollution sensors provide continuous information online, which is collected and processed by AirAct in order to provide understandable and useful information for citizenship.

Compounds information

Carbon Monoxide

It is a non-irritating, colorless gas without odor or taste. It is produced from incomplete combustion of coal both human activities and natural sources. The most important human source of carbon monoxide is motorized traffic and burning wood. This pollutant can damage the heart, brain and lungs. Breathing low levels of carbon monoxide during pregnancy can affect the mental development of the fetus. Breathing high levels can induce abortion.

Sulfur Dioxide

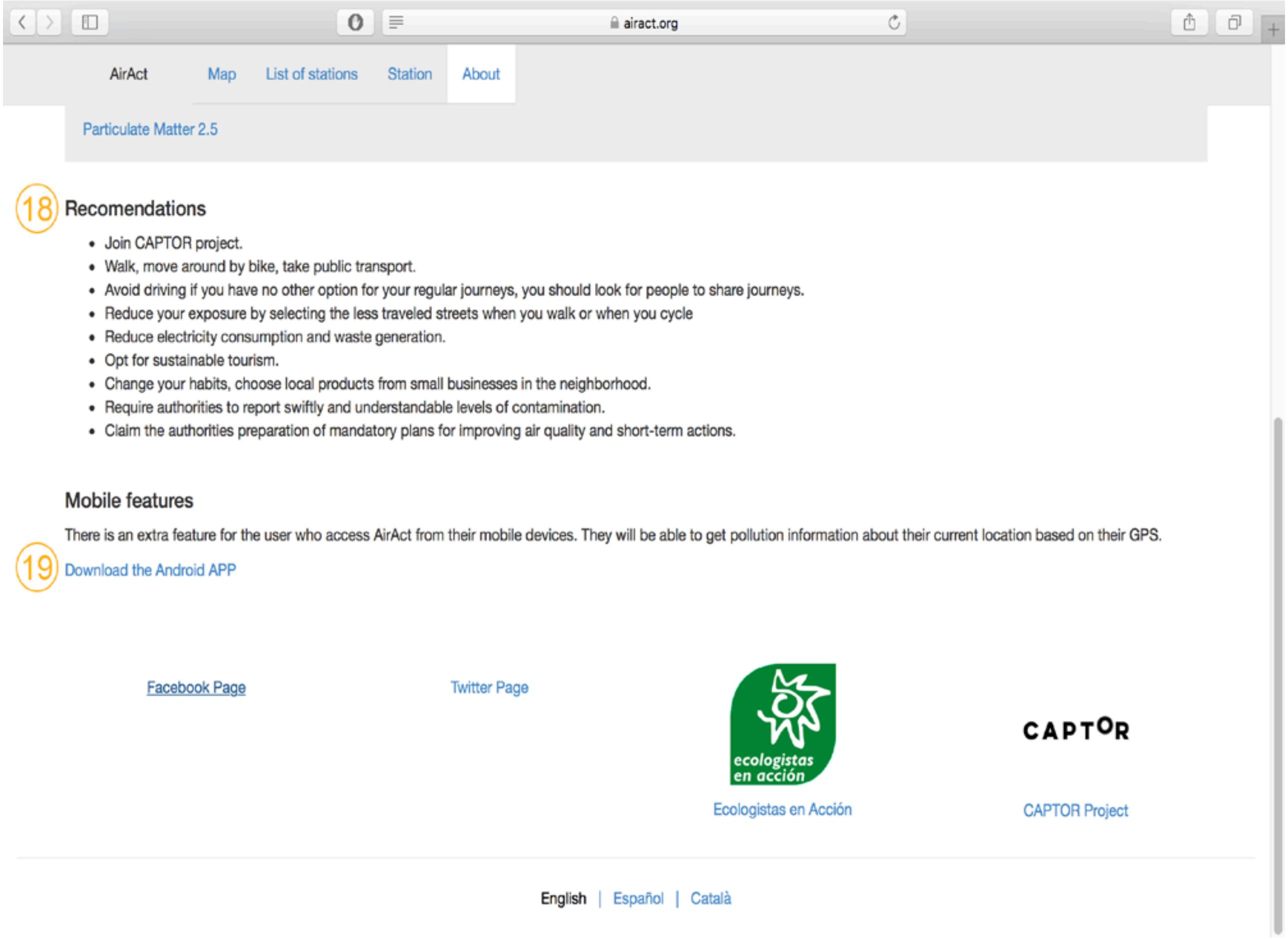
Nitrogen Dioxide

Ozone

Particulate Matter 10

Particulate Matter 2.5

Figure 8. General information about pollutants.



18 Recomendations

- Join CAPTOR project.
- Walk, move around by bike, take public transport.
- Avoid driving if you have no other option for your regular journeys, you should look for people to share journeys.
- Reduce your exposure by selecting the less traveled streets when you walk or when you cycle
- Reduce electricity consumption and waste generation.
- Opt for sustainable tourism.
- Change your habits, choose local products from small businesses in the neighborhood.
- Require authorities to report swiftly and understandable levels of contamination.
- Claim the authorities preparation of mandatory plans for improving air quality and short-term actions.

Mobile features

There is an extra feature for the user who access AirAct from their mobile devices. They will be able to get pollution information about their current location based on their GPS.

19 Download the Android APP

Figure 9. Recommendations and arising awareness.

4. Conclusions

In this deliverable we describe AirAct, a web application that displays pollution data taken from the CommSensum platform. The app allows users to display pollutants and to share this data with other users through several social networks. It will be a key tool in our project to communicate the obtained data to the participants. It will be deployed starting October 2016. We will modify and update this tools according with the feedback obtained from the users.