

Rapid Action on Covid-19 and EO

3 June 2021, TAT-8

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Rapid Action on COVID-19 and EO



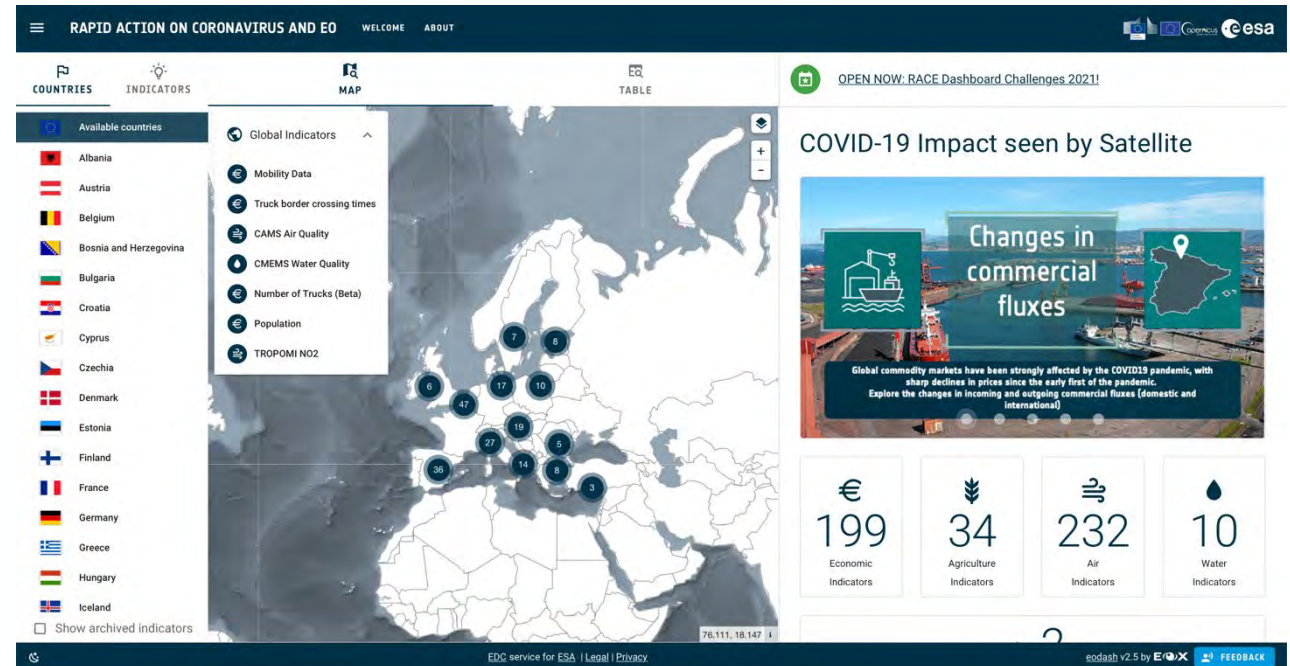
Objectives

- 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



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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

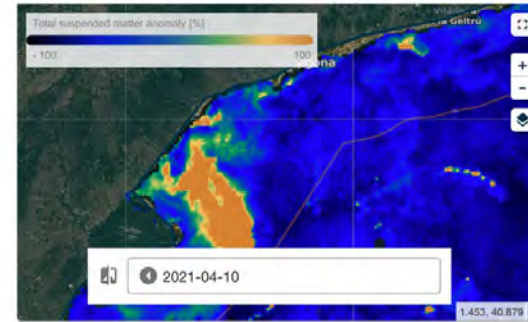
110.000 VISITS



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)

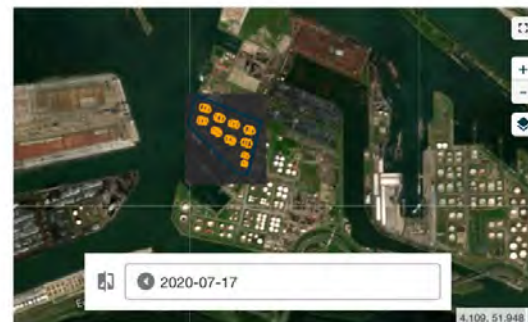
Barcelona - Total Suspended Matter, Water Quality Regional Maps



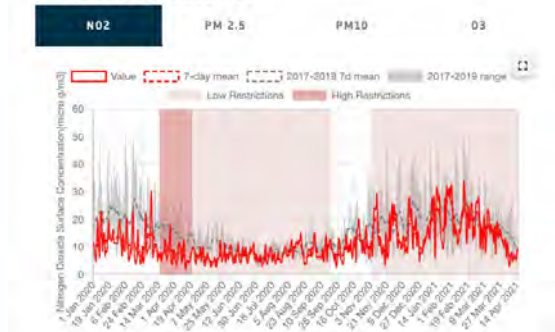
World, Population



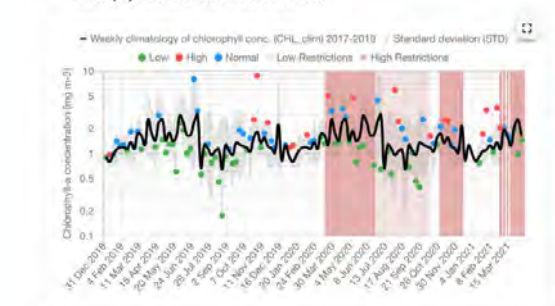
Rotterdam port, Oil Storage Volume



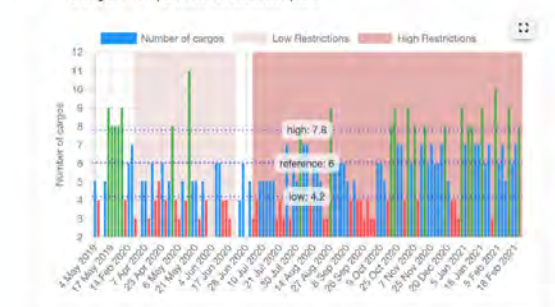
Oslo, CAMS Air Quality
CAMS NO2 daily mean analysis



Marseilles, Water Quality Time Series
Chlorophyll-a concentration at Fos-sur-Mer



Gijon, Import/production sites: status of metallic ores
Changes in Ships traffic at dedicated piers



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)

World food supply amid a pandemic

Tutorial: Monitoring world's food production with satellite imagery

Sara Aparicio
Apr 20 · 6 min read



Lockdown is also changing our Planet at night

Tutorial: Accessing nightlight observations with satellite data

Sara Aparicio
Mar 25 · 6 min read



The pandemic disruption of air traffic -as seen from Space

Tutorial: Monitor air traffic from Space

Sara Aparicio
Jan 20 · 4 min read



Coronavirus and Water Quality – what's the correlation?

Tutorial: Monitor water quality

Sara Aparicio
Jan 20 · 4 min read



Building traffic maps with Space data

Tutorial: Create road traffic maps using Space data

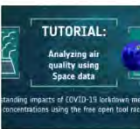
Sara Aparicio
Nov 24, 2020 · 4 min read



Find COVID-19 lockdown measures impacts on your city's air quality

Tutorial: Analyzing air quality using Space data

Sara Aparicio
Nov 17, 2020 · 4 min read



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)

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

EURO DATA CUBE

- Dashboard
- Euro Data Cube
- About**
- Documentation
- Support
- Marketplace
- Blog
- My Contributions
- Settings
- Account
- Billing

The EO Information Factory

The most comprehensive source of Earth Observation, in-situ data and value-added information at your fingertips.

[GUIDE: ESA SPONSORING \(NETWORK OF RESOURCES\)](#)

Watch the introduction video

Join the Euro Data Cube Experience

Copy link

EURO DATA CUBE

Watch on YouTube

EDC RACE Dashboard Challenges 2021
Ready to participate? [Request your EDC resources here](#)
Not yet convinced? [Learn more](#)

[LEARN MORE](#)

The screenshot shows a Jupyter Notebook titled "EDC EO Dashboard Hackathon 2021" with the subtitle "Tutorial Notebook - using the SentinelHub processing API". The notebook content includes:

- An introduction paragraph: "This tutorial gives you insights into how to use the sentinelhub processing API. The documentation for it can be found [here](#)."
- A section titled "Authentication" with the following text: "First we need an authentication token to be able to interact with the API, we will do this with an OAuth library. The next cell is to make sure the correct environment variables have been setup for you, in the result you should see: SH_CLIENT_ID, SH_CLIENT_NAME, SH_CLIENT_SECRET, SH_INSTANCE_ID".
- A code cell (1) containing the following Python code:

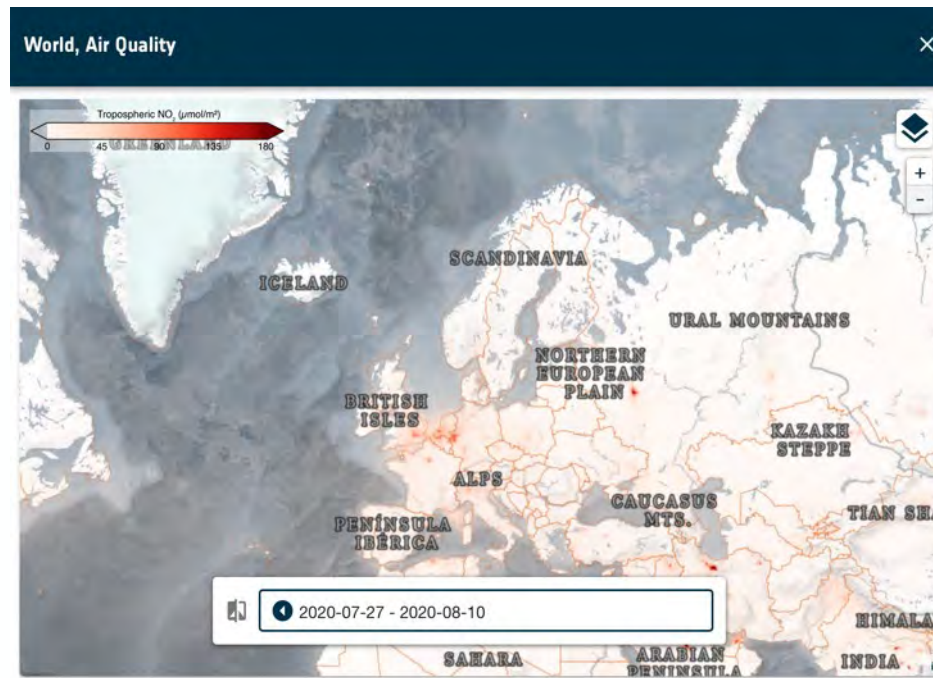
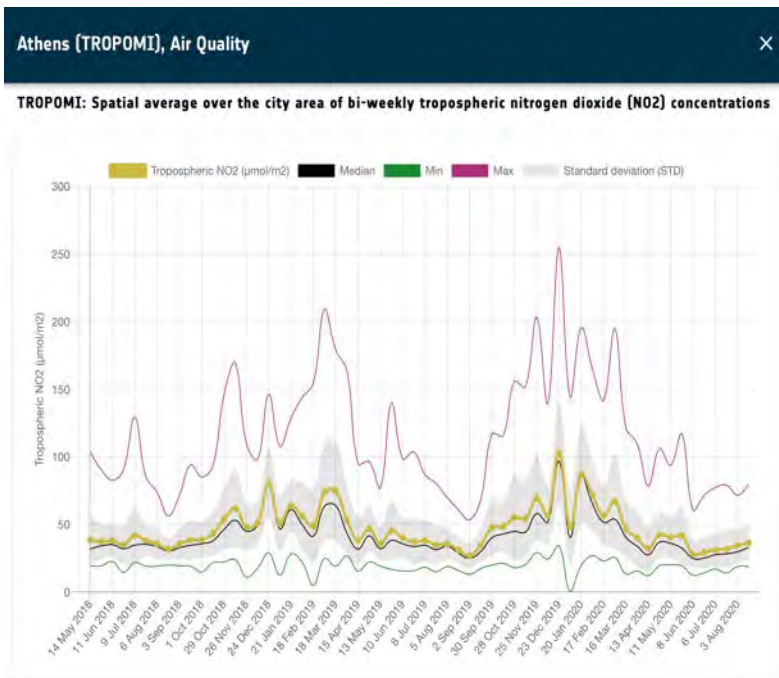
```
(1): from edc import setup_environment_variables
      setup_environment_variables()
```
- Text explaining that API credentials have been injected and listing the available environment variables:
 - SH_CLIENT_ID , SH_CLIENT_NAME , SH_CLIENT_SECRET , SH_INSTANCE_ID
- A code cell (2) containing the following Python code:

```
(2): import os
      from oauthlib.oauth2 import BackendApplicationClient
      from requests_oauthlib import OAuth2Session
      # Your client credentials
      client_id = os.environ['SH_CLIENT_ID']
      client_secret = os.environ['SH_CLIENT_SECRET']
      # Create a session
      client = BackendApplicationClient(client_id=client_id)
      oauth = OAuth2Session(client=client)
```

The interface also shows a file browser on the left with a list of files including "FIS-data-a...", "geodb_and...", "OSM_API...", "processing...", and "xcube_acc...". The status bar at the bottom indicates "EDC 0.24.5 (Python3) | Idle" and "Mode: Command Ln 1, Col 1 processing-API-data-access.ipynb".

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

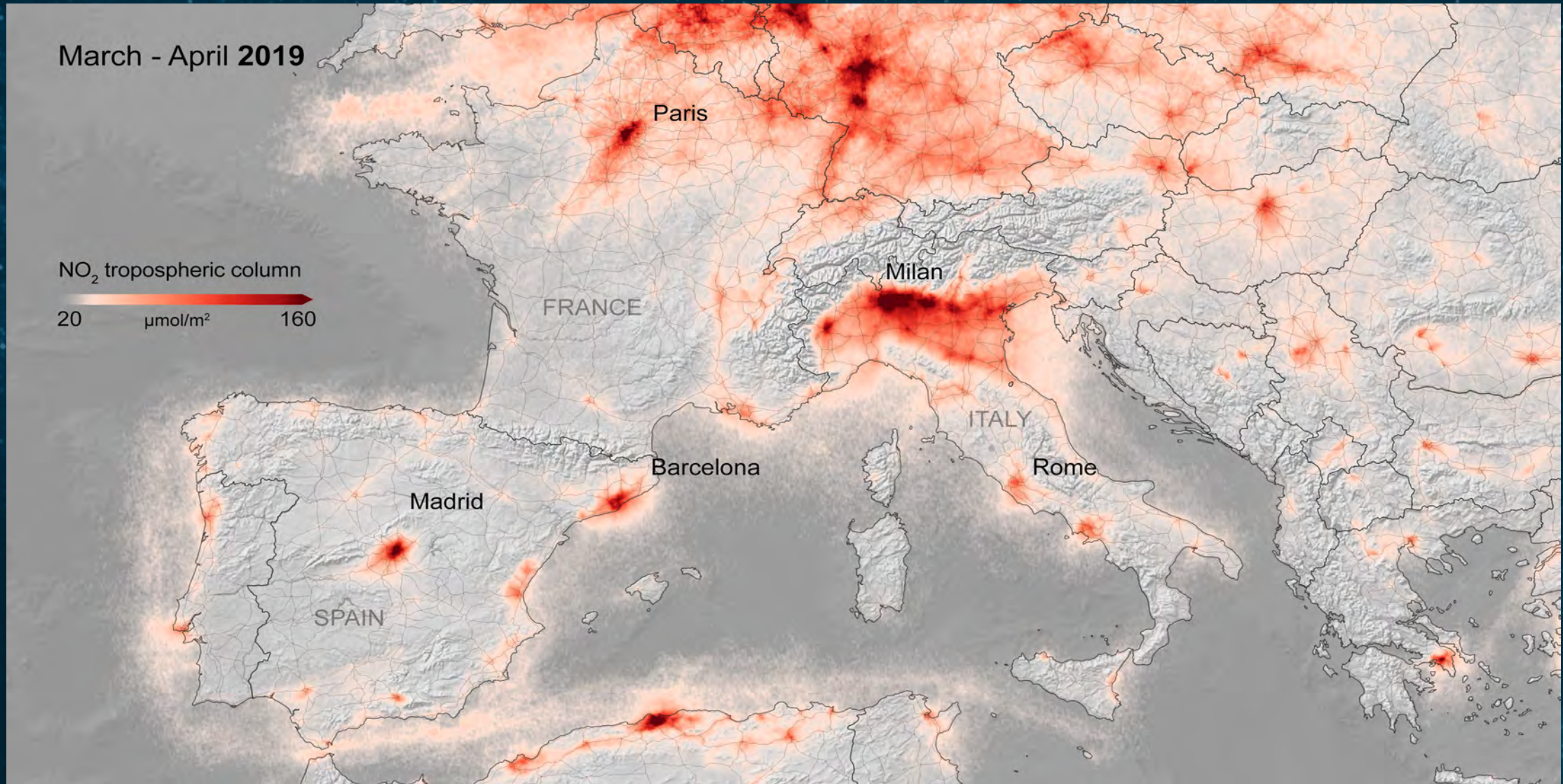


The NO₂ concentrations vary from day to day due to changes in the weather (such as wind speed, cloudiness, etc).

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

[Read more at: race.esa.int](http://race.esa.int)

Air Pollution drops during spring Lockdown



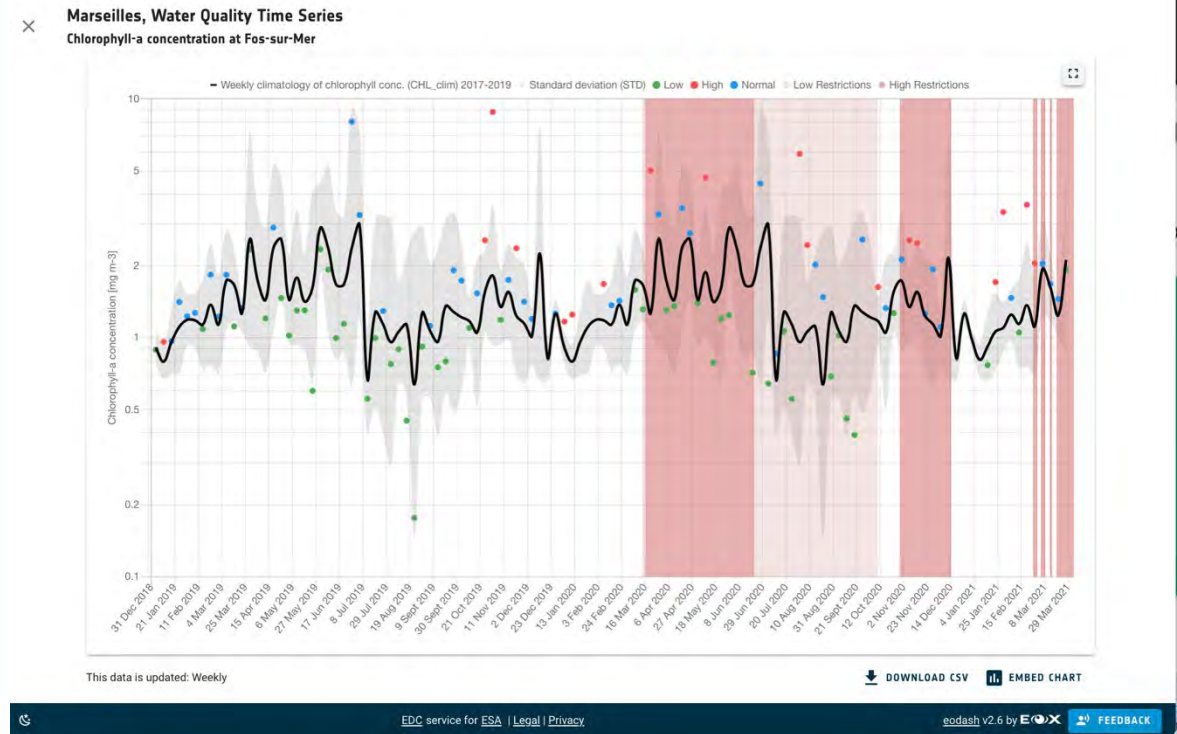
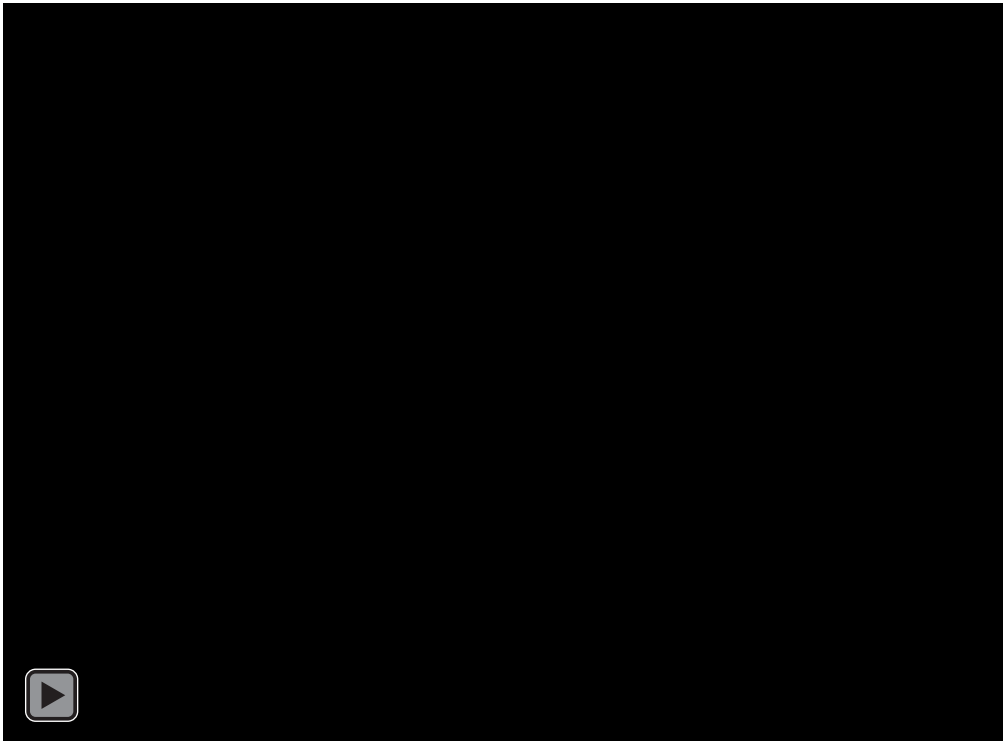
SENTINEL-3 – sea surface topography, sea & land surface temperature & colour

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.

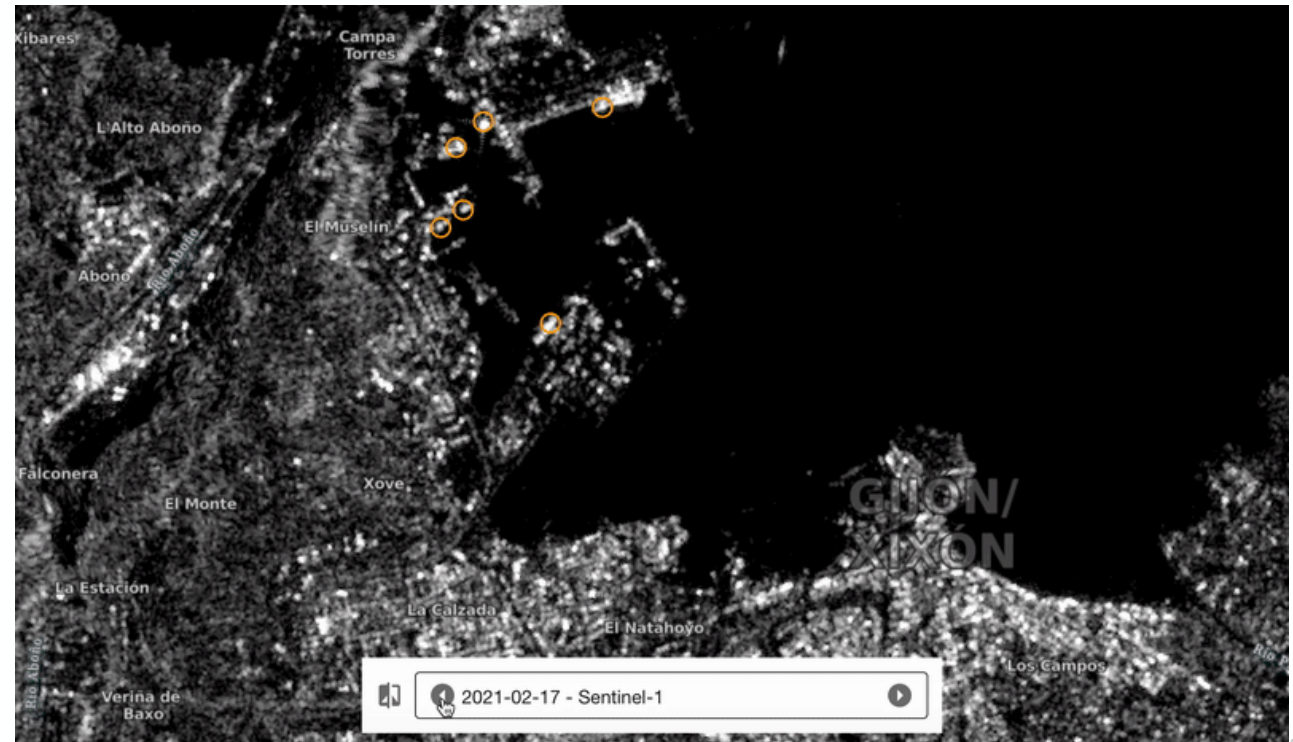
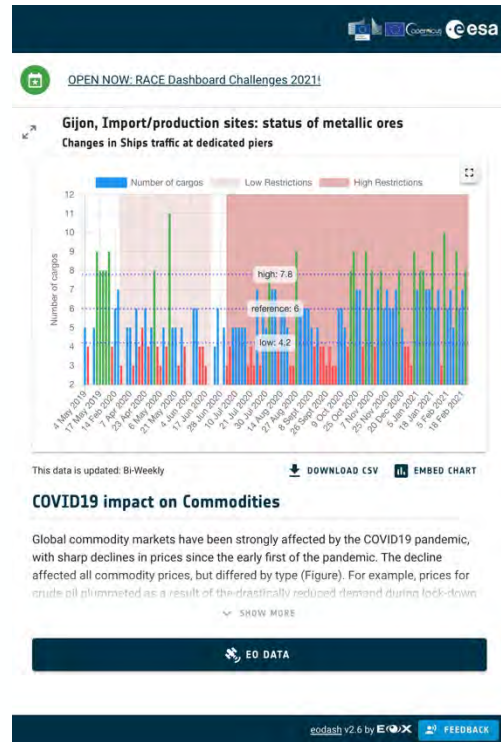
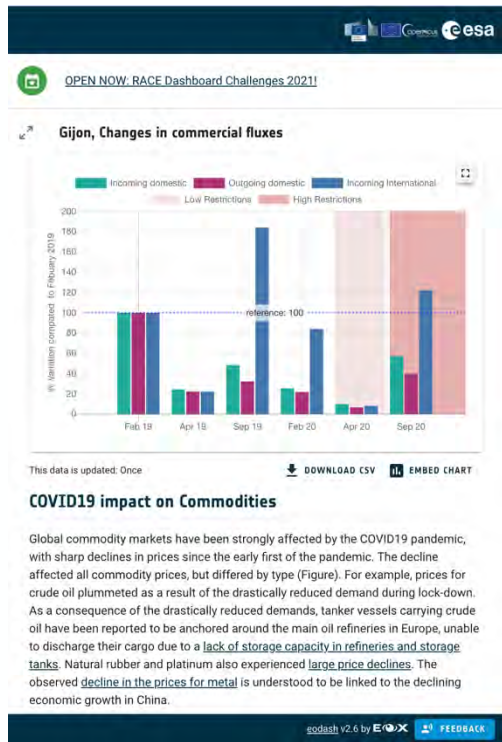
Red: values beyond the climatological variability, poorer water quality.



SENTINEL-1 – SAR (synthetic aperture radar) satellite

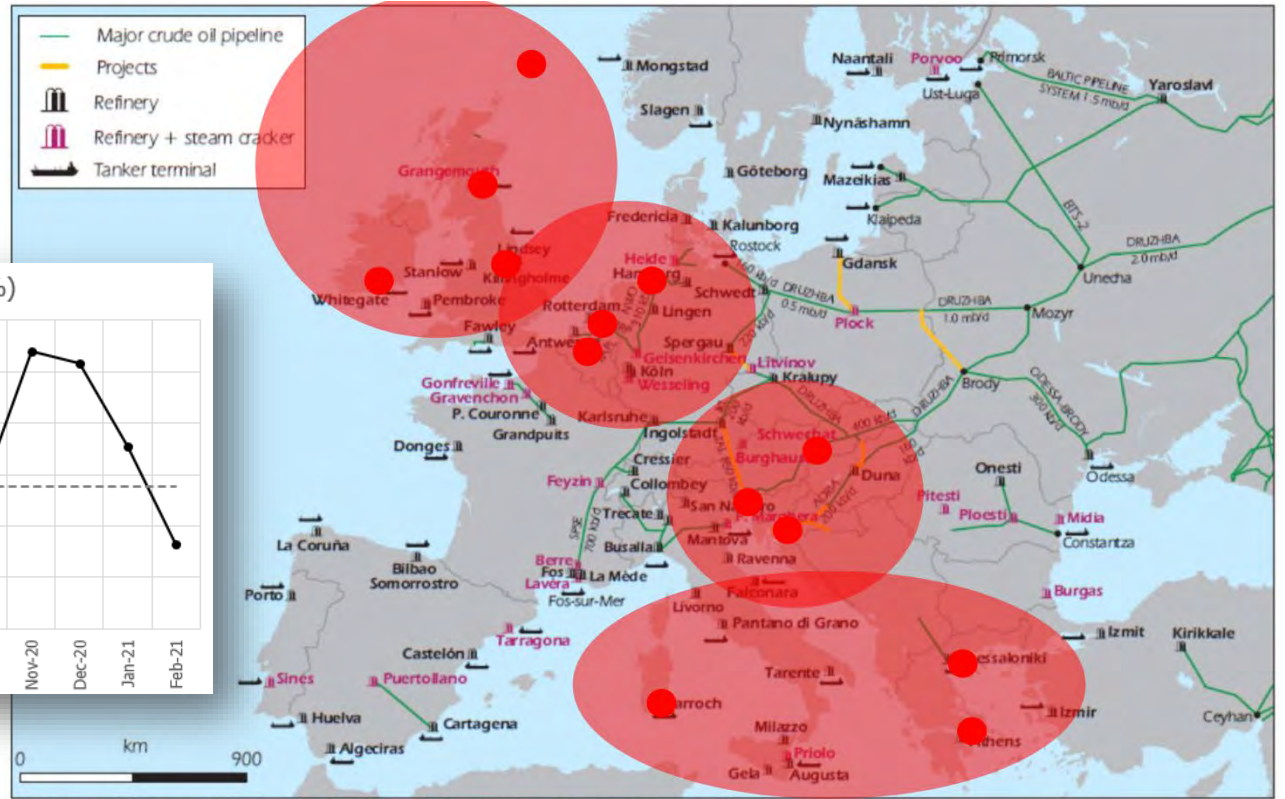
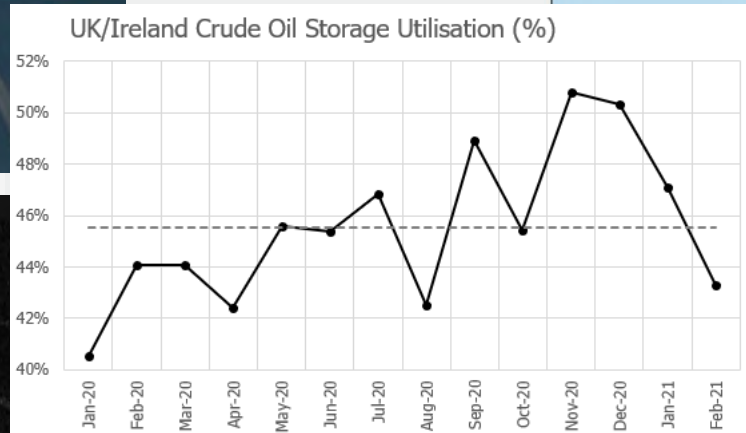
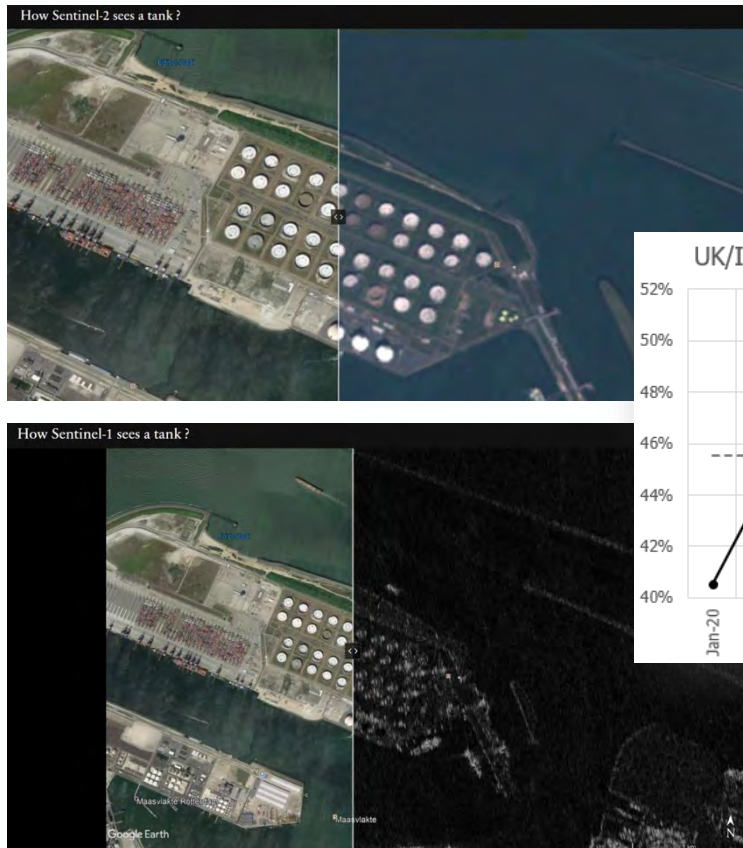
SAR Backscatter (and its variation in time) can be used to detect objects with distinctive signatures, such as ships or accumulation of high volumes of metallic objects

Spain, Port of Gijón – 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)



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.

Table: Import/production sites: status of metallic ores

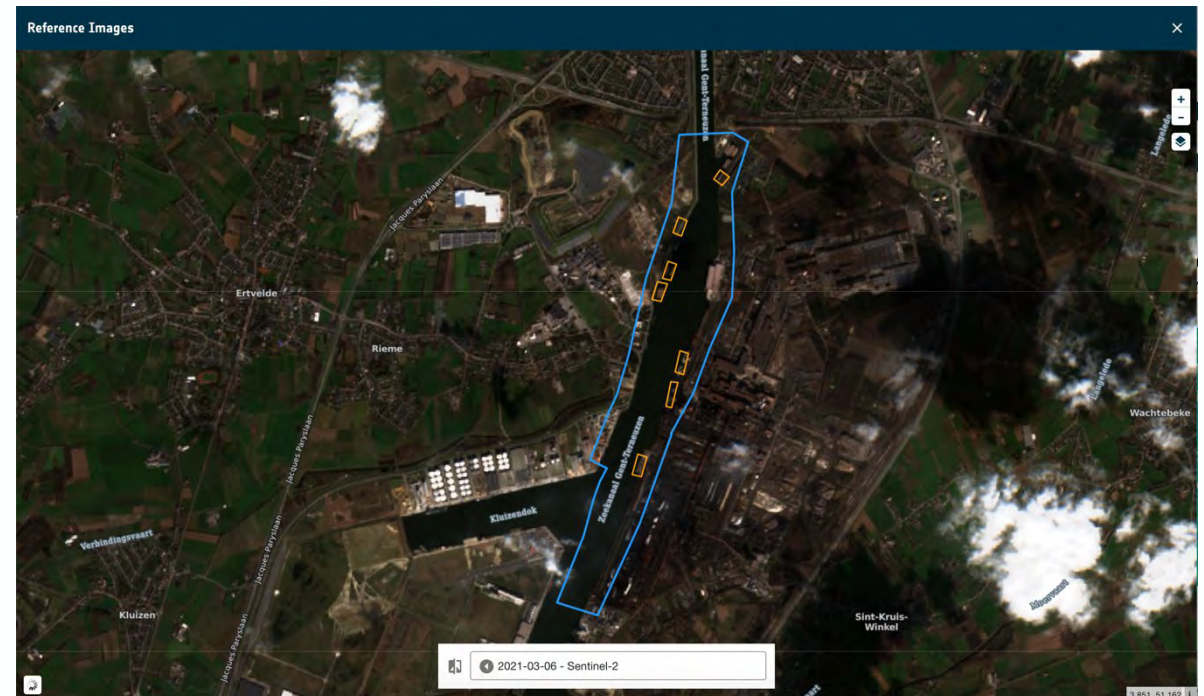
Country	Location	Type	Indicator	Value
Belgium	Ghent	Economic	Import/production sites: status of metallic ores	Normal
Germany	Hamburg	Economic	Import/production sites: status of metallic ores	Normal
Spain	Gijón	Economic	Import/production sites: status of metallic ores	High
France	Dunkirk	Economic	Import/production sites: status of metallic ores	Normal
Italy	Genoa	Economic	Import/production sites: status of metallic ores	Low
Poland	Gdynia	Economic	Import/production sites: status of metallic ores	Low

Ghent, Import/production sites: status of metallic ores
Changes in Ships traffic at dedicated piers

This data is updated: Weekly

COVID19 impact on Commodities

Global commodity markets have been strongly affected by the COVID19 pandemic, with sharp declines in prices since the early first of the pandemic. The decline affected all commodity prices, but differed by type (Figure). For example, prices for copper fell as compared to a period of the commodity market's demand & stock levels.



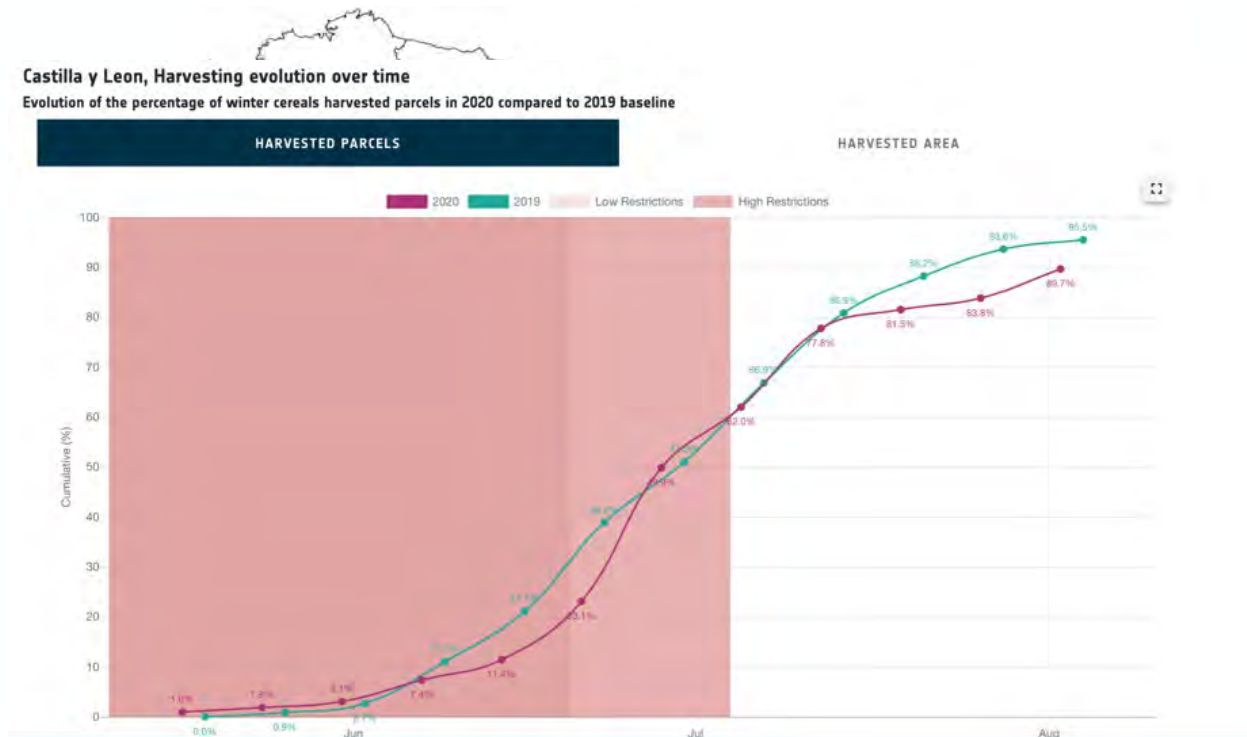
Agriculture – Harvesting

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

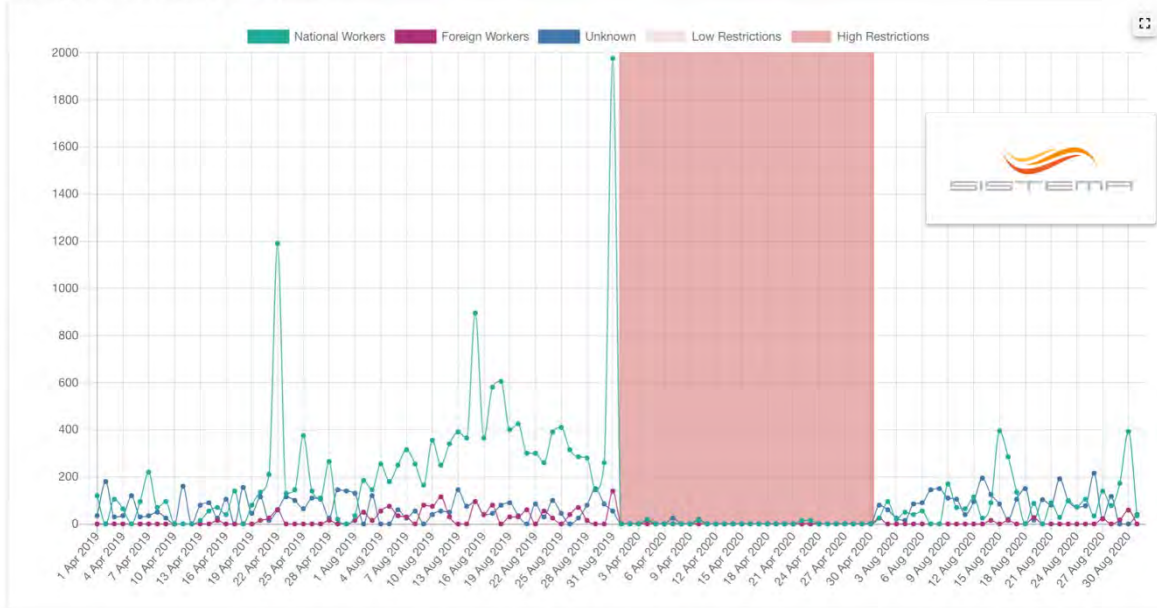
Verification of delay or disruption of **winter crop** harvesting in Spain at national scale (RIGHT)

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

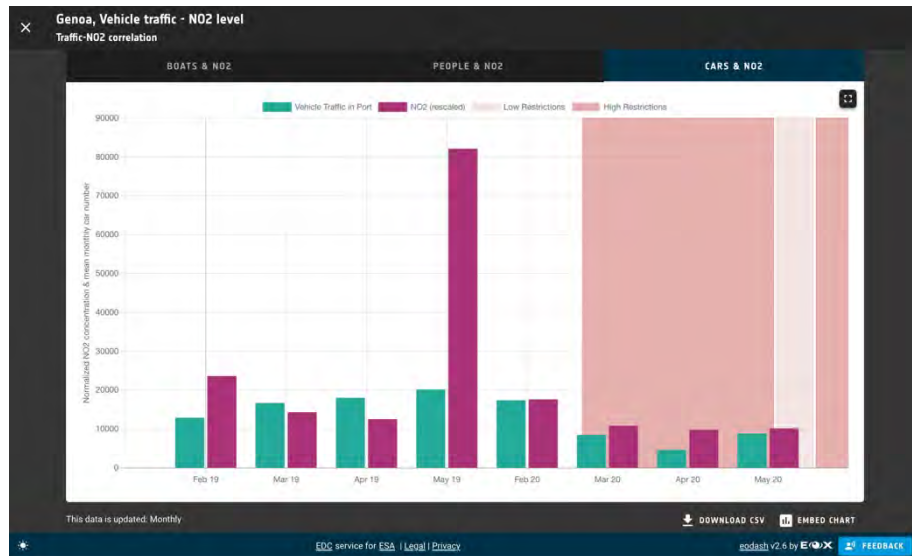
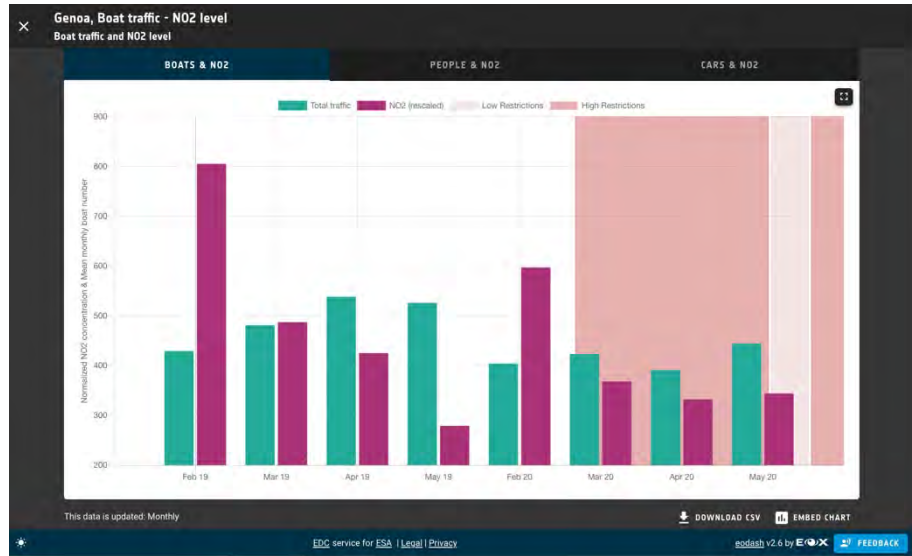


Winter cereals monitored over Spain during 2020. The size of the circles represent the monitored productive area of winter cereal. Scientists from the Université catholique de Louvain, Belgium, used data from the Copernicus Sentinel-1 and 2 missions, and machine learning to monitor the crops on a weekly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

Apulia, Agricultural Workers
Availability of workers for work on tomato fields



Measures & Effects – Activity in ports & NO2

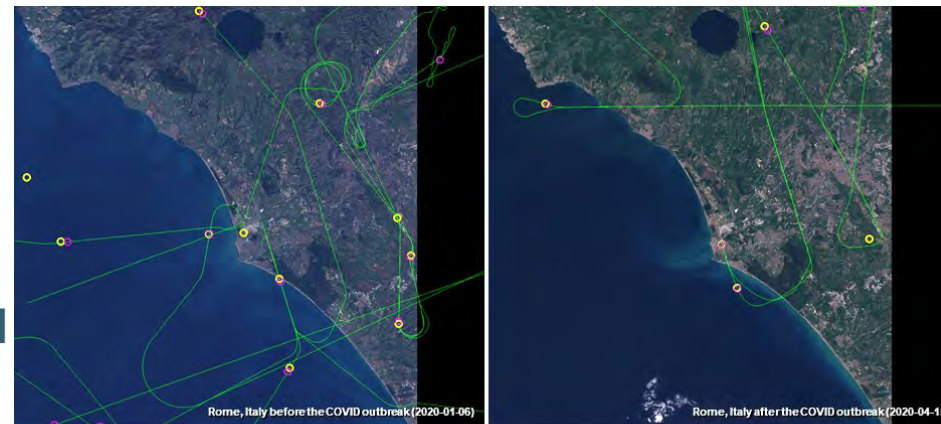
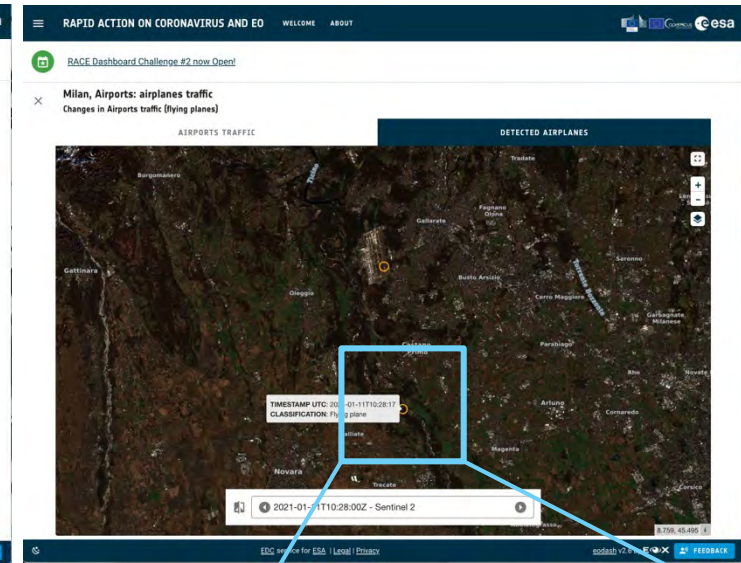
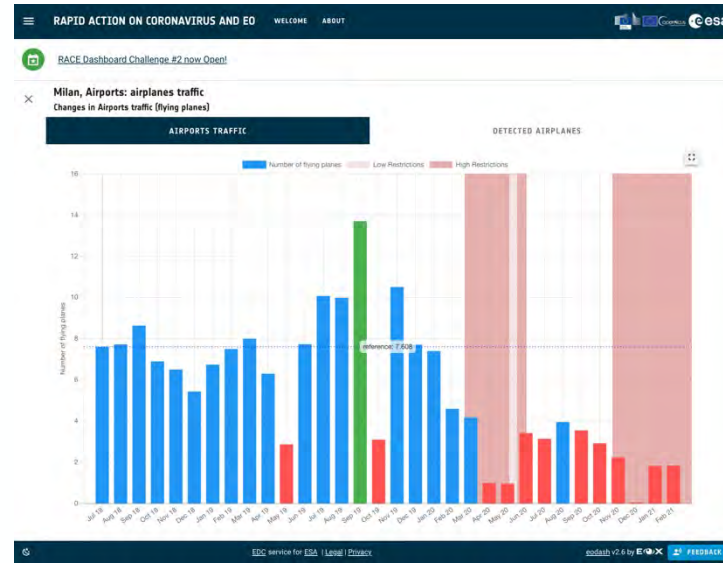


The correlation between NO2 levels and boat traffic: [AIS data of all the boats coming to the ports](#) have been collected and compared with the normalized value of NO2 over the port computed from daily data. The two variable are highly correlated; this may be an indication of how much bog boats traffic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



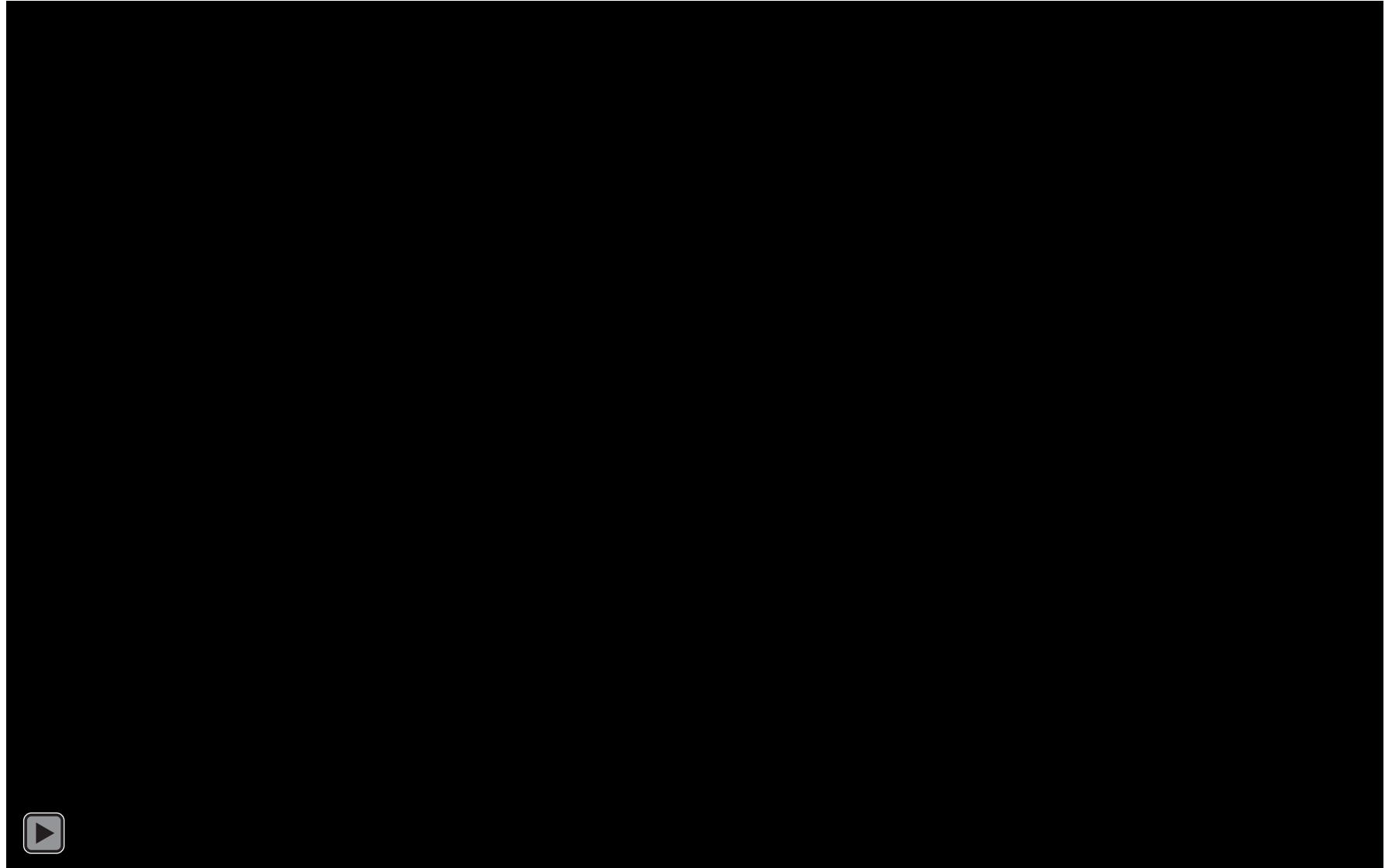
OpenSky paths and interpolated coordinates Correctly detected coordinates



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.

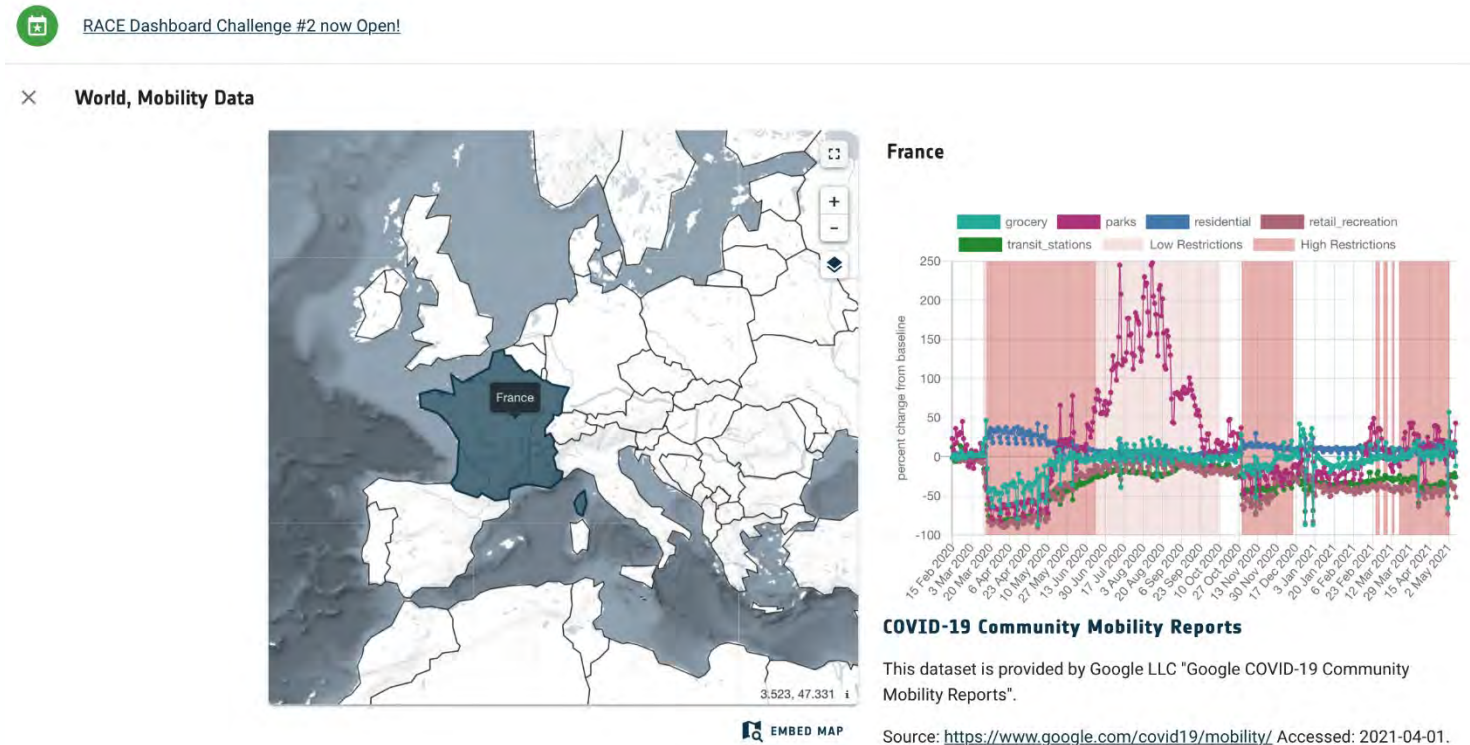
As the truck keeps traveling during this short time offset, it appears spectrally disassembled. This pattern may be used for detecting roaming trucks on roads.



<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).



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

race.esa.int

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



Objectives

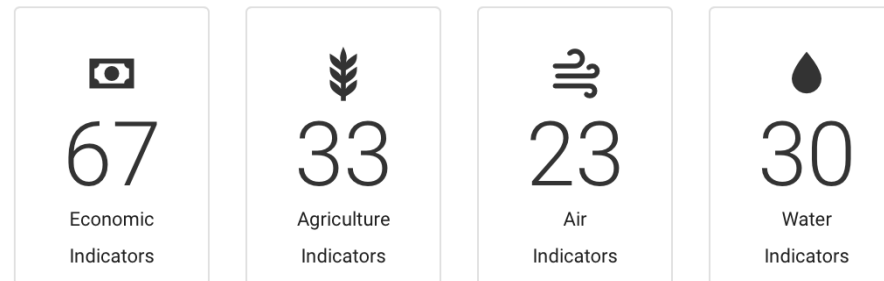
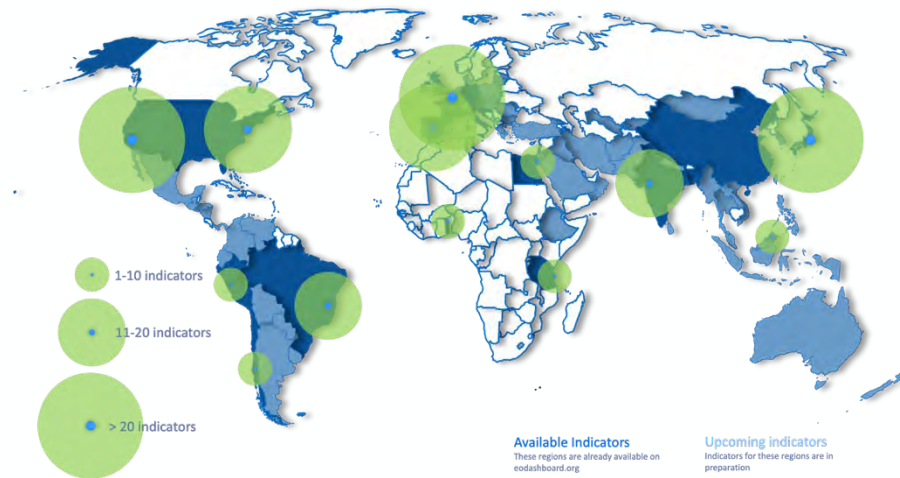
- Demonstrate the joint capabilities of JAXA-ESA-NASA to observe environmental and economic impacts of COVID-19 from space
- Develop Earth observation data-driven dashboards to clearly communicate indicators to the general public and decision makers
- Leverage the strong cooperation and collaboration 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



As lockdown restrictions were put into place around the world in response to the novel coronavirus, the immediate reduction in vehicle and ship traffic led to noticeable improvements in our air quality. Now, researchers are looking to see if those same benefits will be reflected in our water.

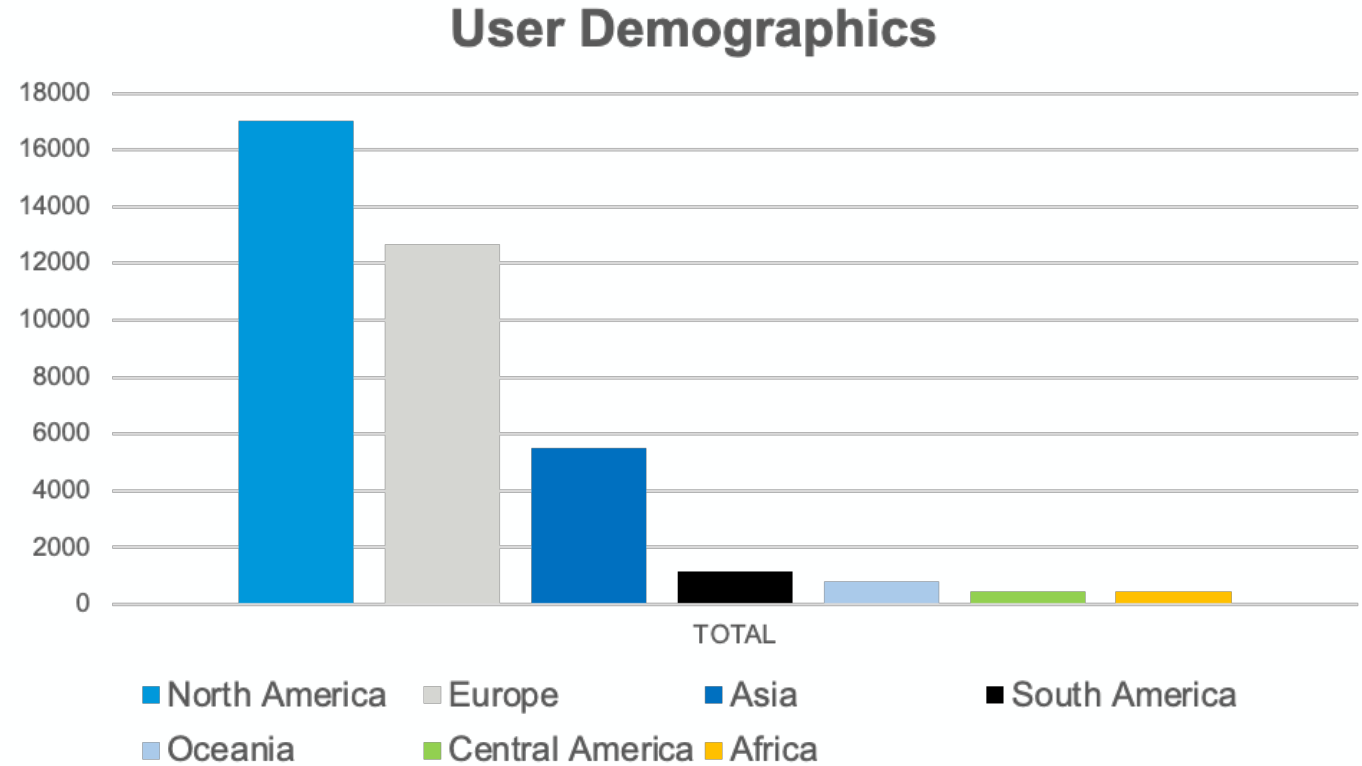
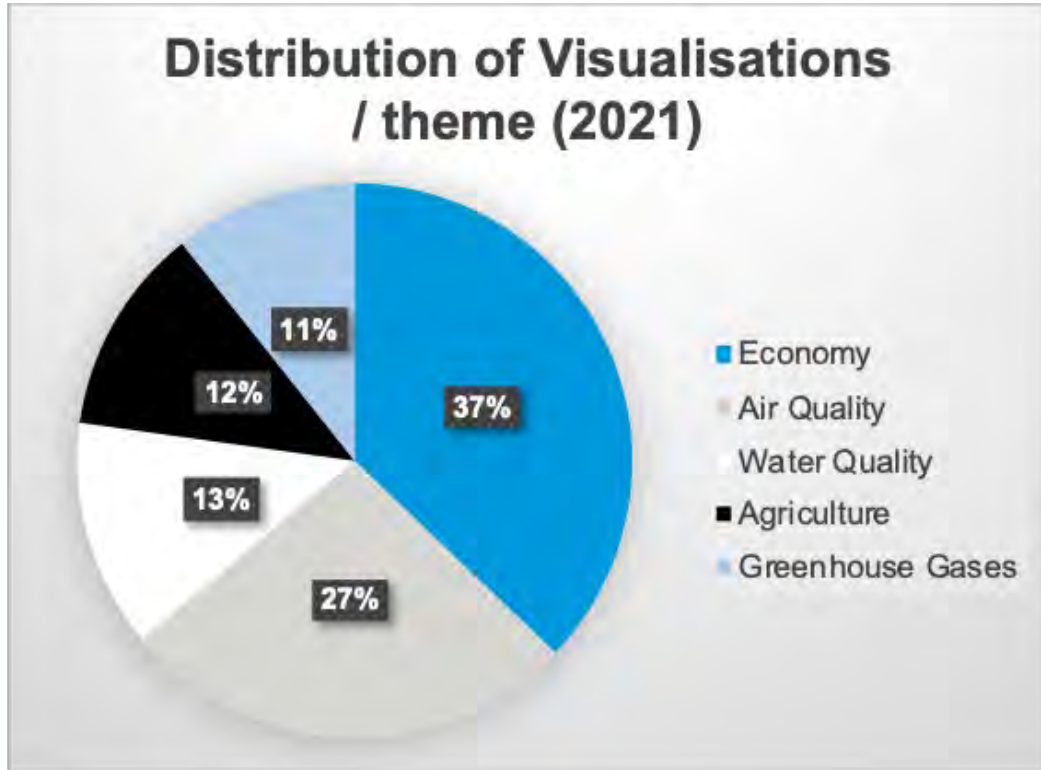
Scientists are examining whether the amount of algae (chlorophyll-a) and sediment (turbidity) in water bodies was affected by the shutdowns in response to the COVID-19 pandemic. However, teasing out those signals from normal variations due to weather and economic changes is challenging.



Chlorophyll-a is an indicator of algae growth. During coronavirus-related shutdowns, changes in our activity may affect the amount of nutrients flowing into water bodies. This image shows the changes in chlorophyll-a for the San Francisco Bay area.



Estimated total visits: 127.800



- 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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