Rapid Action on Covid-19 and EO

3 June 2021, TAT-8

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European Commission
esa
Rapid Action on COVID-19 and EO
Copernicus
Europe's eyes on Earth
European Space Agency

Rapid Action on Covid-19 and EO

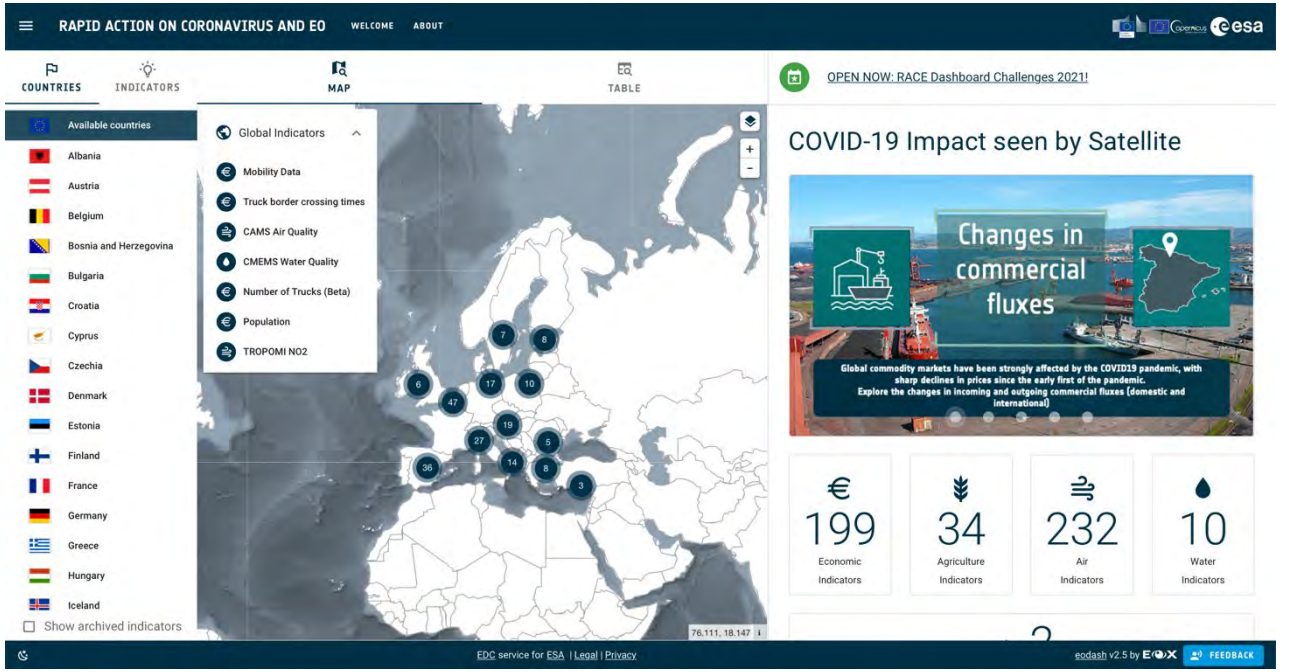
Objectives

- Provide public EO info on the state of European society and economy
- Using European EO: Copernicus Sentinels and Third Party Missions
- Leveraging on European companies capabilities and using AI powered latest platforms technology

Focus areas

- **Climate:** greenhouse gas concentrations
- **Environment**: air and water quality evolution
- **Economic** indicators: industry, shipping, construction, trade, traffic
- **Agriculture**: asparagus, red fruits etc.

Joint initiative of ESA and EU



race.esa.int

Achievements

Single source of truth – EO data from **Copernicus Sentinels** and **Third Party Missions**

Made in Europe, combining ESA expertise with European industrial skills and EO Platforms leveraging AI4EO

Straightforward to use by non-technical users

Informative for general public and decision makers

Communicates the effects of the lockdown on the environment and the economy, **observable from space**

Engaging public and community via the **EuroDataCube contest**

110.000 VISITS

198 ECONOMIC

34 AGRICULTURE

248 ENVIRONMENT

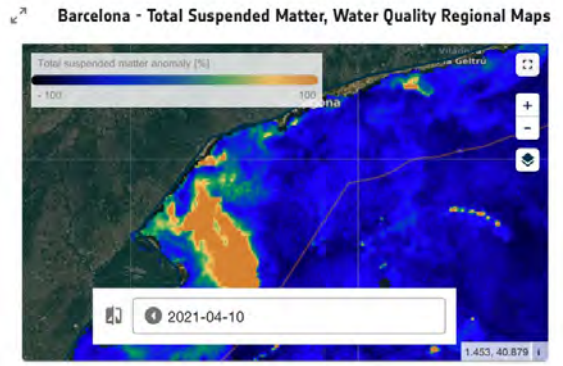
6 COMBINED

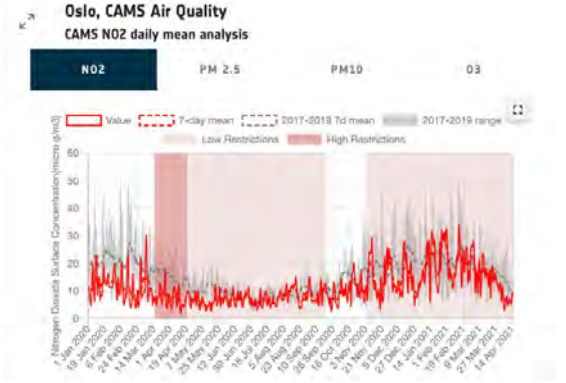
2 HEALTH

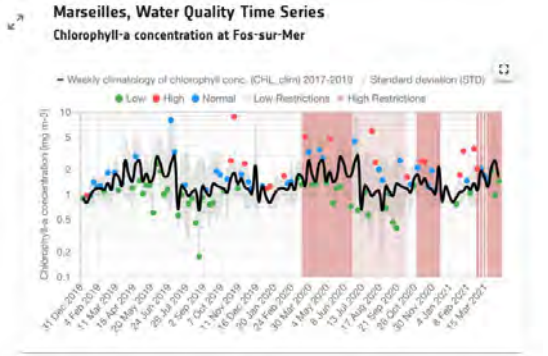
33 COMPANIES

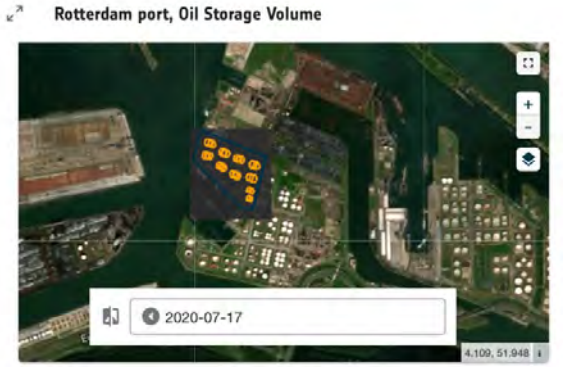
Multiple (Open) Data Sources race.esa.int

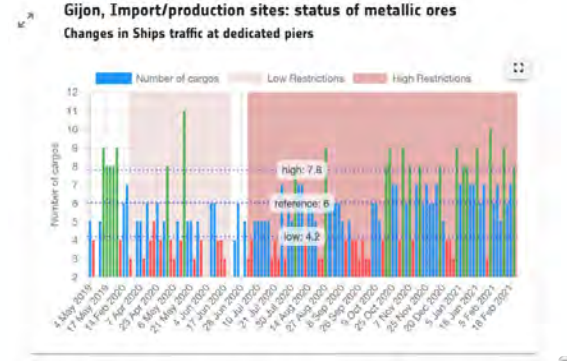
- Copernicus Sentinels (S-1, S-2, S-3, S-5p)
- Third Party Missions (Pleiades, Deimos, Iceye)
- Copernicus Services (CMEMS, CAMS)
- Copernicus Climate Data Store (Temperature, Relative Humidity, Wind)
- AIS
- Statistical data
- OpenStreetMap
- Mobility (Google, GSA)
- Anonymized mobile data
- Health (Our World in Data, Oxford)
- Population (CIESIN)







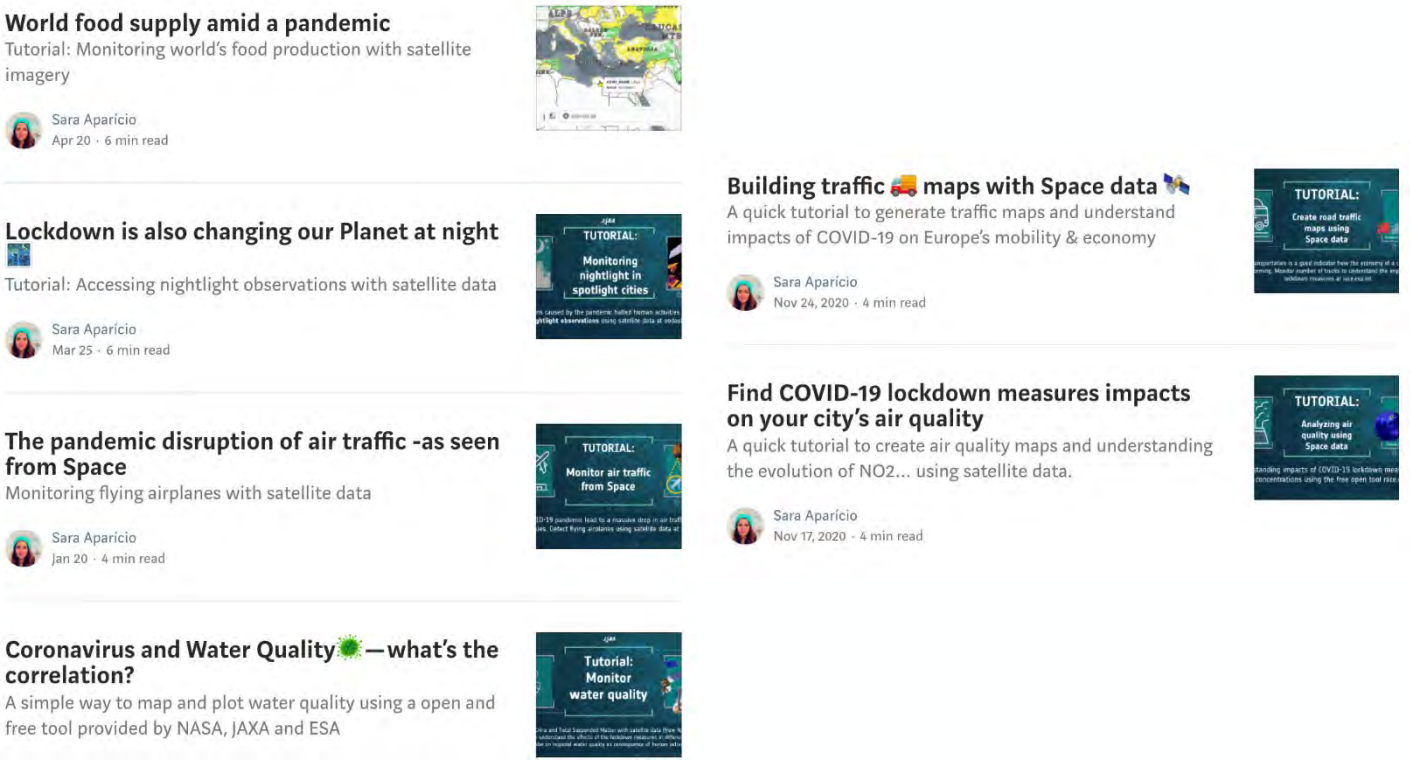




RACE for Education – 1/3

By stakeholder

1. **Education for Students**
   - Lectures to ESA Lab@, Universities
   - Centrale Supelec (Jan. 2021)
   - POLIMI (Apr. 2021)
2. **Education for general public**
   - Copernicus MOOC (Sept. 2020)
   - Tutorials (Medium.com)
   - Competitions (Custom Script Challenges 2020, RACE Challenges 2021)



RACE for Education – 2/3

By topic and content

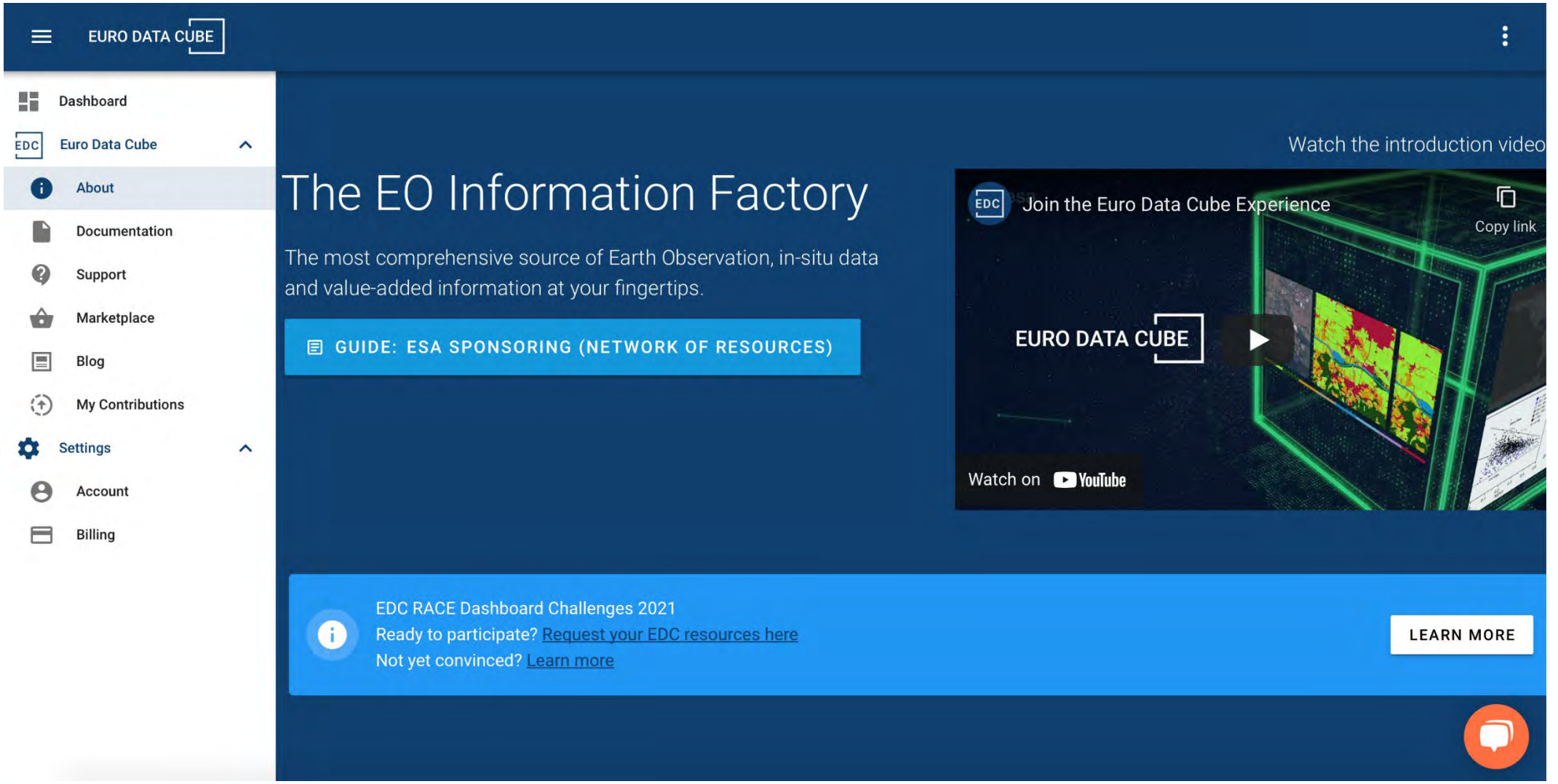
1. **Introduction to EO**
   - Types of EO Platforms
   - Copernicus Sentinels
   - EO data characteristics
   - Information retrieval from EO
2. **EO data analytics**
   - Data preparation
   - Time series (1-D and 2-D signal processing techniques)
   - EO Data fusion (e.g. Sentinel-1 with ALOS-2)
   - Statistical analysis
   - How to combine multiple data sources (e.g. census with EO derived information)

RACE for Education – 3/3

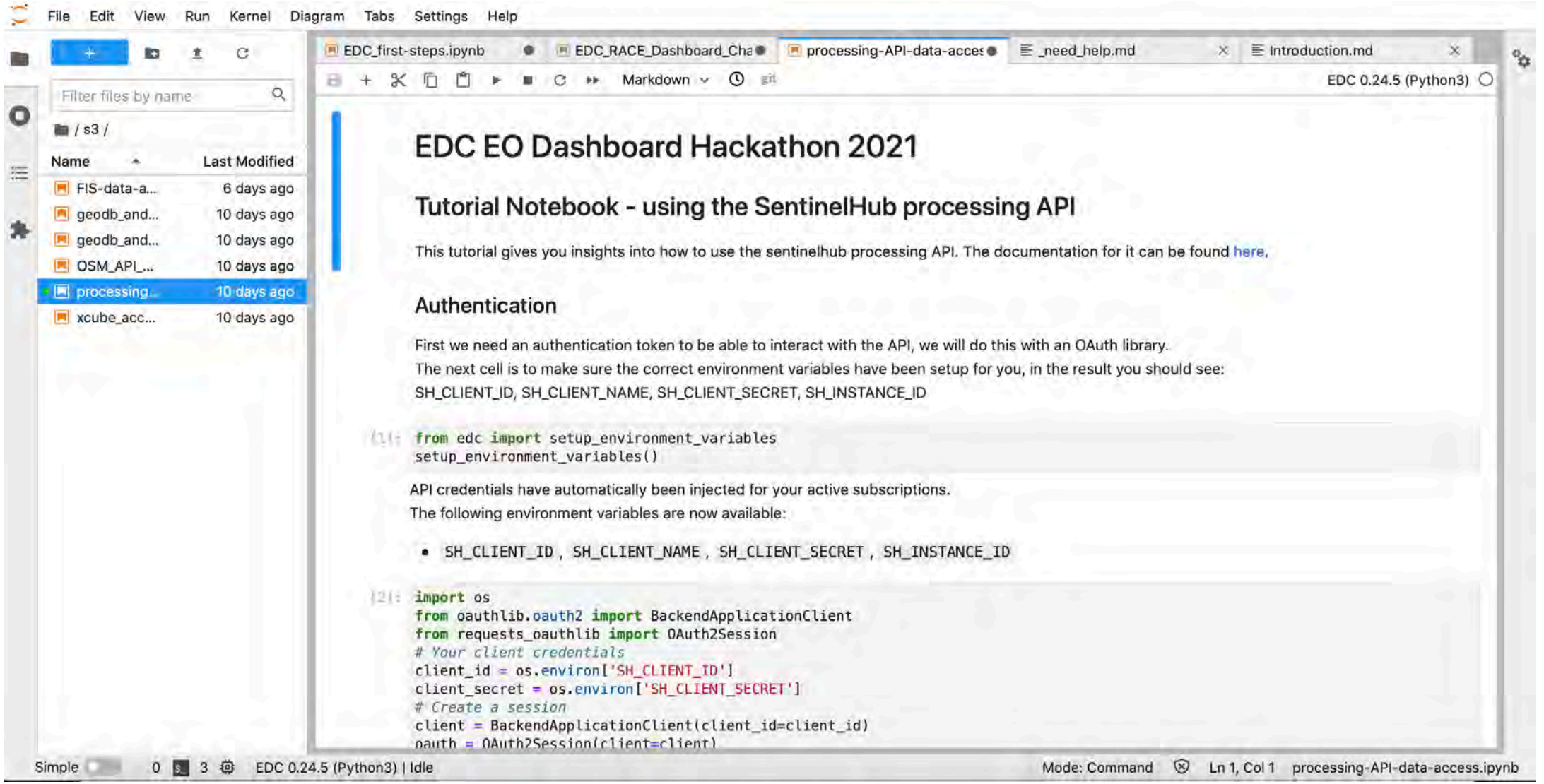
By topic and content

3. **Use of EO Platforms**
   - EuroDataCube and associated services (EOXhub, SentinelHub, Geodb, Xcube)
   - Free provision of resources for challenges
4. **Cloud Computing**
   - Python with Jupyter Notebooks (provision of sample tutorial notebooks to get started)
   - How to access and process the EO data
   - How to access and analyse the tabular data in the Geodb
   - How to create simple visualisations
   - How to scale up the processing from 1 AOI to regional or global

EuroDataCube



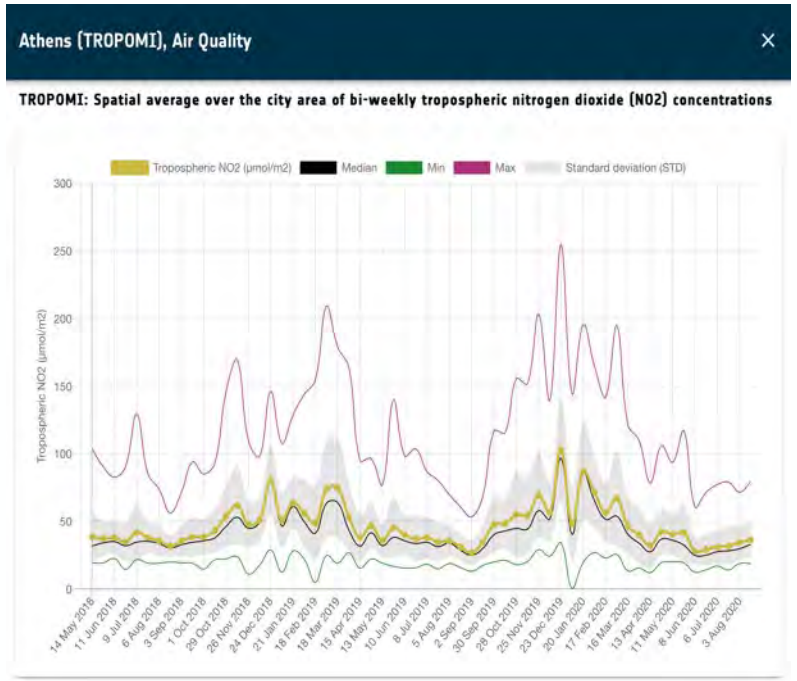
EuroDataCube

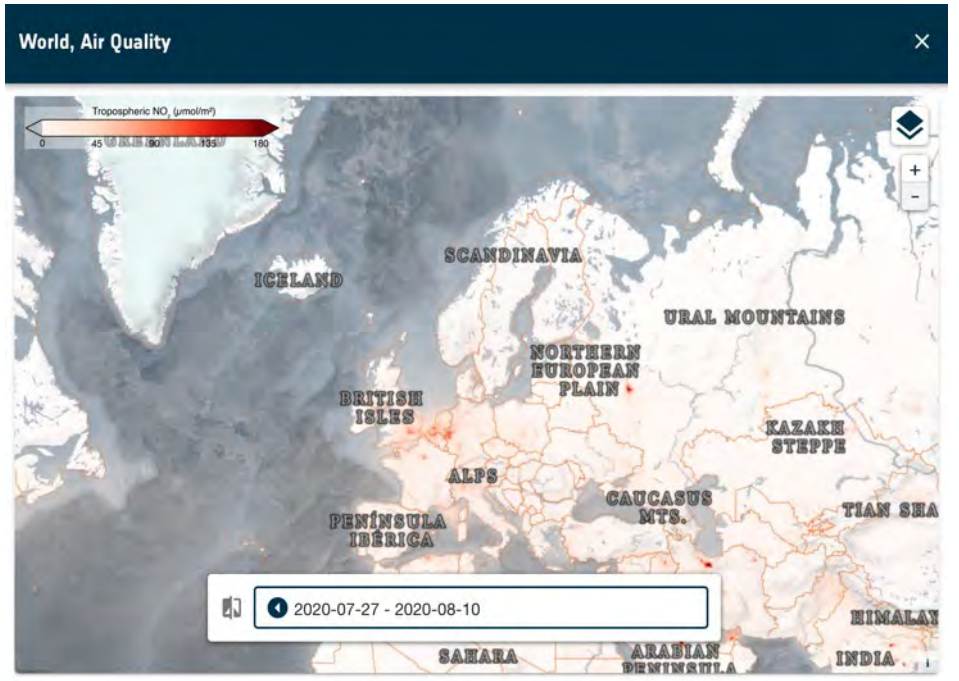


Environment – AIR QUALITY

SENTINEL-5p TROPOMI – Air Quality, Stratospheric Ozone Layer and Climate Change Monitoring and Forecasting. The climate change theme is relevant to the Copernicus Climate Change Service (C3S).

Measurements from the TROPOMI instrument on the Copernicus Sentinel-5P are being used



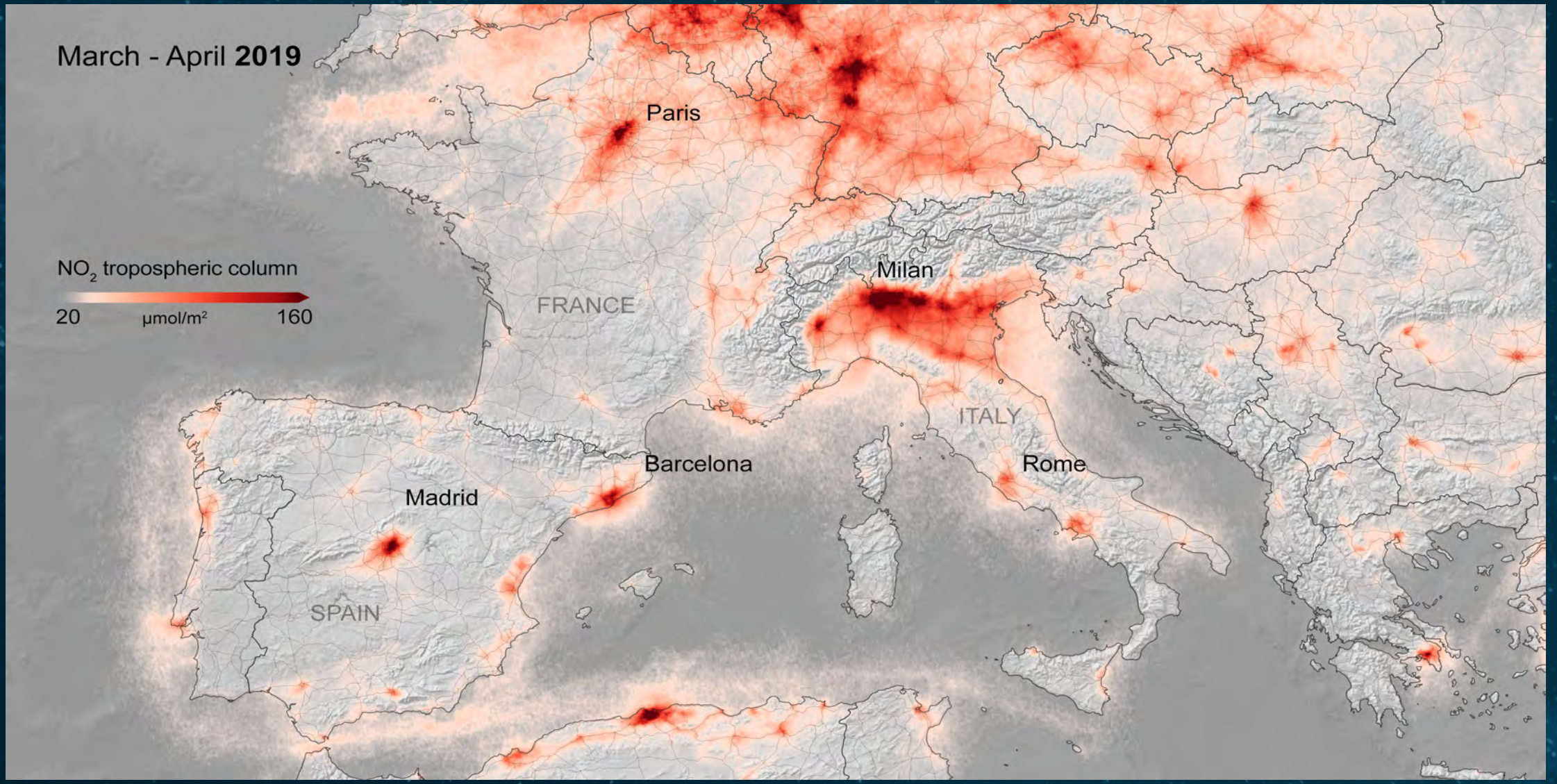


The NO2 concentrations vary from day to day due to changes in the weather (such as wind speed, cloudiness, etc).

Combined data over a specific period of time (e.g. over 14 days) partially averages out meteorological variability, making it more clearly visible how how human activity affects the NO2 levels.

Read more at: race.esa.int

Air Pollution drops during spring Lockdown



Environment – WATER QUALITY

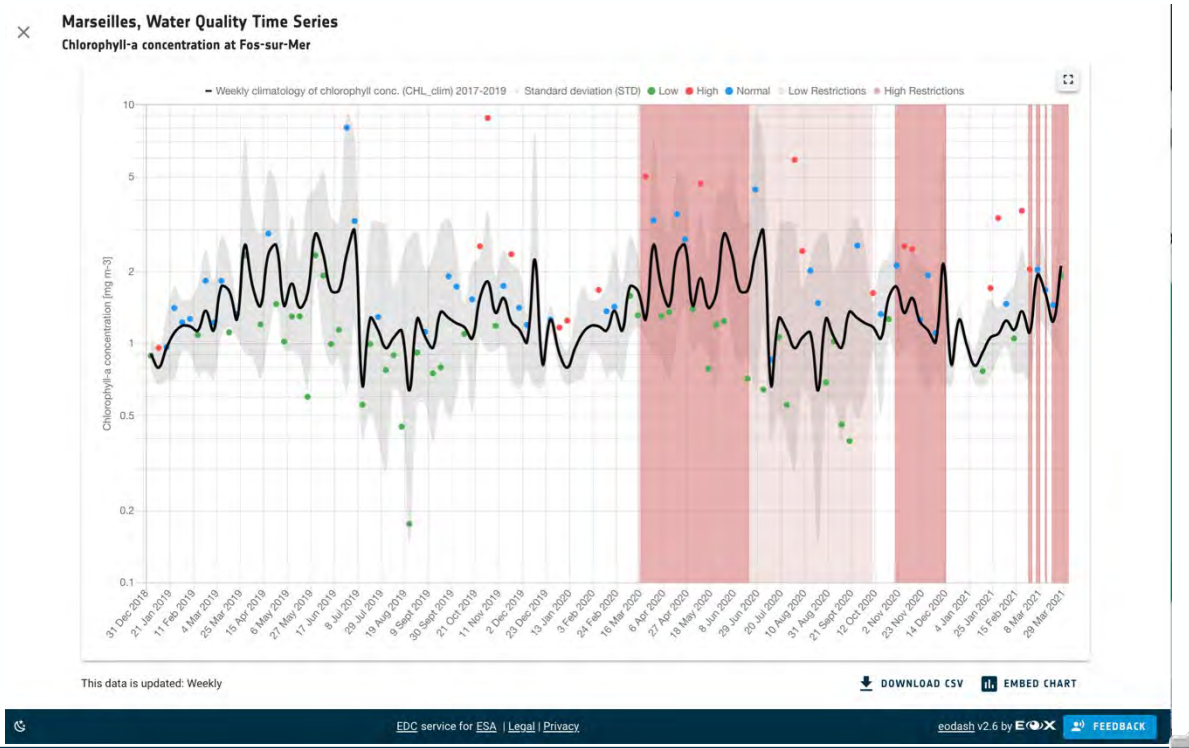
SENTINEL-3 – sea surface topography, sea & land surface temperature & colour

Monitoring the deviation from a climatological mean of Chlorophyll-a concentration provides information about the effects of natural factors and human activities on inland and coastal water quality

Green: weekly values lower than the climatological mean (black), good water quality.

Blue: weekly values greater than the climatological mean but still inside the climatological variability, regular water quality.

Red: values beyond the climatological variability, poorer water quality.

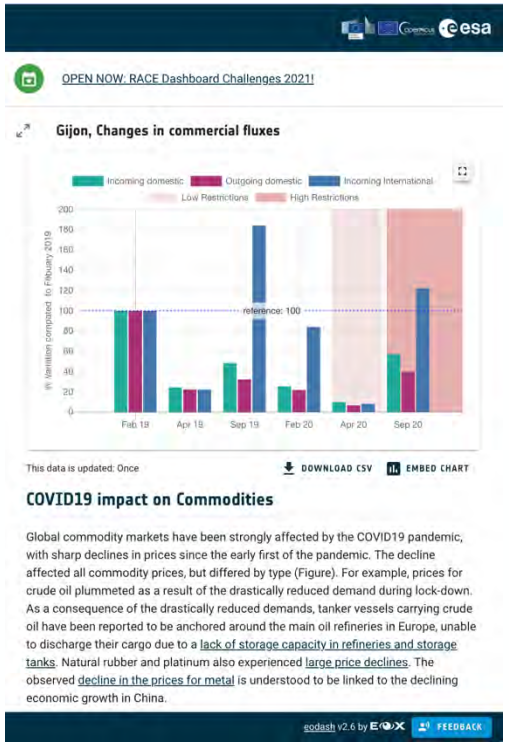


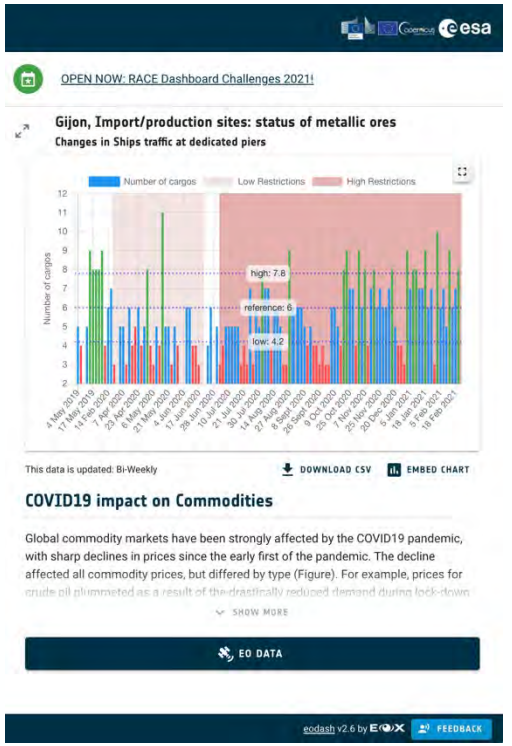
Economy – Activity in Ports

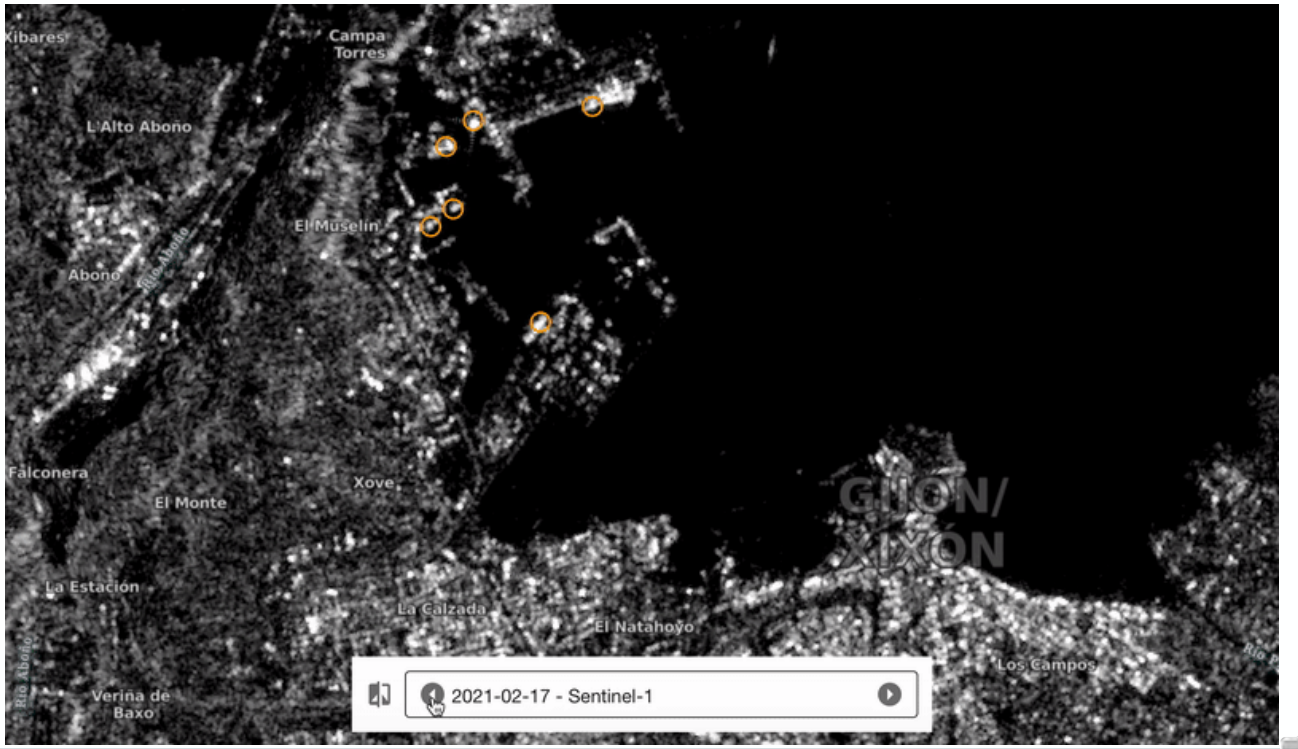
SENTINEL-1 – SAR (synthetic aperture radar) satellite

SAR Backscatter (and its variation in time) can be used to detect objects with distinctive signatures, such as ships or accumulation of high volumes of metallic objects

Spain, Port of Gijon – Changes in commercial fluxes (Sentinel-1, AIS data, Mobile data)

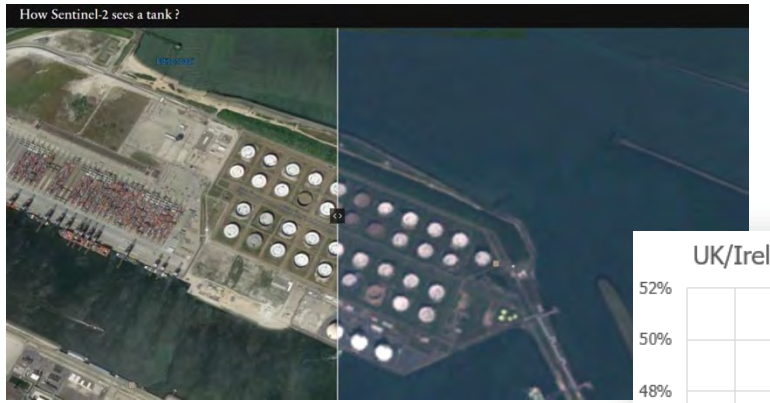


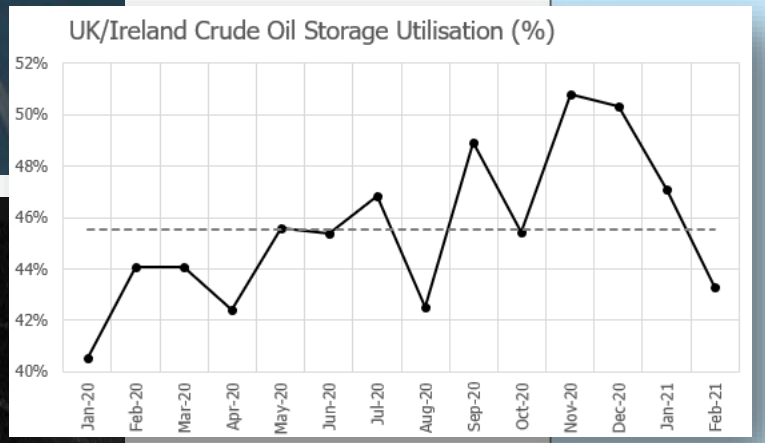


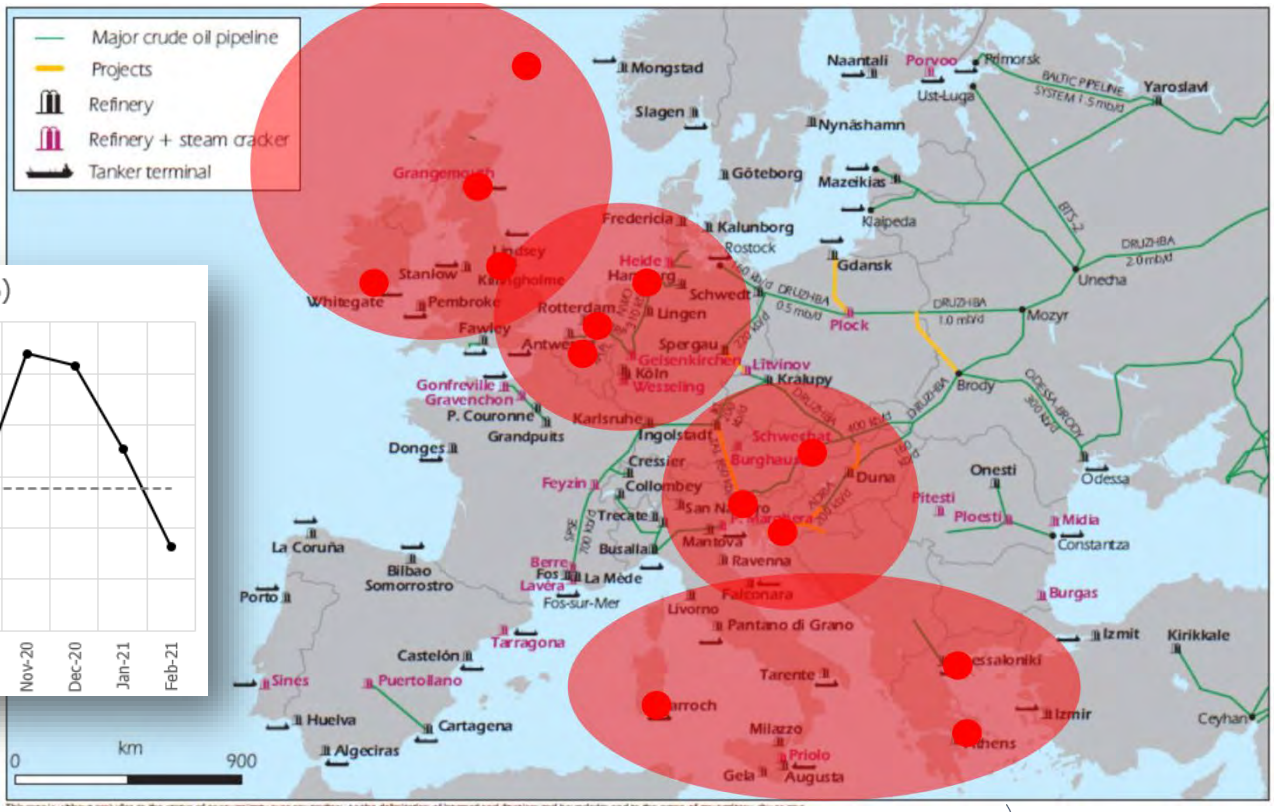


Economy – Oil & Gas Market

In preparation : European Oil Storage Index
A composite indicator based on EO (Sentinel-1, Sentinel-2), AIS and other data to derive the status of crude oil storage utilisation [in %] for 4 geographical clusters (UK/Ireland, ARA+Germany, CEE, Southern Europe)





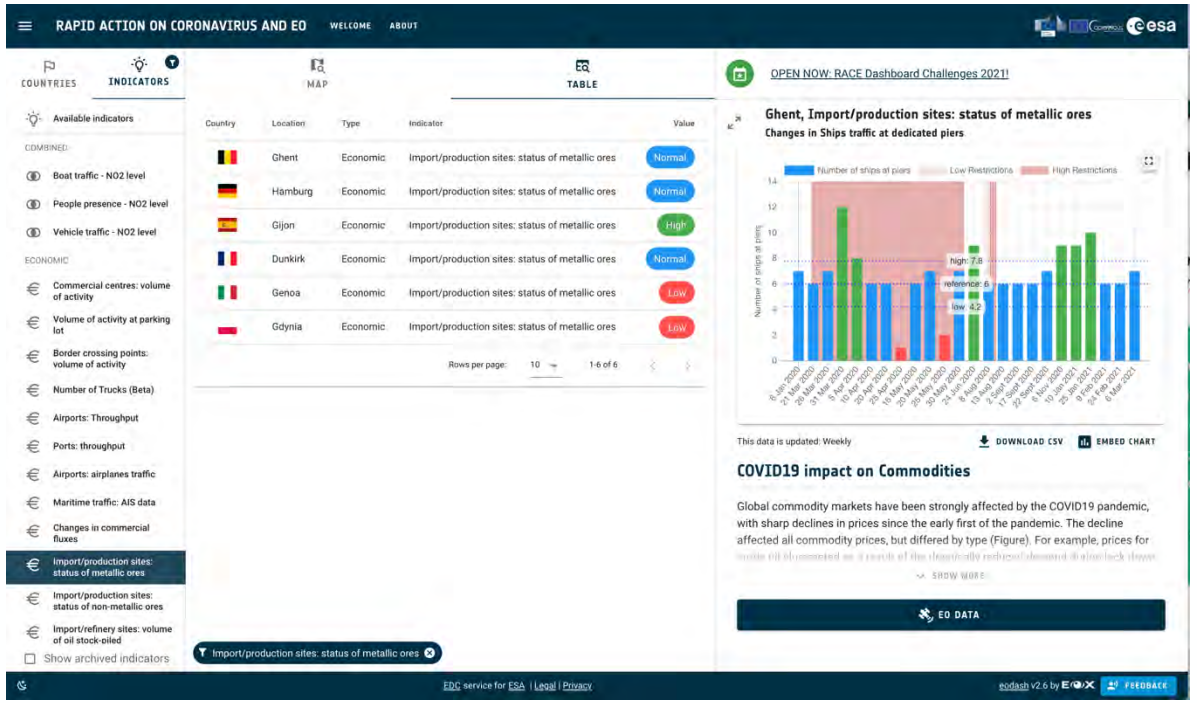


Economy – Commodities

SENTINEL-2 – Multispectral Imaging

Shipping vessels are the primary transport vehicle for most commodities and which can be directly observed and categorised with Sentinel-2 imagery and very high resolution data.

"The changes in vessel dynamics within harbours with known landing piers for certain commodities can be used as a proxy for changes in the volume of metallic/non-metallic ores stockpiled on site.



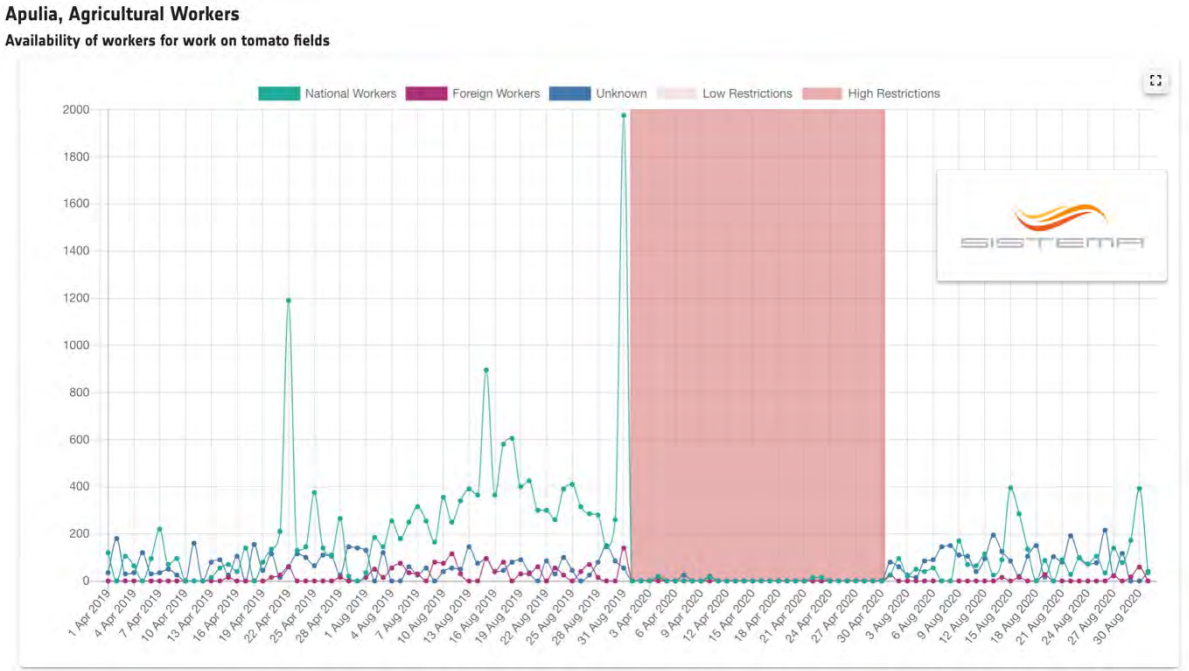
Agriculture – Harvesting

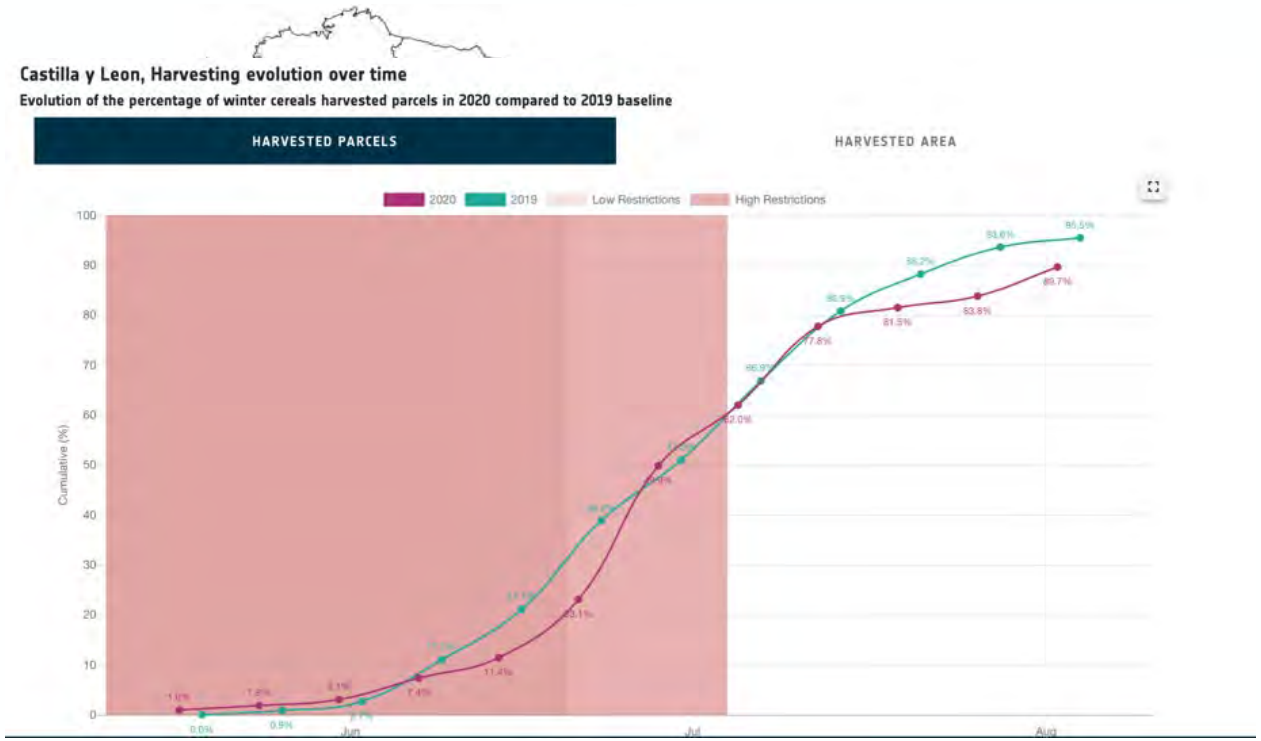
Impact of lock-down& transport restriction on food production and supply chains

Impact on labour intensive harvesting of **vegetables & fruits** (Germany-Spain) based on Sentinel-2

Verification of delay or disruption of **winter crop** harvesting in Spain at national scale (RIGHT)

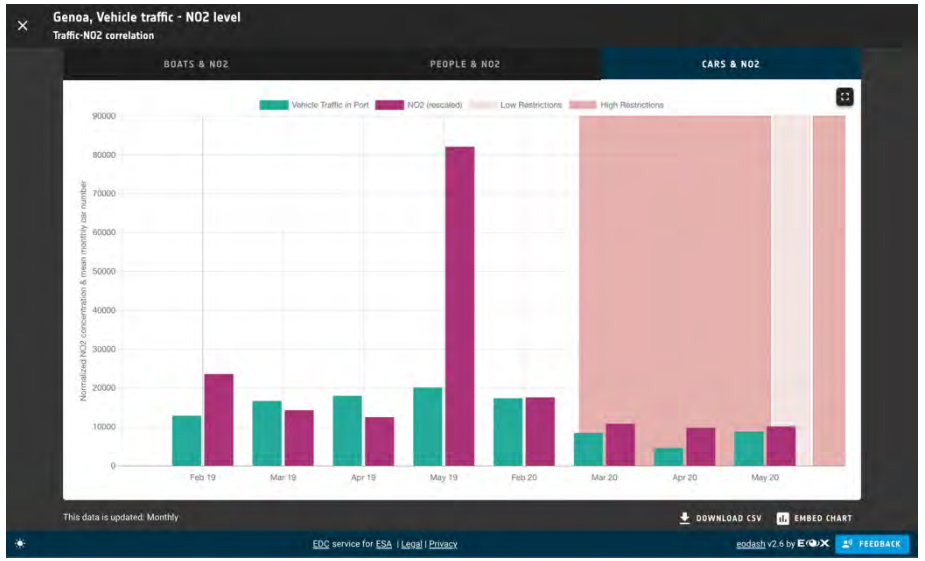
Availability of agricultural workers in Italy (Sentinel-2, Corine LC, Mobile data) (BELOW)





Winter cereals monitored over Spain during 2020.
The size of the circles represent the monitored productive area of winter cereal. Scientists from the Université catholique de Louvain, Belgium, used data from the Copernicus Sentinel-1 and 2 missions, and machine learning to monitor the crops on a weekly basis.

Measures & Effects – Activity in ports & NO2

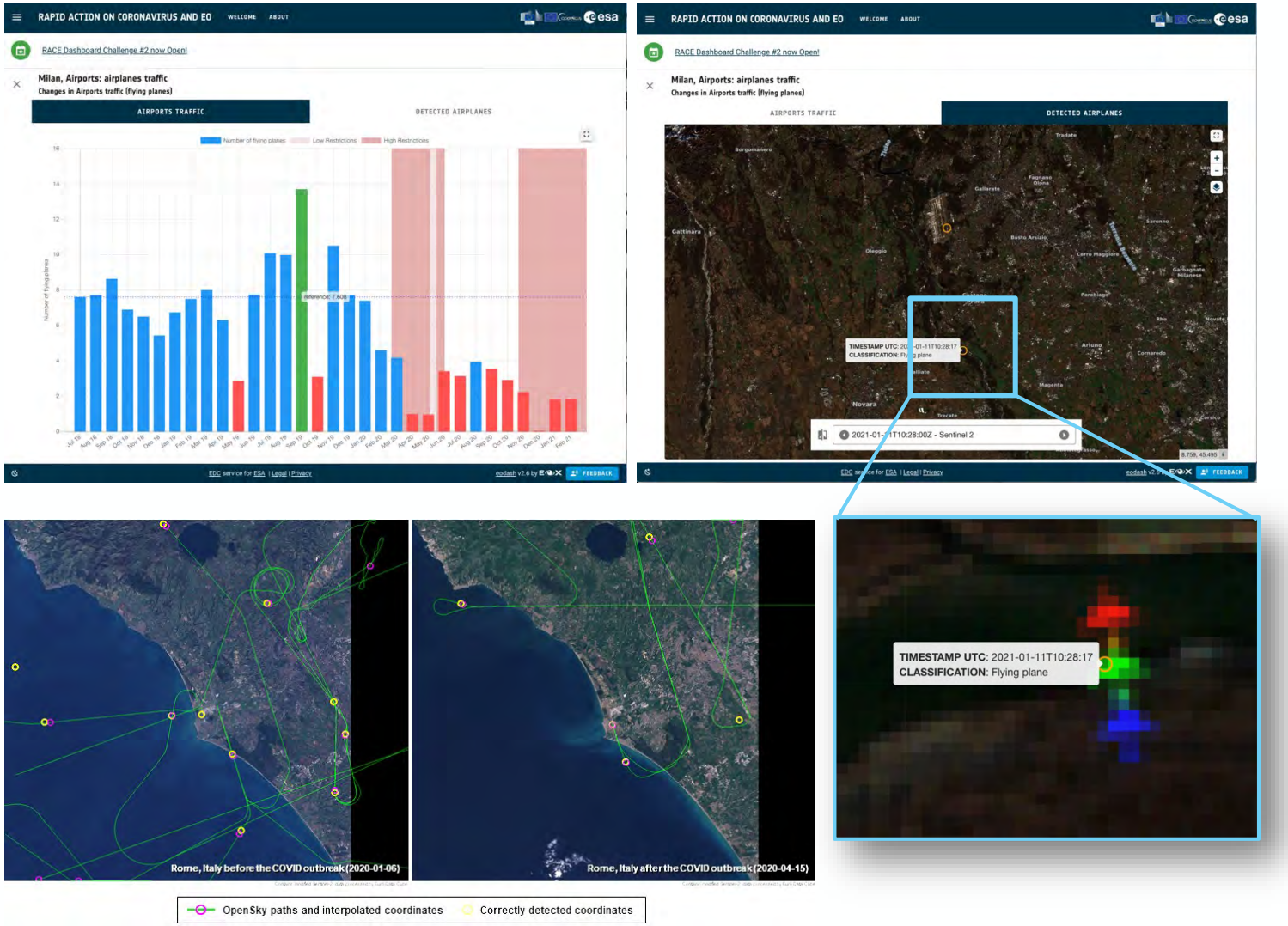


The correlation between NO2 levels and boat traffic: AIS data of all the boats coming to the ports have been collected and compared with the normalized value of NO2 over the port computed from daily data. The two variable are highly correlated; this may be an indication of how much bog boats traffic impacts the pollution of ports areas.

Measures & Effects – International Travel

- International mobility data helps better understand:
- The when and where the health-event
- Track unusual temporal and spatial occurrences
- How the disease spreads
- The effectiveness of containment strategies
- Cascade economic effects

This indicator uses Machine Learning to detect flying airplanes in images captured by the [Copernicus Sentinel-2](#) satellites.



Measures & Effects – Trucks Traffic monitoring

This indicator is based on a method that enables to detect trucks on a large scale using Sentinel-2 data.

The method exploits an effect related to the Sentinel-2 Multispectral Instrument (MSI) geometry. Sentinel-2 does not see a moving truck once but three times in the red-blue-green wavelengths.

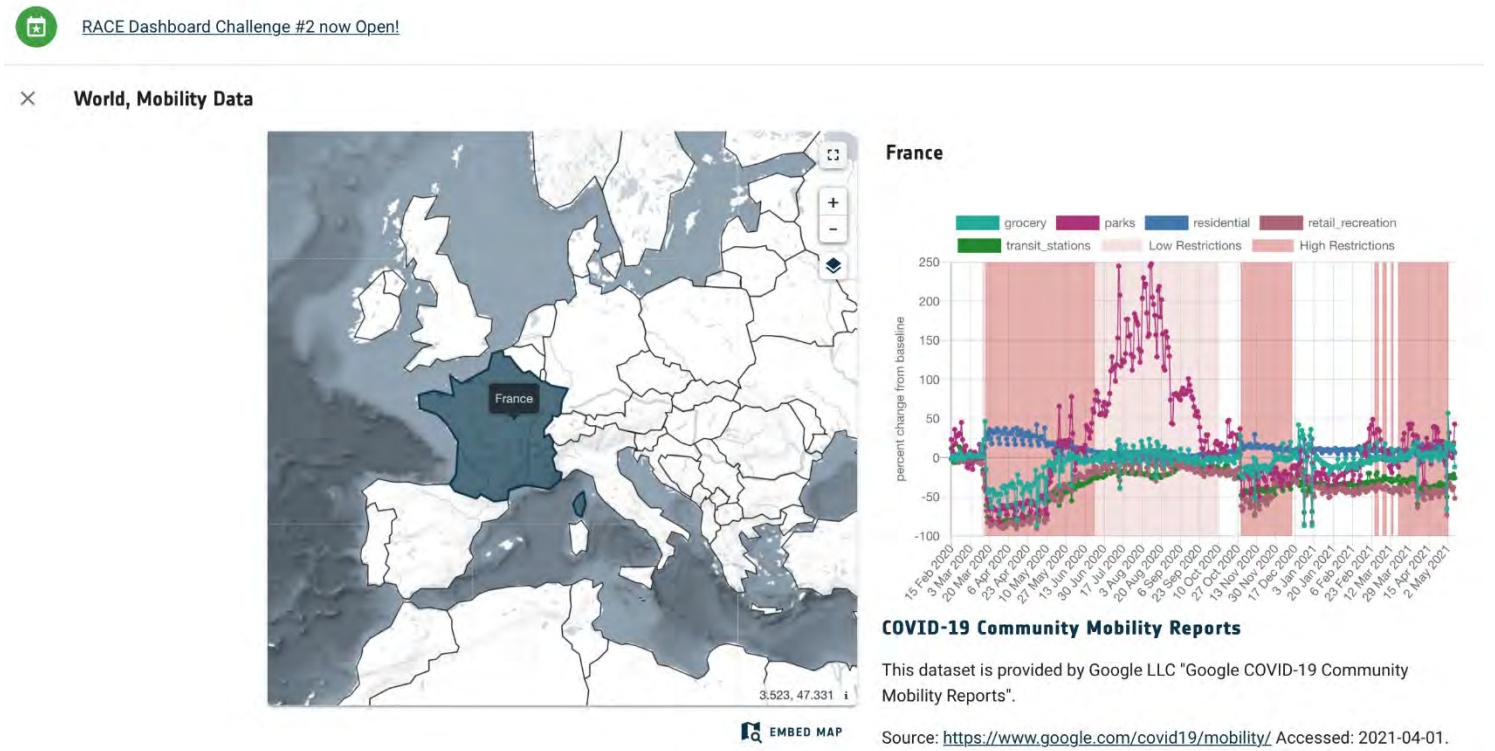
As the truck keeps traveling during this short time offset, it appears spectrally disassembled. This pattern may be used for detecting roaming trucks on roads.

Measures & Effects – Mobility

https://race.esa.int/?poi=GG-GG

Each datasets shows the daily variation of visits and length of stay at different places compared to a baseline value - "the median value, for the corresponding day of the week, during the 5-week period Jan 3–Feb 6, 2020".

Google makes the data available for download as CSV and presents the data as pdfs, one for each country (and art sub-national level for a number of countries).



Next Steps

New Data

continuously expanded with new data throughout the economic reboot

Increased Coverage

All Member States, provision of new indicators, and transfer to operations, building on success

International Cooperation

The Dashboard is coordinated with international cooperation efforts

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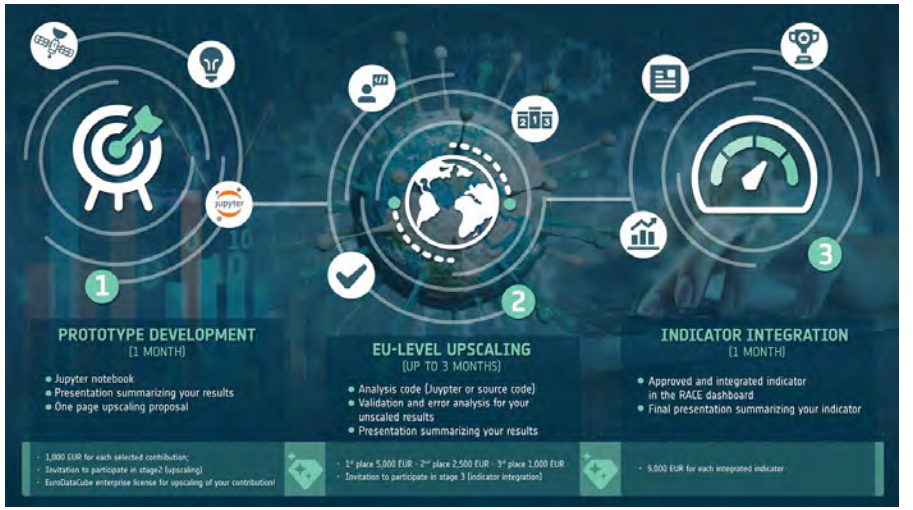
Public Engagement through the RACE Dashboard Challenges



#1 - How does the pandemic affect shipping traffic and related air and water quality?

#2 - How to combine socio-economic indicators into one impact metric across European regions?

#3 – Monitoring the economic recovery and associated environmental effects


ESA / NASA / JAXA Cooperation on COVID-19

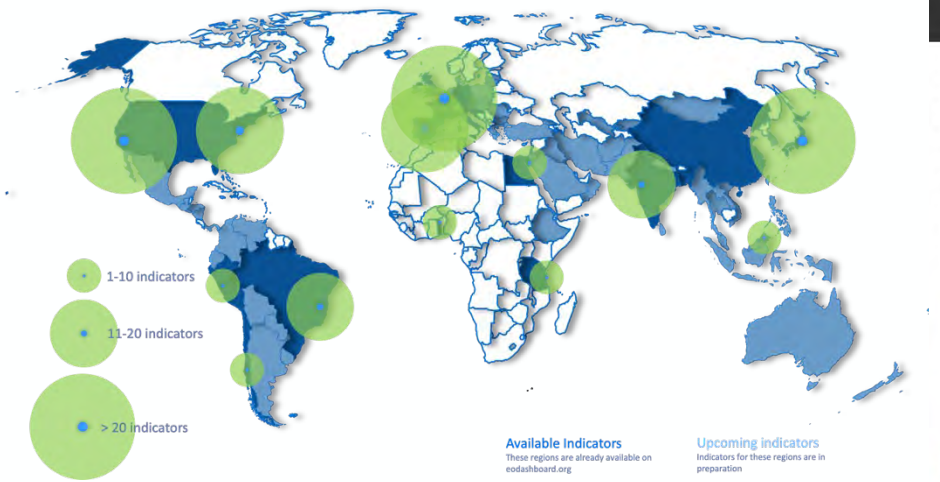
NASA-ESA-JAXA eodashboard.org

Objectives

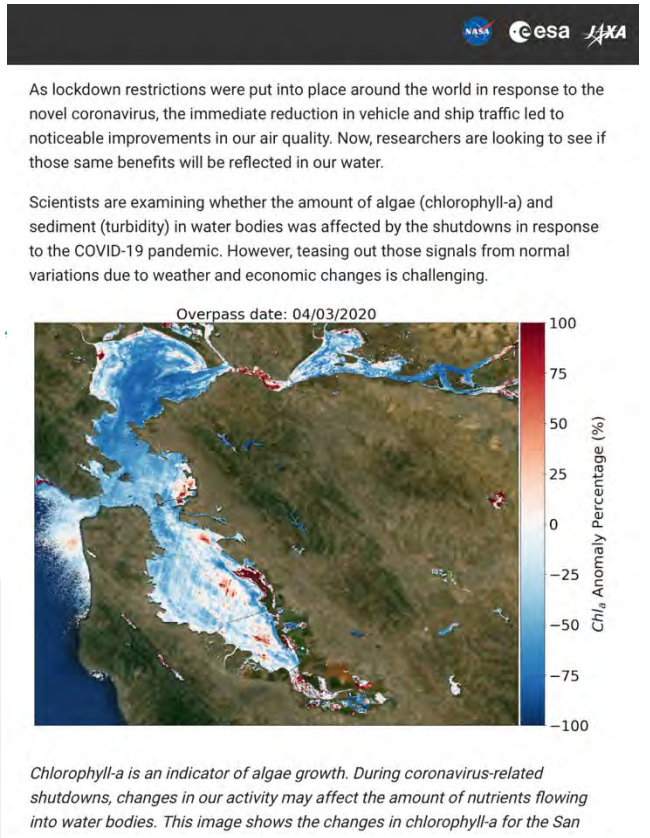
- Demonstrate the joint capabilities of JAXA-ESA-NASA to observe environmental and economic impacts of COVID-19 from space
- Develop Earth observation data-driven dashboards to clearly communicate indicators to the general public and decision makers
- Leverage the strong cooperation and collaboration among ESA-NASA-JAXA to address a global issue
- Engage the wider public via the Space Apps COVID-19 challenge and other initiatives

NASA-ESA-JAXA Cooperation

- Global Coverage, AOIs on 5 continents
- Wide range of EO missions
  - Copernicus Sentinels,
  - Third Party Missions,
  - OMI,
  - OCO-2,
  - SUOMI-VIIRS,
  - GOSAT,
  - ALOS-2,
  - MODIS AQUA,
  - GCOM-C/SGLI,
  - Planet
- Joint scientific analyses on selected AOIs
- Tri-agency coordination on communication

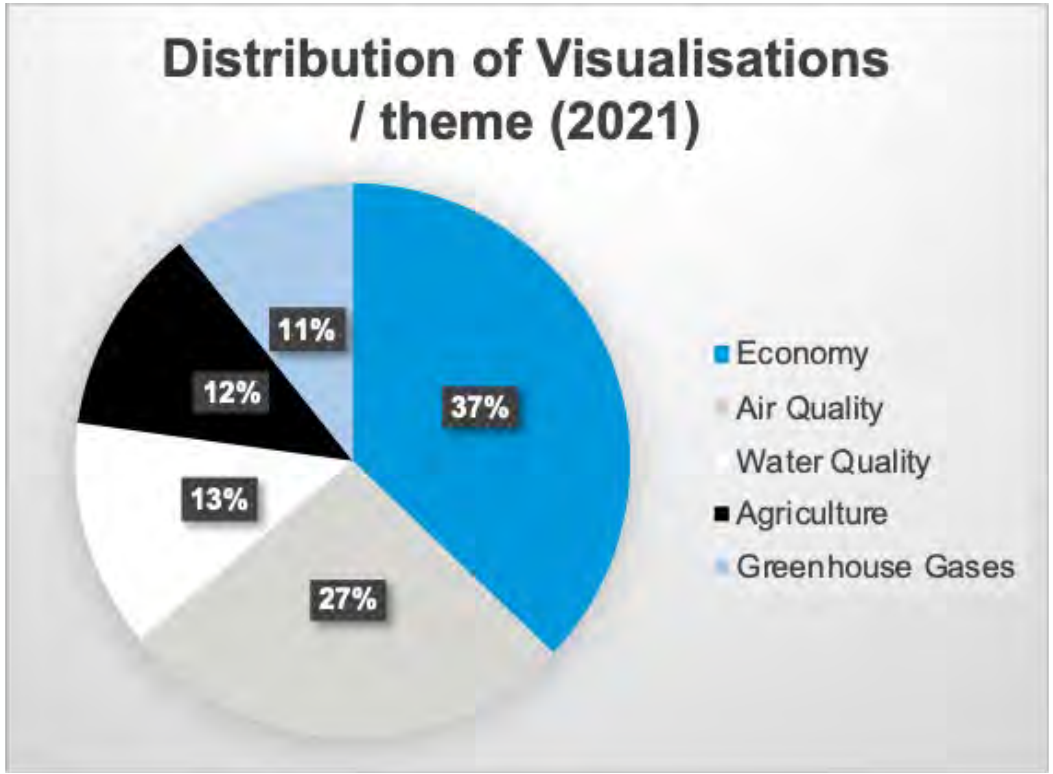


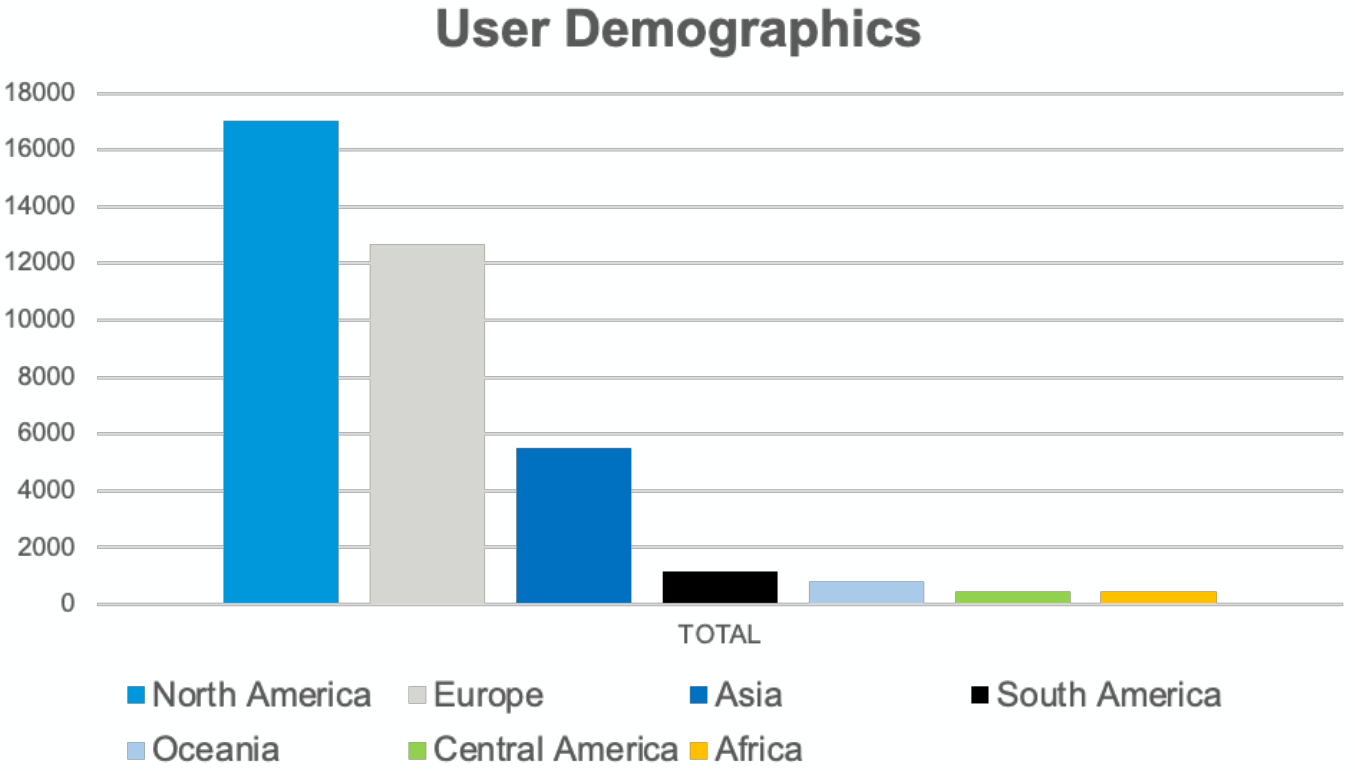
67	33	23	30
Economic Indicators	Agriculture Indicators	Air Indicators	Water Indicators



Eodashboard.org User Statistics

Estimated total visits: 127.800





NASA-ESA-JAXA next steps

- Extend Earth observation dashboard to June 2022
- Focus on open science, promoting education and community engagement
- Expand upon COVID-19 indicators
- Add forest and land change and polar environmental observations
- Host dashboard Hackathon in June 2021
- Promote and organize joint communication actions on the activity
- Continue storytelling for general public

June 23 - June 29, 2021

https://www.eodashboardhackathon.org

eodashboard.org

Are you ready to discover more?

https://race.esa.int

https://eodashboard.org/

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