Technical Guide

This guide is intended for participants of the Rapid Action on Covid-19 with Earth Observation (RACE) Dashboard Challenges.

The instructions contained in this document require users to be signed up and registered for this specific event at https://eurodatacube.com/participate?event=racecontest. Please be patient after registering while your workspace is being tailored for the competition. You will get a notification via email once it is available.

IMPORTANT: Please contact us at racecontest@eurodatacube.com if you have already participated in an earlier challenge or used your free subscription(s) otherwise.

Please note that some of the images used in this guide may not be exact replicas of the platform that will be used for the RACE Dashboard Challenges 2021.

For more information:

If you have questions that are not addressed in this guide or in the other guides located on https://eo4society.esa.int/race-dashboard-challenges-2021/, contact the organizing team with a specific description of your problem:

- all technical issues – racecontest@eurodatacube.com
- more general questions including technical assistance with any of the content in this document – eodash@esa.int

Updates about the RACE Dashboard Challenges are published at:

- https://eo4society.esa.int/race-dashboard-challenges-2021
- https://race.esa.int/challenges

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Contents:

Introduction

The [Rapid Action on COVID-19 with Earth Observation (RACE)](#) initiative was launched in spring 2020 by The European Space Agency (ESA) and the European Commission (EC). Its objective is to use Earth Observations to monitor and understand the impacts of the pandemic on society, in particular on the economy and the environment. The outcomes of the investigations are presented on the public [RACE Dashboard](#).

The RACE initiative is an Open Science collaborative activity, where community contributions play an important role.

The purpose of the [RACE Dashboard Challenges](#) is to get participants engaged with the [RACE Dashboard](#), its data, and computational resources, so they can process and combine EO and non-EO data to develop new ways of monitoring the impacts of the pandemic.

Two community-contributed indicators on [truck](#) and [airplane traffic](#) - outcomes of the 2020 [COVID19 script contest](#) - have already been integrated and can be explored on the RACE Dashboard.

After the first two challenges published in 2021 - upscaling of new indicators is ongoing for subsequent integration in the Dashboard - a [Challenge#3](#) is being opened for 3 months (September-November).

This guide is meant to serve as an overview of the data resources that are made available to participants of this new challenge and explains how to access them. It also contains important information about how your project can be successfully integrated into the Dashboard.

Data Resources

The great majority of the data in the RACE Dashboard is open and can be accessed directly. In the "Data Resources" ANNEX, participants can find:

- The available indicators
  - ECONOMY
  - AGRICULTURE
  - ENVIRONMENT - AIR QUALITY
  - ENVIRONMENT - WATER QUALITY
  - COMBINED (Economic & Air Quality)
  - HEALTH

- What information each indicator provides
- Examples of how the indicators are visualized on the dashboard
- How to access the data, either through APIs or by linking to the CSV files in GitHub

NOTE: *while the indicator data is freely and openly accessible, some of the underlying data used in the analysis, such as the AIS or mobile data are not open and thus cannot be accessed or downloaded through the dashboard.*

You are welcome to bring your own data and use any resource as long as you have the rights granted to use it.

There are a number of different datasets you can make use of for your project. You may also incorporate external data, as long as you demonstrate the use of ESA Earth Observation data and/or some of the data provided in the RACE Dashboard as well.

IMPORTANT: See the *RACE Dashboard Technical Background* section below for more information on how to utilize the resources provided by Euro Data Cube (EDC).

How to create Custom Dashboard views

The RACE Dashboard enables you and your team to collaboratively combine indicators with text and images into personalised views.

You can make use of the Custom-Dashboard feature to create custom analyses, publish your work and share it with your network.

This step by step tutorial is also available on Medium.com.

1. Adding indicators into a Custom Dashboard

In this example, we are using the indicator "COVID19 Data" which presents the number of cases and vaccinations, globally.

First, select the indicator from the indicators list to load its data. You can find the indicator in the INDICATORS list on the left, or in the GLOBAL INDICATORS list floating on the map.
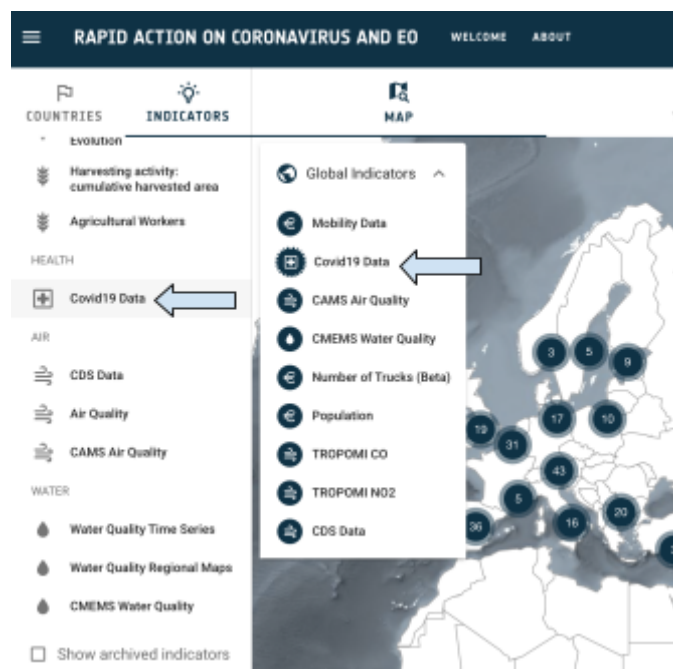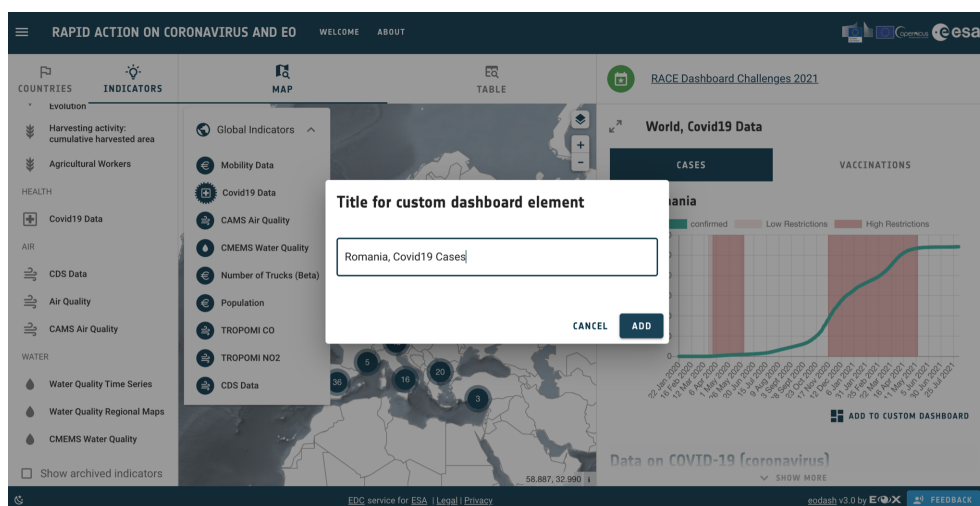
Once you have chosen a country for which to display the data and your chart is loaded, you can use the ADD TO CUSTOM DASHBOARD Button at the bottom of the chart to add that graph to your custom view.
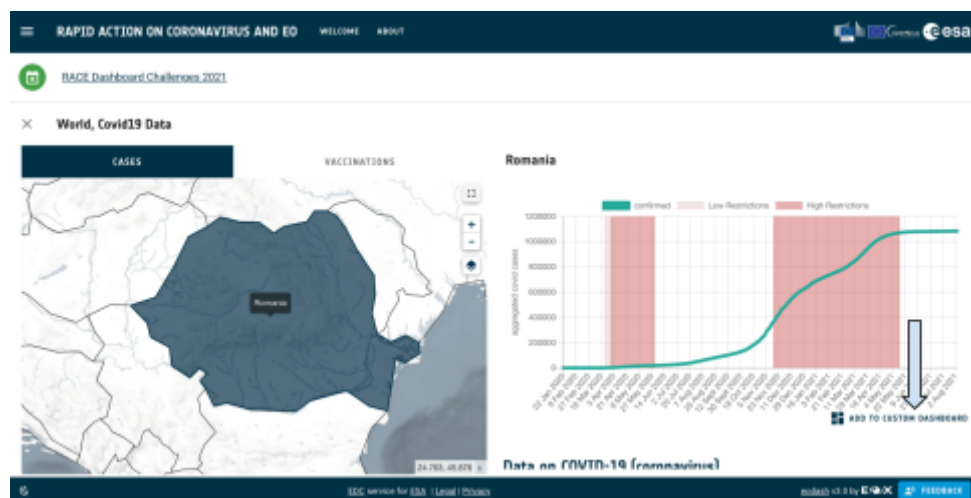
Adding a chart or map to the custom dashboard will prompt you to customise the Title for that element. You will be able to change it later in the edit mode of your custom view.
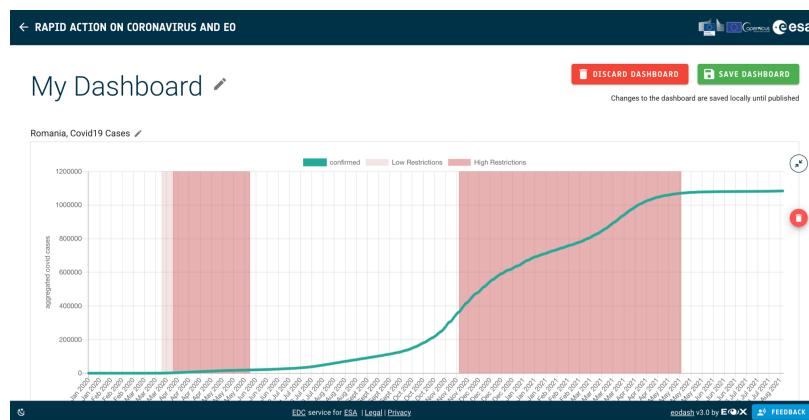
Once you add the first indicator to your custom dashboard, you will be able to access that custom view from the top menu.

You can continue to add indicators or you can visit the custom dashboard.

2. Collaboratively Editing the Custom Dashboard

If you chose to visit the custom dashboard at this point, here is what you'll see:

You can edit the titles, resize and reposition the elements, save the dashboard or discard it. You can also go back to the main RACE Dashboard to continue adding elements. Changes to the dashboard will be saved remotely until published, so you will not lose your progress.

NOTE: For each custom-dashboard you will receive an Edit URL and a View URL (see also Saving and sharing your Custom Dashboard). Users with access to the Edit URL will be able to make edits to your custom dashboard. All edits will be visible in real time in both the Edit and View modes by anyone with access to the respective URLs.

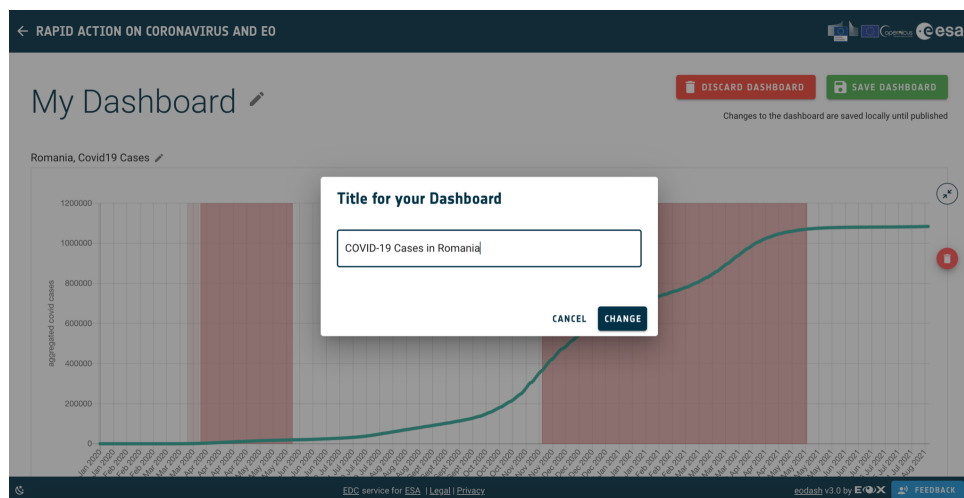You can also add a text block element where you can use markdown to style your document.

3. Saving and sharing your Custom Dashboard

To be able to access your custom dashboard and share it with others you will need to save it before closing your current session. The SAVE DASHBOARD button on the top right will prompt you to fill in the form below. The permanent link to your Dashboard configuration will be sent to the email address you provide.

Euro Data Cube

Some of the indicators and EO data sets used in the RACE dashboard reside in the Euro Data Cube (EDC). To browse the Euro Data Cube catalogue, visit: https://collections.eurodatacube.com/tag/race-challenges/.

Please note: While the data in Euro Data Cube can be openly discovered in the Catalogue, accessing other Euro Data Cube resources requires registration.

To use the Euro Data Cube resources, such as the JupyterLab Workspace, participants need to register for a free account here, once the competition is open (as from 1 September).

Please be patient after registering while your workspace is being tailored for the competition. You will get a notification via email once it is available.

*Please note: Use the full link (https://eurodatacube.com/participate?event=racecontest) to login and do NOT create an account from the main page of the Euro Data Cube site because it will not be tailored to the competition. In particular, it will not have the tailored resources available.

Once you are registered and have been notified that your EDC resources are ready you may access your EDC JupyterLab Workspace from the EDC Dashboard:

In the EDC JupyterLab Workspace you may access the various EDC resources like tutorial notebooks from the Launcher page:
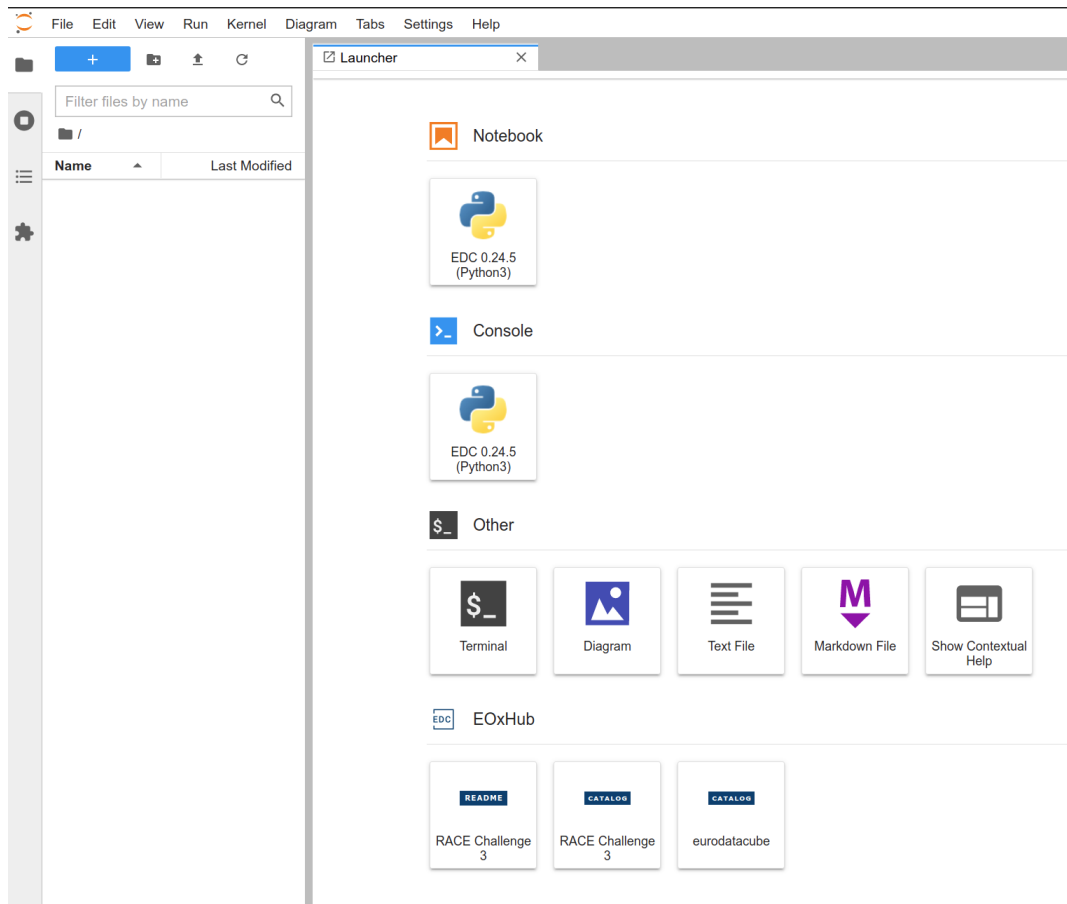
Participants have access to a series of Tutorial Notebooks to get started with the EDC and learn how to access the different Earth observation data and indicators via the various interfaces offered by EDC. They also demonstrate how to generate simple maps and graphs similar to those showcased on https://race.esa.int

If you're unsure how to reach the workspace, watch the video Getting started with the EDC.

1. RACE Dashboard Technical Background

The RACE dashboard (https://race.esa.int) is implemented, maintained, and operated by the Euro Data Cube (EDC, https://eurodatacube.com) consortium.

The dashboard is a vue app as described at https://github.com/eurodatacube/eodash/tree/staging/app. The source code of the dashboard is released under the permissive Open Source MIT license and is publicly available at https://github.com/eurodatacube/eodash. Thus, feel free to run the dashboard locally and propose any specific feature needed for your project via a pull request.

Indicator data is stored either in an EDC service called geoDB (https://eurodatacube.com/marketplace/services/edc_geodb) or as CSV file directly in the GitHub repository at https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data. At this GitHub location you can also find the indicator stories and associated images.

For performance optimizations, most of the indicator data is cached as static JSON files and also stored directly in Git at https://github.com/eurodatacube/eodash/tree/staging/app/public/data/internal. The vue app is built using GitHub actions (see files in https://github.com/eurodatacube/eodash/tree/staging/.github/workflows). These actions also deploy the dashboard by uploading the vue app as well as the JSON files to AWS s3 from where they are served as static files via CloudFront CDN.

An indicator may retrieve additional data at runtime based on user input. For example the Air Quality - TROPOMI: NO2 indicator https://race.esa.int/?poi=World-N1 allows the user to draw an area of interest on the map and show statistical NO2 for the user-drawn area of interest over time. Please feel free to propose other ways to extend your project indicator, for example using geoDB or other EDC services to provide more insights to users.

In order to store the indicator data in geoDB or as CSV it has to be constantly generated. One way to process big volumes of satellite data to derive an indicator - such as the Air Quality, a time series which computes a spatial average of bi-weekly tropospheric nitrogen dioxide (NO2) concentrations over a city area (e.g., over Paris https://race.esa.int/?poi=FR-N1&indicator=N1) - is to use EDC services.

Please register at https://eurodatacube.com/participate?event=racecontest to receive your personal EDC workspace including a hosted JupyterLab to run your Python notebooks.

There are several tutorial notebooks provided detailing how to use the EDC services like geoDB or Sentinel Hub. Feel free to also explore all the notebooks shared on the EDC marketplace (https://eurodatacube.com/marketplace) and propose yours for inclusion via your EDC dashboard (https://eurodatacube.com/dashboard).
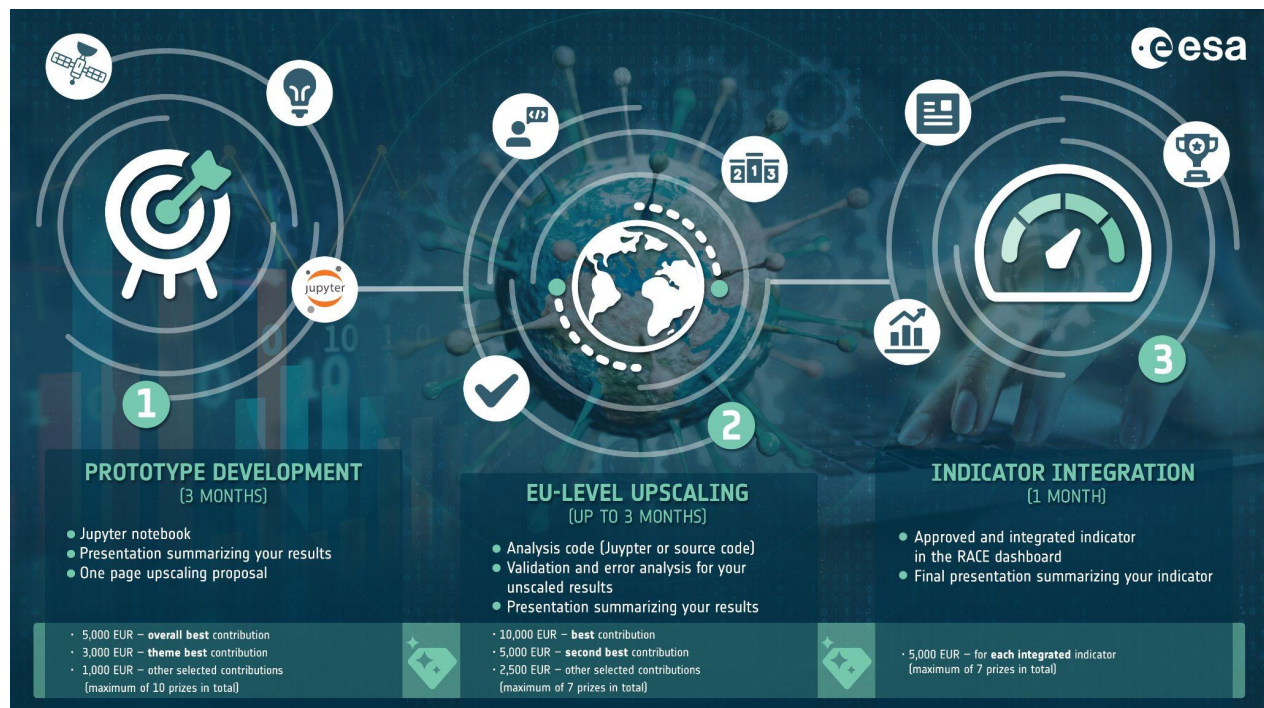
2. Upscaling and Integration

If your solution is selected for RACE dashboard integration (stage 3 in the image above), you will receive support from the ESA science and development team. For the moment, this part is only for information.

Upscaling and integration into the RACE Dashboard will be possible for selected solutions after the challenge stage 1. When submitting your solution, you should only indicate what is needed for your solution to be ready for integration (e.g., more tests at larger scale, or automation).

If you think your contribution is "good to go" for the integration, right-click on your directory and select **EDC: Submit Directory for RACE Challenge 3** (see the figure below). This lets our tech team know that your contribution is ready for revision for potential integration.
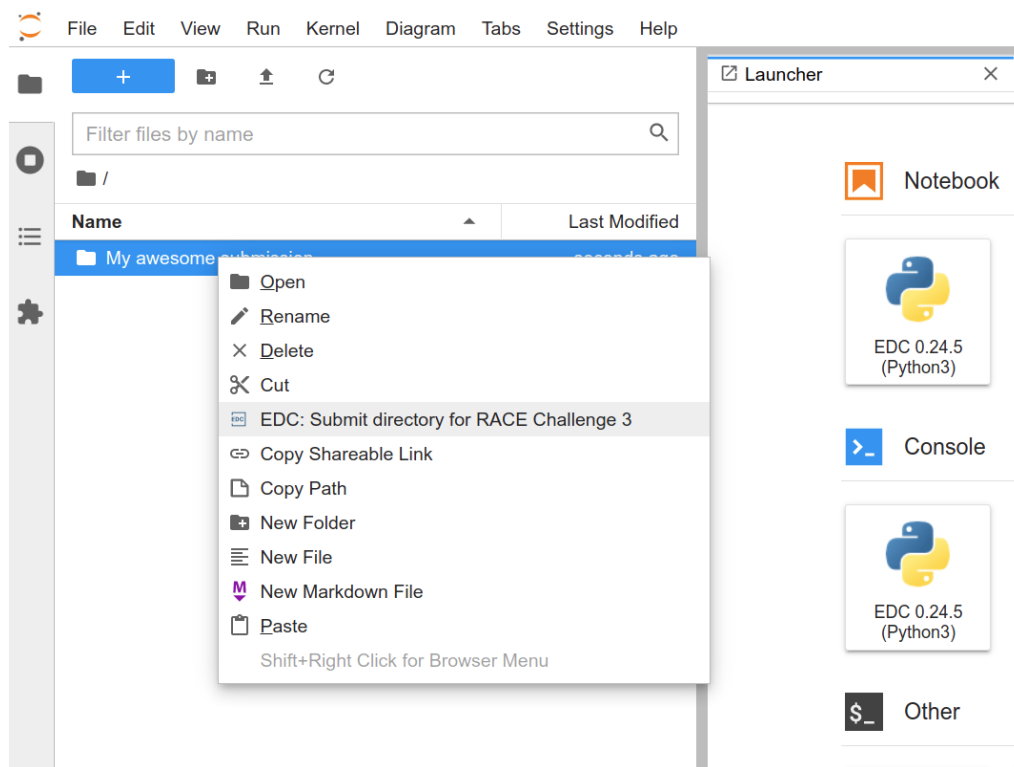
IMPORTANT: this does not constitute your submission for the challenge and you should follow the submission instructions on the RACE Challenge website (https://eo4society.esa.int/2021/08/01/rapid-action-on-coronavirus-and-eo-race-dashboard-challenge-3/) to make sure your submission is complete.

More details are provided in the Readme notebook in the Euro Data Cube workspace.

The upscaling and integration of your solution in the dashboard includes parametrizing your indicator notebook and running it in a headless manner (https://eurodatacube.com/documentation/headless-notebook-execution) on a regular basis to generate new data and extend the CSV or geoDB table.

Please let us know if you have any questions regarding your EDC workspace and don't hesitate to send us an e-mail at <*racecontest@eurodatacube.com*>.

Good luck in the RACE Challenge 3, and we are looking forward to your submission!

3. How to register to the EDC

The registration process to the Euro Data Cube is illustrated in the video below.

Please note that the interface in the actual platform that will be used for the challenges may slightly differ from the video.
How to Register to EDC

After registering, follow the steps illustrated below to get started with the EDC and reach the resources and tutorials for the challenges:
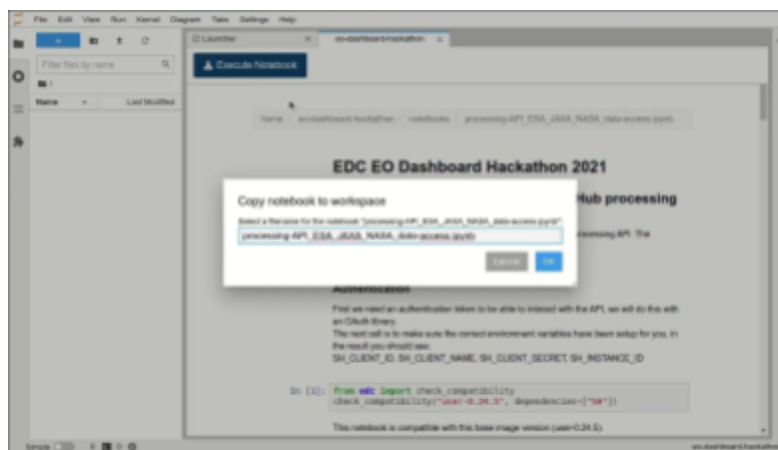
4. Tutorial Jupyter Notebooks in the Euro Data Cube

There are some tutorials provided in the form of Jupyter notebooks describing how to use the provided EDC resources. You can access these tutorials from your JupyterLab workspace in the EDC.

You may want to start from the Notebook called README.ipynb accessible from the Launcher, as shown in the above video.

The following tutorial notebooks below are available. When in the JupyterLab workspace, please use the "Execute Notebook" button as illustrated in the video above at the top left to copy a notebook into your workspace for interactive execution:

- Accessing the challenge data via geodb
- Accessing the challenge data via the Processing API
- Accessing the challenge data via the Statistical Info Service (FIS)
- Accessing the challenge data via xcube
- Using mobility data from Google
- Combined use of mobility data from CSV and geodb
- Pulling in data from OpenStreetMap

ANNEX - Data Resources

LIST OF INDICATORS ON RACE.ESA.INT				
1. ECONOMY				
Indicator Name	**Information**	**EO Data Analysis**	**Illustration**	**Indicator Data access**
Import/production sites: status of metallic ores	Changes in Ships traffic at dedicated piers	Object detection on Sentinel-2	https://race.esa.int/?poi=DE1-E1_S2&indicator=E1_S2	EDC Geodb GeoDB via Jupyter Notebooks (JN) Database = eodash Table name = E1_S2
Import/production sites: status of non-metallic ores	Changes in Ships traffic at dedicated piers	Object detection on Sentinel-2	https://race.esa.int/?indicator=E1a_S2	EDC Geodb GeoDB via JN Database = eodash Table name = E1a_S2
Commercial centres: volume of activity	Status of car park occupancy	Temporal variation of Sentinel-1 backscatter	https://race.esa.int/?indicator=E11&poi=RO3-E11	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E11.csv
		Object detection on High-Resolution Optical (Pleiades)	https://race.esa.int/?indicator=E11&poi=IT4-E11	https://github.com/eurodatacube/eodash/tree/master/a

		(indicator archived and no longer updated)		pp/public/eodash-data/data/E11.csv
Border crossing points: volume of activity	The volume of traffic on the highway	Temporal variation of Sentinel-1 backscatter	https://race.esa.int/?indicator=E12b&poi=UK12-E12b	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E12b.csv Access to Sentinel-1 data https://collections.eurodatacube.com/sentinel-1-grd/
Number of Trucks [Tutorial available](#) *community contribution	Number of moving trucks on motorways in the EU	Object detection on Sentinel-2	https://race.esa.int/?indicator=E12c&poi=W2-E12c (motorways tab)	EDC Geodb https://collections.eurodatacube.com/e12c_motorway/
	Number of moving trucks on primary roads in the EU	Object detection on Sentinel-2	https://race.esa.int/?indicator=E12c&poi=W2-E12c (primary roads tab)	EDC Geodb https://collections.eurodatacube.com/e12d_primary_corrected/
The volume of activity at the parking lot	Parking occupancy	Expert annotation on Iceye imagery	https://race.esa.int/?indicator=E11a&poi=PL7-E11a	N/A
Airports: throughput	Number of parked airplanes	Object detection on Sentinel-2	https://race.esa.int/?indicator=E13b	EDC Geodb GeoDB via JN Database =

				eodash Table name = E13b Access to Sentinel-2 imagery https://collections.eurodatacube.com/sentinel-2-l2a/
Airports: traffic *community contribution	Number of flying airplanes	Object detection on Sentinel-2	https://race.esa.int/?indicator=E13d	EDC Geodb GeoDB via JN Database = eodash Table name = E13d
Ports: throughput	Number of ships	Expert annotation on Iceye imagery	https://race.esa.int/?indicator=E13c&poi=UK9-E13c	N/A
Maritime traffic: AIS Data	Changes in Cargo/ Fishing/ Tanker/ Tug/ Search & Rescue/ Cruise/ Passenger Ships traffic in the port	AIS data analysis	https://race.esa.int/?indicator=E13e	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E13e_cargo.csv https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E13f_fishing.csv

				https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E13g_tanker.csv https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E13h_gioiatauro_tug.csv https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E13i_gioiatauro_SearchRescue.csv https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E13l_genova_pleasure.csv https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E13m_genova_passenger.csv

Changes in commercial fluxes	Number of trucks entering/exiting the port	Mobile data	https://race.esa.int/?poi=ES7-E13n&indicator=E13n	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E13n_traffic.csv
Import/refinery sites: volume of oil stock-piled	Changes in Ships traffic at dedicated piers	Object detection on Sentinel-2	https://race.esa.int/?poi=BE3-E2_S2&indicator=E2_S2	EDC Geodb GeoDB via JN Database = eodash Table name = E2_S2
Oil Storage Volume	Oil tanks' filling level	Expert annotation on Iceye imagery	https://race.esa.int/?poi=NL3-E3&indicator=E3	N/A
Crude Oil Storage Index	Status of crude oil storage utilisation for 4 geographical clusters (UK/Ireland, ARA+Germany, CEE, Southern Europe).	Composite indicator based on EO (Sentinel-1, Sentinel-2), AIS and other data	https://race.esa.int/?poi=100057-OX&indicator=OX	N/A
Intermediate goods production: activity status	Status of activity based on parking lot occupancy as proxy	Object detection on High-Resolution Optical (Pleiades)	https://race.esa.int/?indicator=E4&poi=DE1-E4	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E4.csv

Intermediate goods production: output inventory level	Time series of metal density in open warehouses produced by steel mills	Temporal variation of Sentinel-1 backscatter	https://race.esa.int/?indicator=E5&poi=SE17-E5	EDC Geodb GeoDB via JN Database = eodash Table name = E5
Finished goods production: output inventory level	Time series of car density in open logistic areas of car manufacturers	Temporal variation of Sentinel-1 backscatter	https://race.esa.int/?poi=DE5-E8&indicator=E8	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E8.csv
Mobility Data	Daily variation of visits and length of stay at different places compared to a baseline value	Google COVID-19 Community Mobility Reports	https://race.esa.int/?poi=GG-GG&indicator=GG	https://www.google.com/covid19/mobility/
Population density 2020	Population density 2020	Population Density Adjusted to Match 2015 Revision UN WPP Country Totals	https://race.esa.int/?poi=W6-NASAPopulation&indicator=NASAPopulation	https://doi.org/10.7927/H4F47M65. API: https://gibs.earthdata.nasa.gov/wmts/epsg3857/best/GPW_Population_Density_2020/default/2020-05-14T00:00:00Z/GoogleMapsCompatible_Level7/6/23/19.png
Additional resources				

Tutorials	Exploring air traffic data on the dashboard Measuring economic activity from space: a case study using flying airplanes and COVID-19 https://arxiv.org/pdf/2104.10345.pdf
	How to compute truck traffic graphs using the Truck indicator

2. AGRICULTURE

Indicator Name	Information	EO Data Analysis	Illustration	Indicator Data access
Productive area	White asparagus productive area - 2020 vs 2019 difference, (absolute value [ha] and %)	Seasonal analysis on Sentinel-2 data	https://race.esa.int/?poi=DE11-E10a1&indicator=E10a1	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E10a1.csv GeoDB via JN Database = eodash Table name = E10a1_tri
National Harvesting Evolution	Observed vs. expected harvest progress in 2020	Evolution of the percentage of harvested parcels in 2020 observed with Sentinel-1 compared to modelled expected	https://race.esa.int/?poi=EEb-E10a10&indicator=E10a10	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E10a10.csv

		harvest dates in 2020		
Activity Indicator	White asparagus field - Cumulative proportion of total area under active management in 2020 compared to 2019 baseline	Seasonal analysis on Sentinel-2 data	https://race.esa.int/?poi=DE11-E10a2&indicator=E10a2	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E10a2.csv GeoDB via JN Database = eodash Table name = E10a2_tri
Productive area change	Productive area [%] for white asparagus in 2020 compared to 2019 baseline	Seasonal analysis on Sentinel-2 data	https://race.esa.int/?poi=DE11-E10a3&indicator=E10a3	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E10a3.csv GeoDB via JN Database = eodash Table name = E10a3_tri
Harvesting activity	The activity of red berries trucks - 2020 vs 2019 difference, (absolute value and %)	Detection of picking activity in between the greenhouses of berries in very high-resolution	https://race.esa.int/?poi=ES8-E10a5&indicator=E10a5	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E10a5.csv GeoDB via JN

		optical imagery (Pleiades)		Database = eodash Table name = E10a5
Regional Harvesting Evolution	Evolution of the percentage of winter cereals harvested parcels in 2020 compared to 2019 baseline	Processing of time series of Sentinel-2 vegetation indices and Sentinel-1 backscatter and coherence values on the open source Sen4CAP	https://race.esa.int/?poi=ES30a-E10a6&indicator=E10a6	https://github.com/eurodatacube/eodash/tree/master/app/public/data/trilateral/E10a6.csv GeoDB via JN Database = eodash Table name = E10a6
Harvesting activity: cumulative harvested area	Total monitored area of winter cereals	Processing of time series of Sentinel-2 vegetation indices and Sentinel-1 backscatter and coherence values on the open source Sen4CAP	https://race.esa.int/?poi=ES41-E10a8&indicator=E10a8	https://github.com/eurodatacube/eodash/tree/master/app/public/data/trilateral/E10a8.csv GeoDB via JN Database = eodash Table name = E10a8
Agricultural Workers	Availability of workers for work on tomato fields	Analysis of temporal evolution of vegetation indexes and texture to classify agricultural fields on HR/VHR optical data: Sentinel-2 and Deimos.	https://race.esa.int/?poi=IT_492-E10a9&indicator=E10a9	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/E10a9.csv

		Analysis of anonymised mobile data.		

3. ENVIRONMENT - AIR QUALITY				
Indicator Name	Information	EO Data Analysis	Illustration	Indicator Data access
CDS Data	Temperature	Monthly averages from C3S ERA5 reanalysis	https://race.esa.int/?poi=CDS-CDS1&indicator=CDS1	Climate Data Store Copernicus ERA5 hourly data on single levels from 1979 to present
	Relative humidity 1000HPA		https://race.esa.int/?poi=CDS-CDS2&indicator=CDS1	API documentation: How to use the CDS API | Copernicus Climate Data Store
	Wind U field		https://race.esa.int/?poi=CDS-CDS3&indicator=CDS1	
	Wind V field		https://race.esa.int/?poi=CDS-CDS4&indicator=CDS1	
TROPOMI CO	Global maps of Carbon Monoxide total column	Carbon monoxide observed by Sentinel-5p TROPOMI	https://race.esa.int/?poi=WorldCO-N1&indicator=N1	Copernicus Sentinel-5P Mapping Portal esa european commission
TROPOMI NO2 maps Tutorial available	Global maps of Tropospheric Nitrogen Dioxide (NO2)	Averaged nitrogen dioxide concentrations across the globe – using a 14-day moving average	https://race.esa.int/?poi=World-N1&indicator=N1	Copernicus Sentinel-5P Mapping Portal esa european commission

				EDC S5P-NO2-tropno-daily-check
TROPOMI NO2 time series	Spatial average over the city area of bi-weekly tropospheric nitrogen dioxide (NO2) concentrations	Time series computed from the Tropomi NO2 maps over the city area (considering a polygon of 50 x 50 km centered on the city)	https://race.esa.int/?poi=IE-N1&indicator=N1 (multiple cities available)	Download csv available on race.esa.int RACE Dashboard users can compute time series anywhere on the globe → see tutorial Already available for European capital cities in the geoDB **GeoDB via JN Database = eodash Table name = N1**
(CAMS) Air Quality Maps	European maps of NO2	Daily average surface concentrations of air pollutants based on the latest CAMS regional analyses, with spatial resolution of 10 km x 10 km provided by Copernicus	https://race.esa.int/?poi=GCAQ1-N1b&indicator=N1b	European Air Quality information in support of the COVID-19 crisis | Copernicus S5P-NO2-tropno-daily-check
	European maps of PM2.5		https://race.esa.int/?poi=GCAQ2-N1b&indicator=N1b	
	European maps of PM10		https://race.esa.int/?poi=GCAQ3-N1b&indicator=N1b	

	European maps of O3 (ozone)	Atmosphere Monitoring Service	https://race.esa.int/?poi=GCAQ4-N1b&indicator=N1b	
(CAMS) Air Quality Time Series	CAMS NO2 daily mean analysis	Time series of surface concentrations of the key air pollutants starting on 1 February 2020

available for 50 European cities

provided by Copernicus Atmosphere Monitoring Service | https://race.esa.int/?poi=CZ6-N1b&indicator=N1b | https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/N1b_NO2_CAMS.csv |
	CAMS PM2.5 daily mean analysis		https://race.esa.int/?poi=CZ6-N1a&indicator=N1b	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/N1a_PM25_CAMS.csv
	CAMS PM10 daily mean analysis		https://race.esa.int/?poi=CZ6-N1c&indicator=N1b	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/N1c_PM10_CAMS.csv
	CAMS O3 daily mean analysis		https://race.esa.int/?poi=CZ6-N1d&indicator=N1b	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/N1d_O3_CAMS.csv
Additional resources				
Tutorials	How to compute air quality time series from NO2 maps			
4. ENVIRONMENT - WATER QUALITY				

Indicator Name	Information	EO Data Analysis	Illustration	Indicator Data access
Water Quality Time Series	Chlorophyll-a concentration	weekly Chl-a concentration calculated from Sentinel-3 full resolution (250m) data	https://race.esa.int/?poi=IT6-N3&indicator=N3 (multiple cities available)	EDC Geodb GeoDB via JN Database = eodash Table name = N3
Water Quality Regional Maps Tutorial available	weekly Chl concentration anomalies (%)	Deviation from a weekly climatological mean of chlorophyll-a (Chl) concentration as measured from Sentinel-3	https://race.esa.int/?poi=Barcelona-N3a2&indicator=N3a2	EDC https://collections.eurodatacube.com/tag/race-challenges/
	weekly Total Suspended Matter concentration anomalies (%)	Deviation from a weekly climatological mean of Total Suspended Matters (TSM) as measured from Sentinel-3	https://race.esa.int/?poi=BarcelonaTSM-N3a2&indicator=N3a2	EDC https://collections.eurodatacube.com/tag/race-challenges/
CMEMS Water Quality	daily Chl concentration	Daily interpolated surface chlorophyll concentration from multi-satellite and Sentinel-3 observations	https://race.esa.int/?indicator=N3c&poi=World-N3c	CMEMS

		provided by Copernicus Marine Service		
Additional resources				
Tutorials	Coronavirus and water quality			

5. ENVIRONMENT - LAND

Indicator Name	Information	EO Data Analysis	Illustration	Indicator Data access
Landfill sites: waste volume changes	Landfill sites: waste volume changes	Expert annotation on very high resolution imagery	https://race.esa.int/?indicator=N4a&poi=IT2-N4a	N/A
Landfill sites: waste area changes	Landfill sites: waste area changes	Expert annotation on very high resolution optical imagery (Deimos)	https://race.esa.int/?indicator=N4c&poi=GR4-N4c	N/A

6. COMBINED

Indicator Name	Information	EO Data Analysis	Illustration	Indicator Data access
Port activity & Air Quality	Boat traffic - NO2 level	AIS data from boats entering the ports compared with normalized NO2 over the port computed from Sentinel-5p	https://race.esa.int/?indicator=C1&poi=IT3-C1	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/C1.csv

	People presence - NO2 level	Anonymised 2020 mobile data provided by Vodafone compared with normalized NO2 over the port computed from Sentinel-5p	https://race.esa.int/?indicator=C1&poi=IT3-C2	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/C2.csv
	Vehicle traffic - NO2 level	TomTom mean daily number of cars in the main access street to the port compared with normalized NO2 over the port computed from Sentinel-5p	https://race.esa.int/?indicator=C1&poi=IT3-C3	https://github.com/eurodatacube/eodash/tree/master/app/public/eodash-data/data/C3.csv

7. HEALTH

Indicator Name	Information	EO Data Analysis	Illustration	Indicator Data access
COVID-19 Data	Cases	N/A	https://race.esa.int/?indicator=CV&poi=CV-CV	Our World in Data
	Vaccinations	N/A	https://race.esa.int/?indicator=CV&poi=OW-OW	Our World in Data
Lockdown data	On the indicator charts the light-red/ dark-red chart background	N/A	all charts on https://race.esa.int	Oxford University's coronavirus government response tracker.

	shows the level of restrictions/ lockdown in the respective country			