
esa
IV ESA EARSEL CNR School -Remote Sensing for Forest Fires:
EO Browser Wildfire case study (S1,S2,S5-P)
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European Space Agency

Summary

1. Overview of Sentinel Hub:
    1. Sentinel Playground
    2. EO Browser
    3. Industries and Showcases
    4. Education
2. Wildfires Case Study in EO Browser
3. Wildfire in Madrid, Spain (July 2019)
    1. Sentinel-2: False Colour, Moisture Index
    2. Sentinel-5P NO_2
    3. Sentinel-1
    4. Sentinel-3 F1 Brightness Temperature
    5. Complementary data from Copernicus Emergency Management Service: Standard Precipitation Index, Soil Moisture Anomalies, Country statistics

The summary of the contents we will follow

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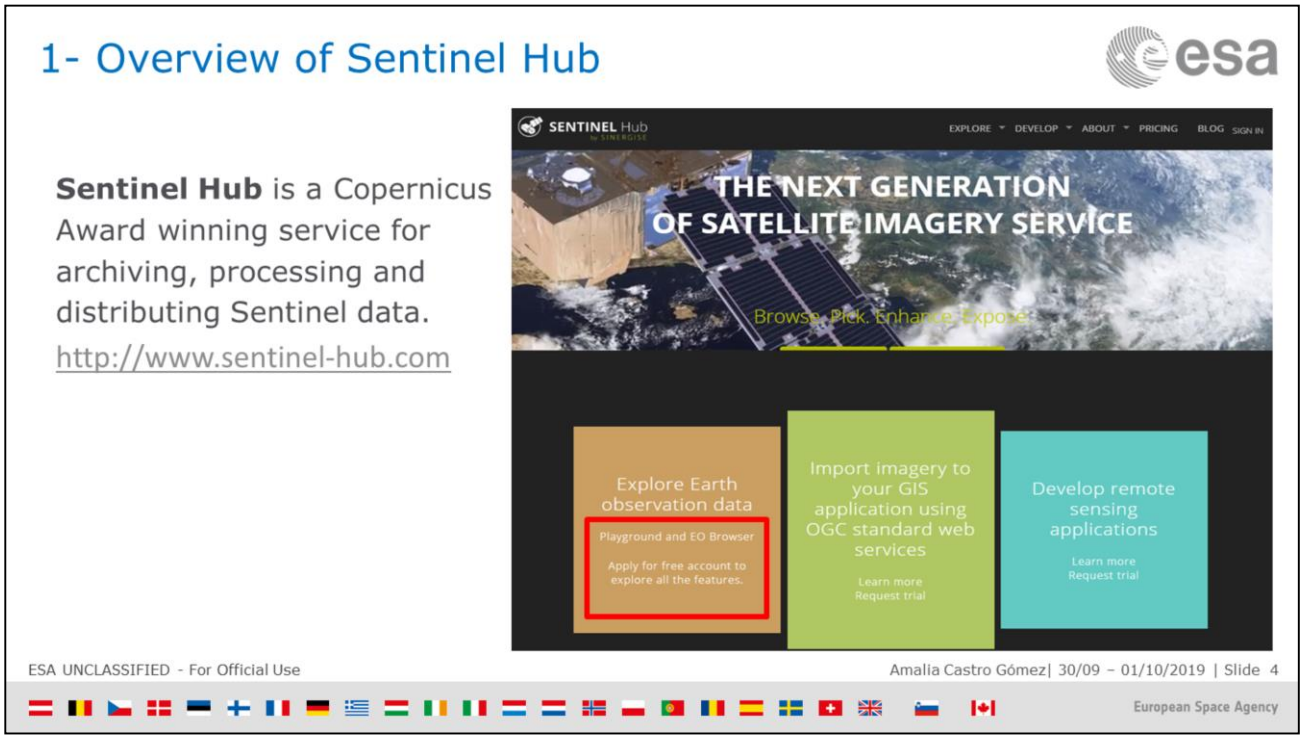
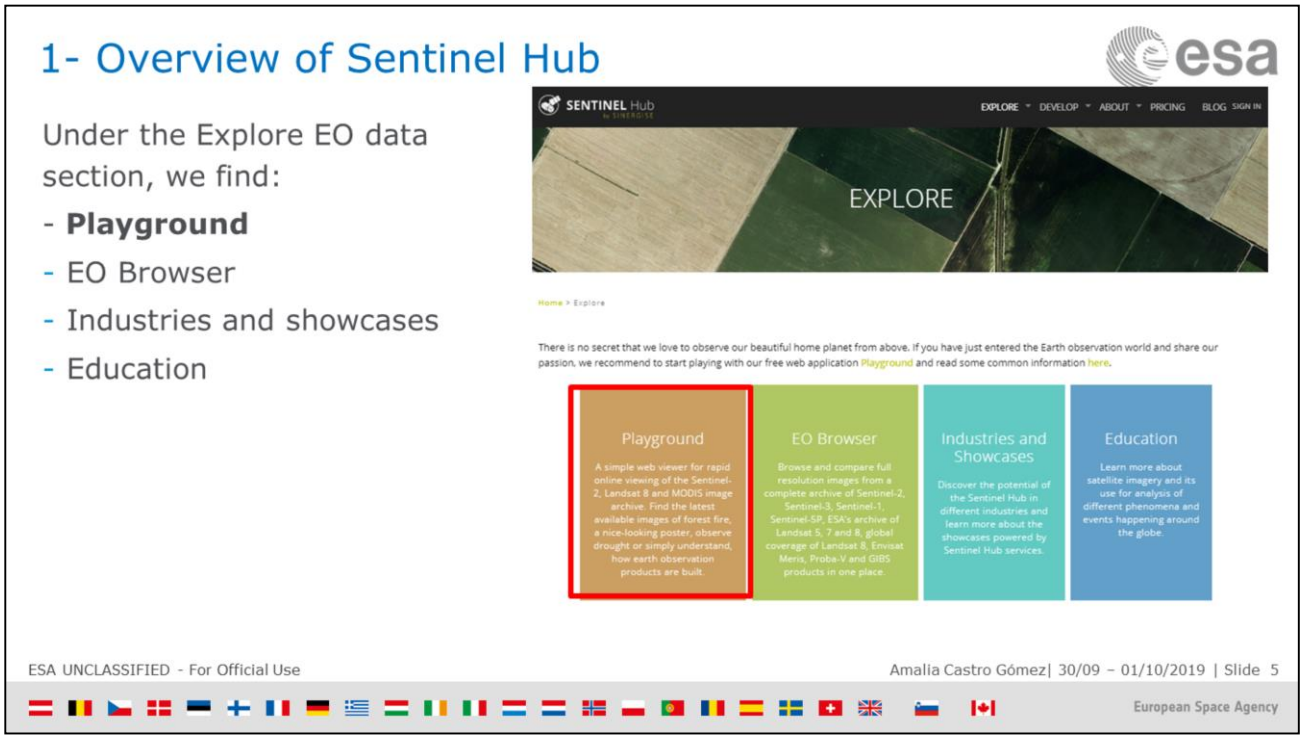


Sentinel Hub is a Copernicus Award (http://www.copernicus-masters.com/index.php?anzeige=press-2016-03.html) winning service for archiving, processing and distribution of Sentinel data.

Users can look closely into the global archive of all the Sentinels and explore this rich archive to monitor changes in the land. They can:

- Observe imagery all over the globe
- Create statistical analysis and compare different sensors
- Export results as a raster for further processing



Under the Explore EO data section, we find:

- Playground,
- EO Browser
- Industries and showcases
- Education

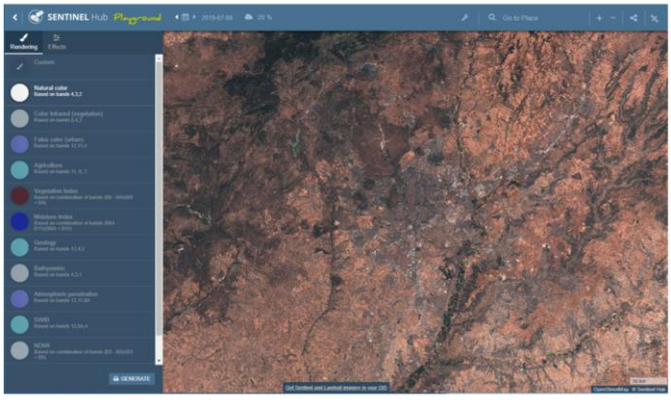
We will use EO Browser, but first let's have a quick overview of what those sections contain.

First the Sentinel Playground section.

1- Overview of Sentinel Hub

http://apps.sentinel-hub.com/sentinel-playground/

Sentinel Playground is a simple web viewer for rapid exploring of Sentinel-2, Landsat-8 and MODIS, along with access to data products (NDWI, etc)



The Sentinel Playground is a web application that is publicly available and allows users to query for Sentinel data all over the world.

It is a graphical interface to a complete and daily updated **Sentinel-2** archive, a massive resource for anyone interested in Earth's changing surface, natural or manmade.

It is perfect for someone who wants to find the latest available images of forest fire, or create a nice looking poster, observe drought or simply understand how EO products are built.

Access it at: http://apps.sentinel-hub.com/sentinel-playground/

1- Overview of Sentinel Hub

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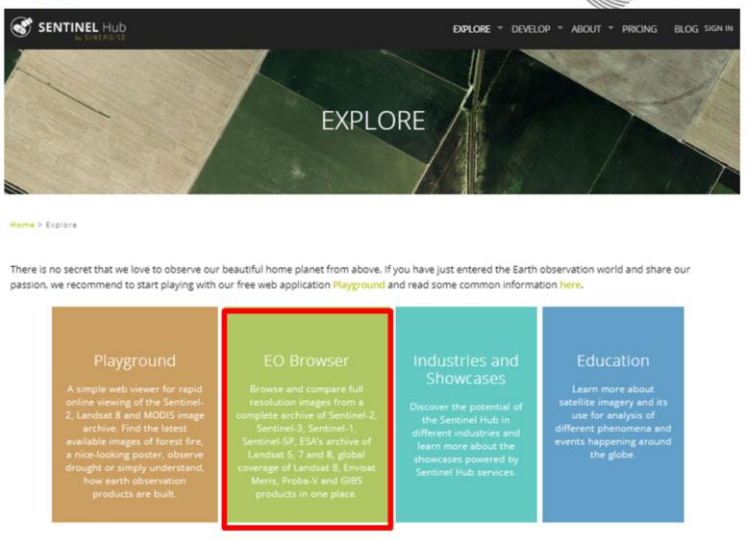


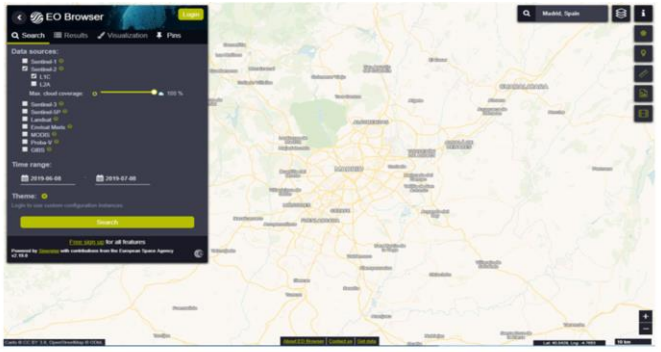
Next let's have a closer look at the EO Browser.

1- Overview of Sentinel Hub

https://www.sentinel-hub.com/explore/eobrowser

EO Browser is a tool to compare the complete archives of all the Sentinels, as well as Landsat, Envisat Meris, Prova-V and GIBS.

It allows instant access to browse through petabytes of newest and archive data.



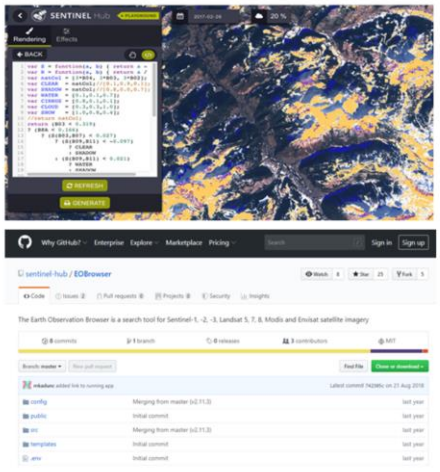
EO Browser allows instant access to browse through petabytes of newest and archive data and chronological comparison of full resolution images.

Their cloud infrastructure can produce results in a few seconds, and the user does not need to download, archive and process the data.

1- Overview of Sentinel Hub

Its features include:

- Comparison of data
- Visualization options (false colour, NDVI…)
- Custom band combination
- Run classification scripts (in java)
- Export georeferenced data
- Store algorithms
- Expert users can use Sentinel Hub OGC services to get the data in their own GIS environment.



More info at: https://sinergise.com/en/news/eo-browser-goes-public

Expert users, who would like to get earth observation data in their own GIS environment, can make use of Sentinel Hub Open Geospatial Consortium (OGC) services.

The front-end application is open source so anyone can take it and build added value services on top of Sentinel Hub OGC services.

For more general information about OGC start here: https://www.sentinel-hub.com/develop/documentation/api/ogc_api
Step-by-step guidelines for integration of Sentinel Hub OGC with ArcMap and QGIS: https://sentinel-hub.com/develop/documentation/integration-guide
Tutorial for the Sentinel-Hub QGIS plug-in: https://medium.com/sentinel-hub/control-sentinel-hub-from-within-qgis-2a83eb7f13db

1- Overview of Sentinel Hub

Demo video: https://www.youtube.com/embed/m3pron0C0kE

1- Overview of Sentinel Hub

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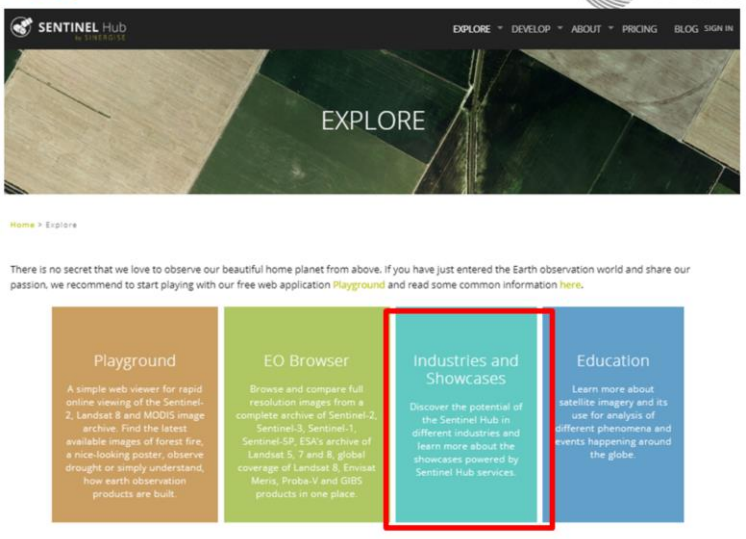

Next let's have a quick look at the "Industries and showcases" section.

1- Overview of Sentinel Hub

https://www.sentinel-hub.com/explore/industries-and-showcases

Several case studies based on the Sentinel Hub are presented, to demonstrate the potential of the Hub for:

- Agriculture
- Land Change Detection
- Water Resources Monitoring
- Drought Monitoring
- Insurance Industry
- Journalism and Media

1- Overview of Sentinel Hub

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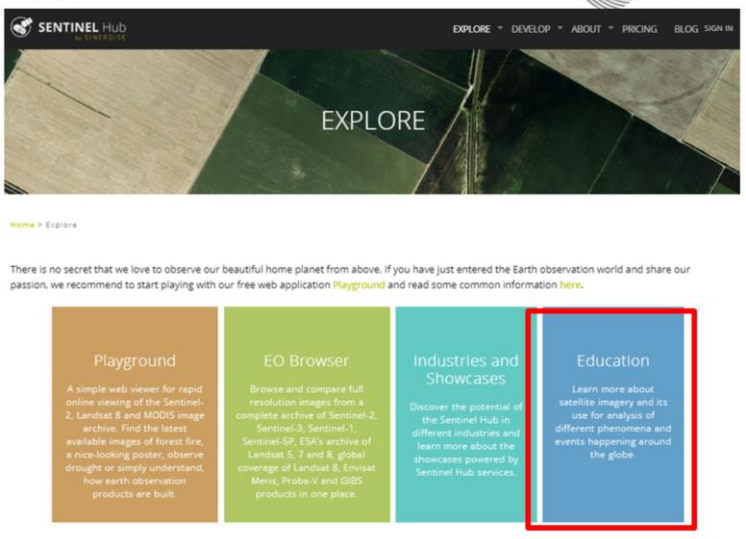
- **Education**



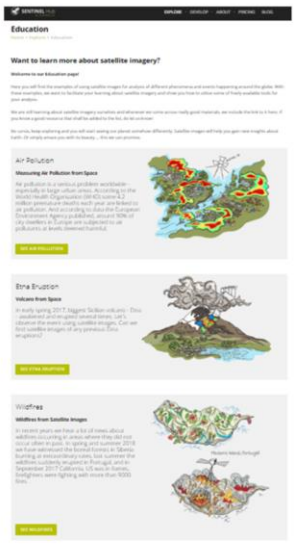
Finally let's have a look at the Education section

1- Overview of Sentinel Hub

https://www.sentinel-hub.com/explore/education

Examples of using satellite images for analysis of different phenomena, to facilitate learning. The current case studies, done in Jupyter Notebook, include:

- Air Pollution (measuring NO_2 and aerosols from **wildfires** with S-5P)
- Volcanology
- **Wildfires (with S2 & S5-P)**
- Other useful resources



With new technologies like machine learning and educational software the traditional educational methods as well as the role of educators are evolving. And so is the role of EO Browser. This free web application for browsing, comparing and analysing various satellite data sources is a very useful tool for experts in remote sensing field. But it is becoming more and more popular in teaching and engaging students with practical learning in Earth Observation. The EO Browser is being introduced to many teachers, during workshops and presentations at universities. Such activities inspired the creation of a landing page with educational materials.

Case studies are done with Jupyter Notebook, and are a mixture of code, text, figures, links, equations, etc.

Case studies inspire the definition of the so-called “Themes”, where the user can find different features related to the case study (e.g. pins).

In the session of today, we will go through the Wildfires case study. It is based on the devastating fire of Madeira in August 2016 and on Siberian fires in 2018.

We will reproduce those steps to get you familiar with the functionalities of EO Browser.

With this knowledge we will use EO Browser to explore the wildfire of Madrid from July 2019, looking at Sentinel-1, Sentinel-2, Sentinel-3 and Sentinel-5P.

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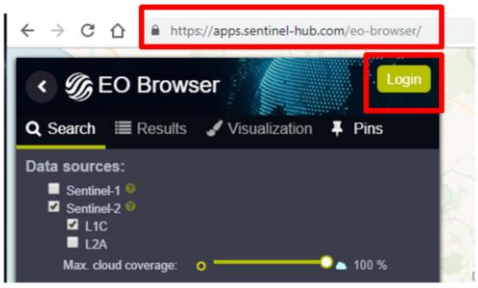
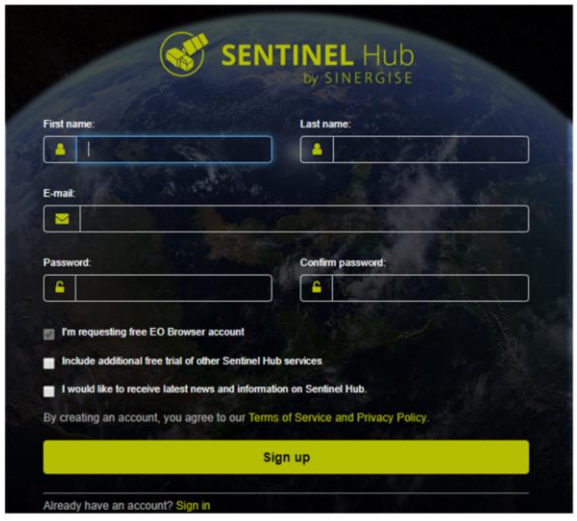
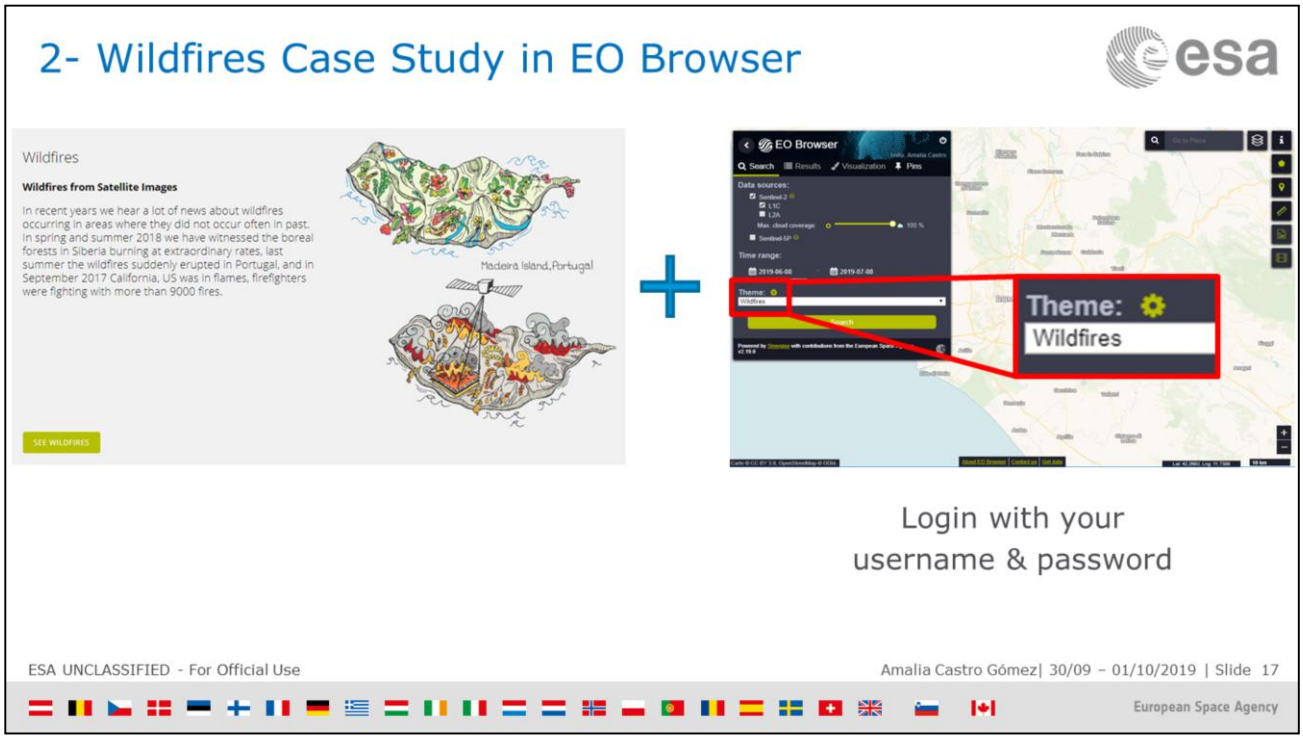
2- Wildfires Case Study in EO Browser

Create an account for free







Open the Wildfires Case Study.

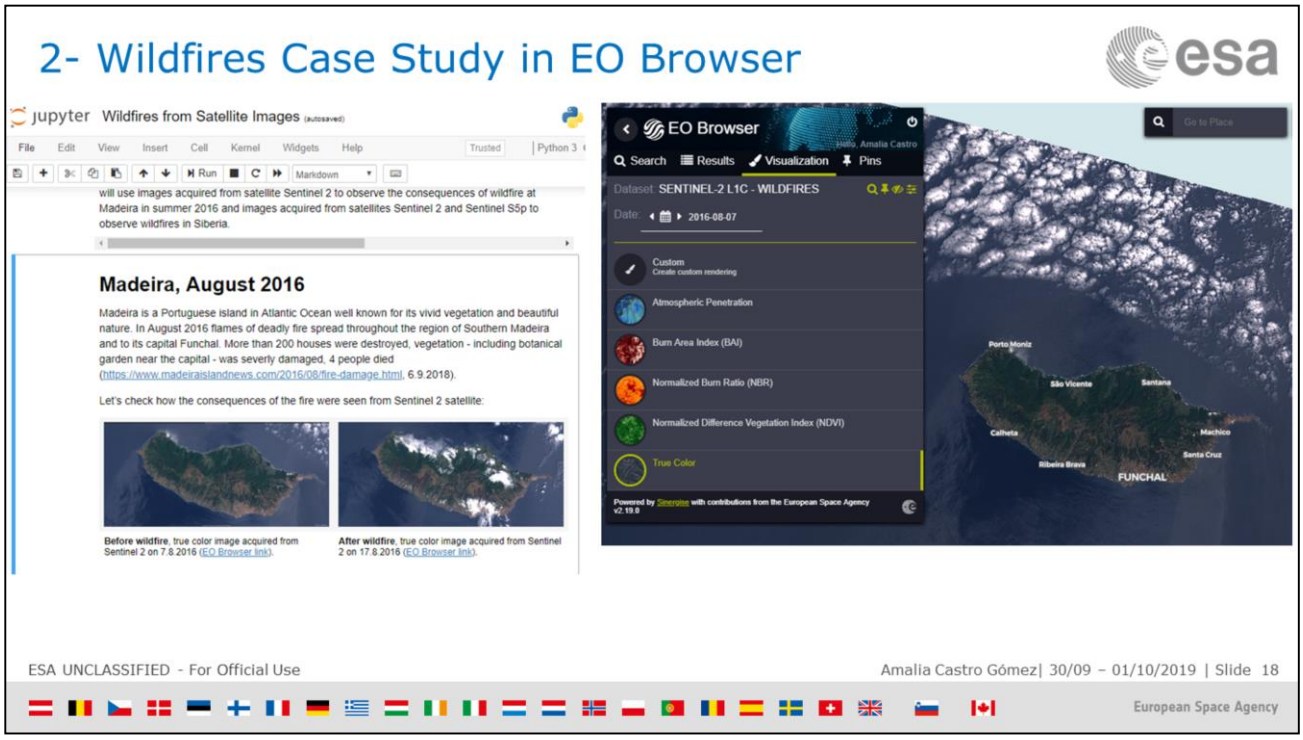
Open the EO Browser and display the Wildfires theme.

We will follow the case study and repeat its steps in parallel.

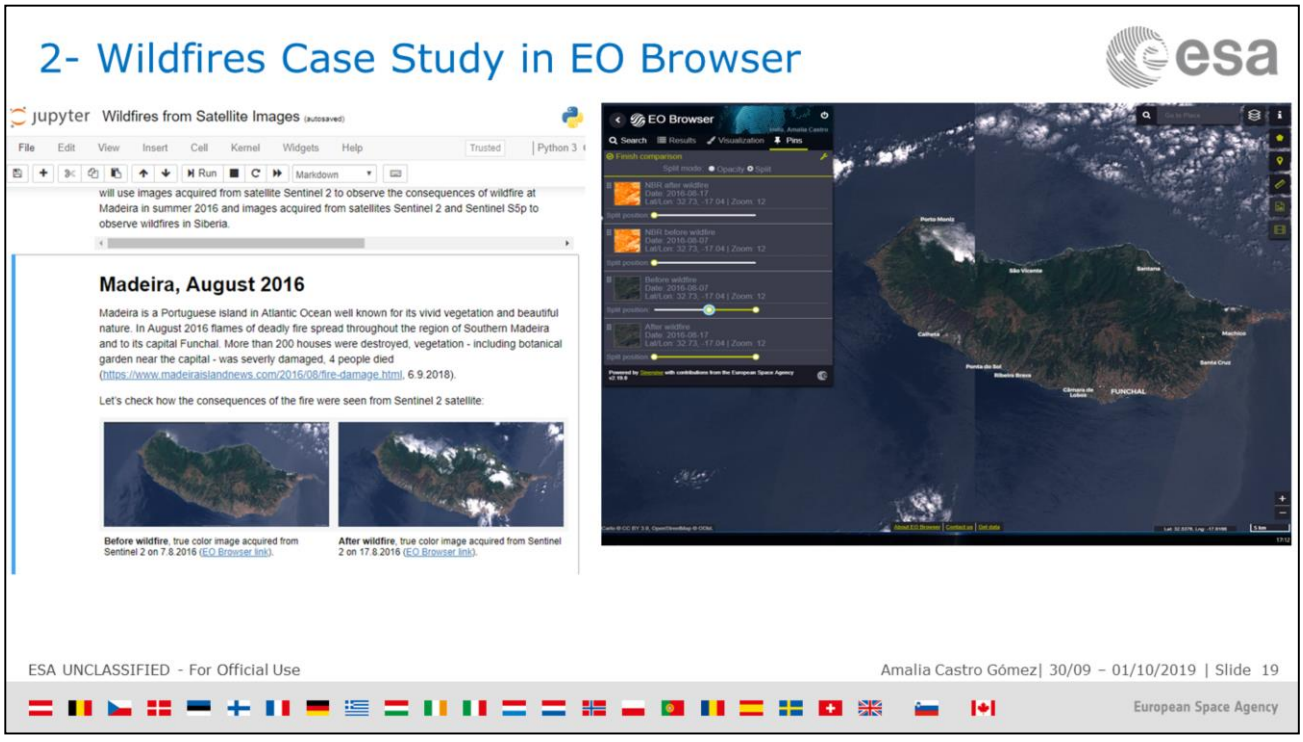
Look at the case study. The introduction gives a quick overview of the negative and beneficial consequences of wildfires. It explains how satellite imagery can be employed, and lists common uses.

In this case study we will check how some of the wildfires and their consequences can be seen from space:

- Madeira fires in summer 2016 (S2)
- Siberian fires in summer 2018 (S2 and S5P)



In the EO Browser Wildfires theme, click Pins. This is a selection of S2 images acquired before and after the fire, and their corresponding NBR.



Compare the images taken before and after the fire. From the demo video of Youtube you have seen it is possible to adjust their opacity and make a split display. Explore the different tools to reproduce this.

Reminder: Demo video at https://www.youtube.com/embed/m3pron0C0kE

In the Case Study, read about the NBR

Compare the NBR products taken before and after the fire, using split or opacity.

If you wanted to calculate the NBR yourself, you would need to:

1- Come out from the Wildfires Theme into the Default Theme

2- Search for the S2 image of your choice (e.g. over Madeira in 17/08/2016)

3- Visualize it

4- Choose Custom view

5- Enter the custom script:

return [(B08-B12)/(B08+B12)];

6- Press Refresh.

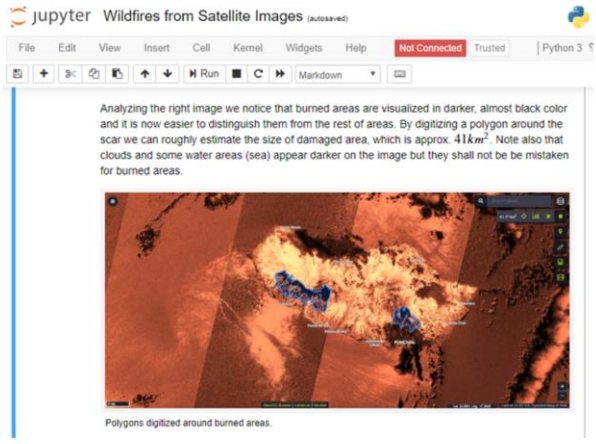
This would not assign a colour scale, which is possible if we extend the custom script. More information on how to assign a continuous colour scale with the colorBlend function:

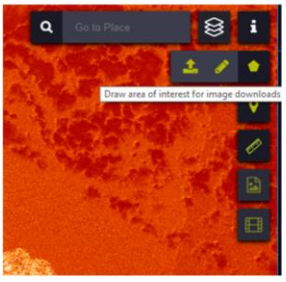
- For programmers: https://www.sentinel-hub.com/develop/documentation/api/custom-evaluation-script (at the

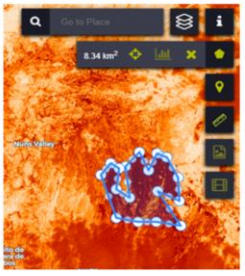
bottom of the page)

- For non-programmers, a simplified version of the tutorial above can be found at https://sentinel-hub.com/sites/default/Custom_script_tutorial.pdf, see chapter 5.2

2- Wildfires Case Study in EO Browser







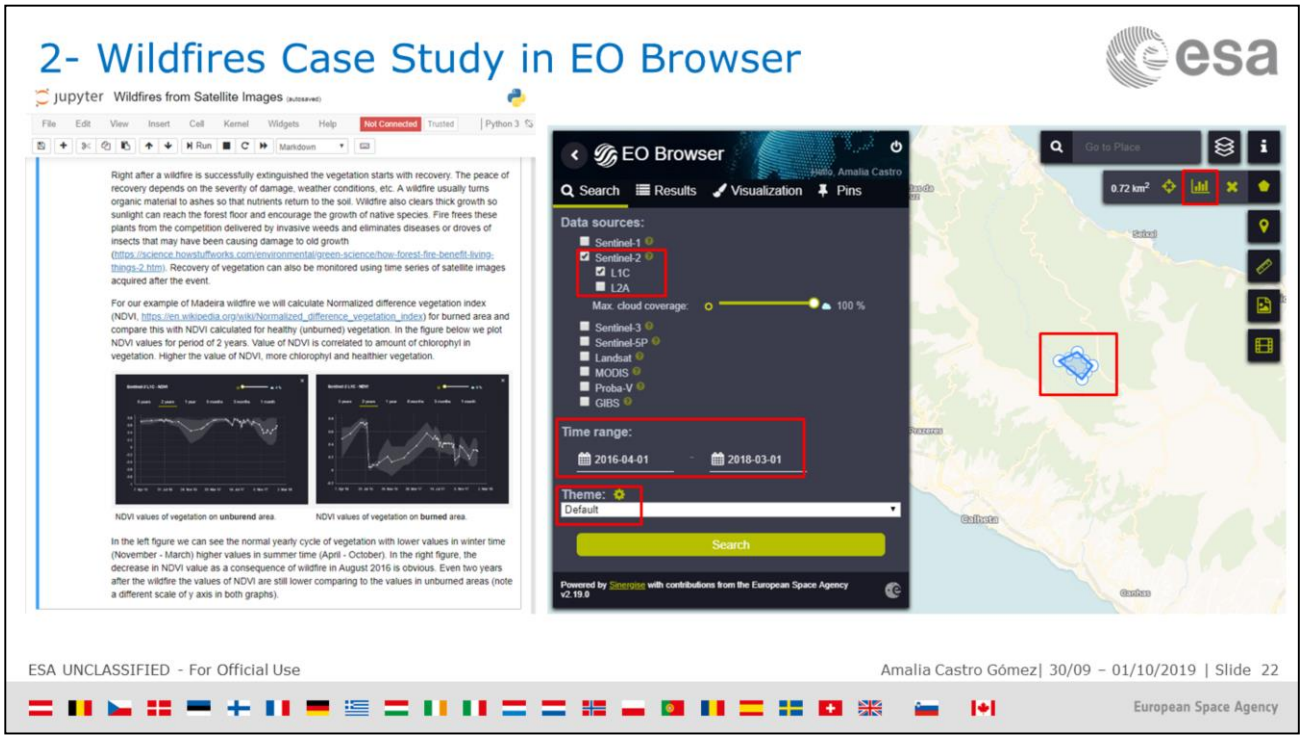
Draw an AOI around the two burned areas, and read their extent.

In the Case Study, read about the digitization of polygons around burned areas.

To repeat this in EO Browser, draw an AOI around each burned area and write down their extent.

The larger area is around 36 km2 and the smaller one is around 8 km2.

Note that within EO Browser it is only possible to digitize a single polygon at once. However, a multi-polygon KML can be created outside EO Browser (e.g. Google Earth) and be uploaded to EO Browser.



In the Case Study, read about the NDVI time series over burned and unburned areas.

Note that within the Wildfires Theme it is not possible to display time series (the feature is not yet available).

To reproduce those steps:

1- Make sure you still have an AOI drawn over burned areas

2- In Search, under Theme choose Default (not Wildfire)

3- As Data sources, keep Sentinel-2 L1C

4- There is no need to specify the time range of the time series we want to visualize. We can simply search for a recent image. However, for clarity, we will enter the same time range as the case study.

5- Click Search

6- In one of the images that appear as a result, click Visualize and select the NDVI layer

7- Click the Statistical info of the AOI

8- The graph will appear. Adjust the maximum cloud cover down to 4%

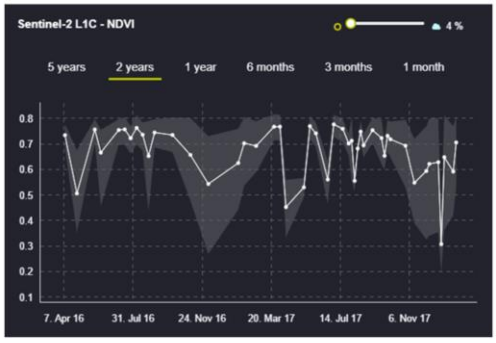
9- Select 2 years

Repeat for unburned areas

The time series plotted is an average of the time series for all pixels contained in the AOI.

In other words, a dot in the time series represents an average over the AOI at a certain moment in time. All the statistics that appear when we hover the mouse over the time series also use only the pixels contained in the AOI.

2- Wildfires Case Study in EO Browser



Unburned area

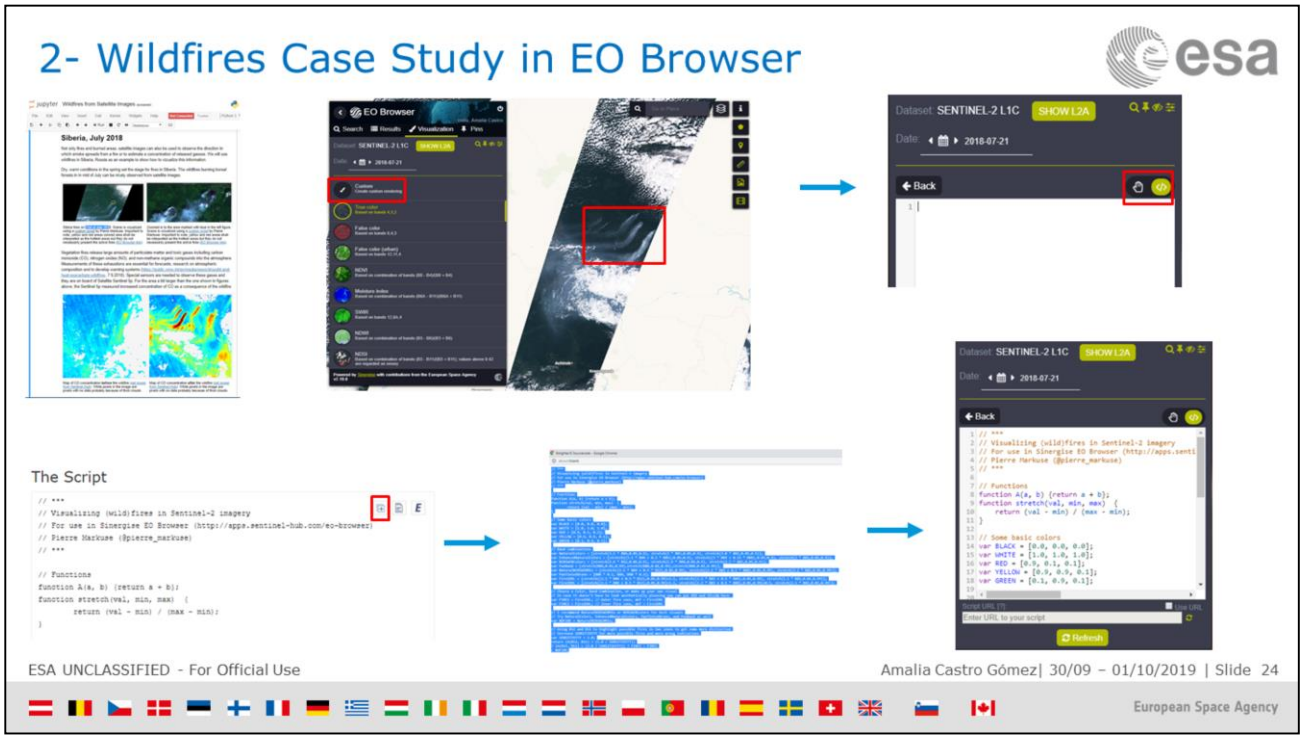
Burned area

Here are the two time series we obtained with the Unburned and Burned AOIs:

Left unburned area

Right burned area.

We can clearly see the abrupt drop in the NDVI values due to the fire event, and the slow recovery that followed afterwards.



Wildfires started in Siberia in mid July 2018.

In this section we will learn how to use a script in the EO Browser, to modify the visualization.

1- In Search, look for a Sentinel-2 L1C image from 21 July 2018 in Siberia, in the area north of Krasnoyarsk

2- Display the True Colour option

3- Pin it. This will be used later on for comparison

Let's see where the script will be entered:

4- Click Custom

5- Select the script symbol (not the hand symbol)

6- Delete the pre-existing script

Now let's get the script from Pierre Markuse, which enhances the visualization of active fires. His first version (also accessible from the Case Study) is

https://pierre-markuse.net/2017/08/07/visualizing-wildfires-sentinel-2-imagery-

eo-browser/

7- At the script section, top right, select Open Code in New Window

8- Copy the script

9- Back in EO Browser, paste it in the white area

10 – Click Refresh

11- Observe the results and Pin them

12- Click on the pen symbol next to the name of your pinned image, and adjust its name as needed (e.g. Custom script version 1)

If you want, repeat the steps for the second version of the script, and pin the results.

Temporal scripts

Note that at the moment, custom scripts (also called “evalscripts” in EO Browser) can only use one data source. In the future there are plans to upgrade this.

Scripts that can combine data from different dates (i.e. temporal scripts) can only be used in Sentinel Playground.

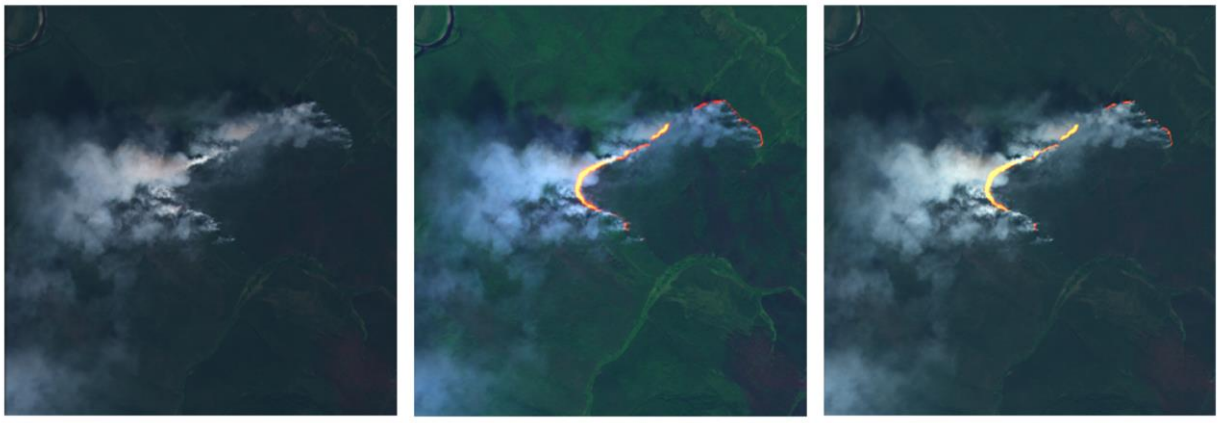
Use URL

If you have your script at some URL you can check "Use URL", paste the URL pointing to the script (if you use a script in GitHub: open a script on GitHub, then click "Raw" and copy the URL) into EO Browser, and click "Refresh" (little arrows in a circle). This shall copy the script from URL to EO Browser and then you work with it as if you inputted the script directly in EO Browser. Sinergise has some examples of scripts stored here: https://github.com/sentinel-hub/custom-scripts.

Storing scripts

Each user can store their own scripts in Configuration Utility, access it here: https://apps.sentinel-hub.com/dashboard/#/ . Log in with Sentinel Hub account and click the second icon on your left: "Configuration Utility". Here users can create your own themes and layers, see User guide here: https://www.sentinel-hub.com/develop/capabilities/configuration_utility/configuration-utility-user-guide

2- Wildfires Case Study in EO Browser



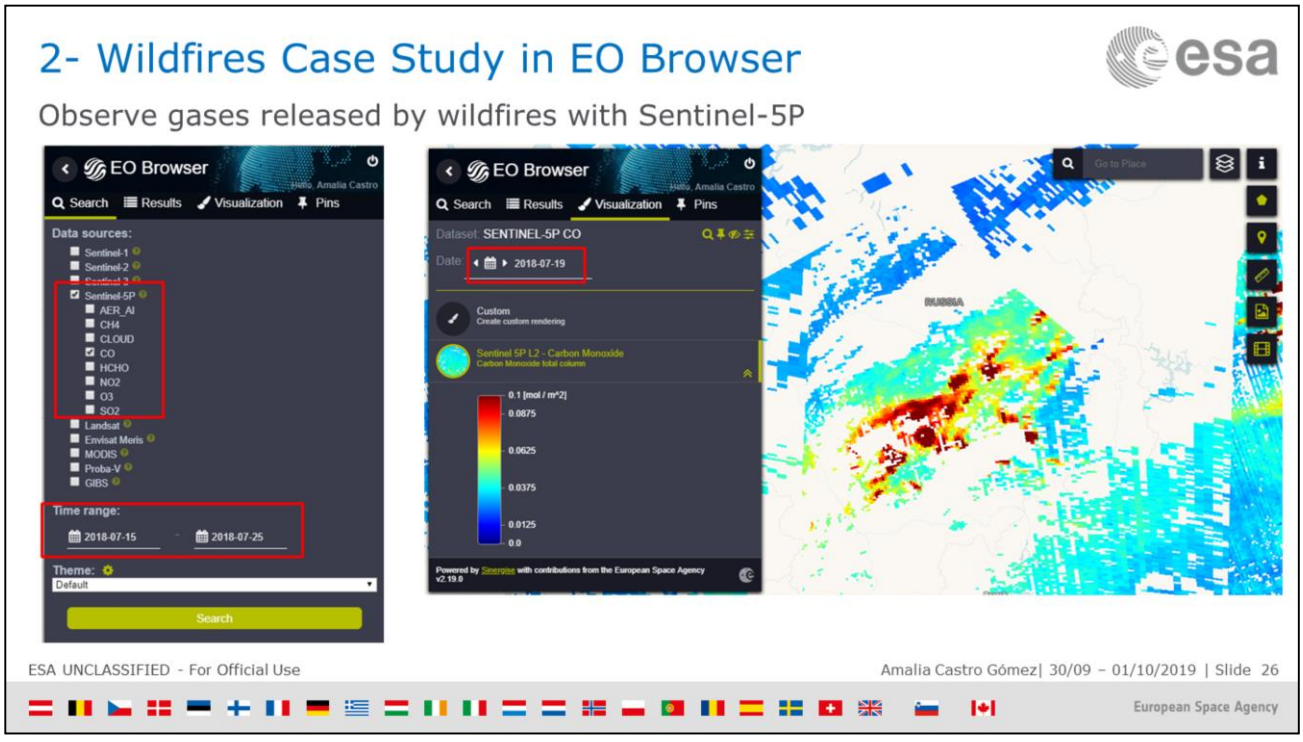
To compare results from the True Colour and from the two versions of the scripts, go to Pins, Compare, and

In this slide we compare results from the True Colour and from the two versions of the scripts:

Left side – True Colour

Centre – using P.Markuse's first version of the script

Right – using P.Markuse's second version of the script



We will use Sentinel-5P to observe the CO released during these fires in Siberia

1-Maintaining the area but zoom out a bit

2- Go to Search

2- Verify that the Time Range is from a date in mid July or late July. For example, 19/07/2018

3- Select only Sentinel-5P

2- Select for example CO

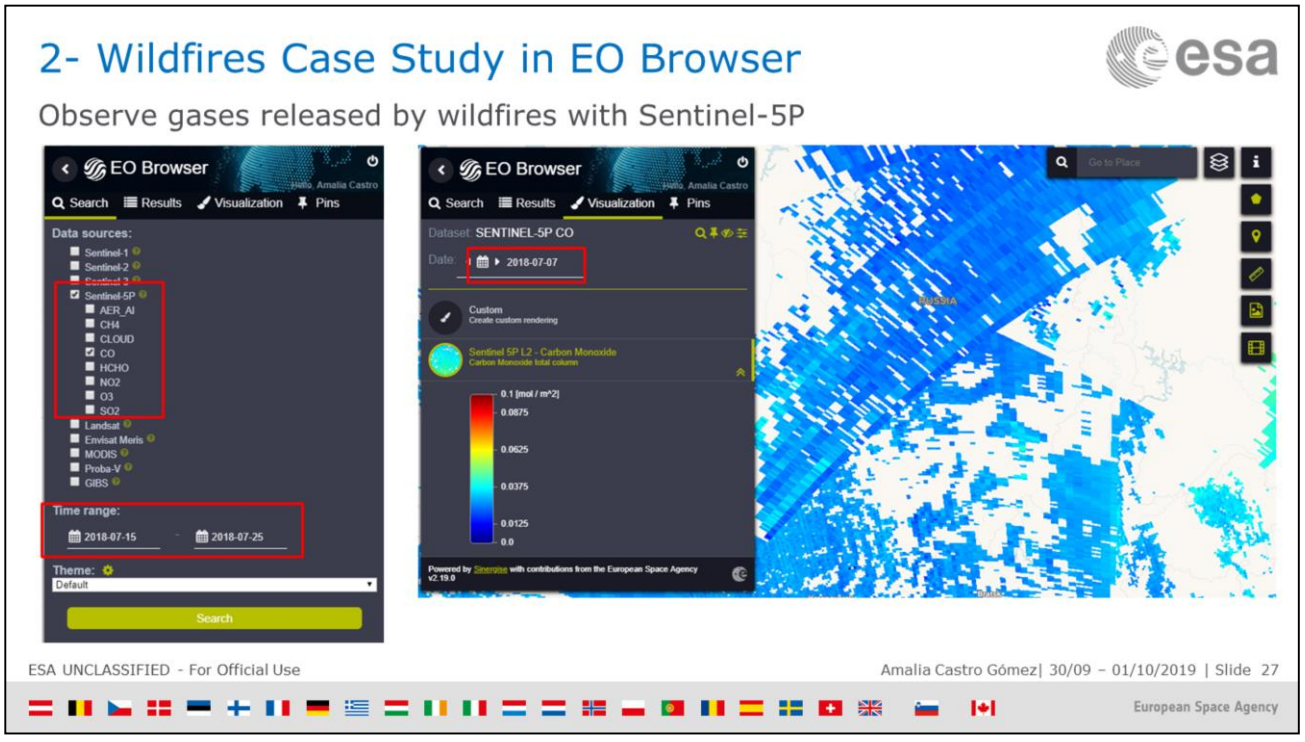
3- Click Search

4- Visualize the image during the wildfire

5- Pin it

Repeat, to find an image before the fire season started. For example, from 07/07/2018. Pin it and compare both.

Repeat for other gases of your choice

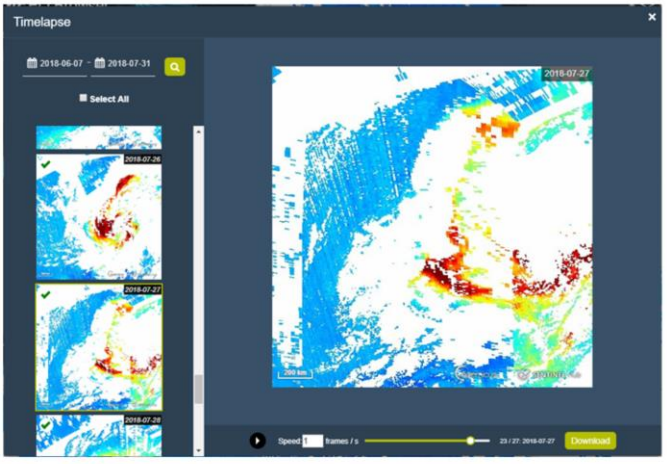


Here some results:

Left: CO from 07/07/2018

Right: CO from 19/07/2018

2- Wildfires Case Study in EO Browser



Let's create a timelapse:

1- Go to the Create Timelapse Animation button (right section of the EOBrowser screen)

2- Select the timerange we are interested in. E.g from early July to end of July.

3- Click Search

4- Scroll down the images and keep selected only those that do not have gaps over our area.

5- Select the Speed of frames

6- Preview and once we are happy with it, Download

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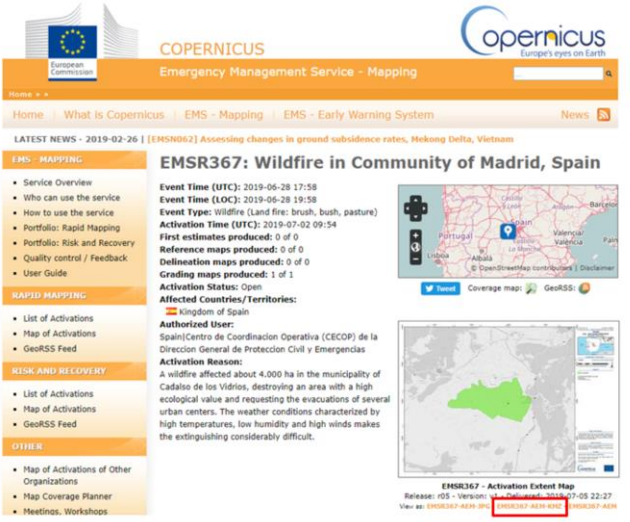
3- Wildfire in Madrid (July 2019)

The fire in Almorox, Toledo, in July 2019
(source: El Pais)

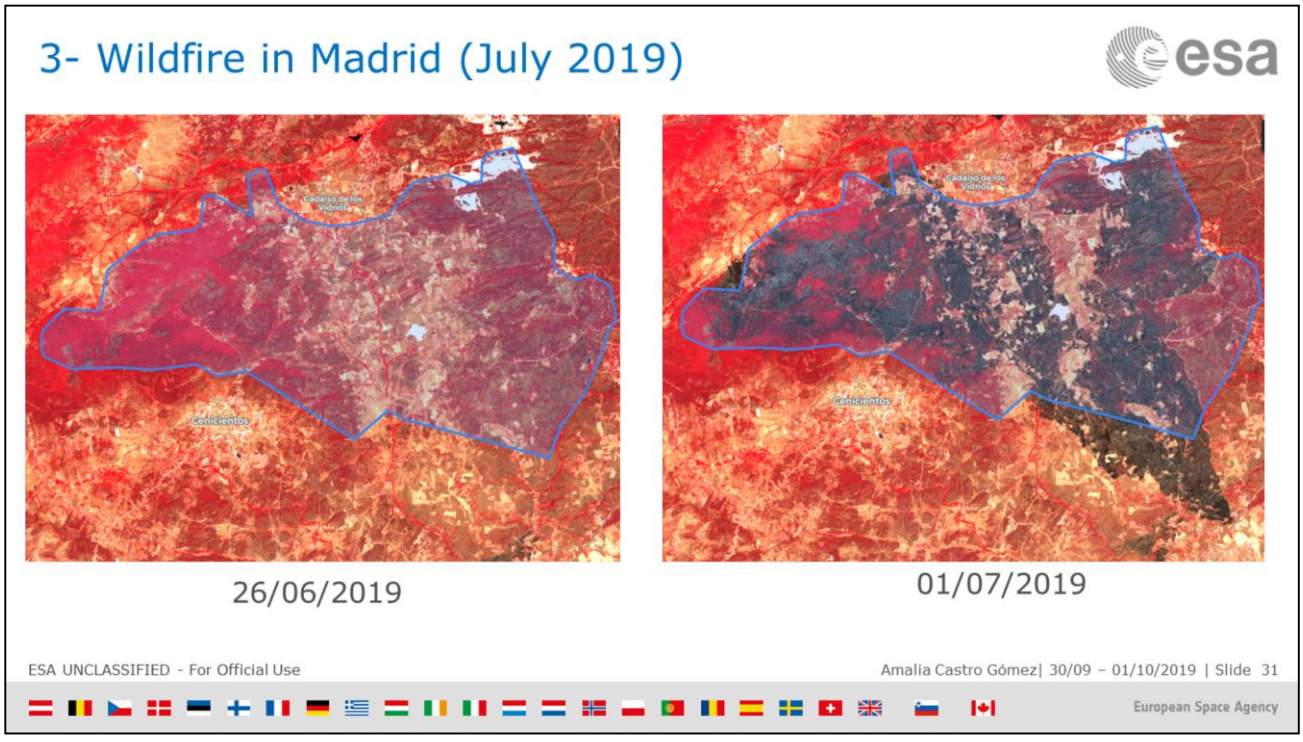


Now we will show an example of a recent fire, where we can have images from Sentinel-2, 3 and 5-P:

Fires in Spain from 28 July 2019 in Madrid, in the area of Cadalso de los Vidrios.

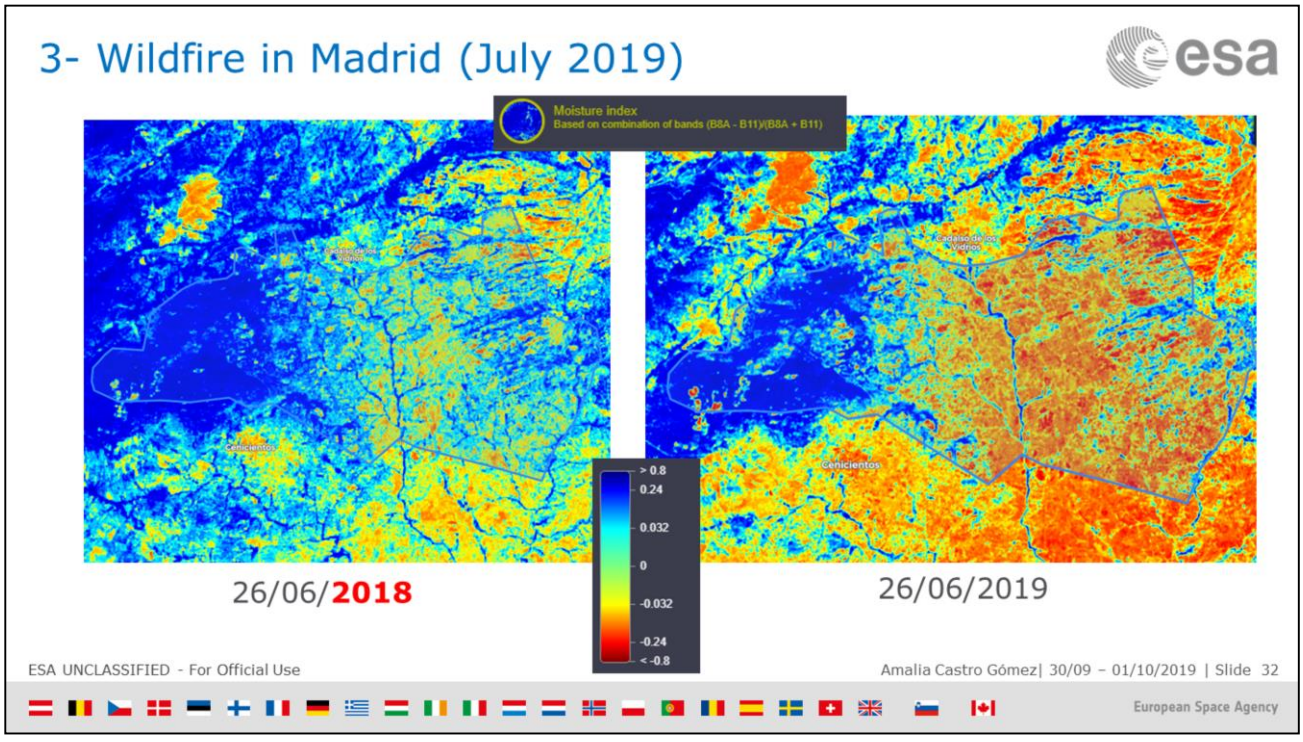
Navigate to the site of this emergency activation on the Copernicus Emergency Management Service: https://emergency.copernicus.eu/mapping/list-of-components/EMSR367

Download the KMZ of the area affected. We rename it as EMSR367-Widlfire in Madrid_June2019.kmz.

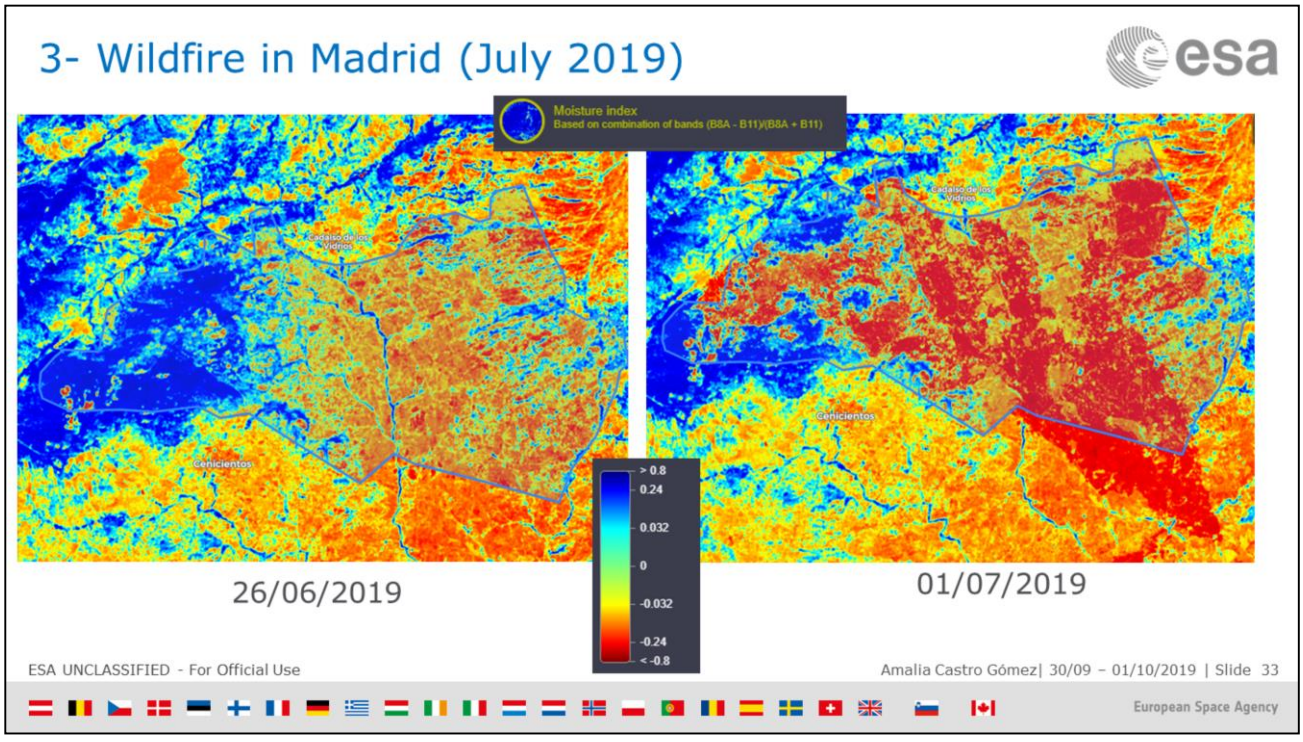


In the EO Browser, go to Area of Interest and click Upload Data to import your kmz.

We display here images of **Sentinel-2** before (26/06/2019) and after the event (01/07/2019), in **False Color** (Bands 8, 4 and 3)

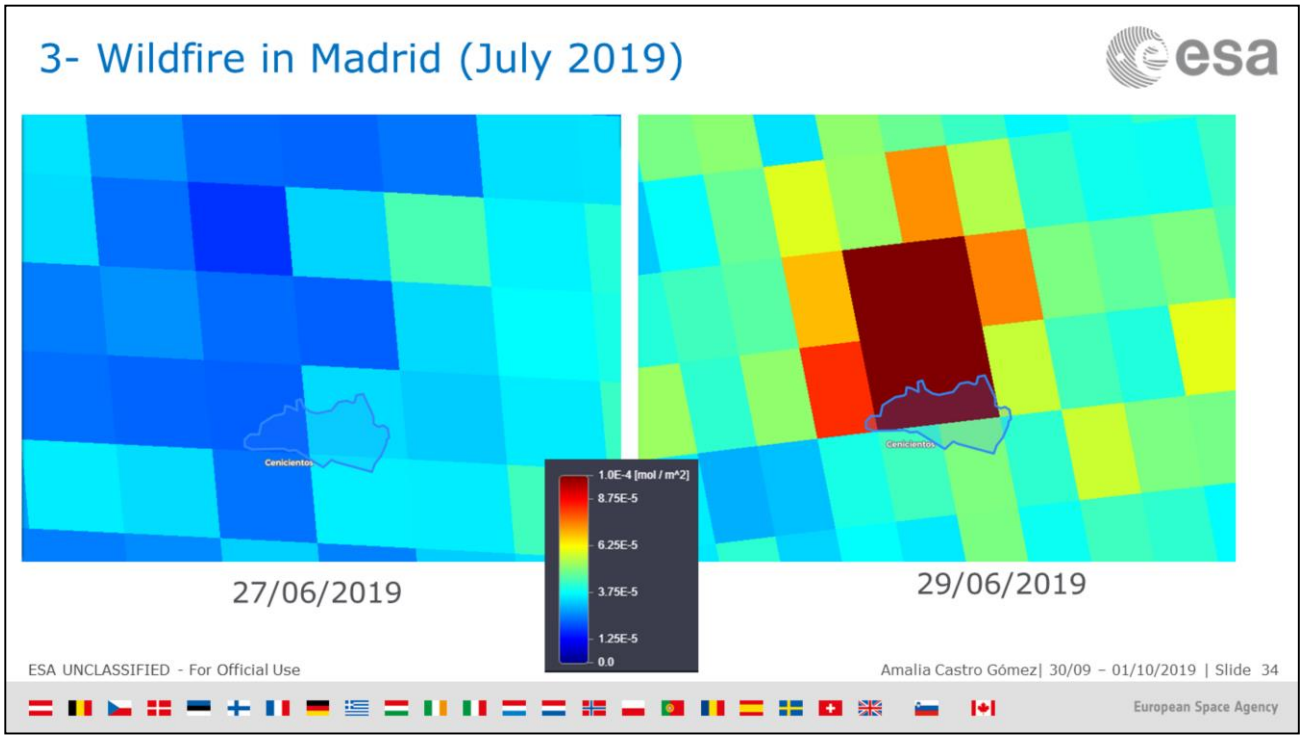


We display here images of **Sentinel-2's moisture index** from **a year before the fire** (26/06/2018) and from immediately before the fire (26/06/2019).

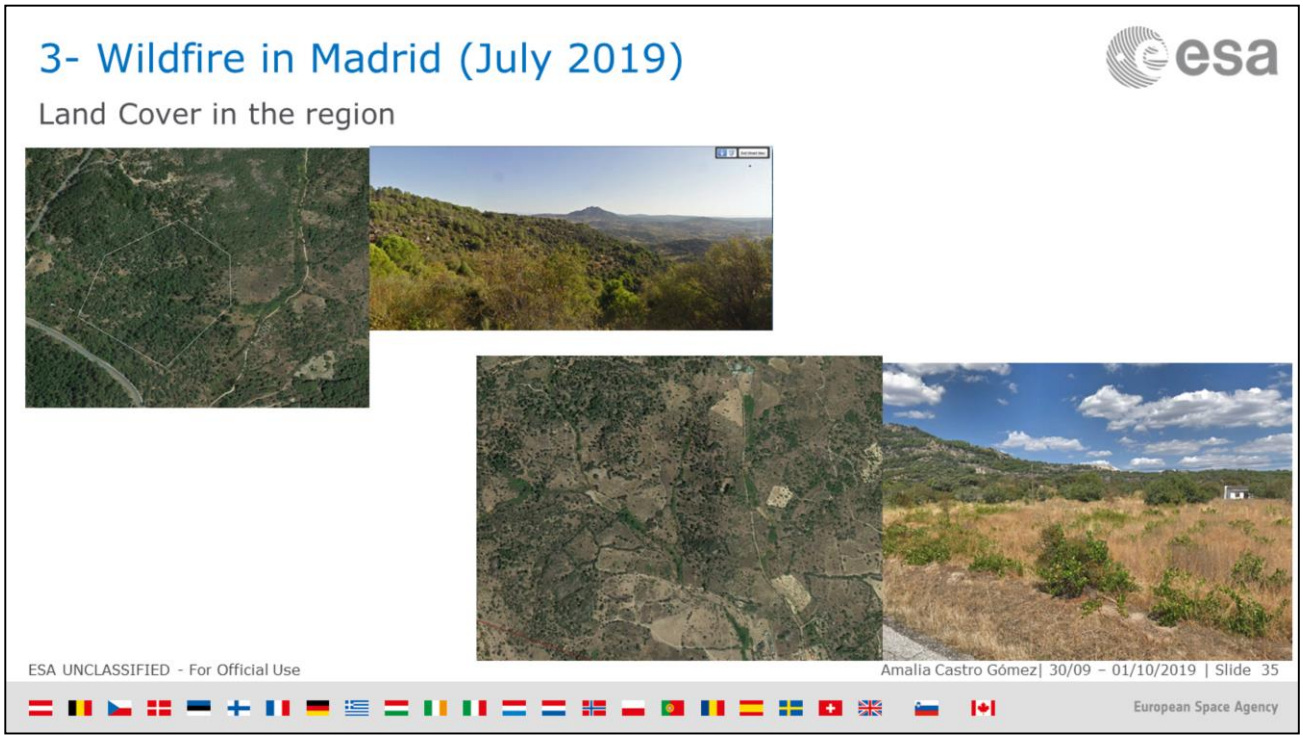


We display here images of **Sentinel-2's moisture index** before (26/06/2019) and after the event (01/07/2019).

You can create a timelapse of the moisture index in the area, to get a better understanding of patterns.



We display here images of **Sentinel-5-P's NO2** before (27/06/2019) and after the event (29/06/2019)

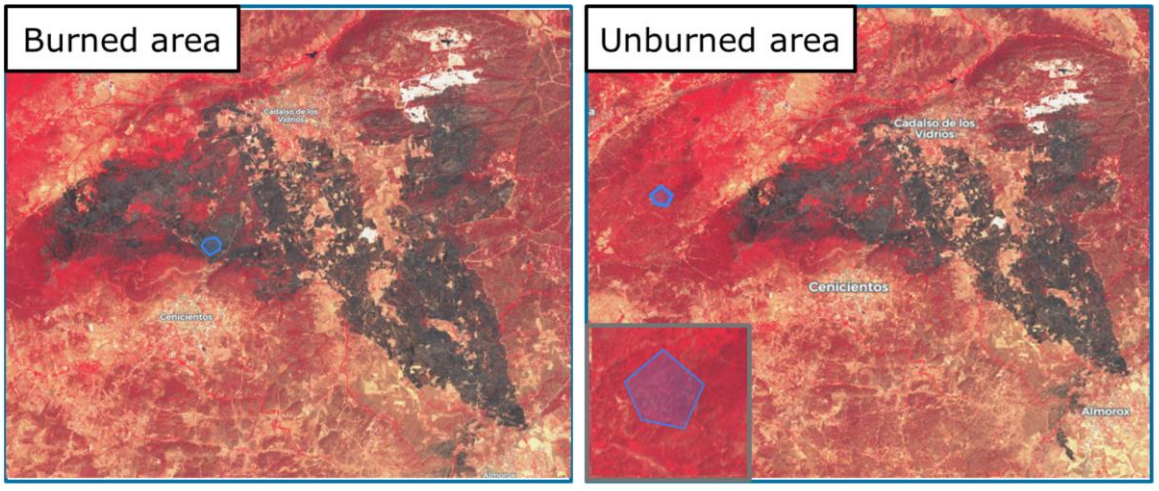


To interpret SAR images correctly, it is important to have as much information from the study area as possible.

In the following slides we will see that **Sentinel-1** does not show clearly the burned scar. The type of land cover in the region can give us clues as to why that is.

To visualize higher resolution datasets, we open the Burned_area.kmz in Google Earth.

3- Wildfire in Madrid (July 2019)



Seeing burnt scars from SAR is often difficult, even after pre and post-processing.

In the following slides we will see that the burnt scar is not easily noticeable for this particular case from EO Browser.

But first, a quick reminder of the location of the burned and unburnt areas that we will study:

- In the EO Browser, display the False Color composite of the **Sentinel-2 L2A** image of 01/07/2019
- Load the Burned_area.kmz
- Observe its location and the damage in the area
- Next, search for **Sentinel-1** images before and after the event. We chose to display **VV[Db] – orthorectified** and **VH[Db] – orthorectified.**
- Observe the results in search for the pattern of the burned area.
- Repeat for the Unburned_area.kmz

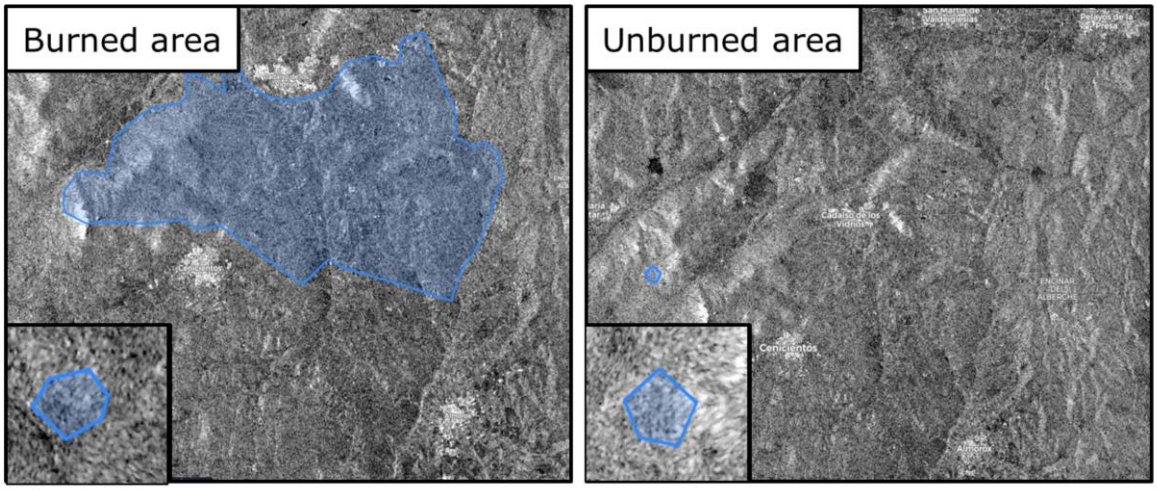
- The results of this search are gathered in the following slides.

Note that Time Series tool is not available for Sentinel-1 in EO Browser, and that

it is currently not possible to load several Areas of Interest. Therefore we need to carry out this comparison for each area (burned and unburned) separately.

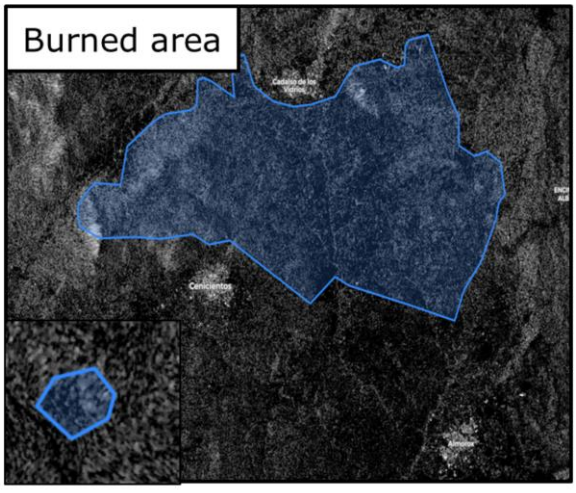
3- Wildfire in Madrid (July 2019)

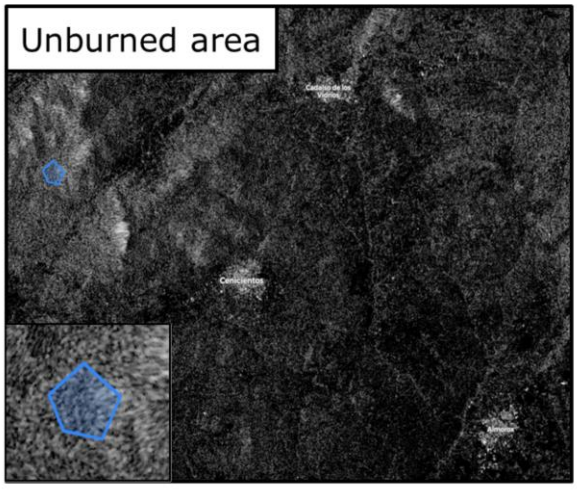
Results with Sentinel-1 VV[Db] – orthorectified from June 23 2019 (BEFORE the fire)



3- Wildfire in Madrid (July 2019)

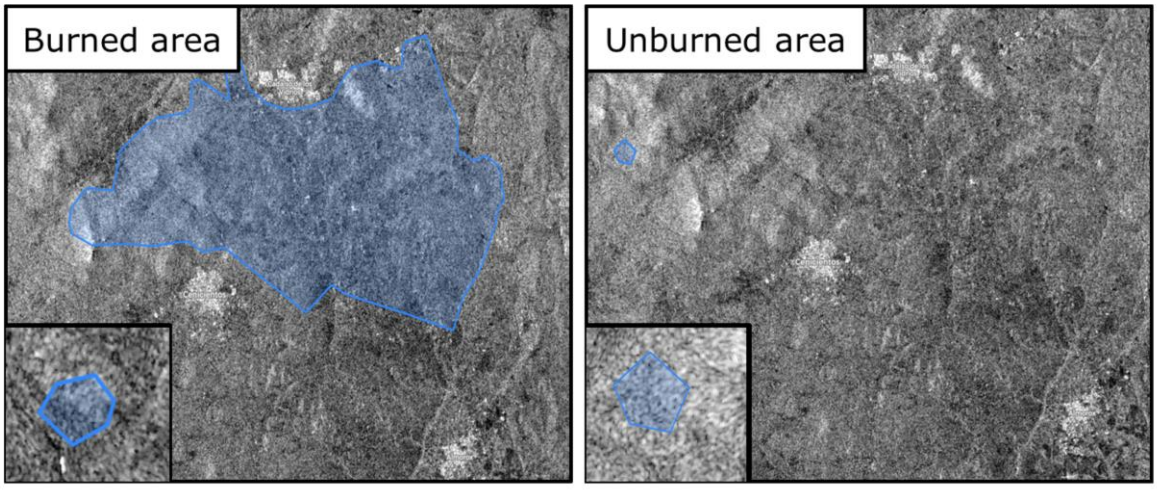
Results with Sentinel-1 VH[Db] – orthorectified from June 23 2019 (BEFORE the fire)





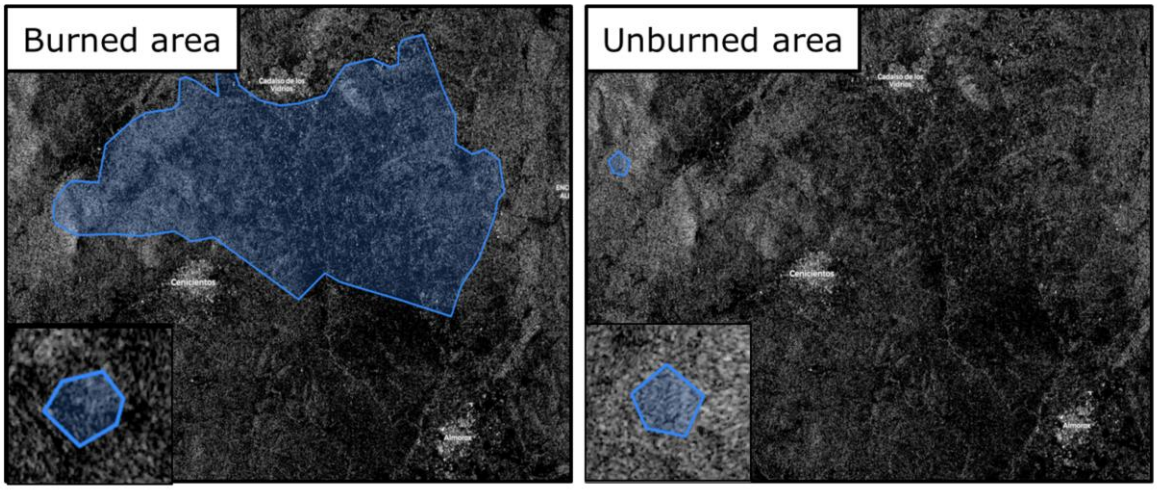
3- Wildfire in Madrid (July 2019)

Results with Sentinel-1 VV[Db] – orthorectified from July 04 2019 (after the fire)



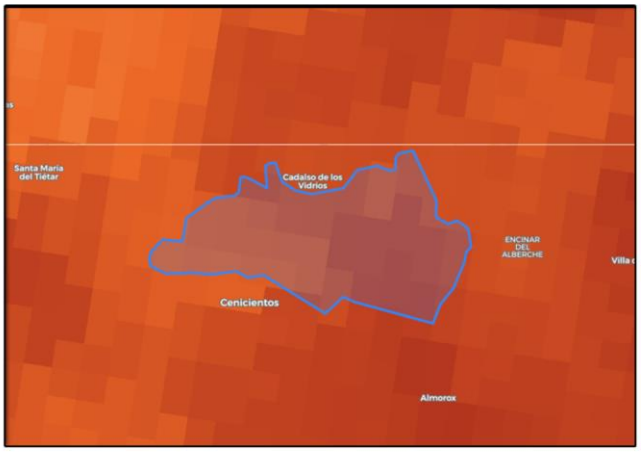
3- Wildfire in Madrid (July 2019)

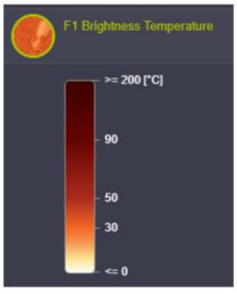
Results with Sentinel-1 VH[Db] – orthorectified from July 04 2019 (after the fire)



3- Wildfire in Madrid (July 2019)

Results with Sentinel-3 F1 Brightness Temperature from June 26 2019 (before the fire)

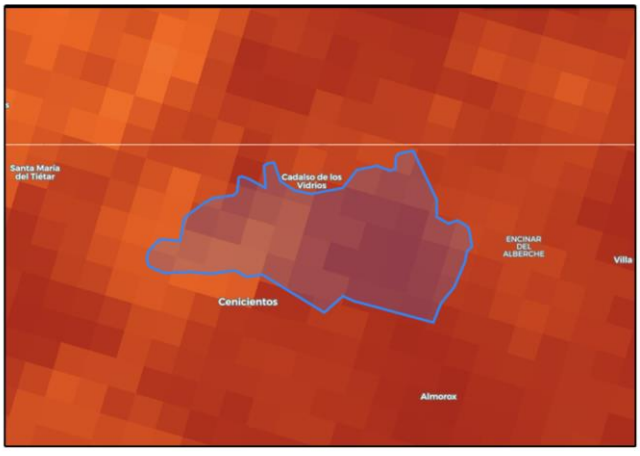


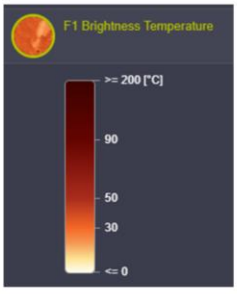


Next we have a look at the area with **Sentinel-3**, in particular the **F1 Brightness Temperature** values, which rise coinciding with the wildfire.

3- Wildfire in Madrid (July 2019)

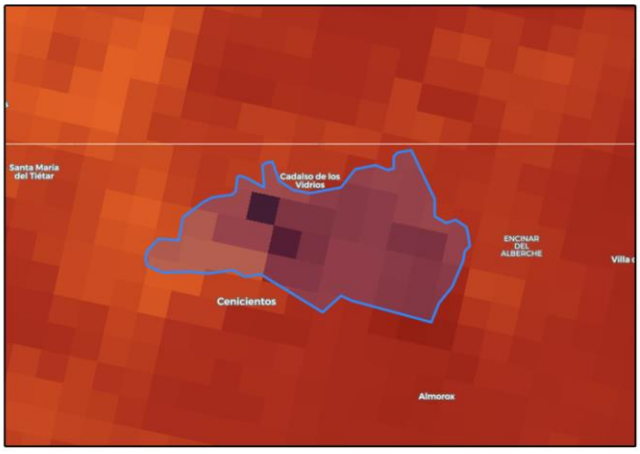
Results with Sentinel-3 F1 Brightness Temperature from June 28 2019 (during the fire)

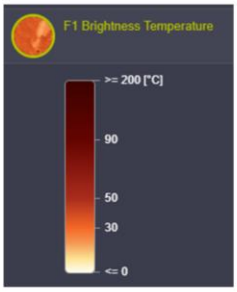




3- Wildfire in Madrid (July 2019)

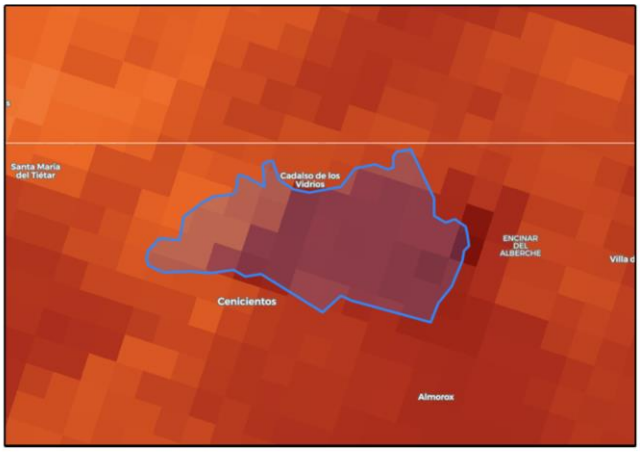
Results with Sentinel-3 F1 Brightness Temperature from June 29 2019 (during the fire)

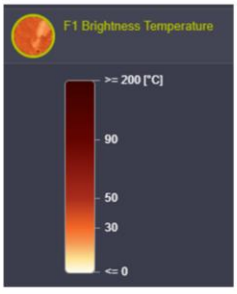




3- Wildfire in Madrid (July 2019)

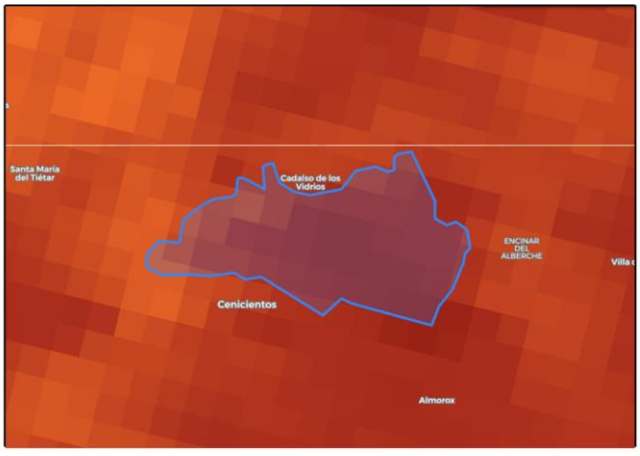
Results with Sentinel-3 F1 Brightness Temperature from June 30 2019 (during the fire)

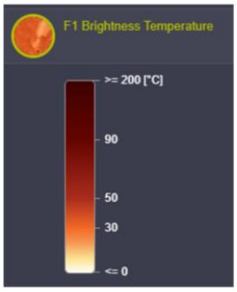


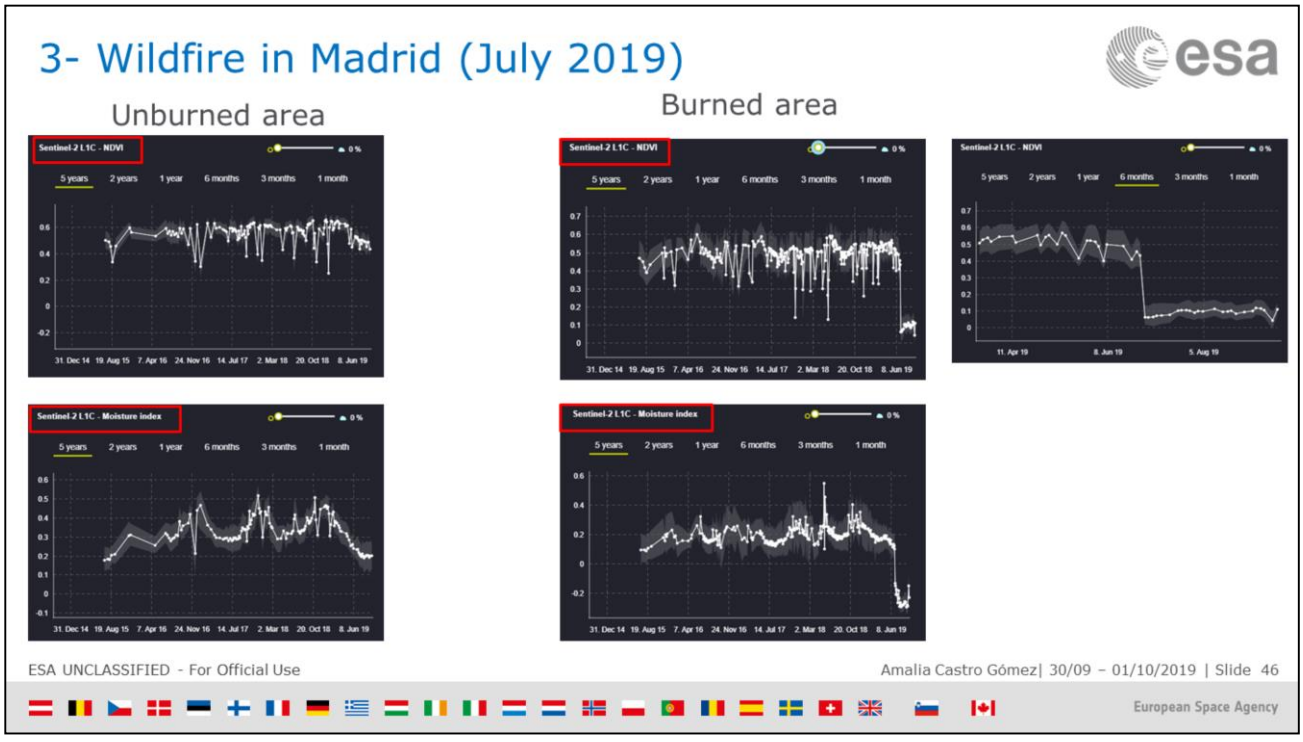


3- Wildfire in Madrid (July 2019)

Results with Sentinel-3 F1 Brightness Temperature from July 01 2019 (after the fire)



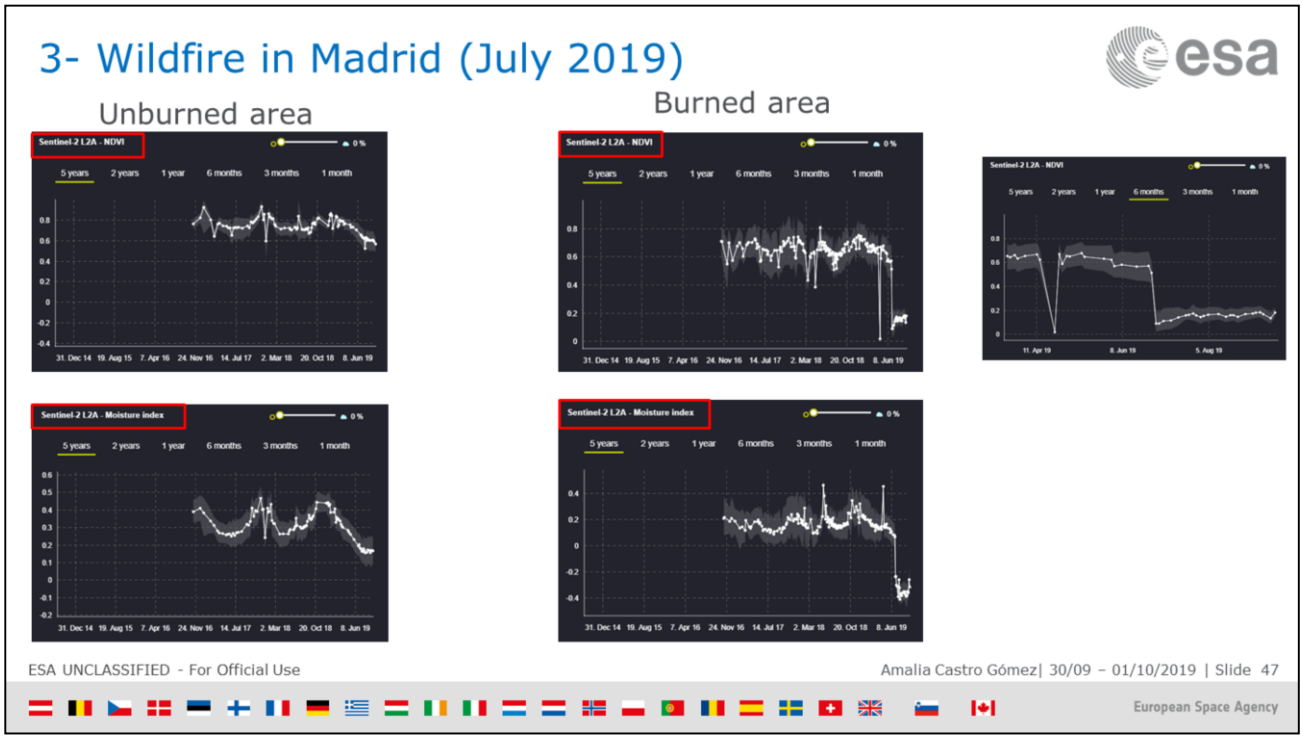




Ideally we would use only Sentinel-2 L2A, since this levels includes atmospheric correction. However, the time series is shorter so here we will show the **Sentinel-2 L1C NDVI** time series and Moisture index time series, for an area that was burned and for an area that remained undamaged.

Results with L2A are shown in the next slide.

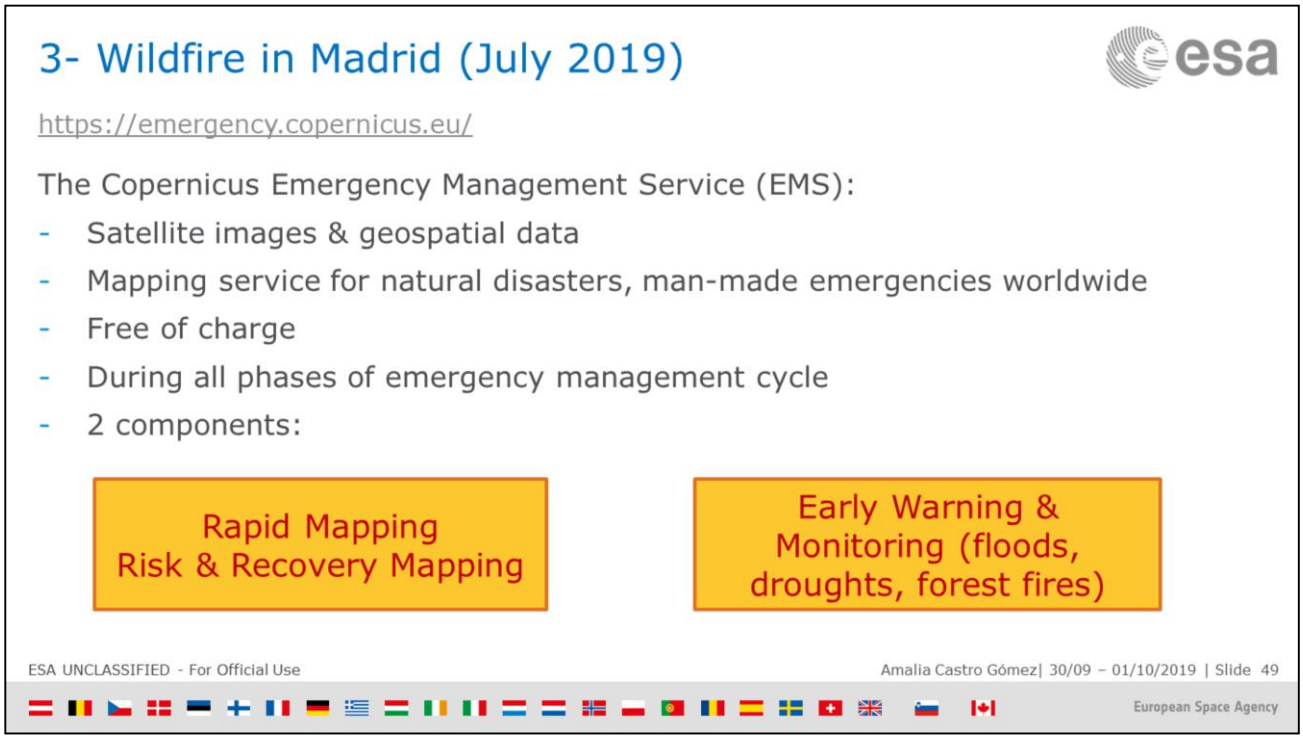
Note: ESA only made the L2A products over Europe directly available from the Copernicus Open Access Hub from May 2017. However Sentinel Hub (and consequently EO Browser) provide S2 L2A data for Europe since November 2016 and globally since December 2018. Within these limits, they process L1C to L2A for areas and dates where ESA does not provide it.



As expected the time series based on **Sentinel-2 L2A** cover a shorter period. Here we show **NDVI** time series and **Moisture index** time series, for an area that was burned and for an area that was not burned.

Summary

1. Overview of Sentinel Hub:
    1. Sentinel Playground
    2. EO Browser
    3. Industries and Showcases
    4. Education
2. Wildfires Case Study in EO Browser
3. **Wildfire in Madrid, Spain (July 2019)**
    1. Sentinel-2: False Colour, Moisture Index
    2. Sentinel-5P NO_2
    3. Sentinel-1
    4. Sentinel-3 F1 Brightness Temperature
    5. **Complementary data from Copernicus Emergency Management Service: Standard Precipitation Index, Soil Moisture Anomalies, Country statistics**

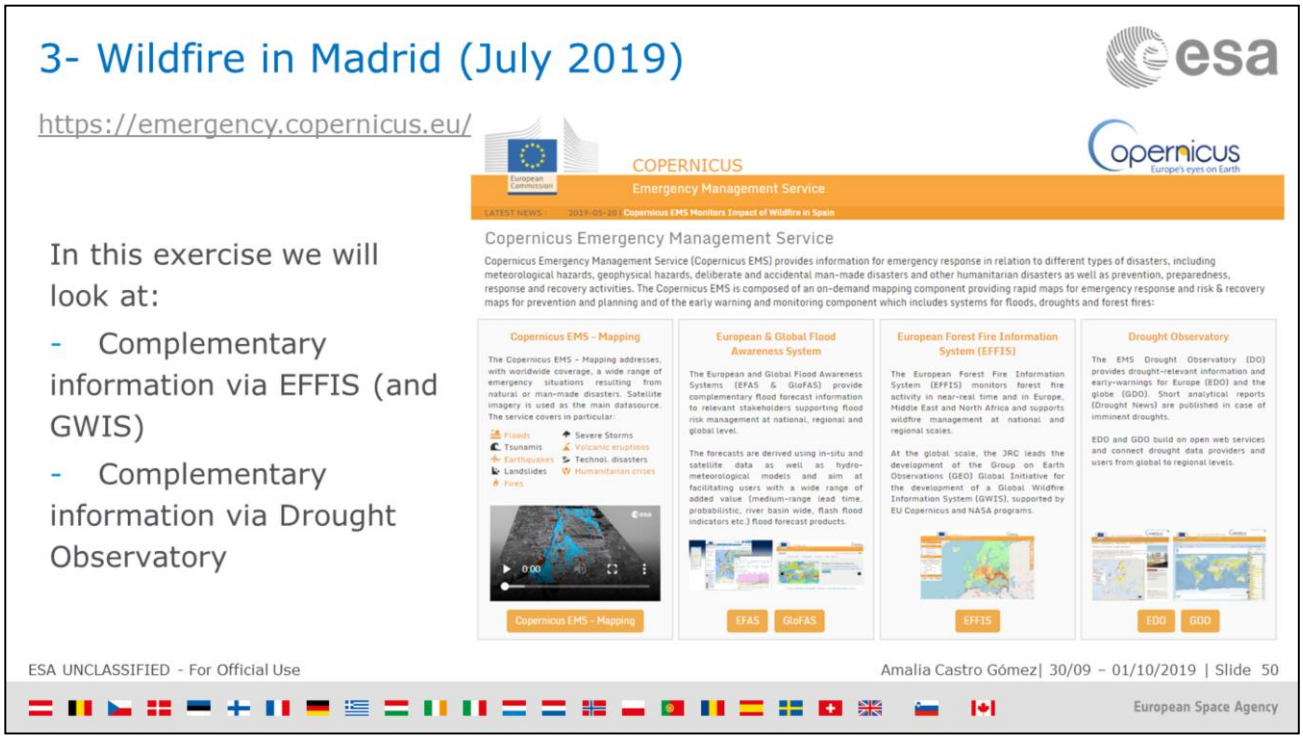


Copernicus Emergency Management Service (Copernicus EMS) provides information for emergency response in relation to different types of disasters, including meteorological hazards, geophysical hazards, deliberate and accidental man-made disasters and other humanitarian disasters as well as prevention, preparedness, response and recovery activities. The Copernicus EMS is composed of an on-demand mapping component providing rapid maps for emergency response and risk & recovery maps for prevention and planning and of the early warning and monitoring component which includes systems for floods, droughts and forest fires

-Rapid Mapping: to support emergency management activities immediately following a disaster.

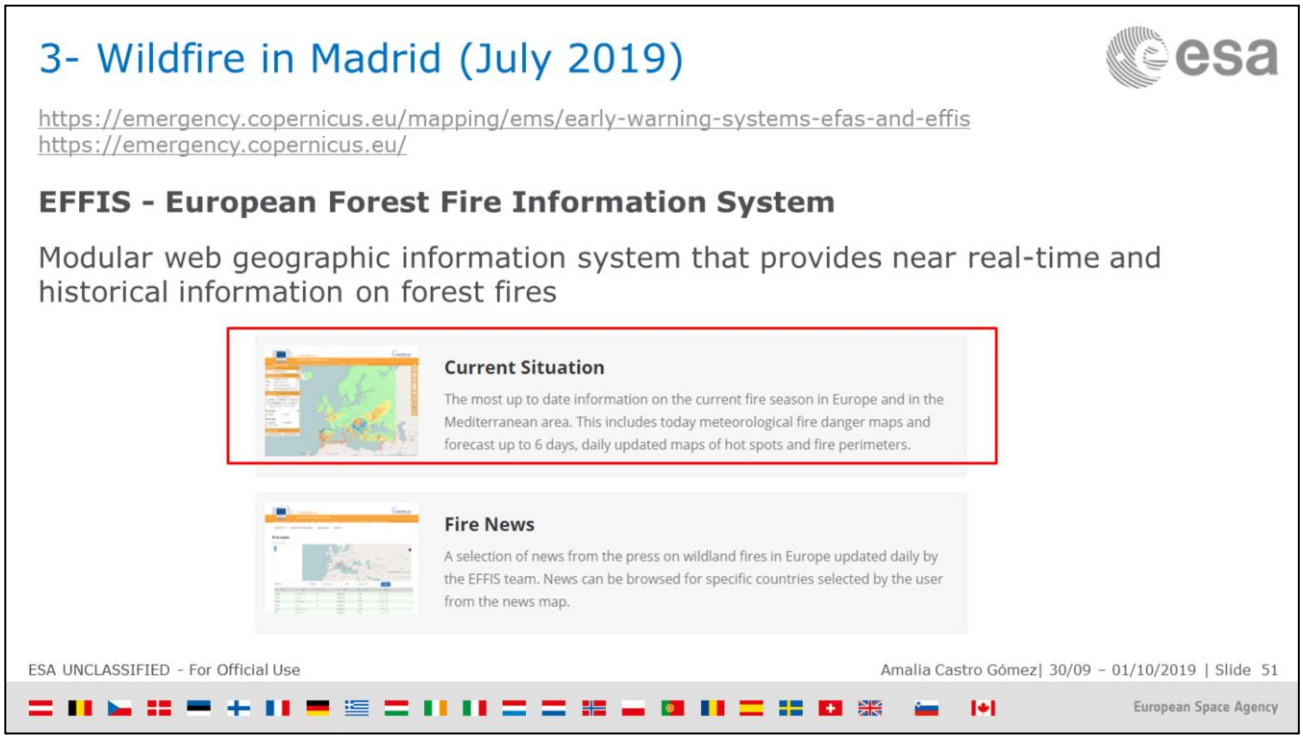
-Risk & Recovery Mapping: on-demand provision of geo-spatial info, to support disaster management activities not related to immediate response (e.g. prevention, preparedness, risk reduction and recovery). This includes Reference maps, Pre-disaster Situation maps, and Post-disaster Situation maps

EMS can be triggered only through an Authorised User.



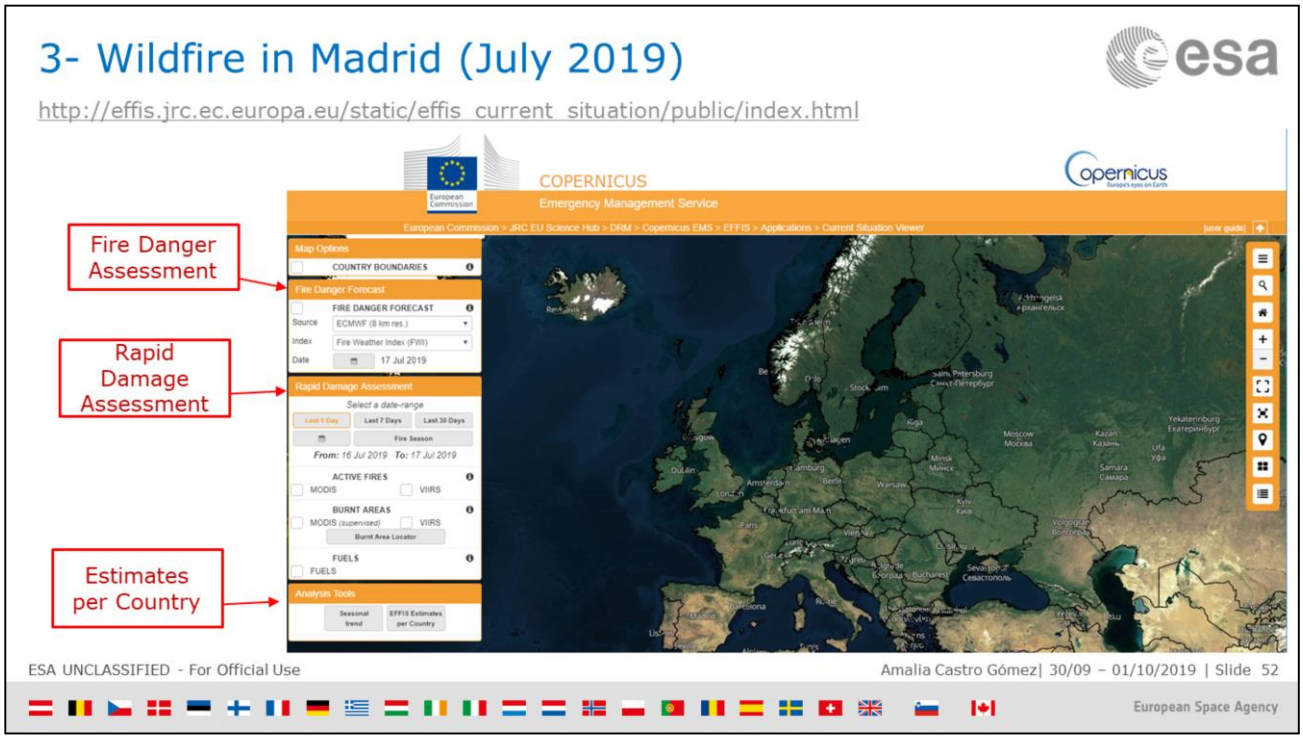
The Copernicus EMS is composed of the Rapid Mapping Service and of three Early Warning Systems: EFAS (European Flood Awareness System), the Drought Observatory (DO) and EFFIS (European Forest Fire Information System).

We will look at what complementary information we can obtain from EFFIS and DO.



The European Forest Fire Information System (EFFIS) consists of a modular web geographic information system that provides near real-time and historical information on forest fires and forest fire regimes in the European, Middle Eastern and North African regions. Fire monitoring in EFFIS comprises the full fire cycle, providing information on the pre-fire conditions and assessing post-fire damages.

More info from EFFIS (from 2012):
https://www.researchgate.net/publication/221928304_Comprehensive_Monitoring_of_Wildfires_in_Europe_The_European_Forest_Fire_Information_System_EFFIS



EFFIS includes, starting from the pre-fire state, the following modules:

Note that not all modules of EFFIS are currently fully operational. More info at https://www.copernicus.eu/sites/default/files/2019-01/Copernicus_Work_Programme_2019.pdf (page 47) and at http://effis.jrc.ec.europa.eu/about-effis/technical-background/under-development/

(1) Fire Danger Assessment,

(2) Rapid Damage Assessment, which includes (for more info on the Fire Severity Assessment and the Land Cover Damage Assessment, refer to http://effis.jrc.ec.europa.eu/about-effis/technical-background/rapid-damage-assessment/)

- (2.1.) Active fire detection
- (2.2.) Fire severity assessment
- (2.3.) Land cover damage assessment

(3) Emissions Assessment and Smoke Dispersion **(not currently shown in EFFIS)**

(4) Potential Soil Loss Assessment, and **(this module is under development)**

(5) Vegetation Regeneration **(this module is under development)**

Regarding (3) Emissions Assessment and Smoke Dispersion, such products are derived from the Copernicus Atmospheric Monitoring Service (CAMS). **In July 2019, they are not shown in EFFIS**, but some can be found in GWIS http://gwis.jrc.ec.europa.eu/static/gwis_current_situation/public/index.html

More info at http://gofc-fire.umd.edu/meeting/static/GOFC_Fire_IT_2017/day3/EFFIS.pdf (slide 49) and http://effis.jrc.ec.europa.eu/about-effis/technical-background/fuels/

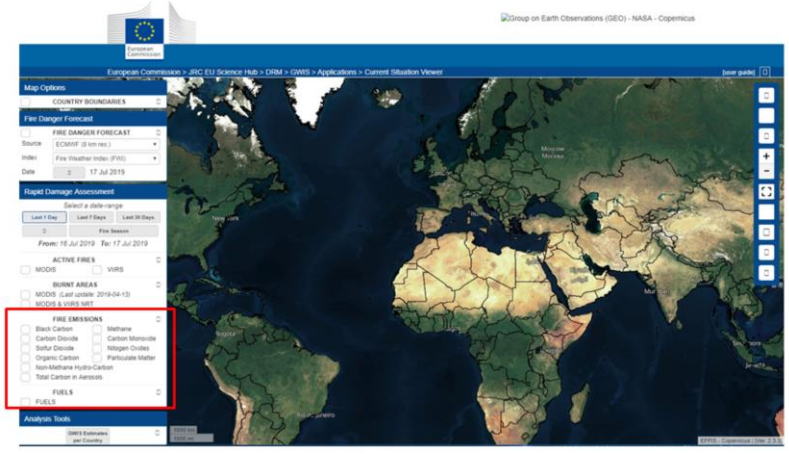
3- Wildfire in Madrid (July 2019)

http://gwis.jrc.ec.europa.eu/static/gwis_current_situation/public/index.html
http://gwis.jrc.ec.europa.eu/

GWIS – Global Wildfire Information System

Builds on EFFIS to complement on-going activities around the globe.

Includes datasets that are not available via EFFIS (e.g. Fire Emissions)



The Global Wildfire Information System is a joint initiative of the GEO and the Copernicus Work Programs.

At the global scale, the JRC leads the development of the Group on Earth Observations (GEO) Global Initiative for the development of a Global Wildfire Information System (GWIS), supported by EU Copernicus and NASA programs.

GWIS builds on the ongoing activities of the European Forest Fire Information System (EFFIS), the Global Terrestrial Observing System (GTOS) Global Observation of Forest Cover- Global Observation of Land Dynamics (GOFC-GOLD) Fire Implementation Team (GOFC Fire IT), and the associated Regional Networks, complementing existing activities that are on-going around the world with respect to wildfire information gathering.

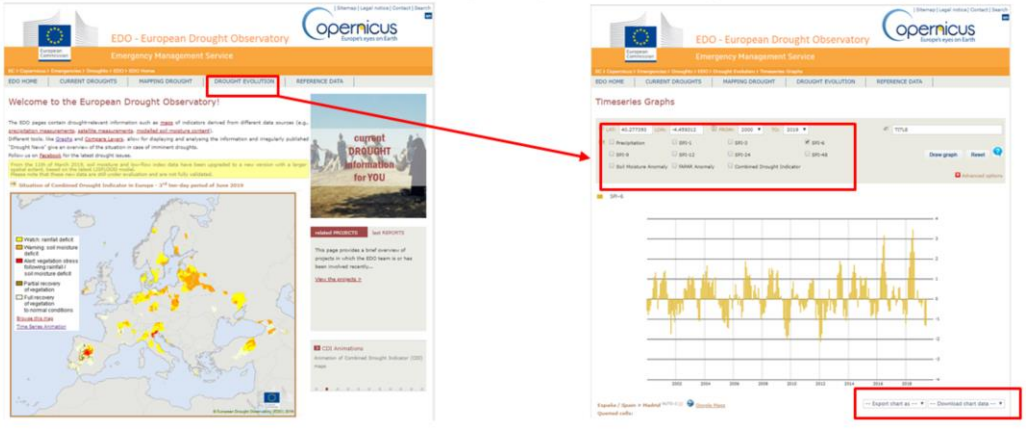
Currently Fire Emissions products are available via GWIS. More info at http://effis.jrc.ec.europa.eu/effis-gwis/

3- Wildfire in Madrid (July 2019)

https://emergency.copernicus.eu/

EDO – European Drought Observatory

We will look at their Time Series Graphs (under Drought Evolution)



The EMS Drought Observatory (DO) provides drought-relevant information and early-warnings for Europe (EDO) and the globe (GDO). Short analytical reports (Drought News) are published in case of imminent droughts.

EDO and GDO build on open web services and connect drought data providers and users from global to regional levels.

Under Drought Evolution / Time Series Graphs it is possible to visualize several variables over time, and to download the graphs and data (as text format).

We enter the coordinates of a pixel that was burned during the fire in Madrid of July 2019. This pixel was identified with EO Browser.

Coordinates burned pixel:

Lat 40.277393

Lon -4.459312

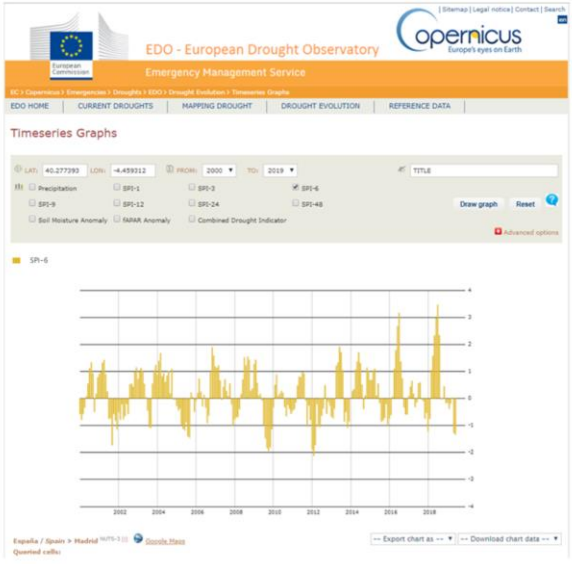
Next, we retrieve the graph for SPI-6. We will export the data (in text format) and plot them in excel, for a more clear visualization.

We repeat the process for the Soil Moisture Anomalies data.

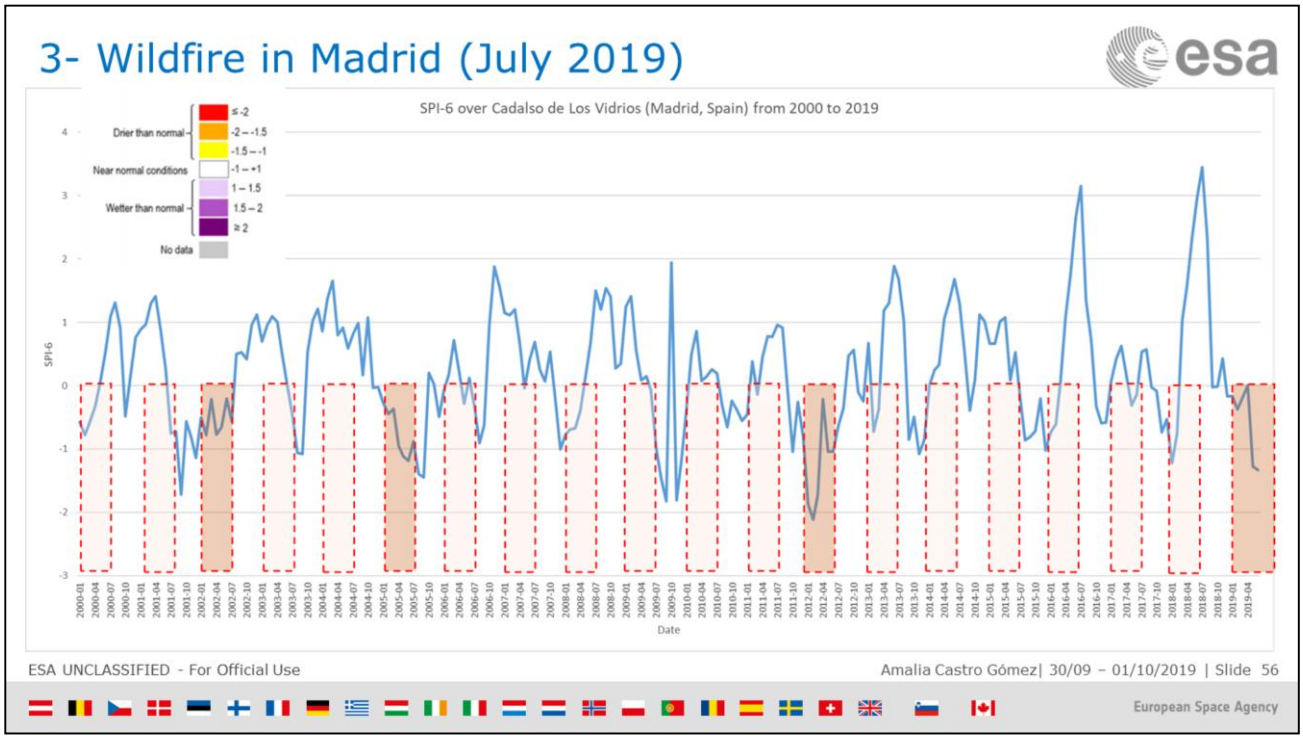
The Factsheets contain detailed technical information of each indicators.

The spreadsheet **2000_2019_CEMS_Complementary_info.xlsx** contains the data downloaded from this site and the graphs created in excel

3- Wildfire in Madrid (July 2019)



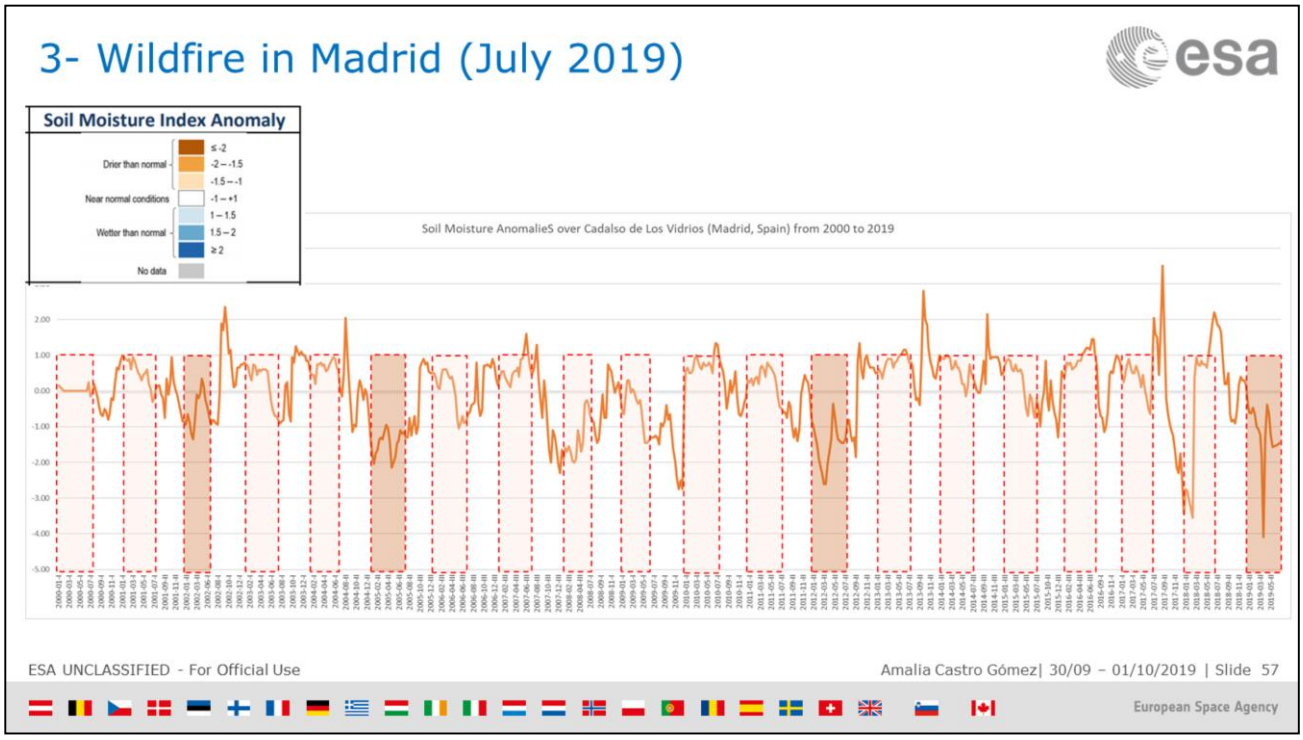
Emergency Management Service is able to show SPI, Soil Moisture Anomalies in combined graphs.



For clarity, we exported the data and plotted them in Excel.

The red boxes (light background) highlight the period from January to April of each year.

The red boxes with a darker background highlight those with lower SPI-6. Those correspond to drier winters.

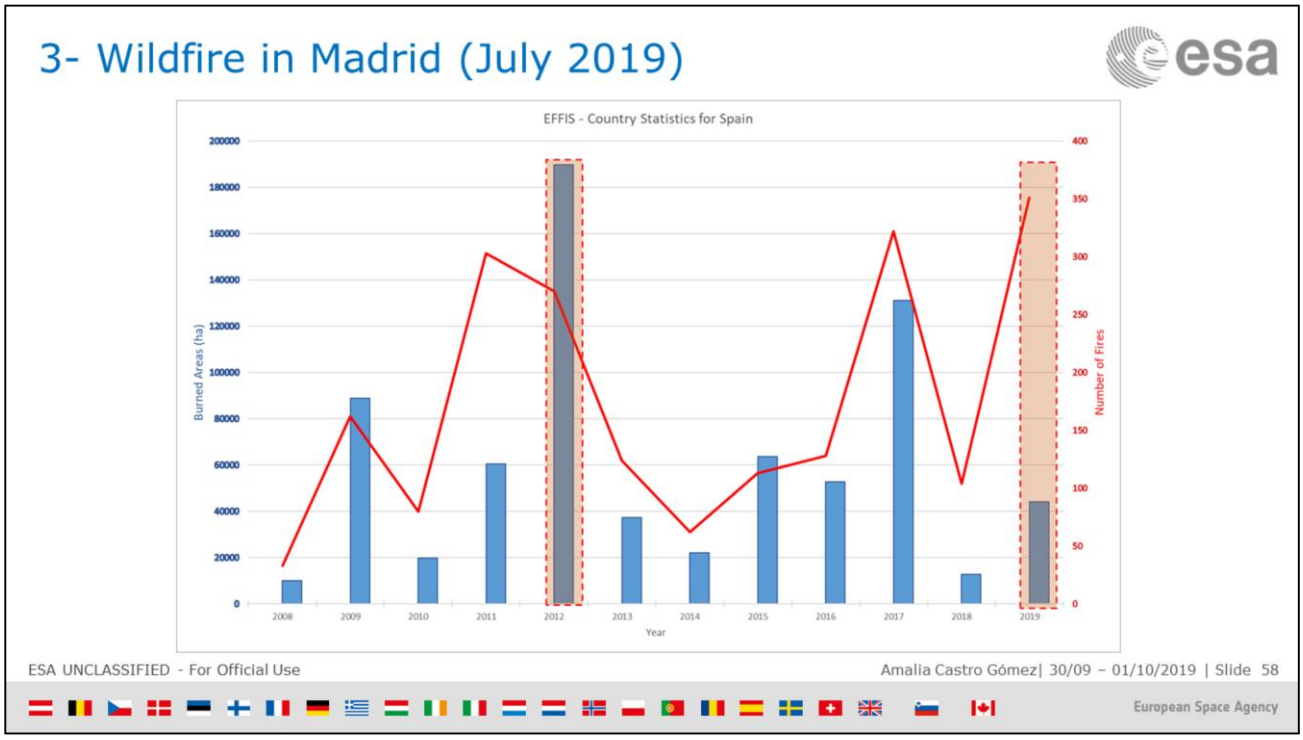


For clarity, we exported the data and plotted them in Excel.

The red boxes (light background) highlight the period from January to April of each year.

The red boxes with a darker background highlight those with lower SPI-6, taken from the previous slide. Those correspond to drier winters.

From the Soil Moisture Anomaly Factsheet: The SMA indicator in EDO is computed every 10-day (dekad) as anomalies of soil moisture index derived from the JRC's in-house LISFLOOD hydrological model (de Roo et al. 2000), and which has been shown to be effective for drought detection purposes (Laguardia and Niemeyer, 2008).

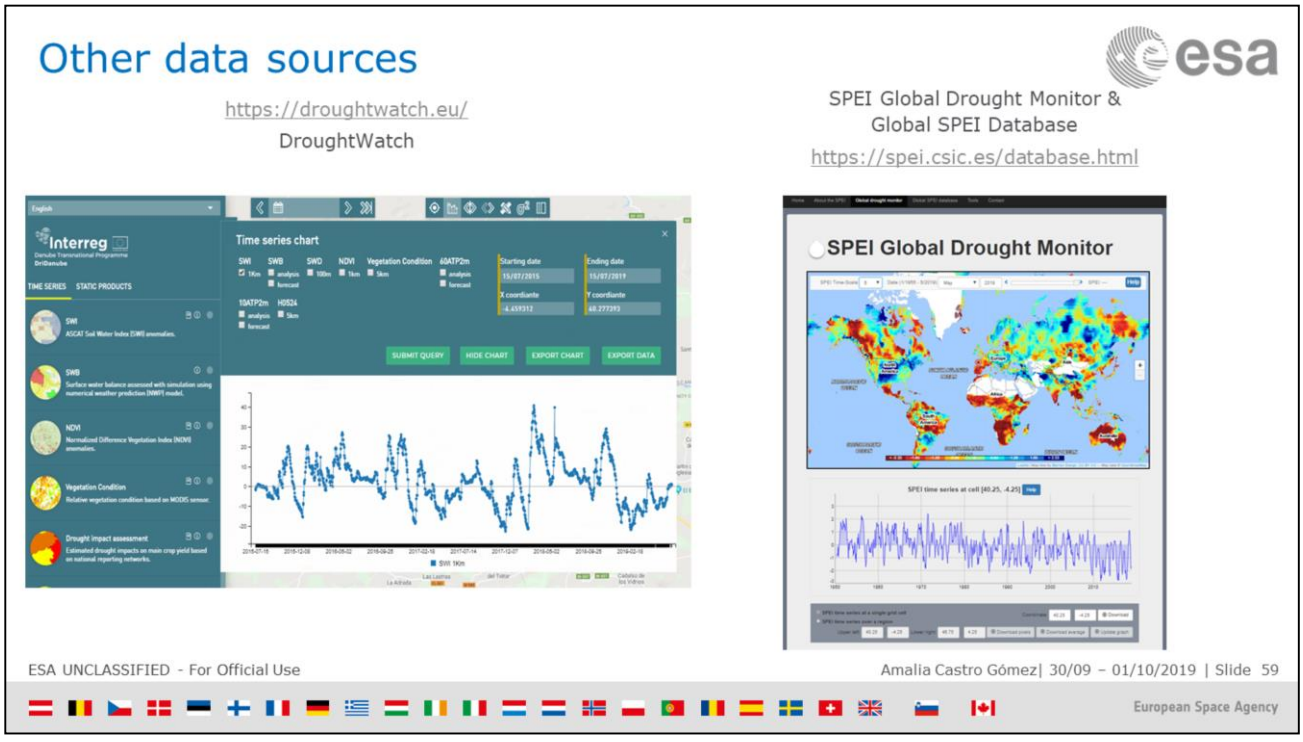


It is also possible to visualize annual estimates for each country (under Analysis Tools), concerning the Burned Areas (ha) and the Number of Fires. Data can be exported as .csv. We have exported the data from Spain and plotted them together for clarity.

These data are derived from European Fire Database.

Note that GWIS also makes available estimates per country for those two parameters. However, in the case of GWIS, the data are derived from MODIS burned area product (MCD64A1) and are not real time. The post-processing applied may cause the GWIS statistics to differ from other data derived directly from MCD64A1. More info at http://gwis.jrc.ec.europa.eu/about-gwis/technical-background/statistics/

Besides the fact that those statistics refer to the whole country (and not only to the region of our study area), they are useful to understand that fire occurrence and extension depends on many other factors besides drought: We can see that larger Burned Areas and larger Number of Fires do not always match the Soil Moisture Anomalies and the lower SPI-6 values.



How to choose where we get the data related to Soil Moisture and Drought?

Make a small review of what is available and which datasets they use (and the periods covered)

Other services are available, but the areas and periods covered with each datasets vary and might not be suitable for your particular case study (e.g. if we are interested in data up to 2019, the sources below are not suitable):

- DroughtWatch https://droughtwatch.eu/

Contains for example ASCAT Soil Water Index anomalies in Europe from 2010 onwards. The product is based on MetOp/ASCAT surface soil moisture distributed by EUMETSAT. View factsheet for more information.

In the screenshot above ,we used the coordinates of our Burned area (below), click Submit Query and also Export Data

Coordinates burned point:

Lat 40.277393

Lon -4.459312

- SPEI https://spei.csic.es/index.html

The Standardized Precipitation Evapotranspiration Index (SPEI) data can be exported from https://spei.csic.es/database.html for the same coordinates.

Note the Global SPEI database has a spatial resolution of 0.5°, and covers the period 1901−2015.

Thanks!

Any questions?