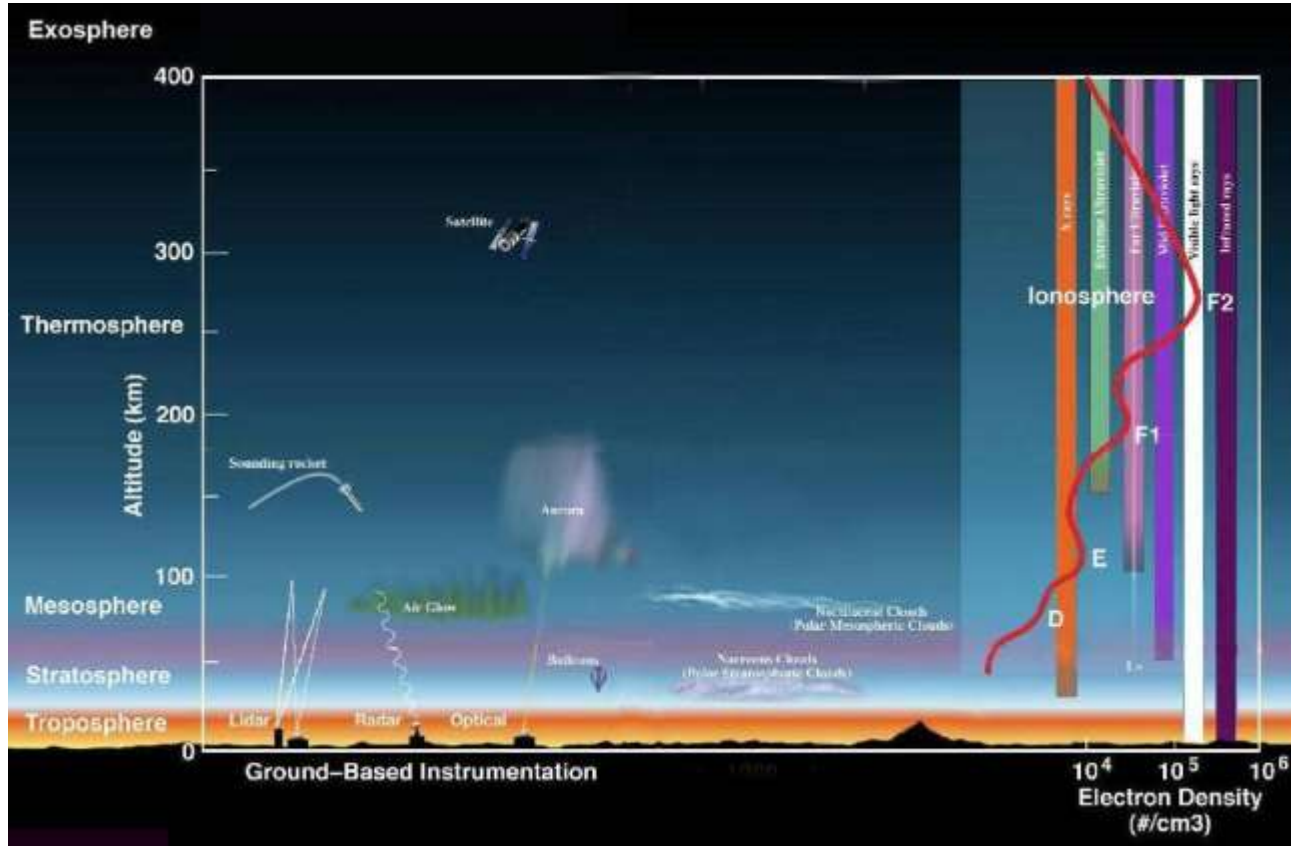
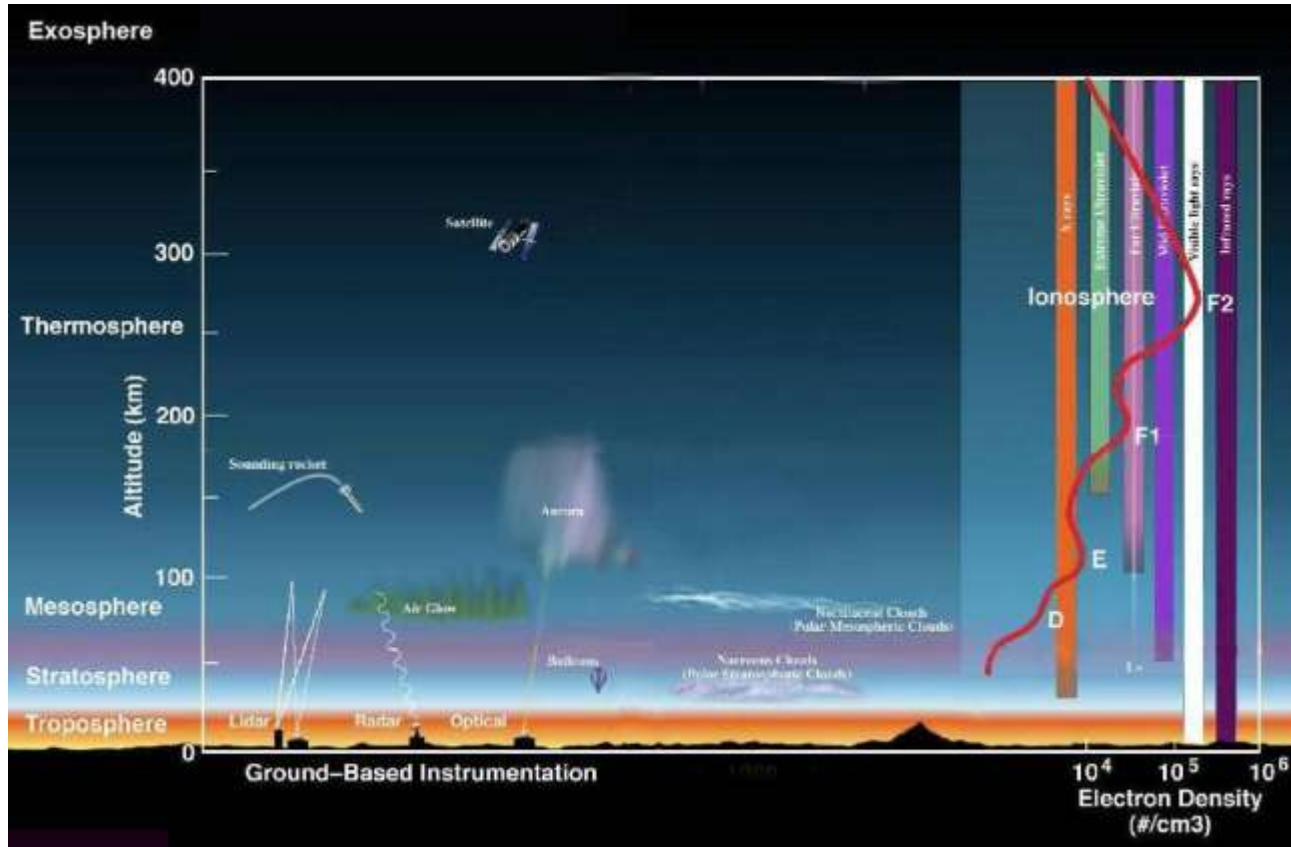


# Remote Sensing of the Atmosphere

# 1. Intro: Our atmosphere's layers



# 1. Intro: Our atmosphere's layers



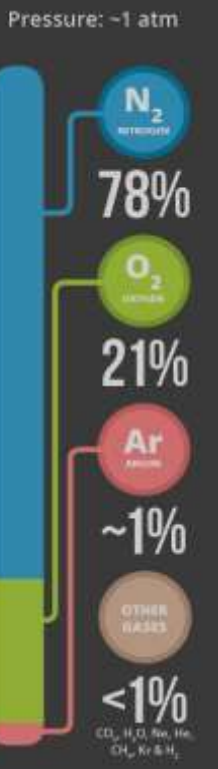
# 1. Intro: troposphere's composition

## Major components:

78% Nitrogen

21% Oxygen

1% (CO<sub>2</sub>, Argon, water vapour, trace of other gases, aerosols and clouds)





# 1. Intro: Our atmosphere: the **Greenhouse Effect**



Gases in our atmosphere trap the heat from the Sun, so the Earth is much warmer than it would be without an atmosphere, and life can flourish.

The gases responsible for this are mainly:

- Carbon dioxide CO<sub>2</sub>
- Methane CH<sub>4</sub>
- Nitrous oxide N<sub>2</sub>O
- Water vapour

How can we measure these gases?

# 1. Intro: Measuring air quality from the ground



**in-situ measurement**

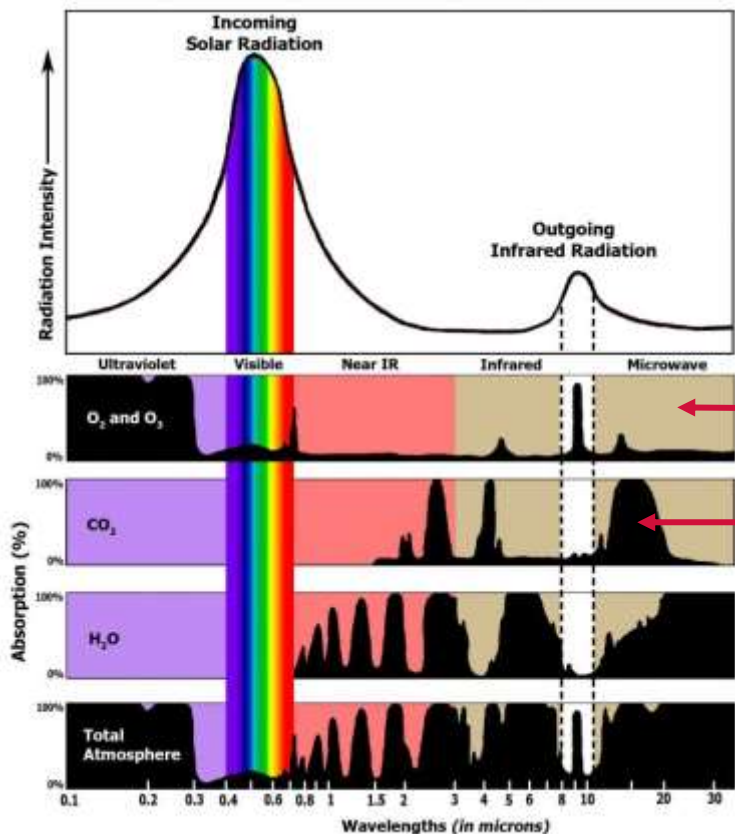
# 1. Intro: Measuring air quality from space

## Needing Remote Sensing

**Remote sensing** is the acquisition of information about an object or phenomenon *without making physical contact with the object* and thus in contrast to on-site observation (performed locally on Earth)



# 1. Intro: Measuring atm. composition from space



Each gas absorbs the sun radiation in certain wavelengths, creating a certain **signature**. Thanks to this, we can differentiate gases from each other.

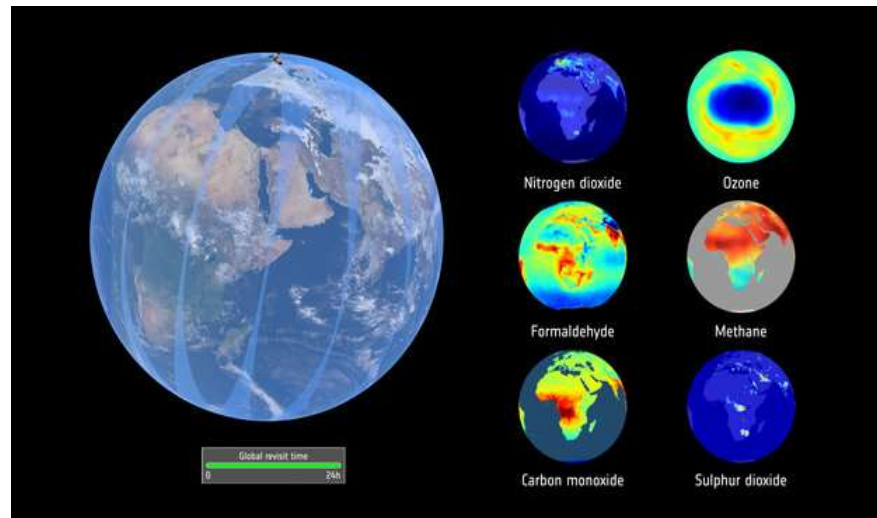
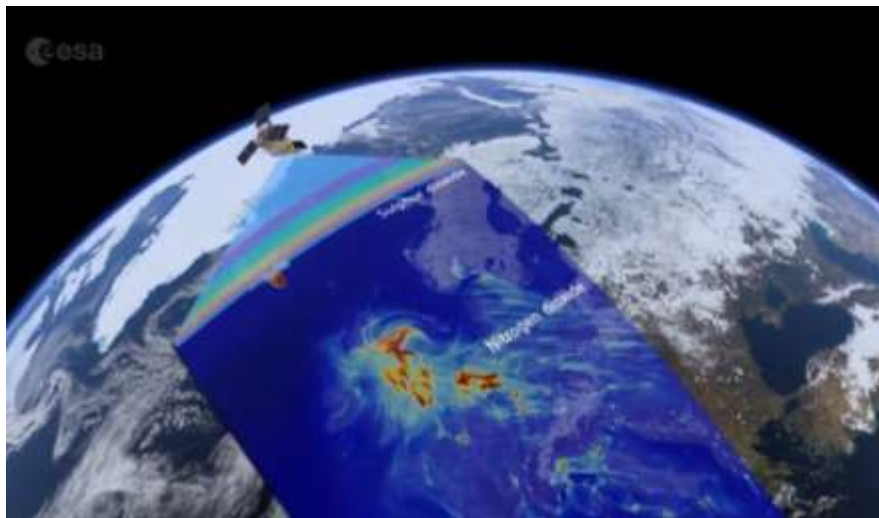
Atmospheric windows are displayed in colour

Absorption bands are shown in black



# 1. Intro: Measuring atm. composition from space

- Measurements from space: Copernicus Sentinel 5P satellite

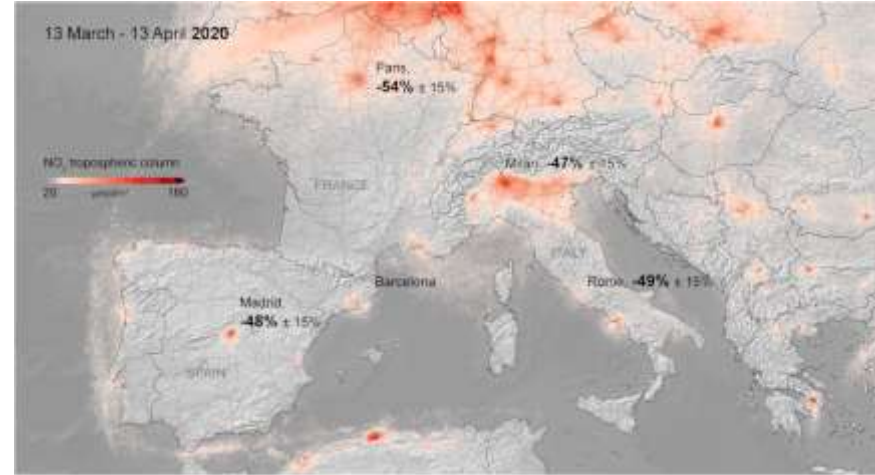
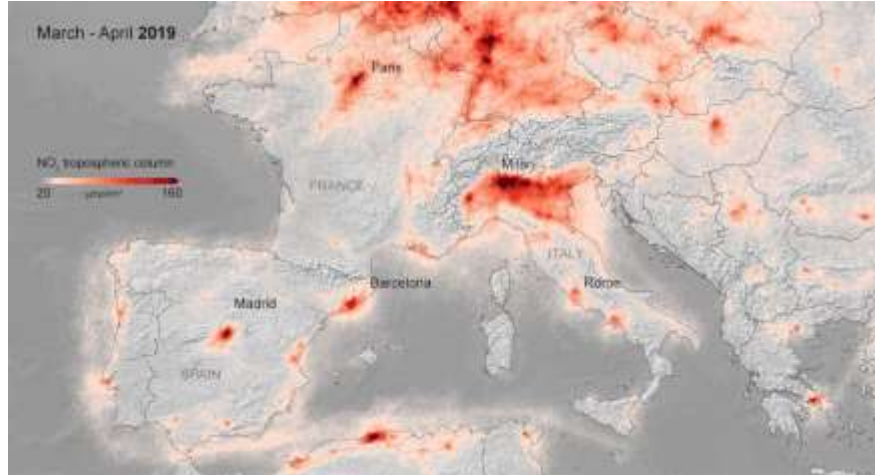


Animation available at  
[http://www.esa.int/spaceinvideos/Videos/2017/07/Bringing\\_air\\_pollution\\_into\\_focus](http://www.esa.int/spaceinvideos/Videos/2017/07/Bringing_air_pollution_into_focus)

# 1. Intro: Measuring atm. composition from space: NO<sub>2</sub>

Coronavirus lockdown leading to drop in pollution across Europe

More info at <https://maps.s5p-pal.com/cases/>



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# 1. Intro: Measuring atm. composition from space: CO<sub>2</sub>



- Carbon Dioxide (CO<sub>2</sub>) is a very potent greenhouse gas and contributes to global warming
- Man-made CO<sub>2</sub> is generally created during the burning of fossil fuels by cars and industry



# 1. Intro: Measuring atm. composition from space: CO<sub>2</sub> (carbon dioxide)



- Odourless gas which is highly toxic
- Sources are mainly car exhaust fumes and the burning of fossil fuels in general
- Even in small concentrations it can lead to poisoning and death



Source: Max Lederer



# 1. Intro: Measuring atm. composition from space: Particulate Matter PM2.5 and PM10 (part of aerosols)



- Very small particles with very varied origins (some natural, some man made)
- PM2.5  $\leq 2.5 \mu\text{m}$ ; PM10  $\leq 10 \mu\text{m}$  (diameter)
- PM2.5 is particularly dangerous since these particles can penetrate deep inside our lungs due to their small size
- Both PM2.5 and PM10 are linked to cancer and respiratory diseases



Source: Holger Link

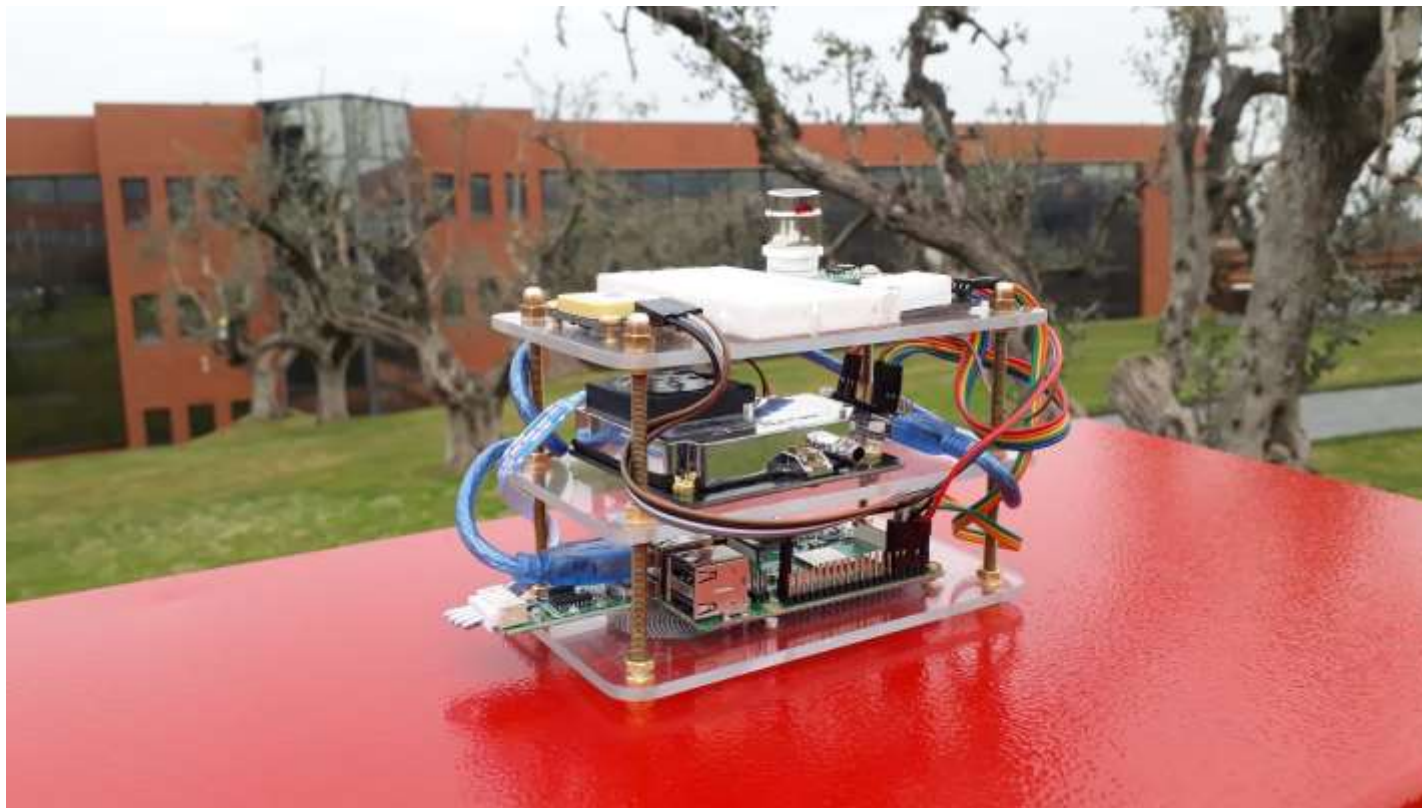
## 2. EXPERIMENTS



- Air Pollution experiment (Air Quality Platform)
- Exploring the EO Browser



# ESA Air Quality Platform



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# ESA Air Quality Platform – the website



<https://lps19airquality.esa.int/map/>



## LPS Air Quality Station

### LPS SCHOOL EXPERIMENT: AIR QUALITY STATION

The LPS School Experiment offers high school students (14 to 18 years) the unique opportunity to be part of an European Space Agency (ESA) project and assemble and operate their own air quality (AQ) station.



LPS Air Quality Station

#### Quick Start Guide

The [Quick Start Guide](#) contains all the information on how to assemble and configure your LPS AQ station and how to make measurements with it.



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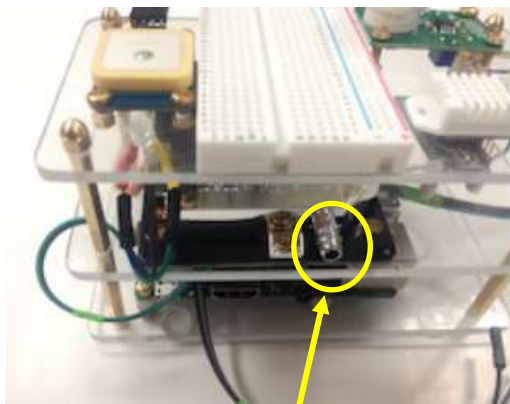


European Space Agency

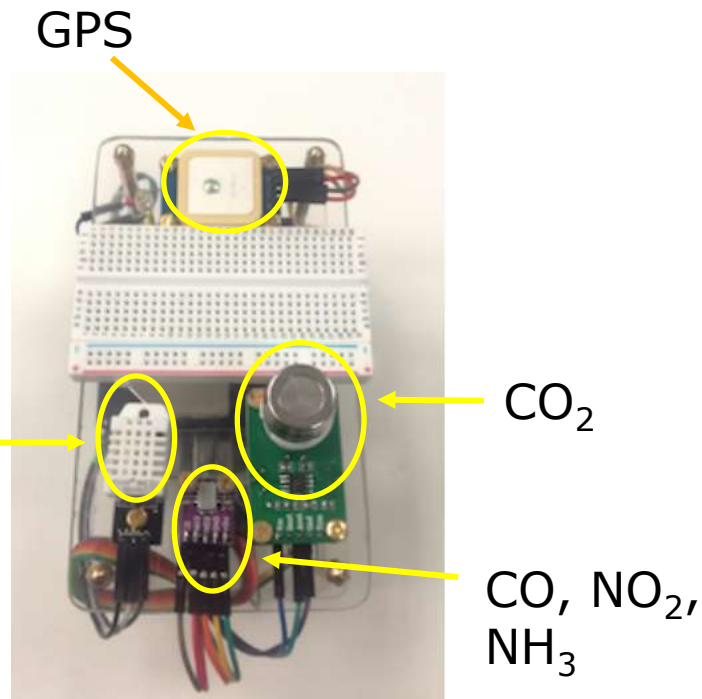


## 2. Experiments: ESA Air Quality Platform

- update it



PM 2.5 & PM 10



## 2. Experiments: EO Browser Overview



The screenshot displays the EO Browser web application. The interface includes a top navigation bar with the 'EO Browser' logo and user information 'Nicolas Wiegner'. A search bar is located in the top right. The main area is a map showing a coastal region. On the left, a search panel is visible with the following elements:

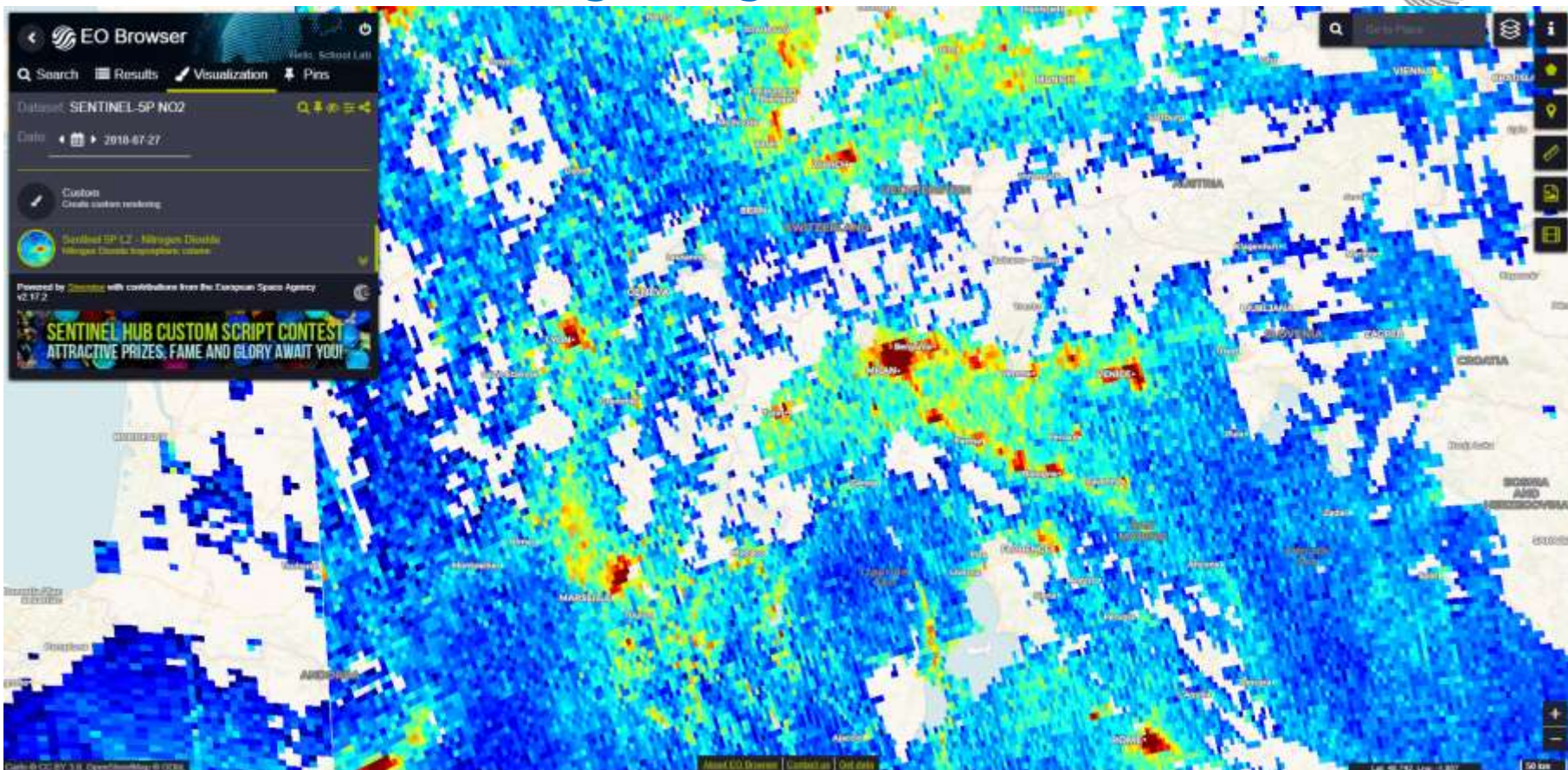
- Search bar with 'Search' button
- Results, Visualization, and Pins icons
- Data sources section
- Time range: 2018-02-24 to 2019-03-24
- Theme: Default
- Search button
- Footer: Powered by GeoEye with contributors from the European Space Agency v2.17.2
- Advertisement: SENTINEL HUB CUSTOM SCRIPT CONTEST ATTRACTION PRIZES, FAME AND GLORY AWAIT YOU!

At the bottom of the map, there are links for 'About EO Browser', 'Contact Us', and 'Get Data'. The map shows coordinates 'Lat 42.504, Long 11.184' and a scale of '20 km'.

- Online tool for visualizing satellite data
- Free of charge
- Contains (almost) complete archive of Sentinel 1,2,3 and 5P data
- Go to: [apps.sentinel-hub.com/eo-browser/](https://apps.sentinel-hub.com/eo-browser/)

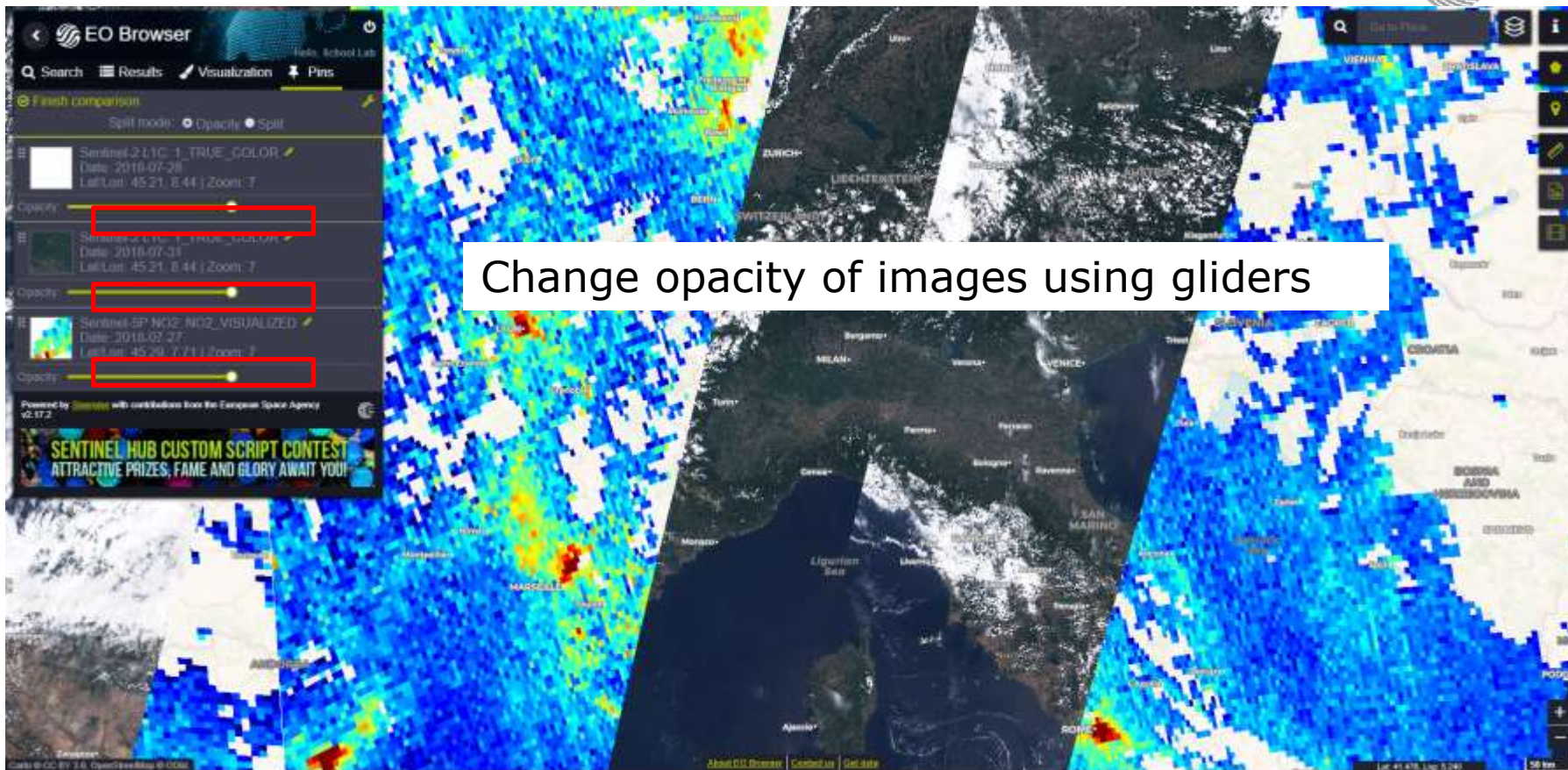


# Air Pollution Monitoring using EO Browser



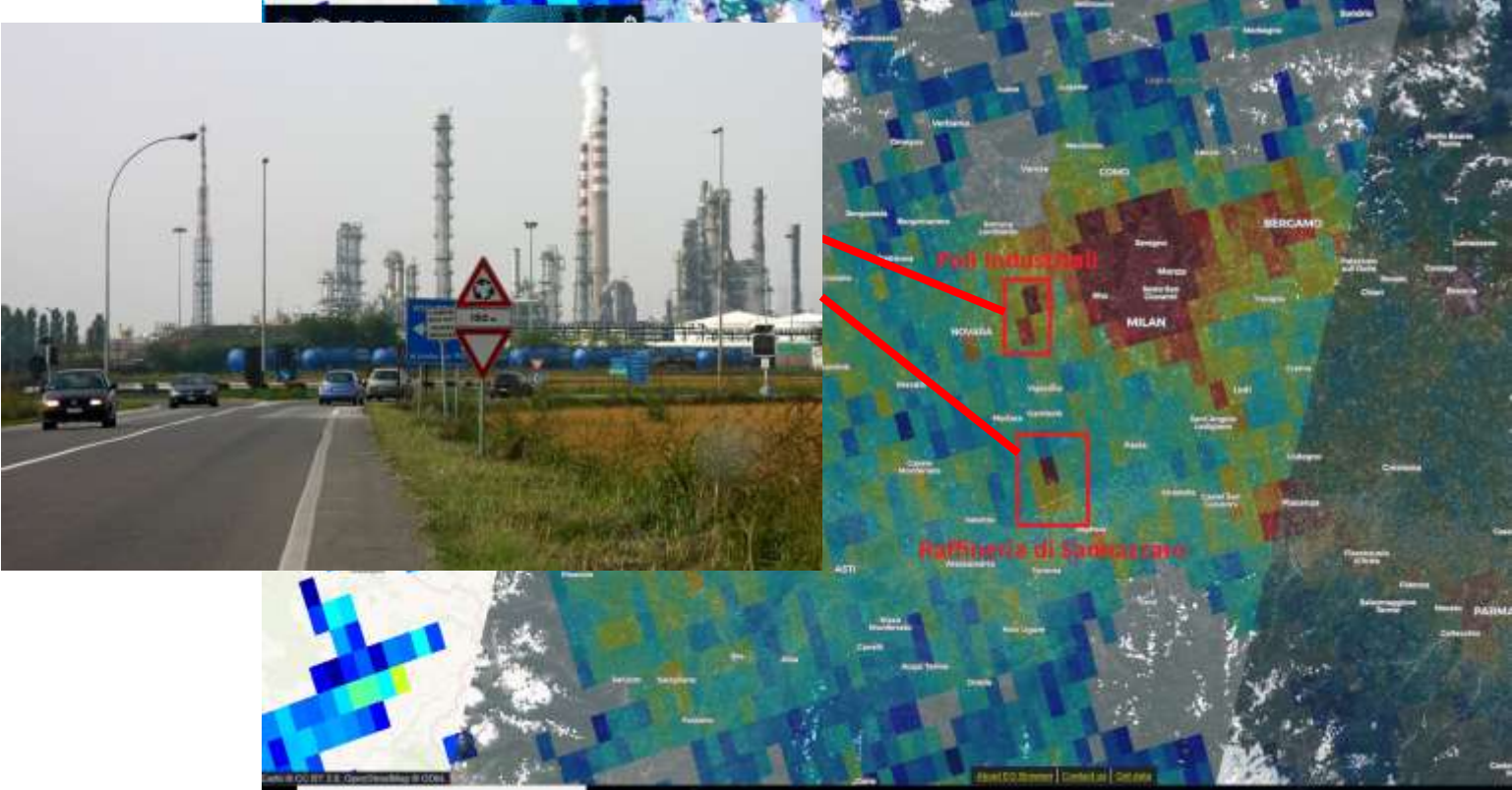


# Air Pollution Monitoring using EO Browser





# Air Pollution Monitoring using EO Browser



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