

miniMET Project

The environmental
observatories for
education and science.
Meteorological network
through internet:
Citizen Science

miniMET



Introduction I

OBSERVATION → **KNOWLEDGE** → **LOVE** →
RESPECT → **CARE** for the **ENVIRONMENT**,
and particularly for the **ATMOSPHERE**.

It is the starting point of an awareness raising state:

- **Scientists and meteorology professionals, as well as educators of every level, have the unavoidable duty of communicating to students of every age the love for the study and observation of the environment, providing them the appropriate tools and the enthusiasm of the discovery.**

Introduction II

- From meteorology, and with the support of education community, we will be able to involve the whole society, encouraging to potential amateur scientists of every age the vocation and voluntary commitment to participate in this scientific process of observation and discovery.
- This commitment will also contribute to obtain huge and valuable feedback data to the scientific, professional and academic environment, within the **OPEN SCIENCE** paradigm.
- This new paradigm is promoted both from the scientific community and civil society, as well as from the European Union through **CITIZEN SCIENCE** projects.

Introduction III

- **Citizen Science and the principles of Research and Responsible Innovation (RRI) are part of the European agenda for research and innovation - HORIZON 2020 - which is based on the concept of “Science with and for society” (SWAFS)**
- **SWAFS promotes active participation of citizens in science and the social commitment of researchers and innovators with society, in order to build effective cooperation between science and society that links scientific excellence with social awareness and responsibility.**

WHY AEMET?

- **AEMET**, the Spanish State Agency of Meteorology, is the ideal civil entity to promote the educational development and citizen science related to this matter.
- “Fomenting education and citizen science” is included in its fifth strategic line and faces the research and innovation challenge of the European Union's **HORIZON 2020**

miniMET Project for schools will provide didactic materials to several educational areas

- **Technology, ICT** (hardware, programming, internet)
- **Environmental studies:** meteorology and climatology
- **Statistics, analysis of results, comparisons** with data from other stations / schools, etc.

miniMET in AEMET

- miniMET is a necessarily cross-project that involves the following areas of AEMET:
 - Observation Network,
 - Exploitation and Data Management,
 - Climatology,
 - Training,
 - Innovation,
 - Quality,
 - Communication
 - Institutional Relationships, among others

WHAT IS THE miniMET PROJECT?

- AEMET will contribute with the definition and construction of a network of environmental observatories for schools, AEMET official collaborators, and also, amateur meteorologists.
- **HOW?** Several Automatic Weather and Air Quality Station (**AWAQS**) prototypes of simple and well-defined construction are proposed to schools as a technology project with affordable elements of open hardware and free software.

miniMET covers the following aspects

- DIY a weather station shelter
- Introducing miniPCs and development boards.
- Introducing sensors and communications.
- Introducing programming in Python and others.
- Integration and testing of the station.
- Location, installation and start up.
- Reading and analysis of observed data.
- Transmission and retrieval of data.

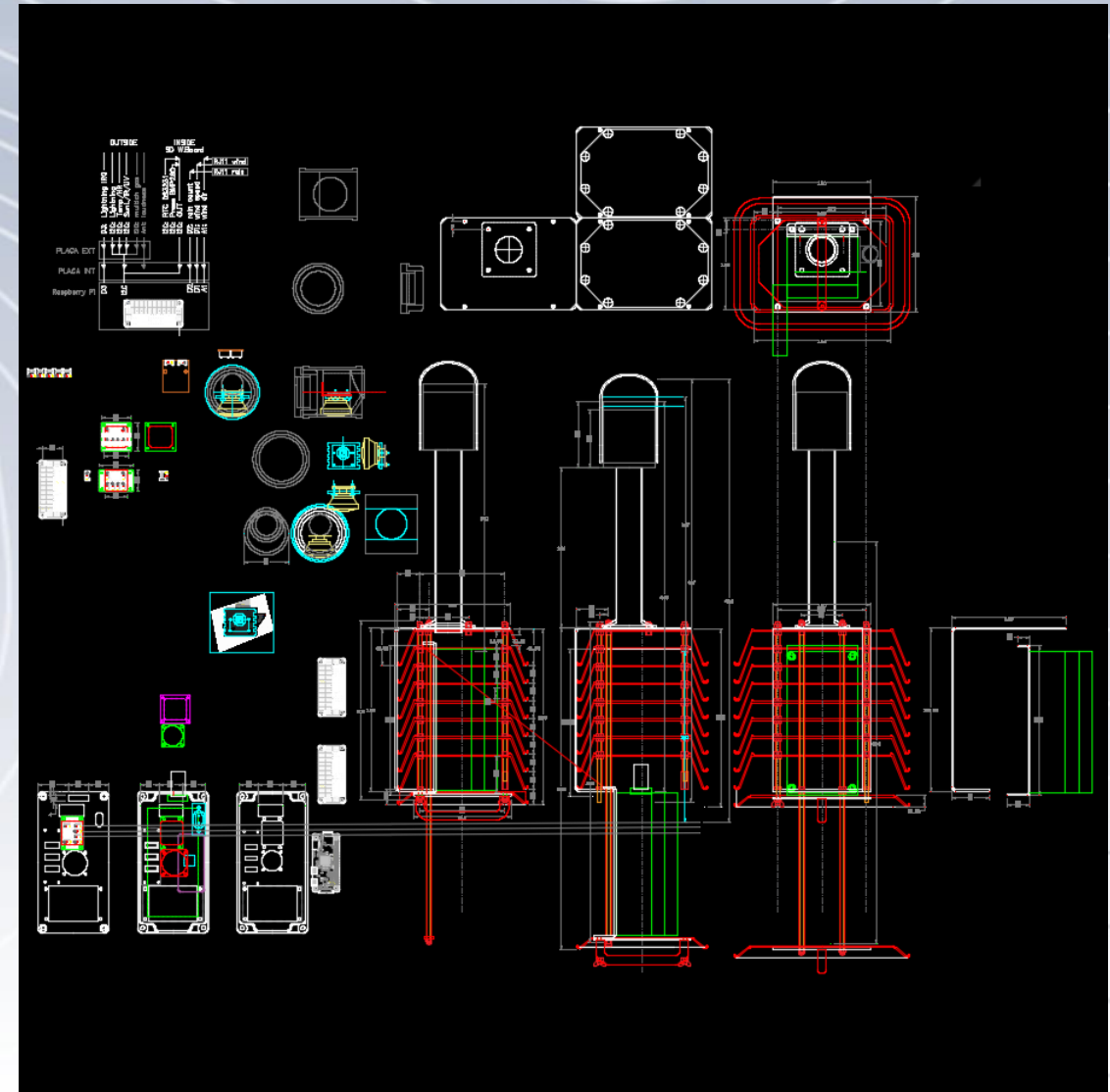
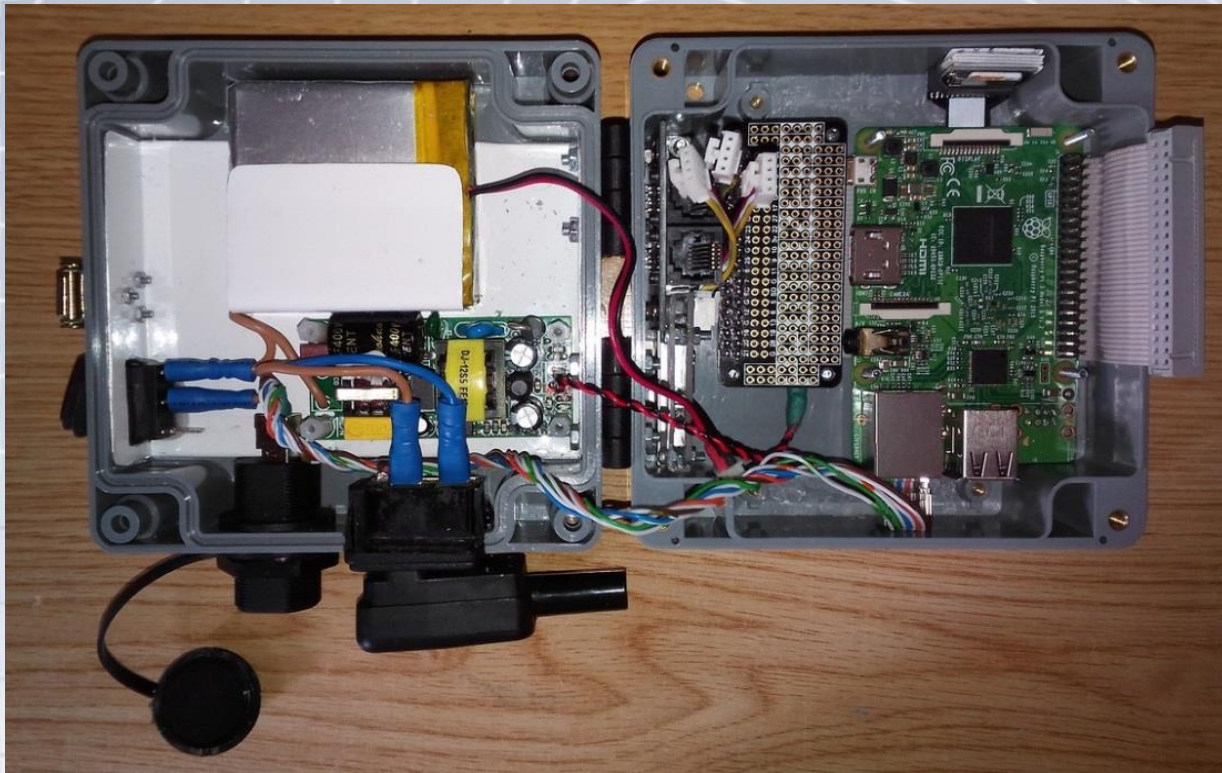
WHAT DO THE PROTOTYPE STATIONS MEASURE?

- Temperature / Humidity
- Pressure
- Direction and wind speed
- Precipitation
- Air quality
- Lightning detector
- Luminance / Infrared / Ultraviolet

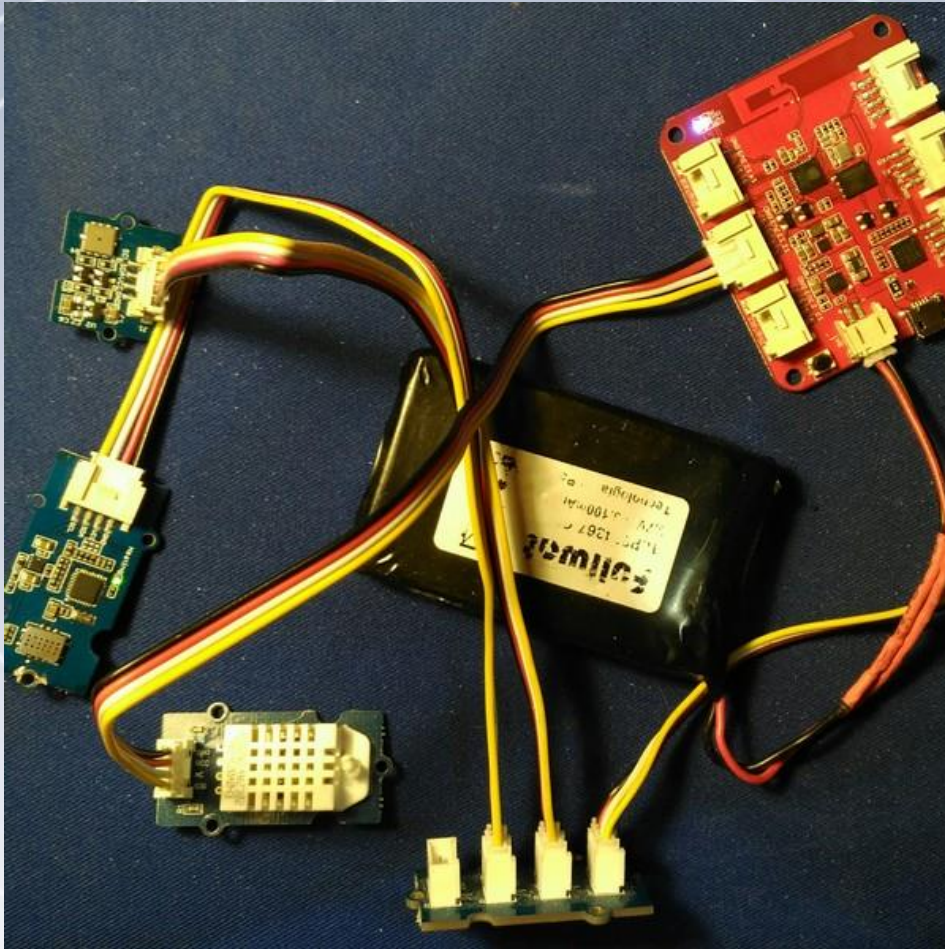
Also they have:

- Webcam
- Rechargeable batteries
- Solar panel
- Internet connectivity through Ethernet cable or Wi-Fi

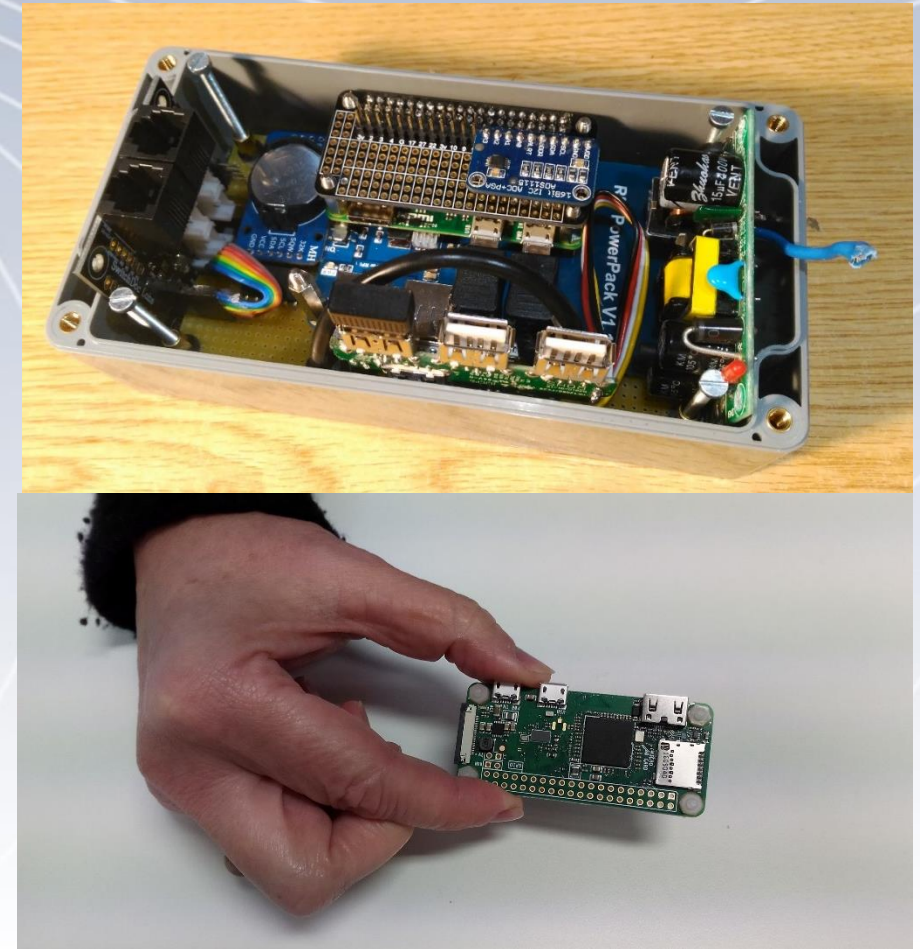
PROTOTYPE STATION based in RASPBERRY PI 3



PROTOTYPE based in WIOLINK IoT DEVICE with WIFI capabilities



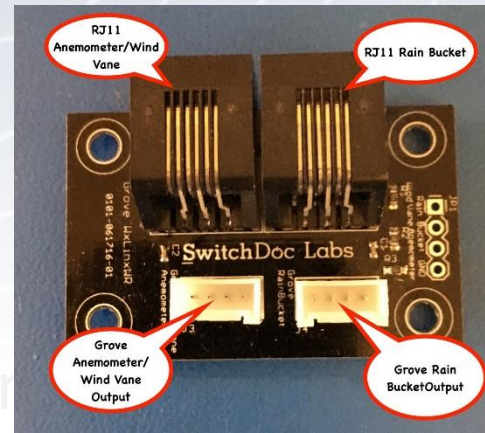
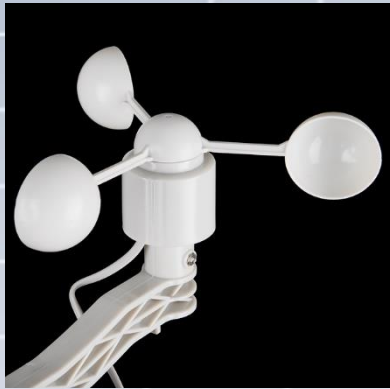
PROTOTYPE STATION based in RASPBERRY PI ZERO



DIY A WEATHER STATION SHELTER



WIND AND RAIN SENSORS



Location of the station prototypes on the AEMET terrace



Energy management II



HOW MUCH DO THESE PROTOTYPE STATIONS COST AND WHERE TO BUY THEM? I

- Each prototype is designed and documented to be built by each one, whether it is a school classroom or a particular amateur meteorologist, so **every component** must be easily found and purchased for everyone, either in local physical or virtual stores, or abroad (only a few one of them).
- Small hardware, electric and electronic components including minipcs and sensors may sum around **400~500€** really far from those 12000~18000€ of a Thies or Vaisala official automatic weather stations.

HOW MUCH DO THESE PROTOTYPE STATIONS COST AND WHERE TO BUY THEM? II

- However, the quality and precision of its measurements are not so far from official stations as one could think regarding these costs...
- AEMET have a network of more than 2000 official collaborators and implementing **miniMET AWAQSS** to those with the necessary connectivity and power supply specifications will be our goal and will require a serial production of stations with a consequent lowering costs, of course.

The guys of the RasPiMAX initiative who dreamed up miniMET



Informative Website of miniMET

<http://minimet.net> > <http://es.minimet.net> > <http://uk.minimet.net>
etc



HOW WILL THE DATA BE MANAGED?

Aemet has the necessary operational capacity to handle this project through its OpenData infrastructure and will manage this data network from the **Aemet collaborative OpenData** with a triple function:

1. Collecting observations data
2. Showing them to the educational community and society through digital maps on the Internet
3. Sharing them back as open data because:

Open Science and ***Open Data*** are inseparable concepts

AEMET COMMITMENTS I

- ✓ AEMET will enable this collaborative opendata input including the related Application Programming Interfaces (APIs), as well as develop the public environment for visualization of received data georeferenced in internet OpenMaps.
- ✓ Also will develop and freely distribute every prototype station software, mostly written in Python, based entirely in free software within the GNU/Linux Operating System

AEMET COMMITMENTS II

- ✓ AEMET will define and publish a technical specification of each prototype, as well as the manuals for mounting it
- ✓ Supervise and approve each of the candidate stations to admit them to this school network
- ✓ Provide training through courses and seminars to the ICT managers and teachers of each center enrolled in the project

AEMET COMMITMENTS III

- ✓ **Training courses for high school technology teachers**
- ✓ **Jointly with Education Ministry, AEMET will promote and sponsor the research, development and improvement of station prototypes with annual school competitions that reward the best initiatives.**

The final BENEFITS

Finally, the society will benefit from this return data, with an extensive and homogeneous **layer** of environmental measurements throughout the territory, testable with the official measures of AEMET automatic weather stations, providing decisive added information within its mission to ***"contribute to the safety of people and goods, and to the welfare and sustainable development of Spanish society."***

Meteorological network through internet: Citizen Science resources

- **AEMET collaborative OpenData**
- **minimet.net, Sharing/exporting project**
- **AEMET VISOR internet maps**
- **Climatological charts**
- **Socientize Project support**



AEMET OpenData is an API REST (Application Programming Interface. REpresentational State Transfer) through which can be downloaded free data listed in Annex II of the resolution of 30 December 2015 of AEMET, in which the public prices that will govern the provision of meteorological and climatological services are established. This resolution has been published in the BOE (Official State Gazette) no. 4, on 5 January 2016.




AEMET OpenData

AEMET OpenData allows two types of access: General access and AEMET OpenData API. Both of them provide access to the same data catalogue and they offer downloading data in reusable formats.

General access

This is a chart access for the general public. It aims to enable user to get access to data in a user-friendly way. Interaction with data is punctual: it's made through a human user-friendly interface, directed step by step and by choosing options.

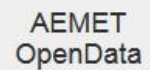
 [Resolution of 30 December 2015 of the State Meteorological Agency of Spain, in which the public prices that will govern the provision of meteorological and climatological services are established.](#) (522 KB)

AEM

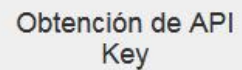
AEMET OpenData API allows other interaction way with the data: this interaction can be periodic or programmed, from any programming language, without user-friendly interfaces, with self-discovery option. This make possible that AEMET data can be included by re-users of information in their own information systems.



Sistema para la difusión y reutilización de la información de AEMET



¿Qué es?



Solicitar



Entrar












Entrar

opendata.aemet.es

GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE
AEMET
Agencia Estatal de Meteorología

Ejemplos de Programas Cliente

001001010101
10PEN10DATA0
100100100110
Agencia Estatal de Meteorología

 CURL Entrar	 Java Entrar	 Python Entrar
 PHP Entrar	 Ruby Entrar	 HTTP Entrar
		

opendata.aemet.es



C

Entrar



C#

Entrar



Go

Entrar



Java Script

Entrar



NodeJS

Entrar



Objective-C

Entrar



OCaml

Entrar



Shell

Entrar



Swift

Entrar

opendata.aemet.es

Ejemplo en Python http.clien (Python 3)

```
import http.client

conn = http.client.HTTPSConnection("opendata.aemet.es")

headers = {
    'cache-control': "no-cache"
}

conn.request("GET", "/opendata/api/valores/climatologicos/inventarioestaciones/todasestaciones/?api_key=jyJhbGciOiJIUzI1NiJ9.eyJzdWIiOiJqbW9udGVyb2dAYWVtZXQ", headers=headers)

res = conn.getresponse()
data = res.read()

print(data.decode("utf-8"))
```

Ejemplo en Python Requests

```
import requests

url = "https://opendata.aemet.es/opendata/api/valores/climatologicos/inventarioestaciones/todasestaciones/"

querystring = {"api_key": "eyJhbGciOiJIUzI1NiJ9.eyJzdWIiOiJqbW9udGVyb2dAYWVtZXQuZXMiLCJqdGkiOiI3NDRIYmVmMy02NDEyLTQxYWVtYmYzOC01MjhlZWJlM2FhMWEiLCJleHAiOiJE0Nz"}

headers = {
    'cache-control': "no-cache"
}

response = requests.request("GET", url, headers=headers, params=querystring)

print(response.text)
```

Taking the challenge of sharing/exporting

- **Phase I: informative**

Aemet provides subdomains with translations to several languages within the European zone, which explain the basis of the project, launching an **invitation** to participate.

- **Phase II: NMHS supporting initiatives**

Interested NMHS's **coordinate efforts** to implement the project in a similar way, taking responsibility for their own stations and country educational commitments, and even creating a **common and shared database**.

Taking the challenge of sharing/exporting

minimet.net

Projecto miniMET v.beta 4.0 20170525
email: minimet@aemet.es

RasPi MAX

./res/butn01.txt
./res/butn02.txt
./res/butn03.txt
./res/butn04.txt

Domains and logos for miniMET Network Project

miniMET.net
[project].miniMET.net

- EU.miniMET.net
- ES.miniMET.net
- IT.miniMET.net
- UK.miniMET.net
- DE.miniMET.net
- FR.miniMET.net
- etc.miniMET.net

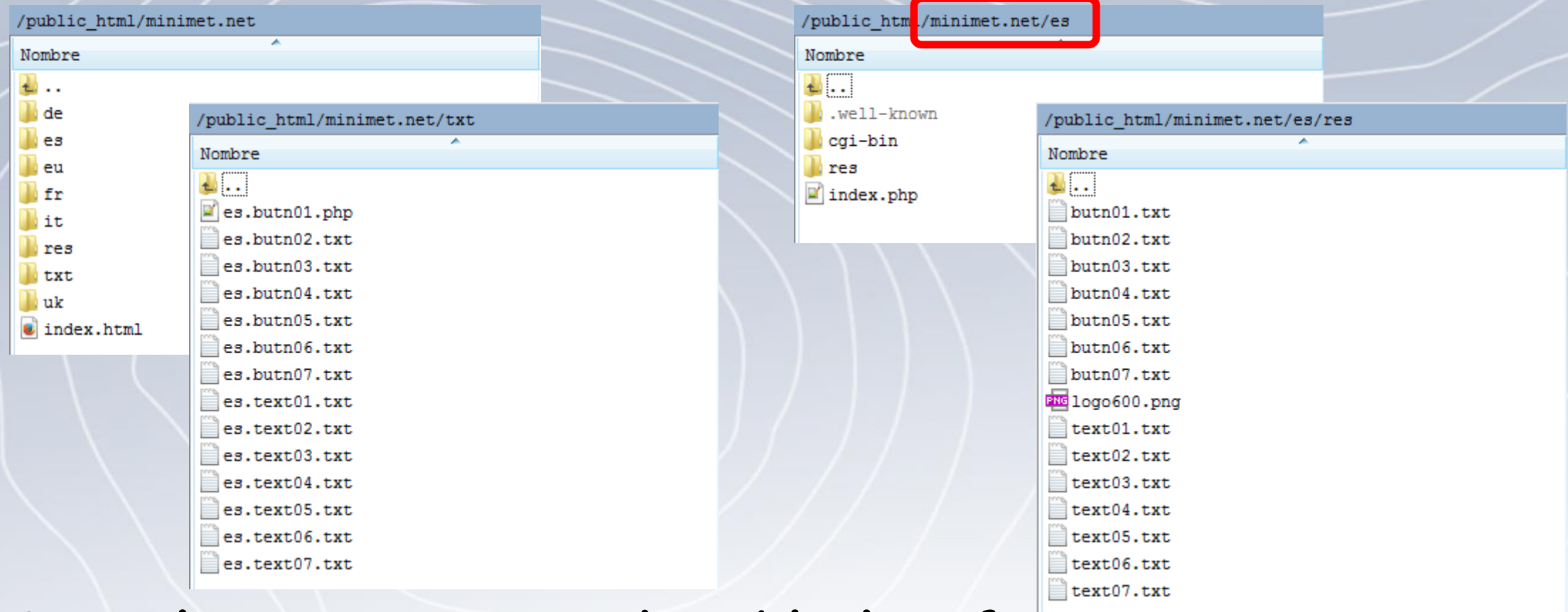
SWAFS-13-2017: Integrating Society in Science and Innovation – An approach to co-creation AEMET

The guys of the RasPiMAX initiative who dreamed up miniMET



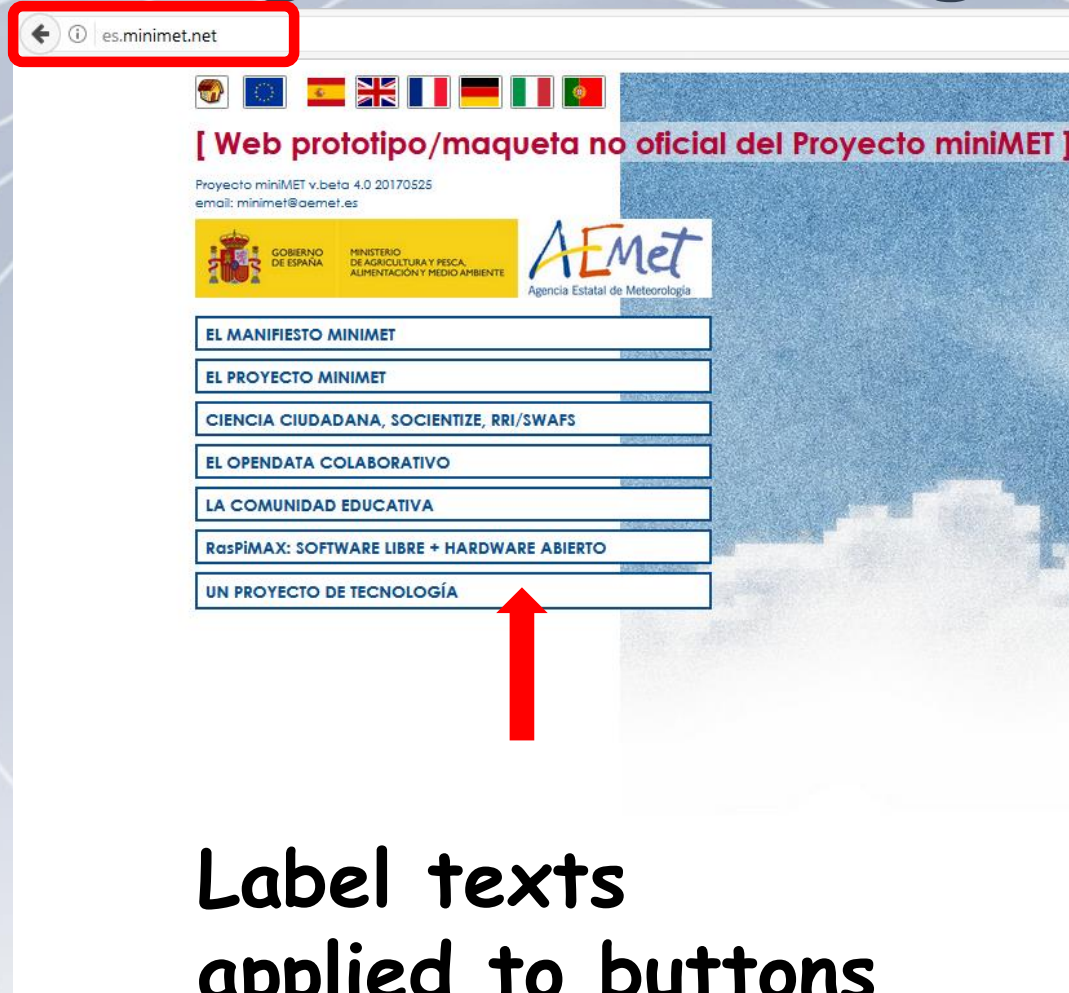
Multi-domain environment
using country codes
top-level domain, ccTLD

Taking the challenge of sharing/exporting



**Translations structured as blocks of text
for button labels and contents displayed**

Taking the challenge of sharing/exporting



es.minimet.net


[Web prototipo/maqueta no oficial del Proyecto miniMET]

Proyecto miniMET v.beta 4.0 20170525
email: minimet@aemet.es

GOBIERNO DE ESPAÑA
MINISTERIO DE AGRICULTURA Y PESCA, ALIMENTACIÓN Y MEDIO AMBIENTE
AEMET
Agencia Estatal de Meteorología

- EL MANIFIESTO MINIMET
- EL PROYECTO MINIMET
- CIENCIA CIUDADANA, SOCIENTIZE, RRI/SWAFS
- EL OPENDATA COLABORATIVO
- LA COMUNIDAD EDUCATIVA
- RasPiMAX: SOFTWARE LIBRE + HARDWARE ABIERTO
- UN PROYECTO DE TECNOLOGÍA

Label texts applied to buttons



uk.minimet.net

[Unofficial prototype/model website of miniMET Project]

Proyecto miniMET v.beta 4.0 20170525
email: minimet@aemet.es

NMHS official logo

- THE MINIMET MANIFESTO
- THE MINIMET PROJECT
- CITIZEN SCIENCE, SOCIENTIZE, RRI/SWAFS
- THE COLLABORATIVE OPENDATA
- THE EDUCATIONAL COMMUNITY
- RasPiMAX: OPEN SOFTWARE + FREE HARDWARE
- A TECHNOLOGY PROJECT

Taking the challenge of sharing/exporting

es.minimet.net

[Web prototipo/maqueta no oficial del Proyecto miniMET]

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miniMET

El **cuidado** y **respeto** de nuestro medio ambiente, y de la atmósfera en particular, son la respuesta natural del **amor** por ellos y ésta surge del **conocimiento**, por lo que promovemos como método, la **observación del aire**, no sólo en sus aspectos **dinámicos** y **fenoménicos**, sino también en los de **calidad**, y en nuestra influencia sobre éstos; es el punto de partida de una **toma de conciencia**.

Los científicos y profesionales de la meteorología, y los educadores de todos los niveles, tenemos el **deber ineludible** de transmitir a los estudiantes de todas las edades, ese amor por el estudio y observación del medio ambiente como base del conocimiento y del **método científico**, aportando al sistema educativo las **herramientas** apropiadas y también el **entusiasmo del descubrimiento**.

Desde la **Meteorología** y contando con la complicidad y apoyo de la **Educación** conseguiremos involucrar al conjunto de la **Sociedad**, fomentando **desde la escuela**, en potenciales *científicos aficionados* de todas las edades, la **vocación** y compromiso voluntario para **participar** en este proceso científico de observación y descubrimiento.

Taking the challenge of sharing/exporting

uk.minimet.net

[Unofficial prototype/model website of miniMET Project]

Projecto miniMET v.beta 4.0 20170525
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NMHS official logo

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- RasPiMAX: OPEN SOFTWARE + FREE HARDWARE
- A TECNOLOGY PROJECT

miniMET

Aemet, the State Meteorological Agency, is the ideal civil entity to promote the **educational development and citizen science** within his scope, becoming the aim of his fifth strategic line, in order to face the research and innovation challenge of the European Union's **HORIZON 2020**.

The **Production Department** of Aemet will develop this initiative of clear scientific, educational and social vocation, defining the basis of the **miniMET Project**, a **necessarily cross-project**, with the advice and support of agency areas such as *Observation Network, Exploitation and Data Management, Climatology, Training, Innovation, Quality, Communication and Institutional Relationships*.

Finally, Aemet and accordingly society itself, will benefit from these **return data**, as they will constitute an extensive and homogeneous layer of air measurements throughout the territory. This methodology will produce at the same time a way to test and to know if it is possible to extrapolate results from these data, comparing them to the measures from the Aemet official **automatic weather stations** network, providing valuable added information within its mission to "contribute to the safety of people and goods, and to the welfare and sustainable development of Spanish society".

Taking the challenge of sharing/exporting



Para materializar este proyecto aportamos desde la **iniciativa RasPiMAX**, la definición y construcción de una **red de observatorios del aire** para escuelas, colaboradores oficiales de AEMET, y también para aficionados a la meteorología, presentando varios prototipos de **estación meteorológica y de calidad del aire automática (EMCAA)**, de construcción sencilla y bien definida como **proyecto de tecnología** con elementos asequibles de **hardware abierto** y **software libre**.

RasPiMAX, acrónimo de **Raspberry Pi** con GNU/Linux **MAX**, es una iniciativa educativa particular para difundir el uso del software libre y el hardware abierto, proponiendo ideas creativas e innovadoras de las TICs para todas las edades. Se apoya principalmente en **Raspberry Pi**, el miniPC por excelencia, con una amplia difusión en el mundo educativo anglosajón y en **MAX** (de **MA**drid_linuX) la versión de GNU/Linux que desarrolla **EducaMadrid** - Consejería de Educación, Juventud y Deporte de la Comunidad de Madrid para sus colegios.



Taking the challenge of sharing/exporting

uk.minimet.net

uk.minimet.net

[Unofficial prototype/model website of miniMET Project]

Proyecto miniMET v.beta 4.0 20170525
email: minimet@aemet.es

NMHS official logo

- THE MINIMET MANIFESTO
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- THE EDUCATIONAL COMMUNITY
- RasPiMAX: OPEN SOFTWARE + FREE HARDWARE**
- A TECNOLOGY PROJECT

In order to materialize this project, we do contribute, from the **RasPiMAX initiative**, with the definition and building of an **air observatories network** for schools, Aemet official collaborators, as well as for amateur meteorologists, proposing several **automatic weather and air quality station (AWAQS)** prototypes, of simple and well-defined construction as **technology projects** with affordable elements of **open hardware** and **free software**.

RasPiMAX, acronym of **Raspberry Pi** with GNU/Linux **MAX**, is a particular educational initiative to spread the use of free software and open hardware, proposing creative and innovative ideas of ICTs for people of all ages. It relies mainly on **Raspberry Pi**, the miniPC par excellence, with a wide spread in the Anglo-Saxon educational world, and on **MAX** (from **MAdrid_linuX**) a versión of GNU/Linux developed by **EducaMadrid** - *Consejería de Educación, Juventud y Deporte* of the community of Madrid for his schools.

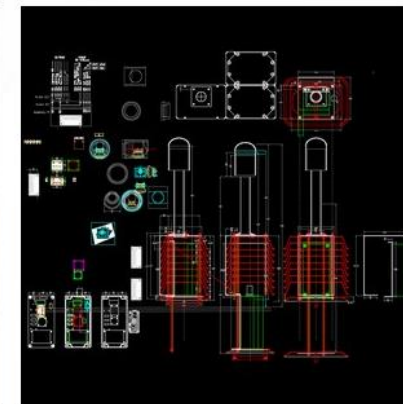


Taking the challenge of sharing/exporting



El proyecto desarrolla los siguientes aspectos:

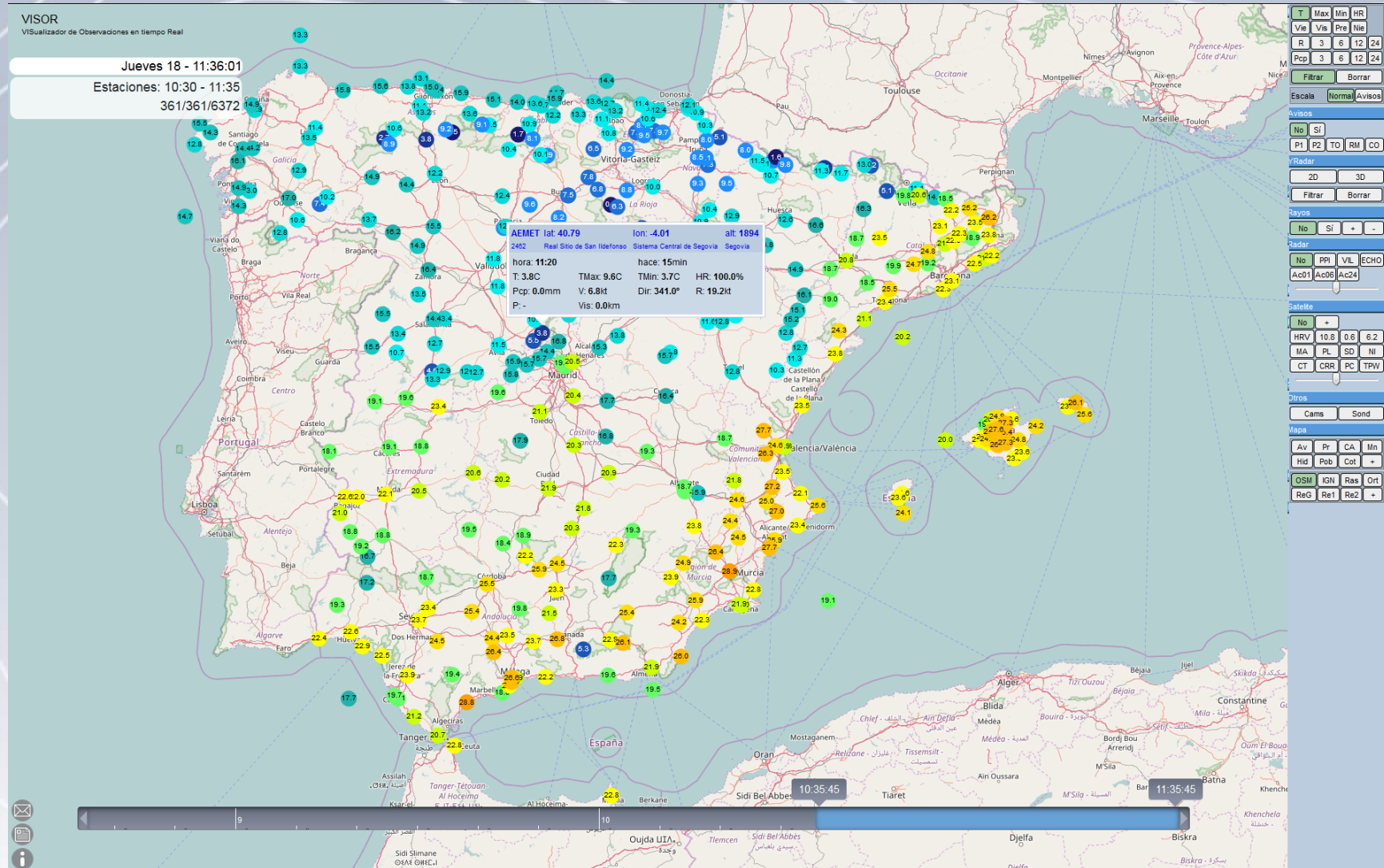
- Bricolaje para construir una garita meteorológica
- Introducción a los miniPCs y tarjetas de desarrollo
- Introducción a los sensores y las comunicaciones
- Iniciación a la programación en Python y otros
- Integración y pruebas de la estación
- Ubicación, instalación y puesta en marcha
- Lectura y análisis de los datos observados
- Transmisión y recuperación de los datos



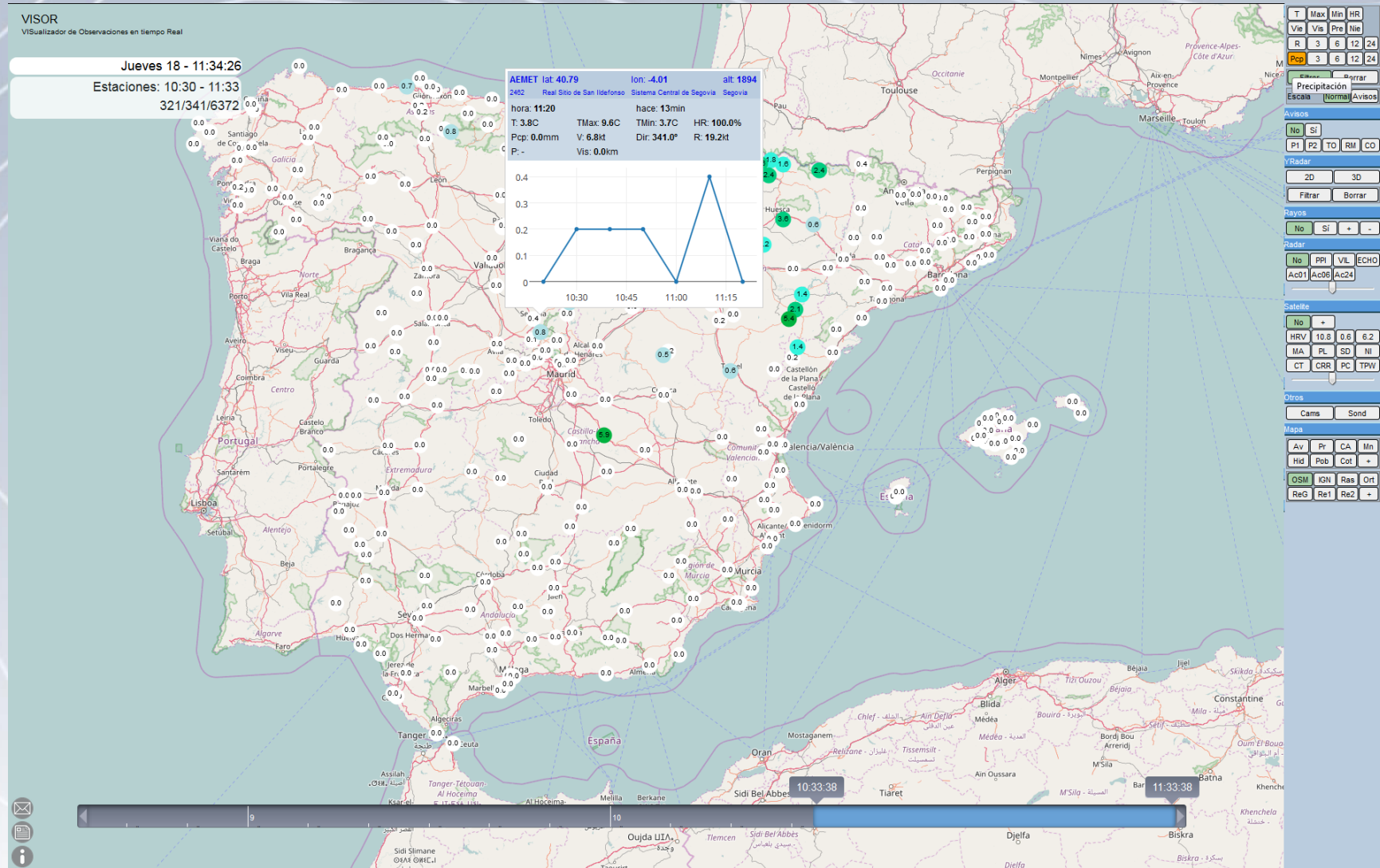
VISOR of AEMET

- **VISOR** is an AEMET's experimental application for visualizing several types of weather-related information managed in **LAYERS** over an **OpenMaps** base.
- Although at present moment it is an intranet application for our own production work, it is intended to be our candidate for showing publicly on the Internet the **miniMET network**.
- It will locate on the map every registered **AWAQS** (automatic weather and air quality station), whether it is an official collaborator, a school team or a particular amateur meteorologist.

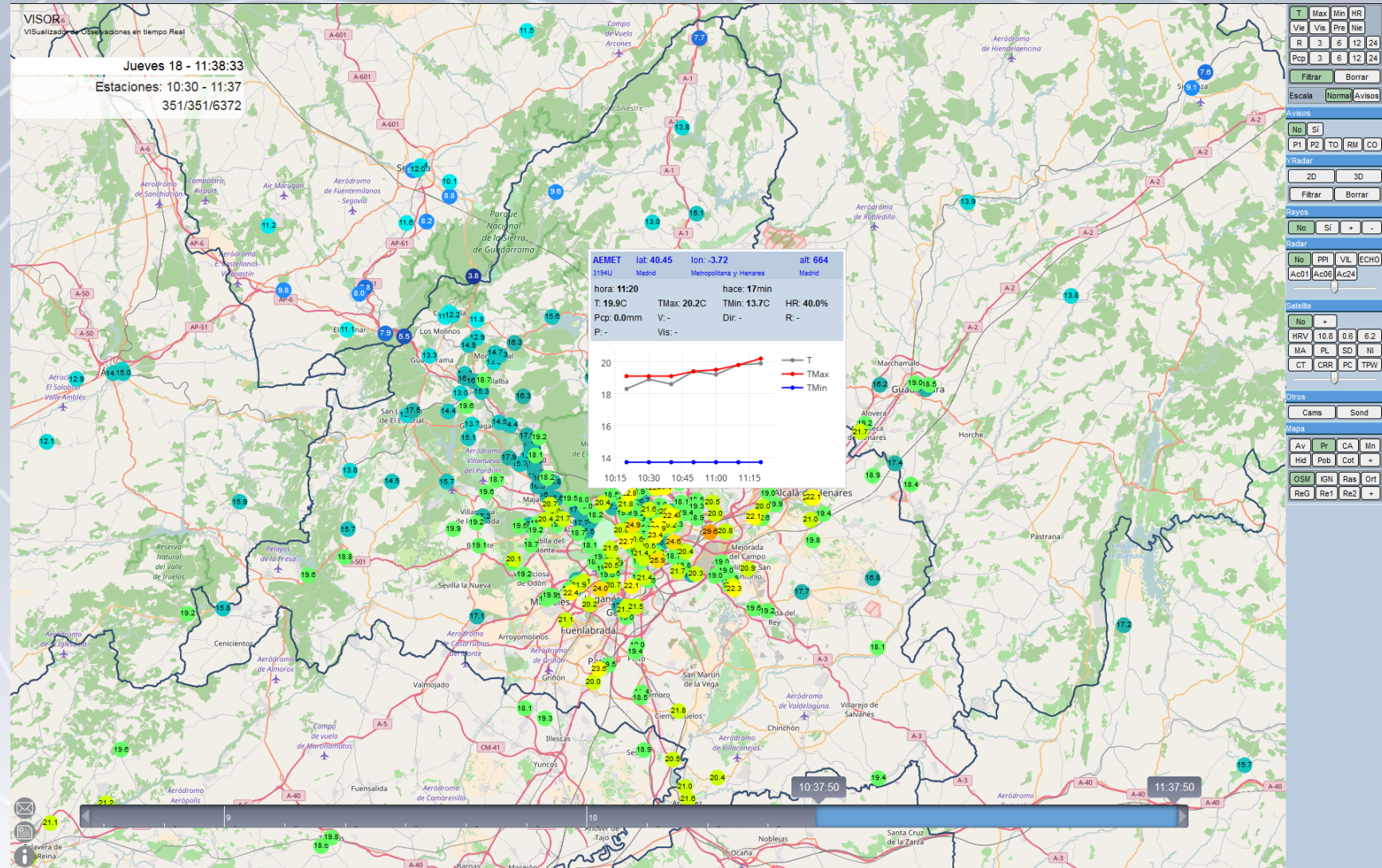
VISOR of AEMET



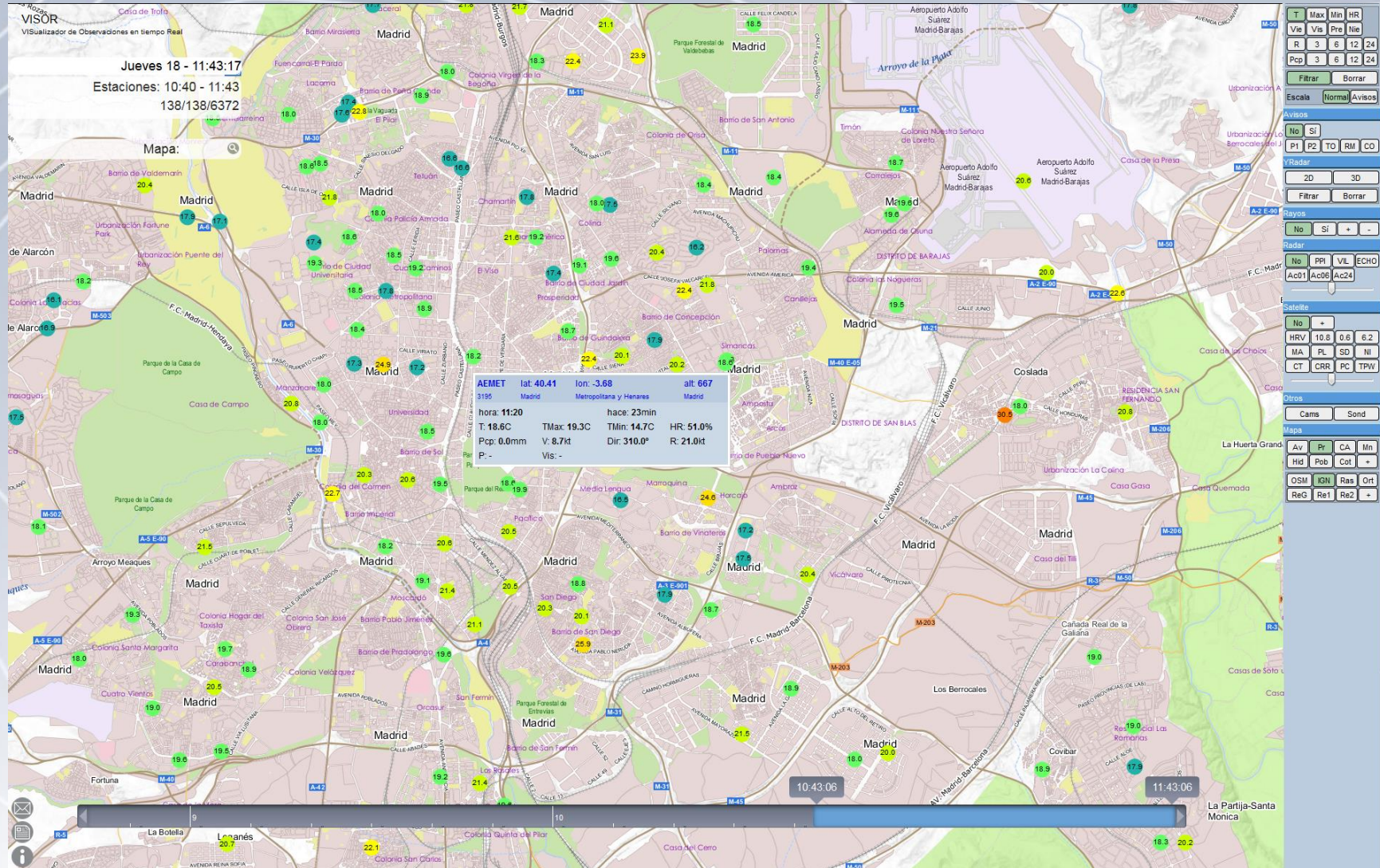
VISOR of AEMET



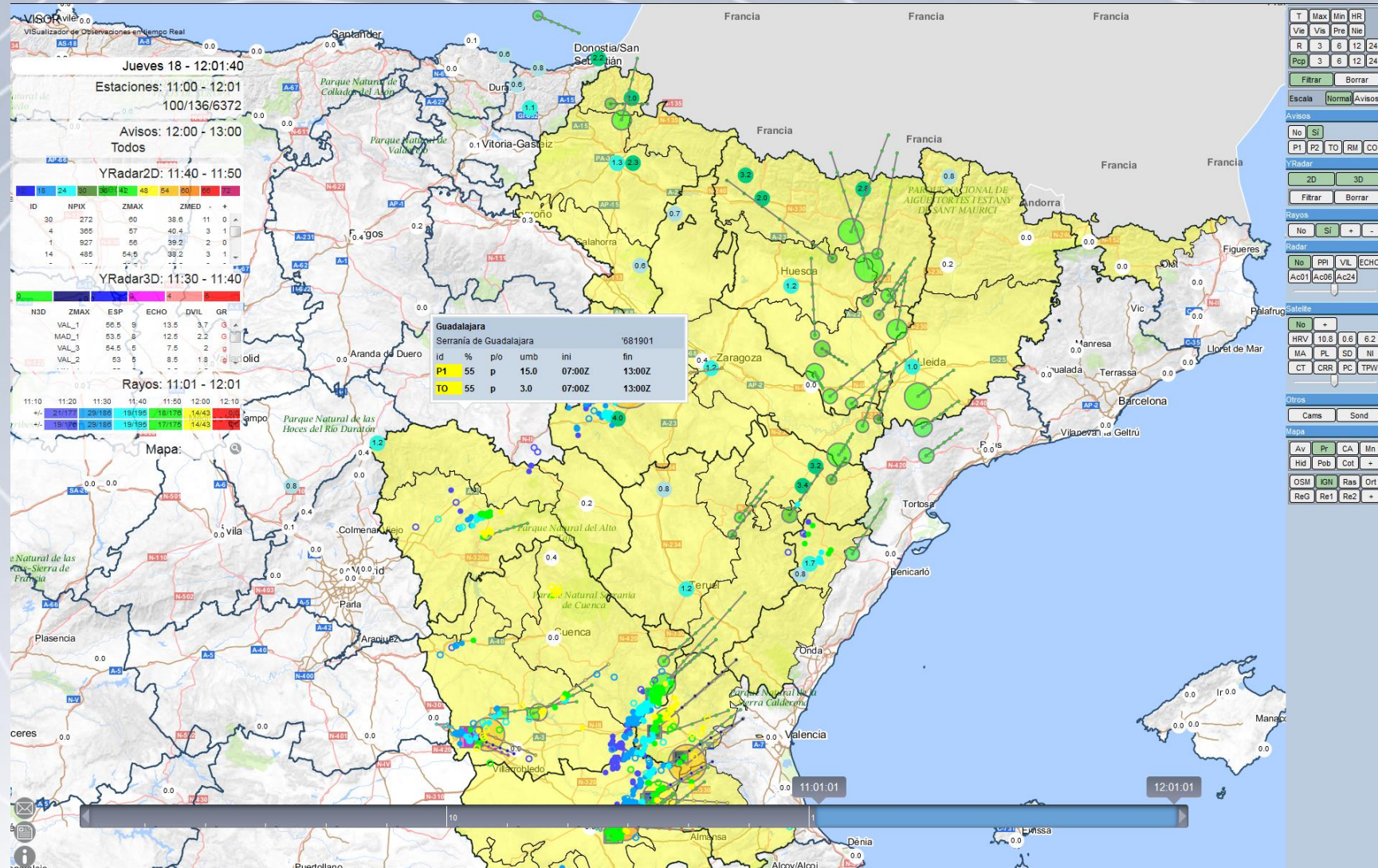
VISOR of AEMET



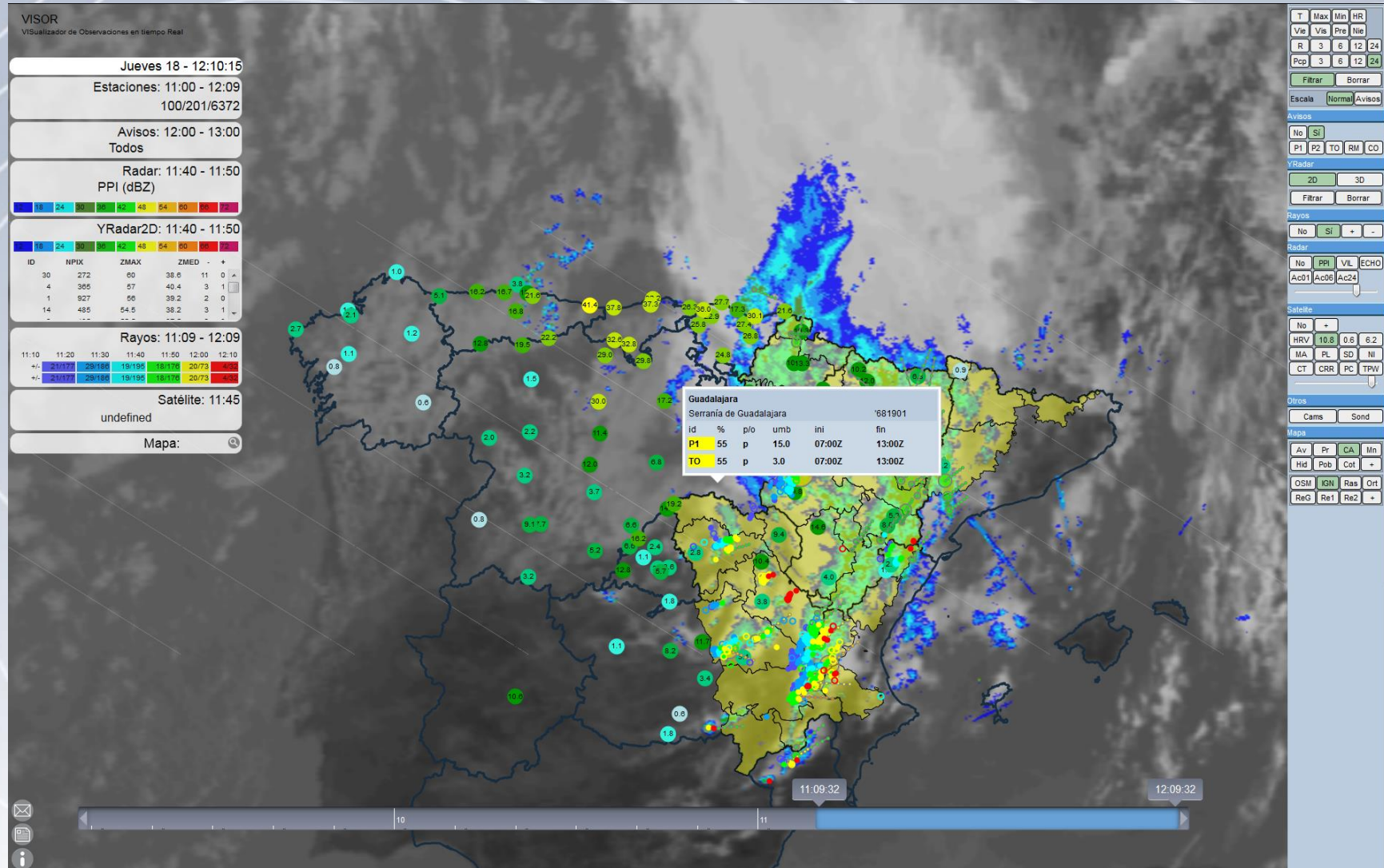
VISOR of AEMET



VISOR of AEMET



VISOR of AEMET



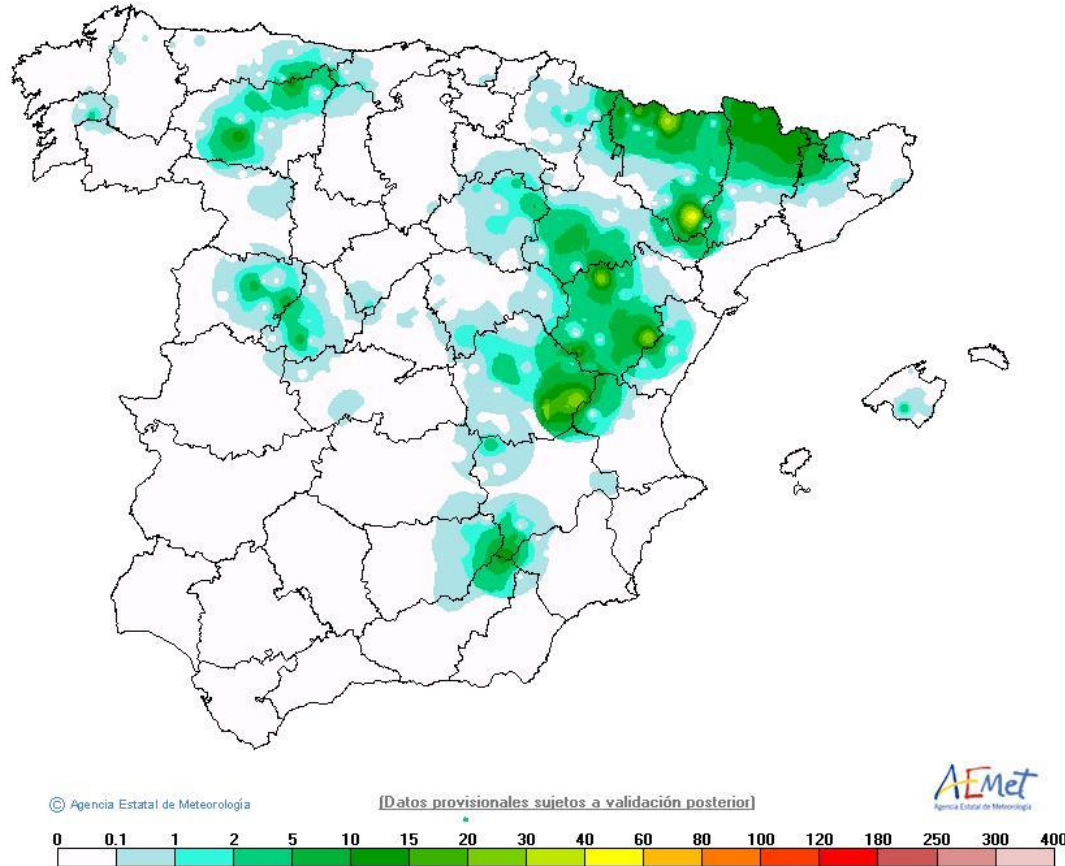
Climatological Charts

Aemet's **Climatological Data Bank Service** is ready to provide **daily charts** and **monthly summaries** of every layer of data either from his own data bank or from Aemet's **Open Data**, which includes those from the **miniMET Project Stations**.

Example charts courtesy of **Cesar Rodriguez Ballesteros** ([@crballesteros](https://twitter.com/crballesteros))
from Aemet's Climatological Data Bank
and from his blog <http://climaenmapas.blogspot.com.es>

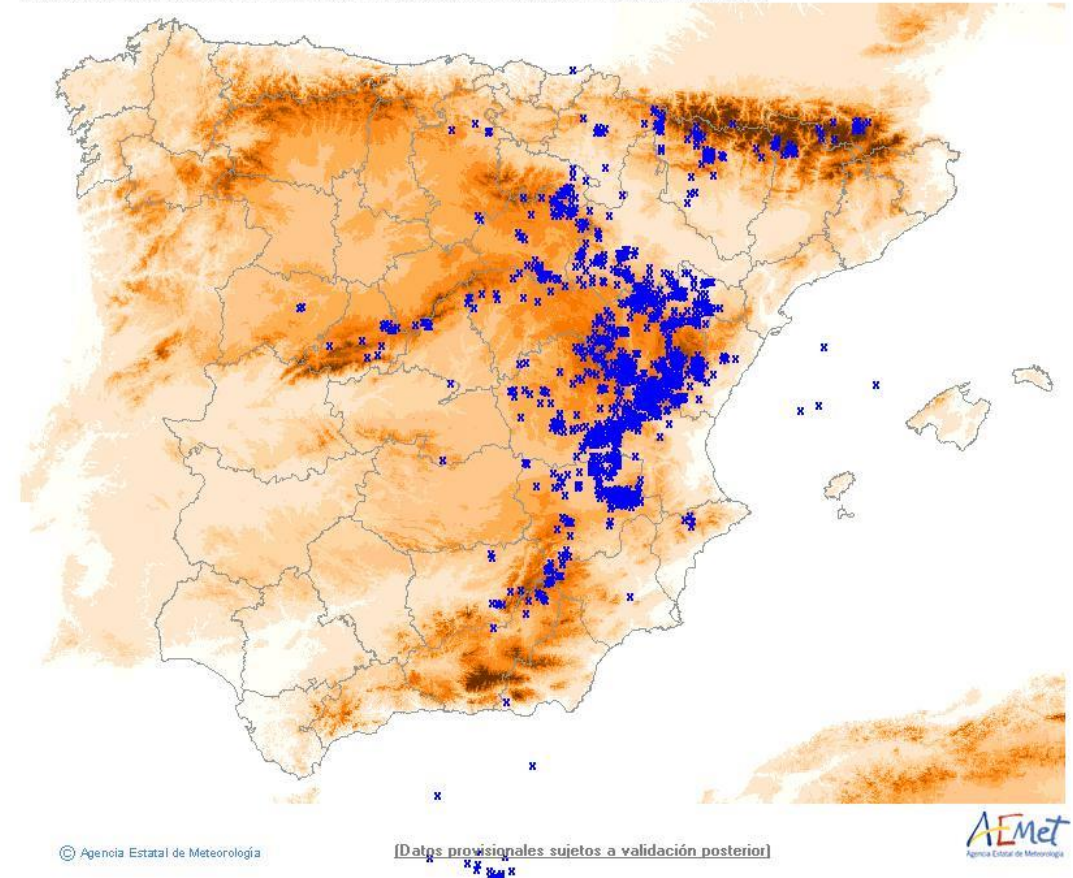
Climatological daily charts

Precipitación (mm) entre las 20:10UTC del día 30/05/2017 y las 20:00UTC del día 31/05/2017



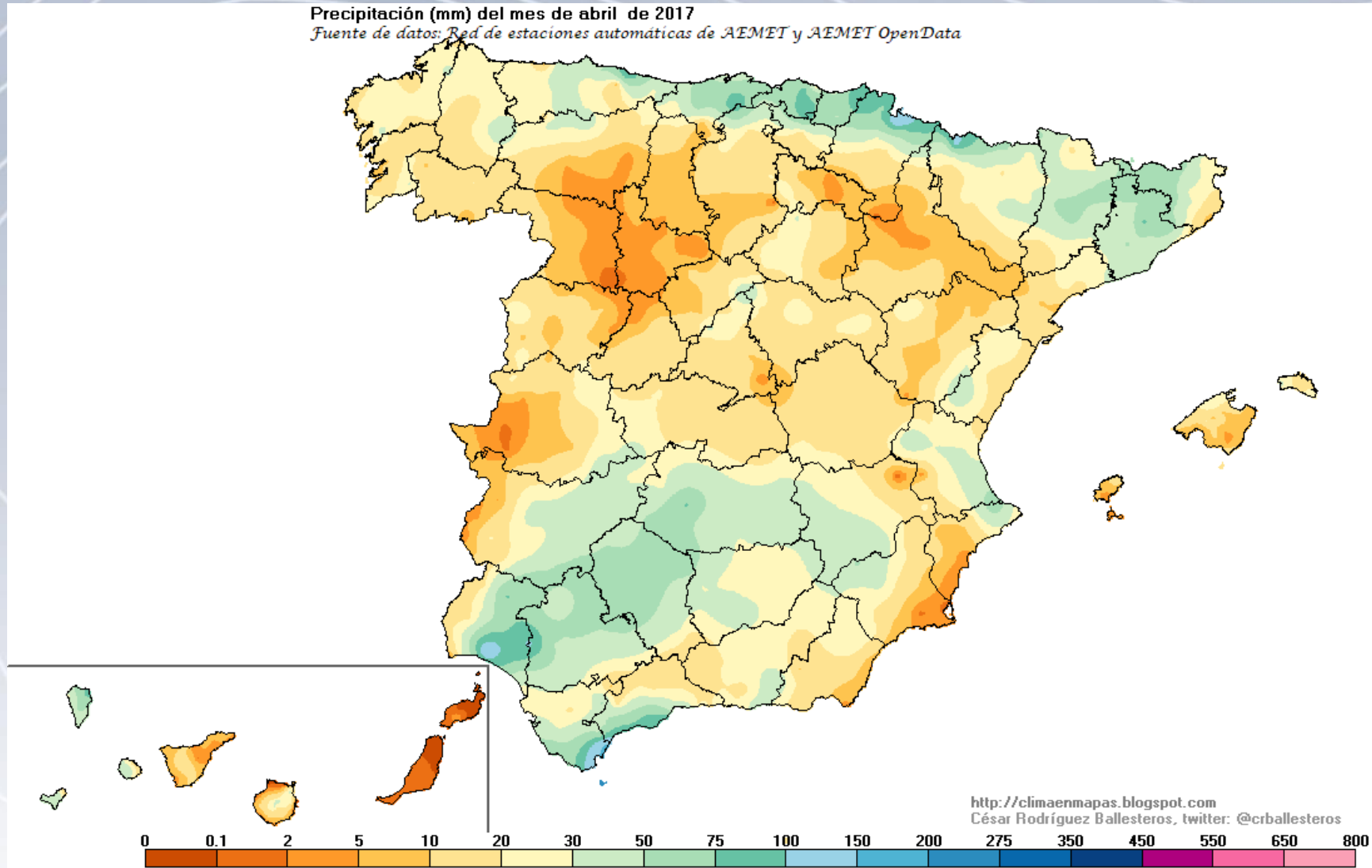
Last 24h rain

Rayos registrados entre las 20:00:01UTC del día 30/05/2017 y las 20:00:00UTC del día 31/05/2017

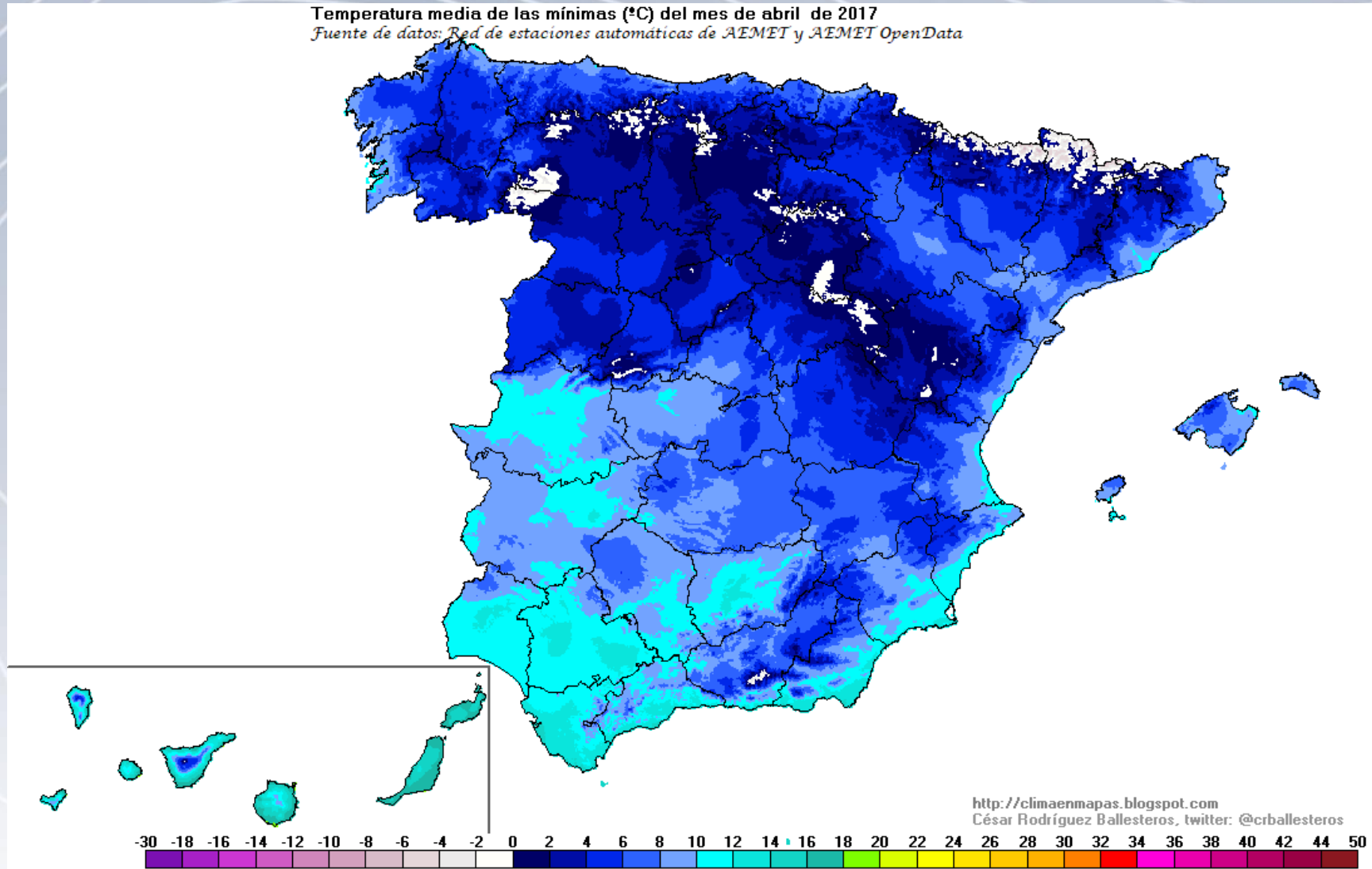


Last 24h lightning

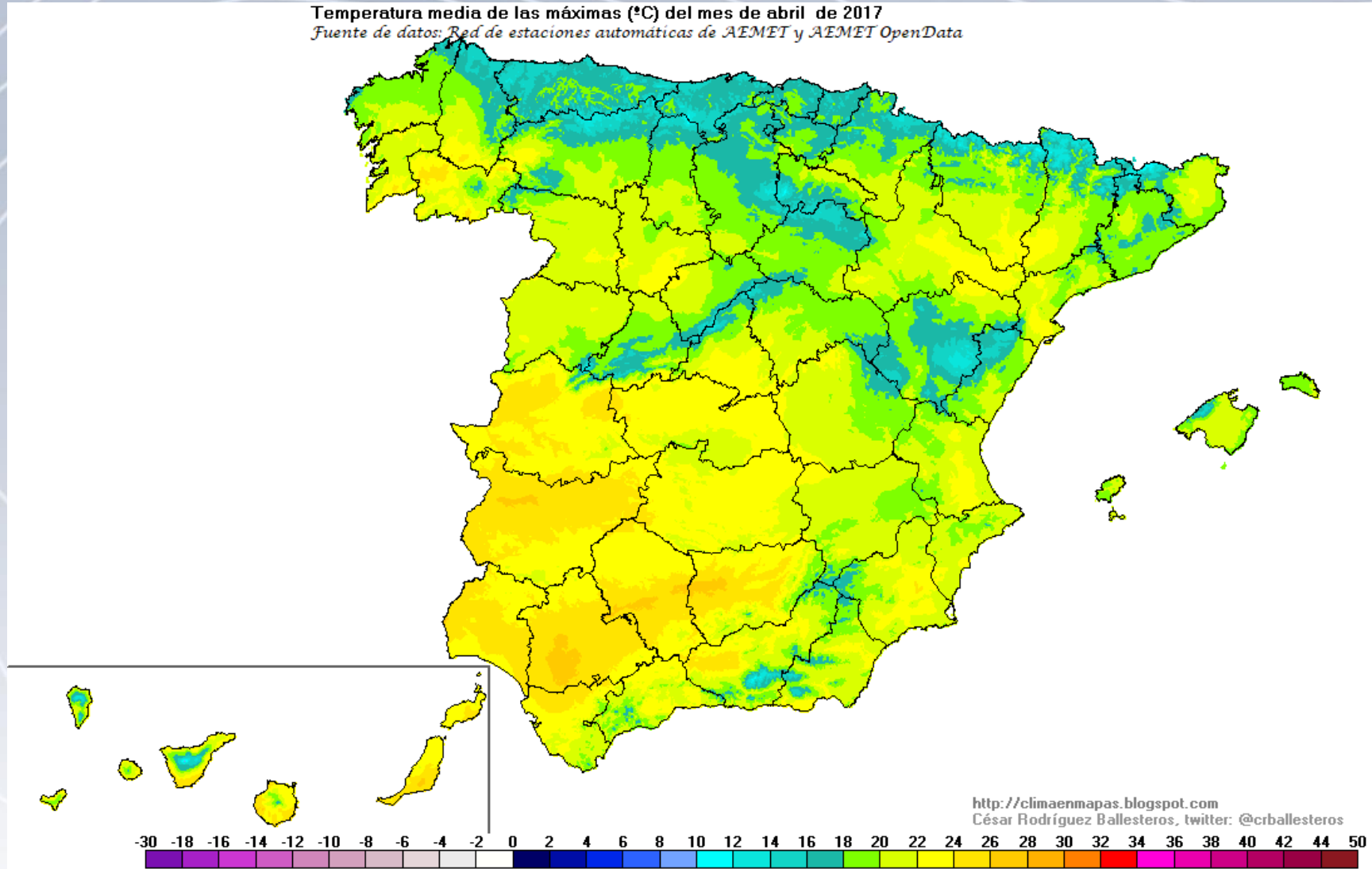
Climatological monthly summary charts

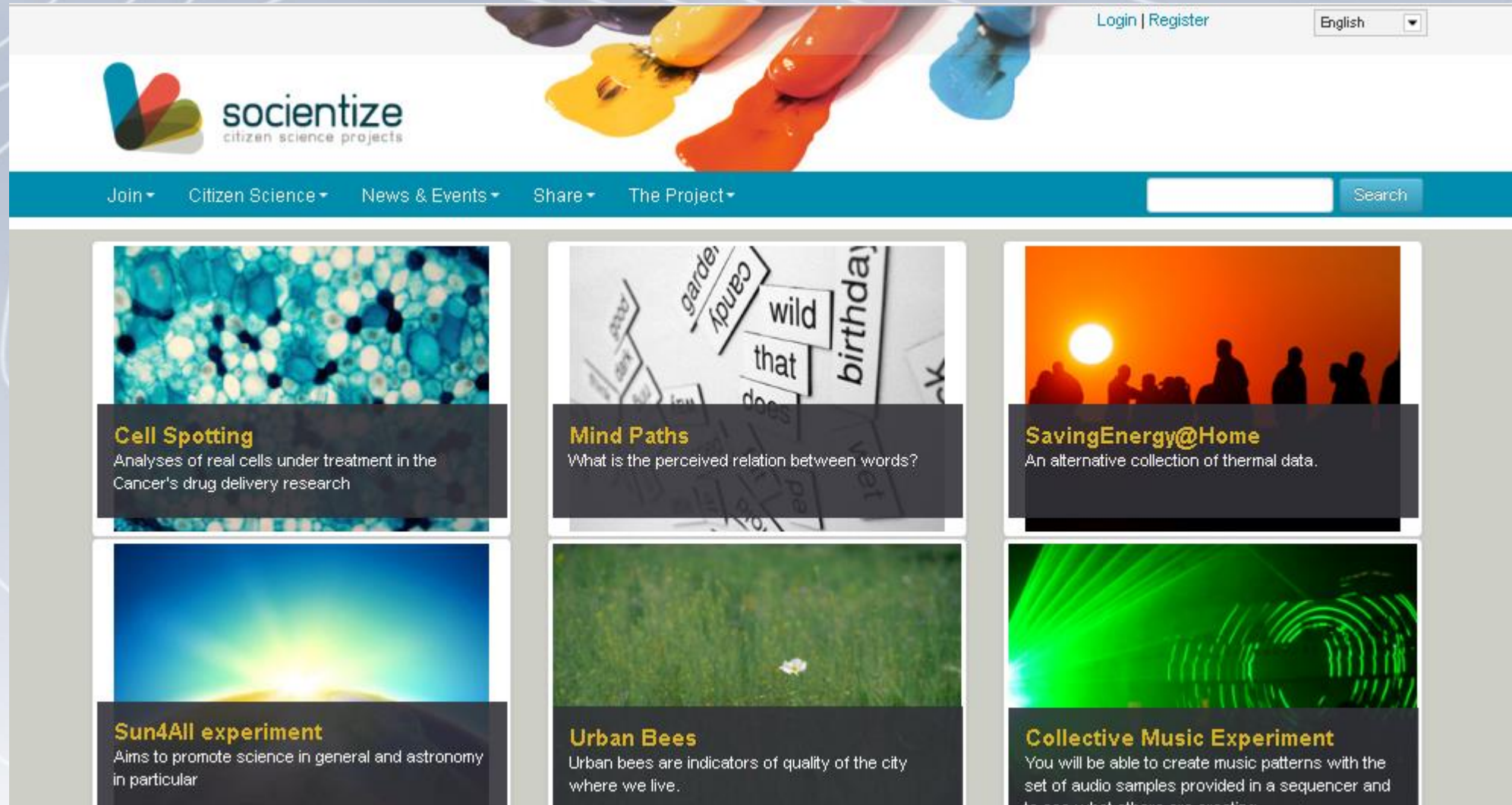


Climatological monthly summary charts



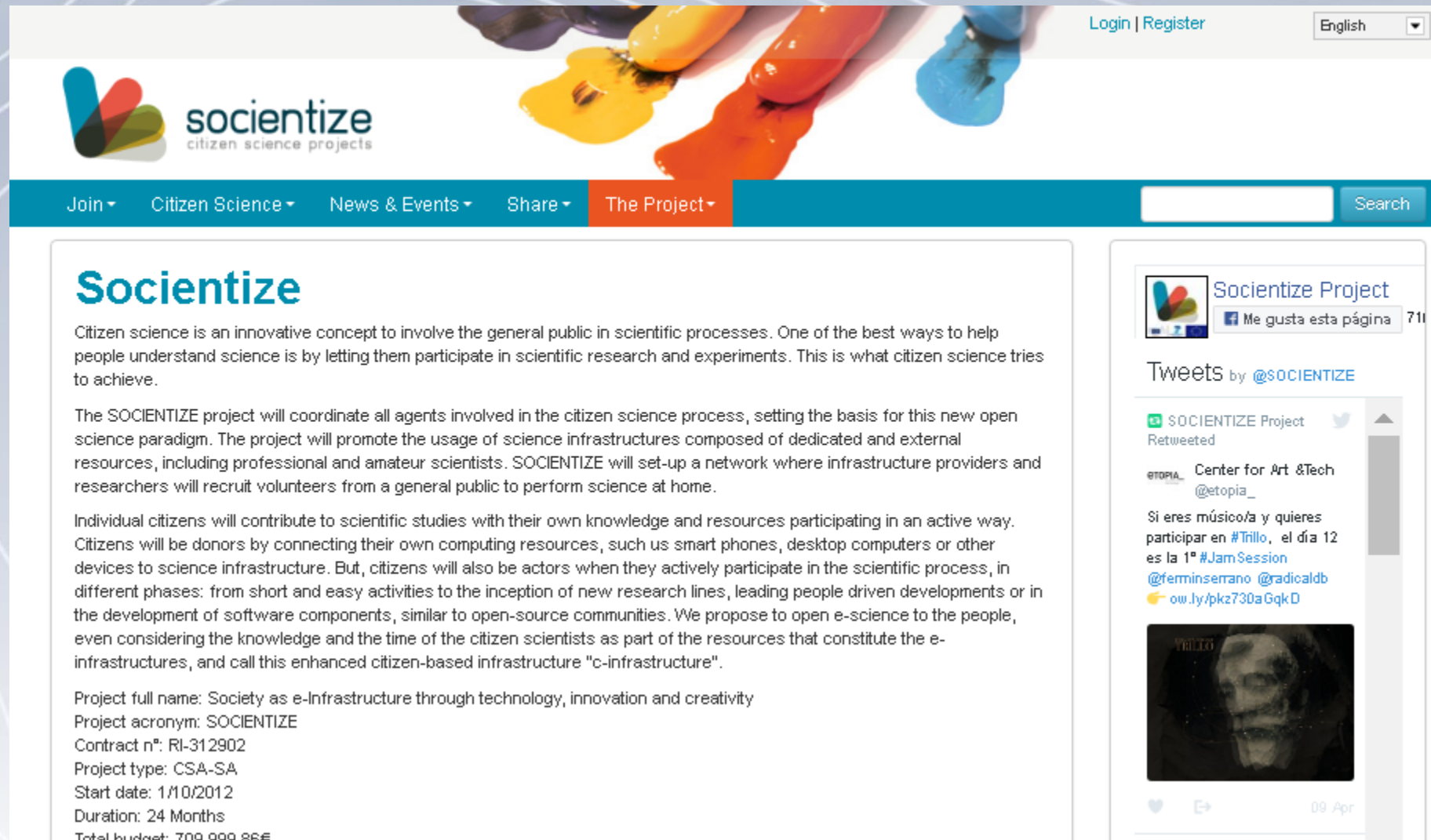
Climatological monthly summary charts



socientize.eu

The screenshot displays the homepage of the socientize.eu website. At the top, there is a navigation bar with the site's logo, "socientize citizen science projects", and links for "Login | Register" and a language dropdown set to "English". Below this is a teal navigation bar with menu items: "Join", "Citizen Science", "News & Events", "Share", and "The Project", followed by a search bar. The main content area features a grid of six project cards, each with a representative image, a title, and a brief description.

- Cell Spotting**: Analyses of real cells under treatment in the Cancer's drug delivery research. (Image: Microscopic view of cells)
- Mind Paths**: What is the perceived relation between words? (Image: Word cloud with terms like "garden", "wild", "birthday")
- SavingEnergy@Home**: An alternative collection of thermal data. (Image: Silhouettes of people against a sunset)
- Sun4All experiment**: Aims to promote science in general and astronomy in particular. (Image: Sunrise over a horizon)
- Urban Bees**: Urban bees are indicators of quality of the city where we live. (Image: A bee on a green lawn)
- Collective Music Experiment**: You will be able to create music patterns with the set of audio samples provided in a sequencer and to see what others are creating. (Image: Green laser light patterns)

socientize.eu

The screenshot shows the homepage of the socientize.eu website. The header features the Socientize logo (a stylized 'V' made of three colored shapes) and the text 'socientize citizen science projects'. To the right of the logo is a navigation bar with links: 'Join', 'Citizen Science', 'News & Events', 'Share', and 'The Project'. Further right are links for 'Login | Register' and a language dropdown set to 'English'. Below the navigation bar is a search bar with a 'Search' button. The main content area on the left is titled 'Socientize' and contains three paragraphs of text describing the project's goals and citizen science concept. On the right side, there is a social media section for 'Socientize Project' showing a tweet from '@etopia_' about a music jam session.

Socientize

Citizen science is an innovative concept to involve the general public in scientific processes. One of the best ways to help people understand science is by letting them participate in scientific research and experiments. This is what citizen science tries to achieve.

The SOCIENTIZE project will coordinate all agents involved in the citizen science process, setting the basis for this new open science paradigm. The project will promote the usage of science infrastructures composed of dedicated and external resources, including professional and amateur scientists. SOCIENTIZE will set-up a network where infrastructure providers and researchers will recruit volunteers from a general public to perform science at home.

Individual citizens will contribute to scientific studies with their own knowledge and resources participating in an active way. Citizens will be donors by connecting their own computing resources, such as smart phones, desktop computers or other devices to science infrastructure. But, citizens will also be actors when they actively participate in the scientific process, in different phases: from short and easy activities to the inception of new research lines, leading people driven developments or in the development of software components, similar to open-source communities. We propose to open e-science to the people, even considering the knowledge and the time of the citizen scientists as part of the resources that constitute the e-infrastructure, and call this enhanced citizen-based infrastructure "c-infrastructure".

Project full name: Society as e-Infrastructure through technology, innovation and creativity
Project acronym: SOCIENTIZE
Contract n°: RI-312902
Project type: CSA-SA
Start date: 1/10/2012
Duration: 24 Months
Total budget: 709.000.86€

Socientize Project
Me gusta esta página 711

Tweets by @SOCIENTIZE

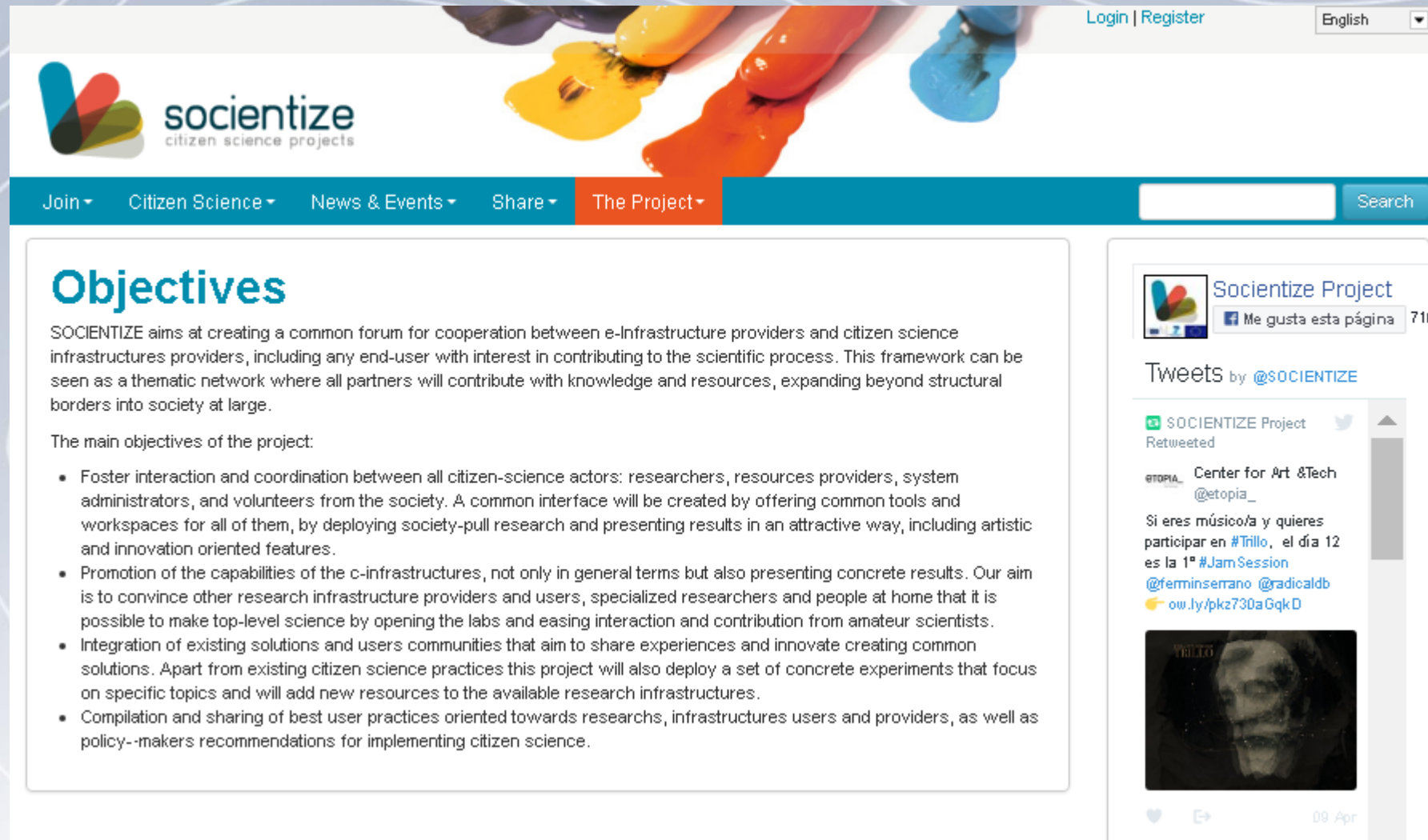
SOCIENTIZE Project Retweeted

etopia_ Center for Art &Tech @etopia_

Si eres músico/a y quieres participar en #Trillo, el día 12 es la 1ª #JamSession @fermineserrano @radicaldb ow.ly/pkz730aGqkD

09 Apr

socientize.eu



The screenshot displays the Socientize website interface. At the top, there's a header with the Socientize logo (a stylized 'V' made of three colored shapes) and the text 'socientize citizen science projects'. To the right of the logo are links for 'Login' and 'Register', and a language dropdown menu set to 'English'. Below the header is a navigation bar with several menu items: 'Join', 'Citizen Science', 'News & Events', 'Share', and 'The Project' (which is highlighted in orange). A search bar is located to the right of the navigation bar.

Objectives

SOCIENTIZE aims at creating a common forum for cooperation between e-Infrastructure providers and citizen science infrastructures providers, including any end-user with interest in contributing to the scientific process. This framework can be seen as a thematic network where all partners will contribute with knowledge and resources, expanding beyond structural borders into society at large.

The main objectives of the project:

- Foster interaction and coordination between all citizen-science actors: researchers, resources providers, system administrators, and volunteers from the society. A common interface will be created by offering common tools and workspaces for all of them, by deploying society-pull research and presenting results in an attractive way, including artistic and innovation oriented features.
- Promotion of the capabilities of the c-infrastructures, not only in general terms but also presenting concrete results. Our aim is to convince other research infrastructure providers and users, specialized researchers and people at home that it is possible to make top-level science by opening the labs and easing interaction and contribution from amateur scientists.
- Integration of existing solutions and users communities that aim to share experiences and innovate creating common solutions. Apart from existing citizen science practices this project will also deploy a set of concrete experiments that focus on specific topics and will add new resources to the available research infrastructures.
- Compilation and sharing of best user practices oriented towards researchs, infrastructures users and providers, as well as policy-makers recommendations for implementing citizen science.

On the right side of the page, there's a Twitter feed for the 'Socientize Project' (@SOCIENTIZE). It shows a tweet from 'Center for Art & Tech' (@etopia_) about a music session, which has been retweeted by the Socientize Project. The tweet includes a link to a website and a small image of a person's face.

Thank you very much! Questions?

