

Introduction to data processing using OpenEO and Terrascope

EO4GEO EO Tools

Hande Erdem

VITO

EO4GEO

We are supporting EO4GEO vision by providing a **fully prepared environment** through [Terrascope](#) platform and **hiding** software processing **complexity** through [OpenEO](#), allowing users to focus on gaining the skills relevant to their domain.



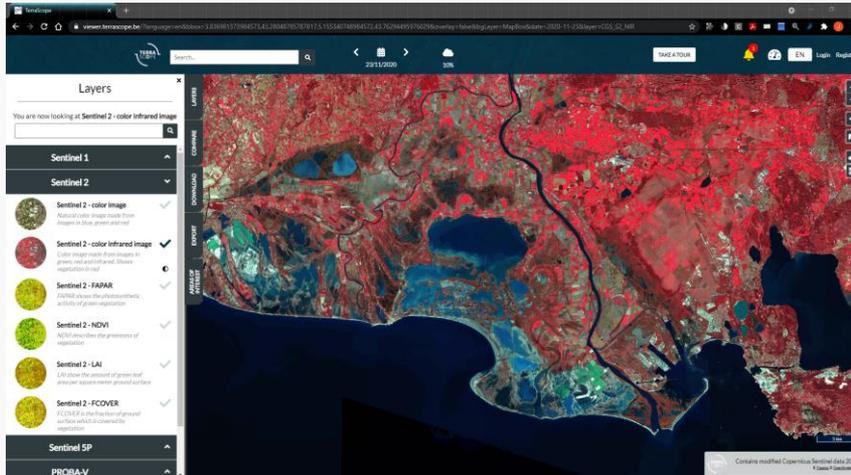
What is Terrascope?

- Belgian Collaborative Ground Segment for Sentinel missions
- **Easy access to**
 - satellite data
 - products derived from satellite data
 - services (OGC web services, time series service)
 - cloud processing capacity (Jupyter Notebooks, Virtual Machines, openEO)
- **Enabling platform**
- Open for everyone (scientists, public authority, industry, citizens)
- **Free to use for everyone**
- Funded by BELSPO

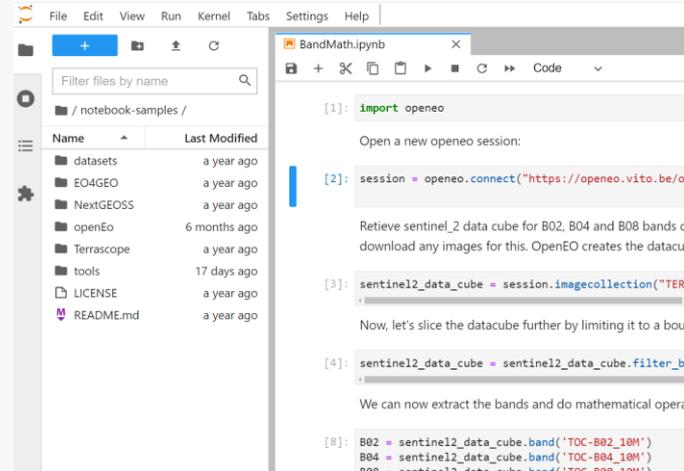
What makes Terrascope stand out?

- **Analysis Ready Data**
 - preprocessed (atmospheric correction, georeferencing, ...)
 - in Cloud Optimized GeoTIFF format
 - not just satellite imagery or data, but also value added products
 - ✓ a unique long term global vegetation data set (from 1998 onwards)
- **Analysis tools**
 - catalogue – where do I find data of interest
 - comparison – see change or different perspectives
 - trend analysis – evolution over time
- **Cloud processing**
 - bring your analysis to the data
 - save on storage and processing power
 - free tier, funding opportunity for higher requirements (Network of Resources)

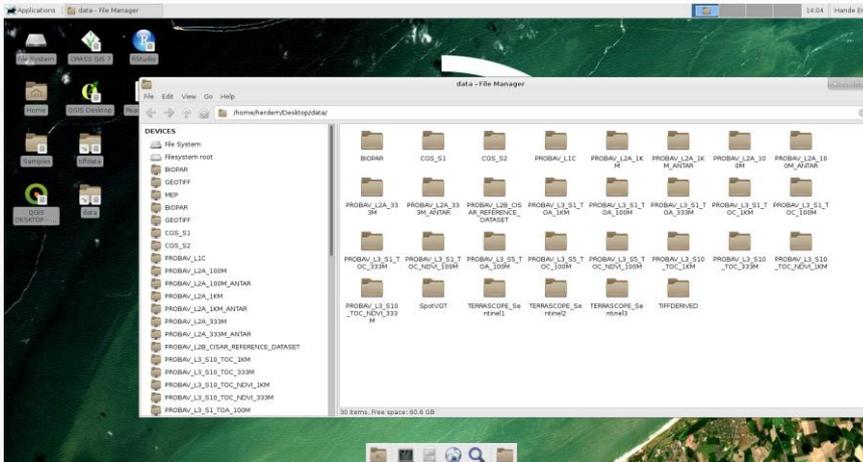
Terrascope Viewer



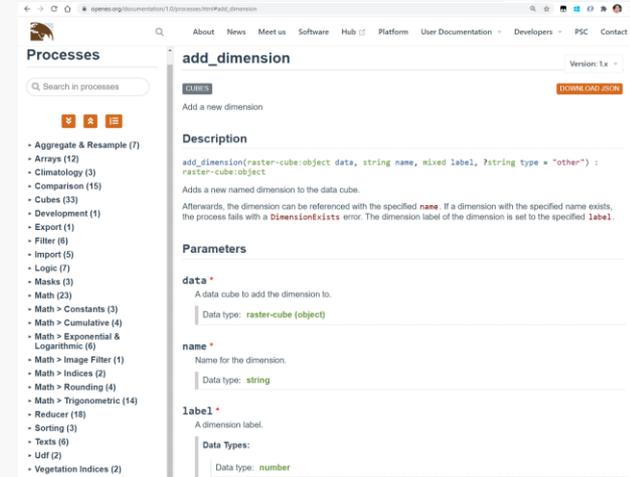
Jupyter Notebooks



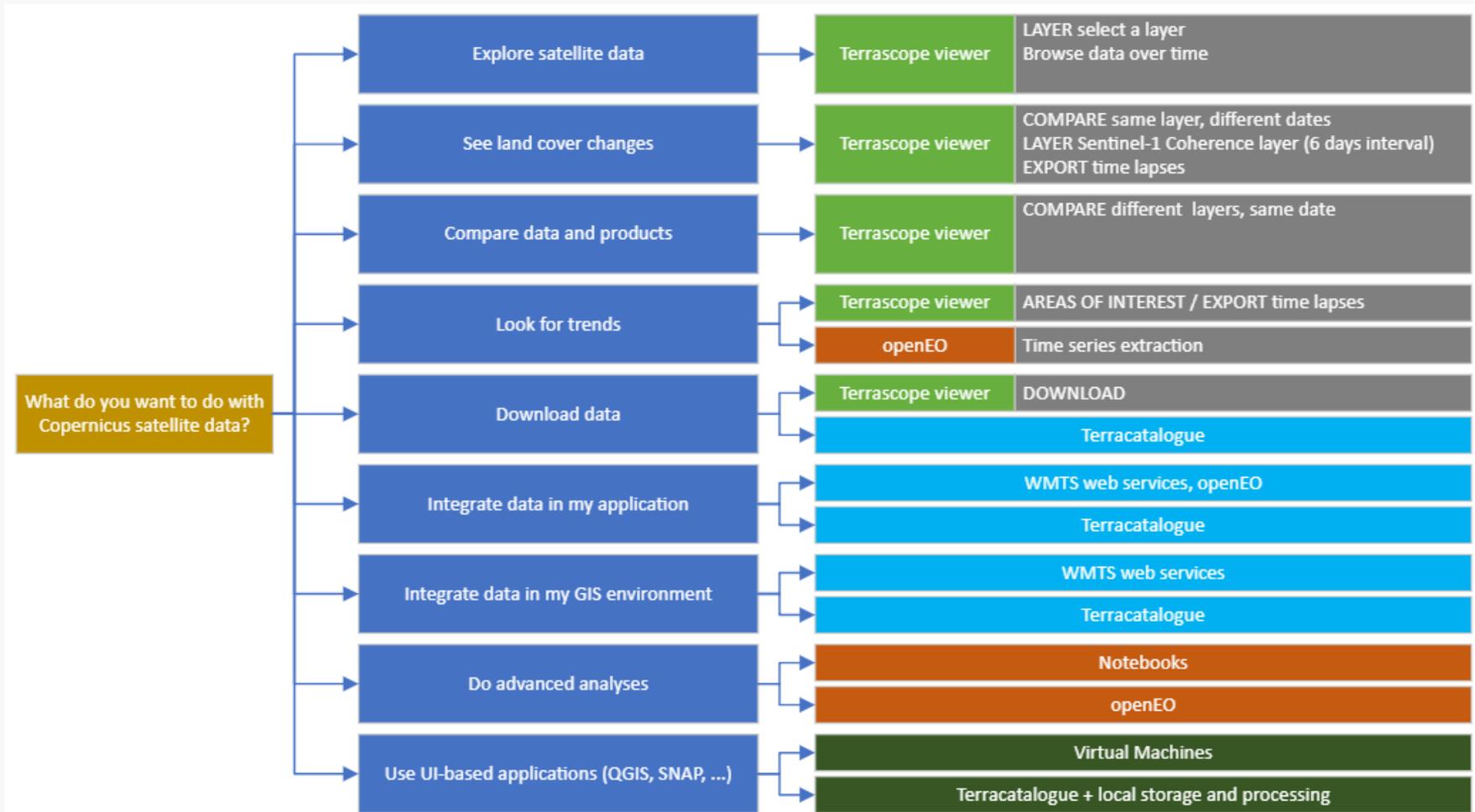
Virtual Machines



OpenEO

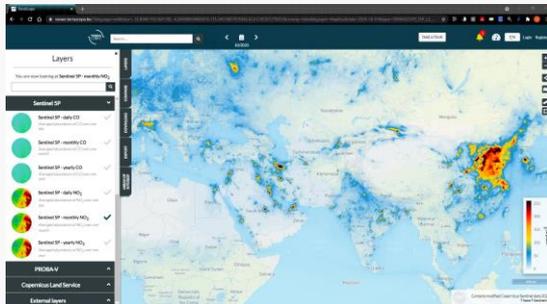
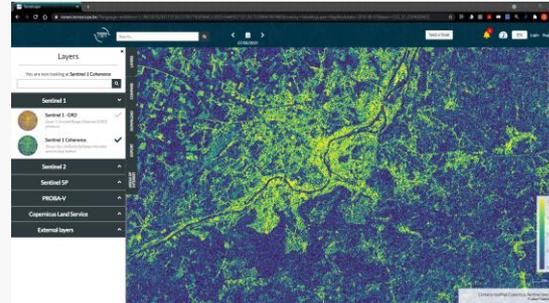
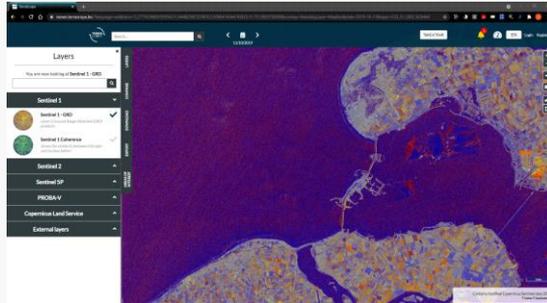
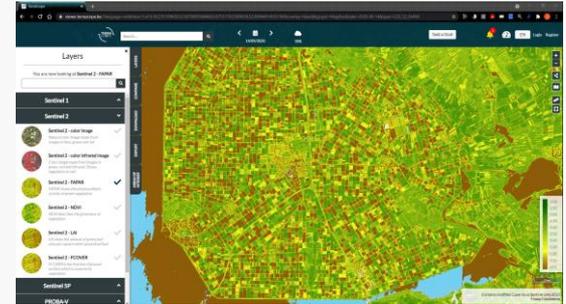
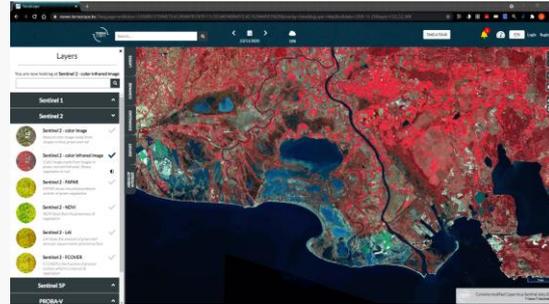
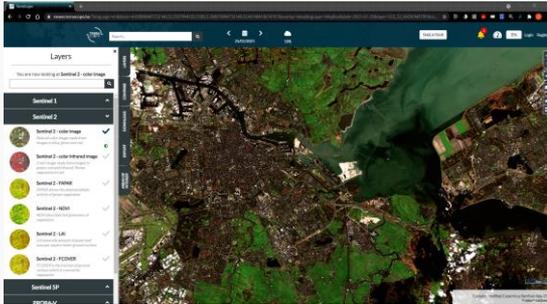


Service Overview

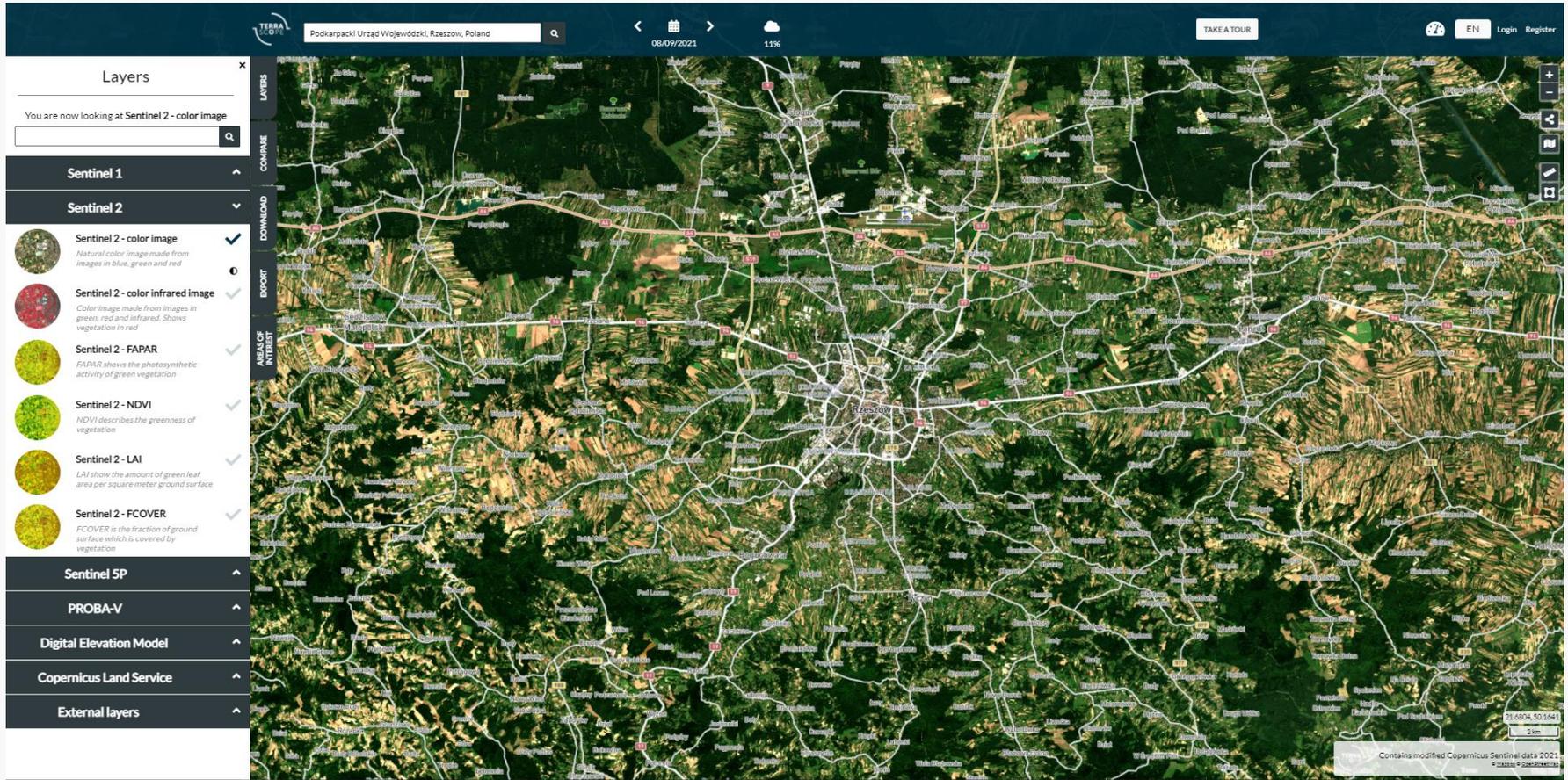


Terrascope Viewer

<https://viewer.terrascope.be>



Layers

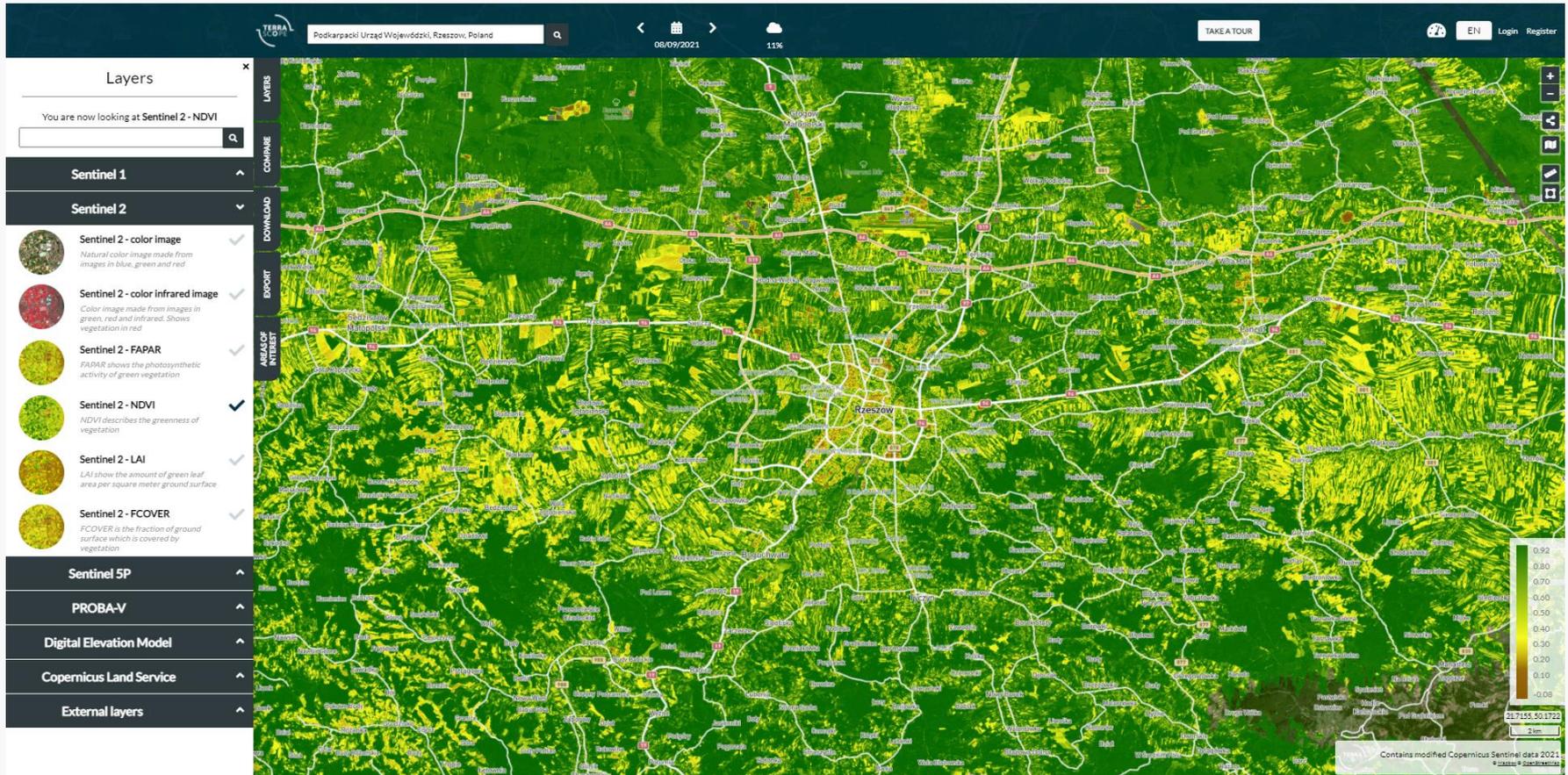


The screenshot displays the Terrascope Viewer interface. At the top, there is a search bar containing "Podkarpacki Urząd Wojewódzki, Rzeszów, Poland", a date selector for "08/09/2021", and a "TAKE A TOUR" button. The main map area shows a satellite view of Rzeszów, Poland, with various layers overlaid. On the left, a "Layers" panel is open, listing several layers with their respective icons and descriptions:

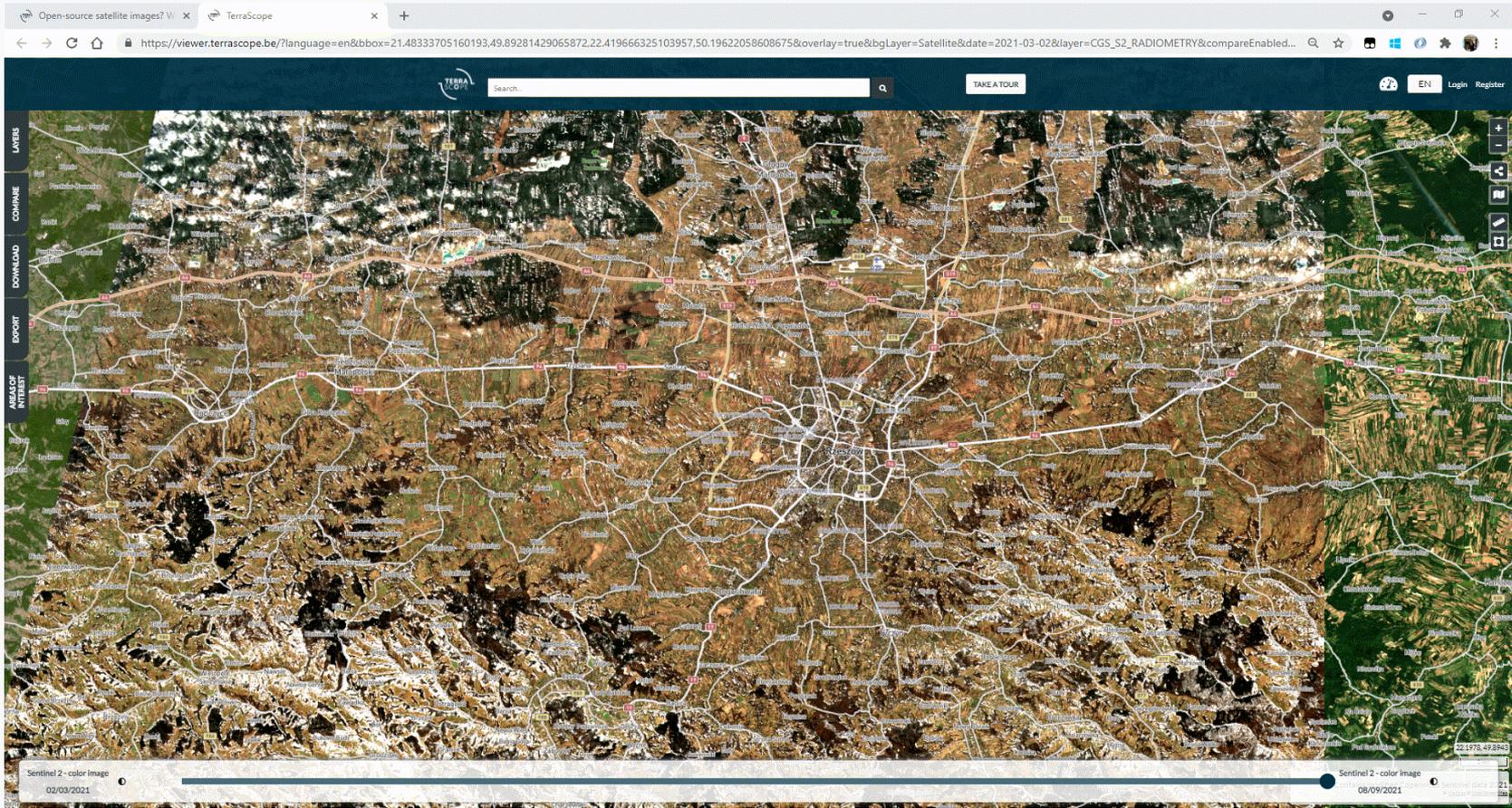
- Sentinel 1**
- Sentinel 2**
 - Sentinel 2 - color image**: Natural color image made from images in blue, green and red
 - Sentinel 2 - color infrared image**: Color image made from images in green, red and infrared. Shows vegetation in red
 - Sentinel 2 - FAPAR**: FAPAR shows the photosynthetic activity of green vegetation
 - Sentinel 2 - NDVI**: NDVI describes the greenness of vegetation
 - Sentinel 2 - LAI**: LAI show the amount of green leaf area per square meter ground surface
 - Sentinel 2 - FCOVER**: FCOVER is the fraction of ground surface which is covered by vegetation
- Sentinel 5P**
- PROBA-V**
- Digital Elevation Model**
- Copernicus Land Service**
- External layers**

The interface also includes a "LAYERS" sidebar with "COMPOSE" and "DOWNLOAD" options, a "MAPS OF INTEREST" sidebar, and a "TERRASCOPE" logo in the top left corner. The bottom right corner of the map shows a scale bar and a copyright notice: "Contains modified Copernicus Sentinel data 2021 © UTM 49 SDC/BR/101010".

Layers



Compare Images



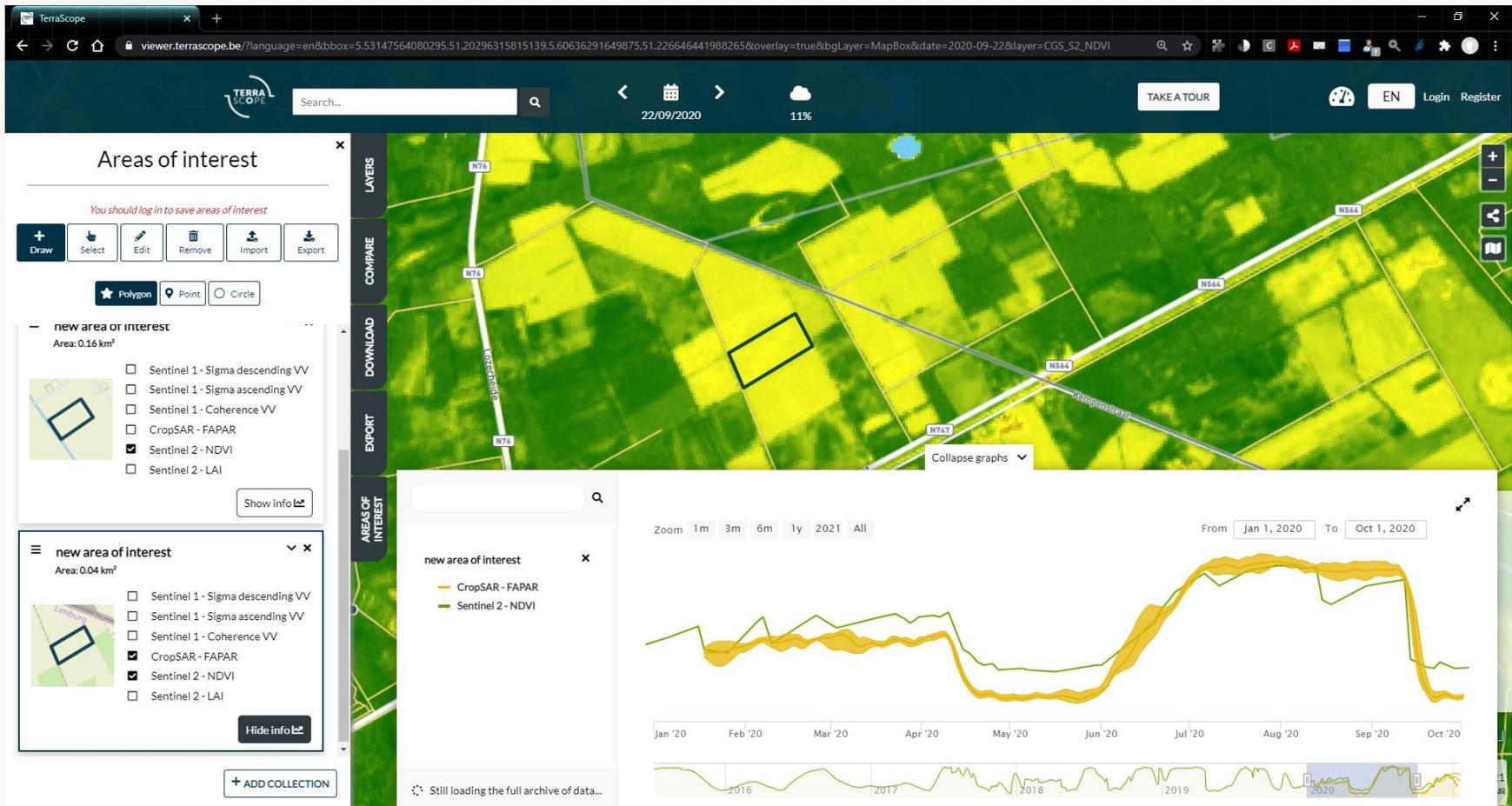
Timelapse



Areas of Interest



Areas of Interest



The screenshot displays the TerraScope viewer interface. At the top, there is a search bar and navigation controls. The main map shows a satellite view of agricultural fields with a black rectangle highlighting a specific area of interest. To the left, a sidebar titled "Areas of interest" provides tools for drawing and managing these areas. Below the map, a time-series graph shows the NDVI values for the selected area from 2016 to 2020. The graph includes a legend for "CropSAR - FAPAR" (yellow) and "Sentinel 2 - NDVI" (green). The x-axis represents time, with zoom options for 1m, 3m, 6m, 1y, 2021, and All. The y-axis represents NDVI values. The graph shows a seasonal cycle with a peak in late summer and a trough in late winter. A "Collapse graphs" button is visible above the graph.

Areas of interest

You should log in to save areas of interest

Draw Select Edit Remove Import Export

Polygon Point Circle

new area or interest
Area: 0.16 km²

- Sentinel 1 - Sigma descending VV
- Sentinel 1 - Sigma ascending VV
- Sentinel 1 - Coherence VV
- CropSAR - FAPAR
- Sentinel 2 - NDVI
- Sentinel 2 - LAI

Show info

new area of interest
Area: 0.04 km²

- Sentinel 1 - Sigma descending VV
- Sentinel 1 - Sigma ascending VV
- Sentinel 1 - Coherence VV
- CropSAR - FAPAR
- Sentinel 2 - NDVI
- Sentinel 2 - LAI

Hide info

+ ADD COLLECTION

new area of interest

- CropSAR - FAPAR
- Sentinel 2 - NDVI

Zoom 1m 3m 6m 1y 2021 All

From Jan 1, 2020 To Oct 1, 2020

Jan '20 Feb '20 Mar '20 Apr '20 May '20 Jun '20 Jul '20 Aug '20 Sep '20 Oct '20

2016 2017 2018 2019 2020

Still loading the full archive of data...

Download

Podkarpacki Urząd Wojewódzki, Rzeszów, Poland
TAKE A TOUR
EN Logout

Download

Advanced

Start: 01/09/2021

End: 08/09/2021

Sentinel 2 - color image

Extent: Current view

Sep '21

<https://services.terrascope.be/catalogue/products?coll>

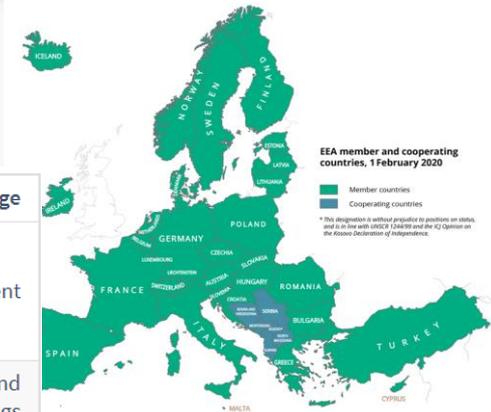
Results

Selected 0/79 products

<input type="checkbox"/> Title	Date	Tile ID	Cloud cover	Relative orbit number	Size
<input type="checkbox"/> S2B_20210906T094029_34UGB_TOC_V200	2021-09-06T09:40:29.024Z	34UGB	0.13 %	36	12.59 MB
<input type="checkbox"/> S2B_20210906T094029_34UFV_TOC_V200	2021-09-06T09:40:29.024Z	34UFV	0.05 %	36	321.34 MB
<input type="checkbox"/> S2B_20210906T094029_34UFB_TOC_V200	2021-09-06T09:40:29.024Z	34UFB	0.66 %	36	855.26 MB
<input type="checkbox"/> S2B_20210906T094029_34UFA_TOC_V200	2021-09-06T09:40:29.024Z	34UFA	0.01 %	36	586.99 MB
<input type="checkbox"/> S2B_20210906T094029_34UEV_TOC_V200	2021-09-06T09:40:29.024Z	34UEV	0.03 %	36	988.52 MB
<input type="checkbox"/> S2B_20210906T094029_34UEB_TOC_V200	2021-09-06T09:40:29.024Z	34UEB	0.05 %	36	1,024.23 MB
<input type="checkbox"/> S2B_20210906T094029_34UEA_TOC_V200	2021-09-06T09:40:29.024Z	34UEA	0.05 %	36	1,026.12 MB
<input type="checkbox"/> S2B_20210906T094029_34UDV_TOC_V200	2021-09-06T09:40:29.024Z	34UDV	0.66 %	36	1,009.69 MB
<input type="checkbox"/> S2B_20210906T094029_34UDB_TOC_V200	2021-09-06T09:40:29.024Z	34UDB	0.06 %	36	1,022.78 MB
<input type="checkbox"/> S2B_20210906T094029_34UDA_TOC_V200	2021-09-06T09:40:29.024Z	34UDA	0.05 %	36	1,044.69 MB

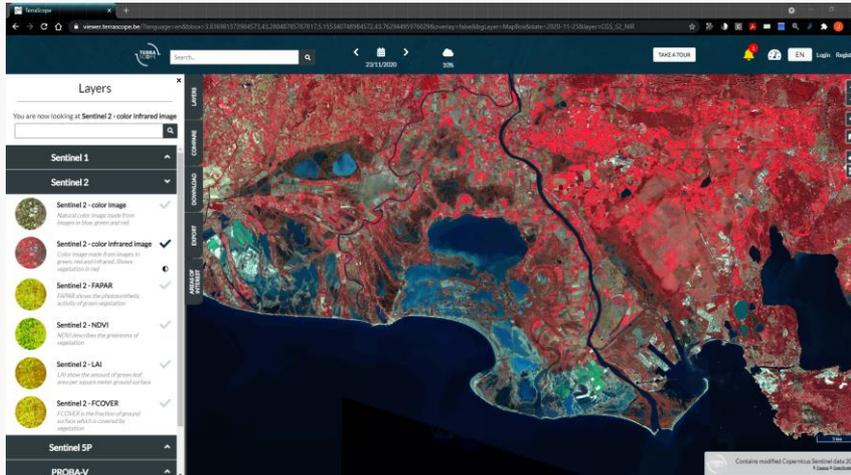
Please select one or more products **NEXT**

Product Portfolio



Satellite/Provider	Instrument(s)	Data Products	Available Region	Temporal range
Sentinel-1	C-SAR	GRD GRD σ_0 SLC SLC Coherence	Belgium and surroundings	2015 - present
Sentinel-2	MSI	Level-2A TOC Vegetation Indicators	Europe, Africa, Asia	2015 - present for Belgium and surroundings 2-year rolling archive outside this region
Sentinel-5P	TROPOMI	NO₂ CO	Global	2018 - present
PROBA-V	VGT	Level-1C TOA Level-2A TOA Level-3 TOC, NDVI	Global	2013 - 2020
SPOT-VGT	Végétation	Level-2A TOA (VGT-P) Level-3 TOC, NDVI (VGT-S)	Global	1998 - 2014
Copernicus Land Monitoring Service	PROBA-V Sentinel-3 OLCI	S10 LAI S10 FAPAR	Global	2014 - present
Copernicus Digital Elevation Model (DEM)	TanDEM-X	Digital Elevation Model	Global	2011 - 2015

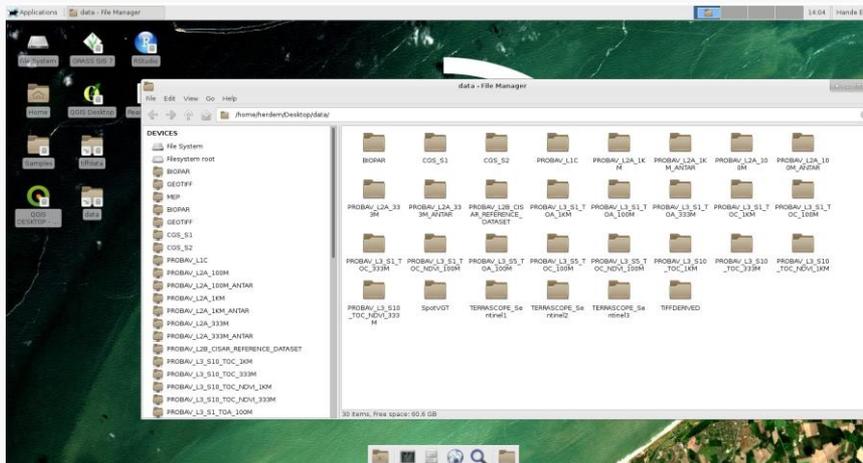
Terrascope Viewer



- Explore satellite images and derived products
- See land cover changes
- Compare different layers or different dates for the same layer
- Look for trends in areas of interest
- Create time lapses
- Download data

<https://viewer.terrascope.be>

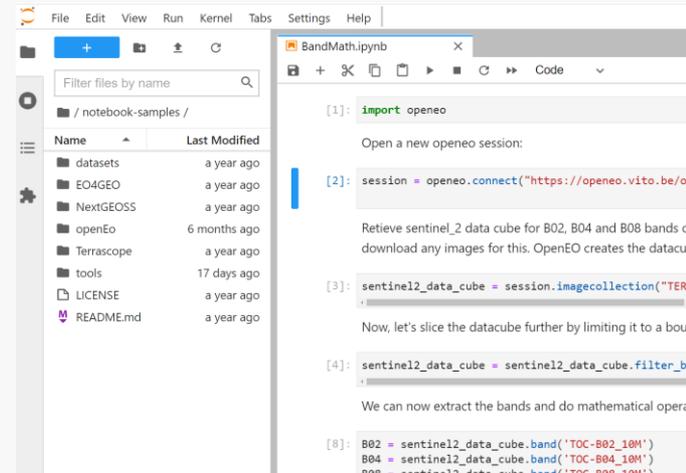
Virtual Machines



- Fully prepared virtual desktop environment offering powerful tool set and libraries for further data exploration and analysis (using e.g. the SNAP toolbox, GRASS GIS, and QGIS)
- Direct access to available data archives
- use develop-debug-test applications (in e.g. R, Python or Java)

Jupyter Notebooks

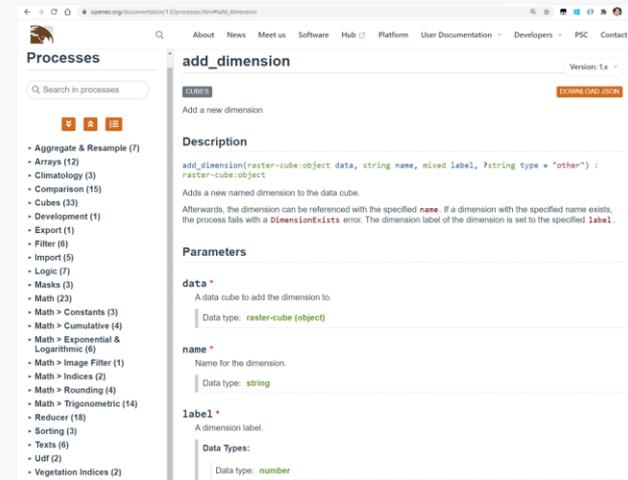
- A web environment on the Terrascope server in which you can work directly with satellite data.
- Start with the data in the programming language you are familiar with.
- Easily track and export the data you need in the code.
- Do not just work in the code, but also add information about the code. This is useful for secondary and higher education.



```
File Edit View Run Kernel Tabs Settings Help
BandMath.ipynb
[1]: import openeo
Open a new openeo session:
[2]: session = openeo.connect("https://openeo.vito.be/oj
Retieve sentinel_2 data cube for B02, B04 and B08 bands o
download any images for this. OpenEO creates the datacube
[3]: sentinel2_data_cube = session.imagecollection("TERI
Now, let's slice the datacube further by limiting it to a bou
[4]: sentinel2_data_cube = sentinel2_data_cube.filter_bl
We can now extract the bands and do mathematical opera
[8]: B02 = sentinel2_data_cube.band('TOC-B02_10M')
B04 = sentinel2_data_cube.band('TOC-B04_10M')
B08 = sentinel2_data_cube.band('TOC-B08_10M')
```

- A standard API to process the EO data in a simple and unified way to reduce complexity
- Work with datacubes: “I want time series of of the median NDVI of these parcels between 2018 and 2021, using Sentinel-2 data”.
- Provides out of the box functions and processes tailored for EO.
- Readily available via Terrascope Jupyter notebooks.

OpenEO



Processes

add_dimension

Description

add_dimension(raster-cube:object data, string name, mixed label, ?string type = "other") : raster-cube:object

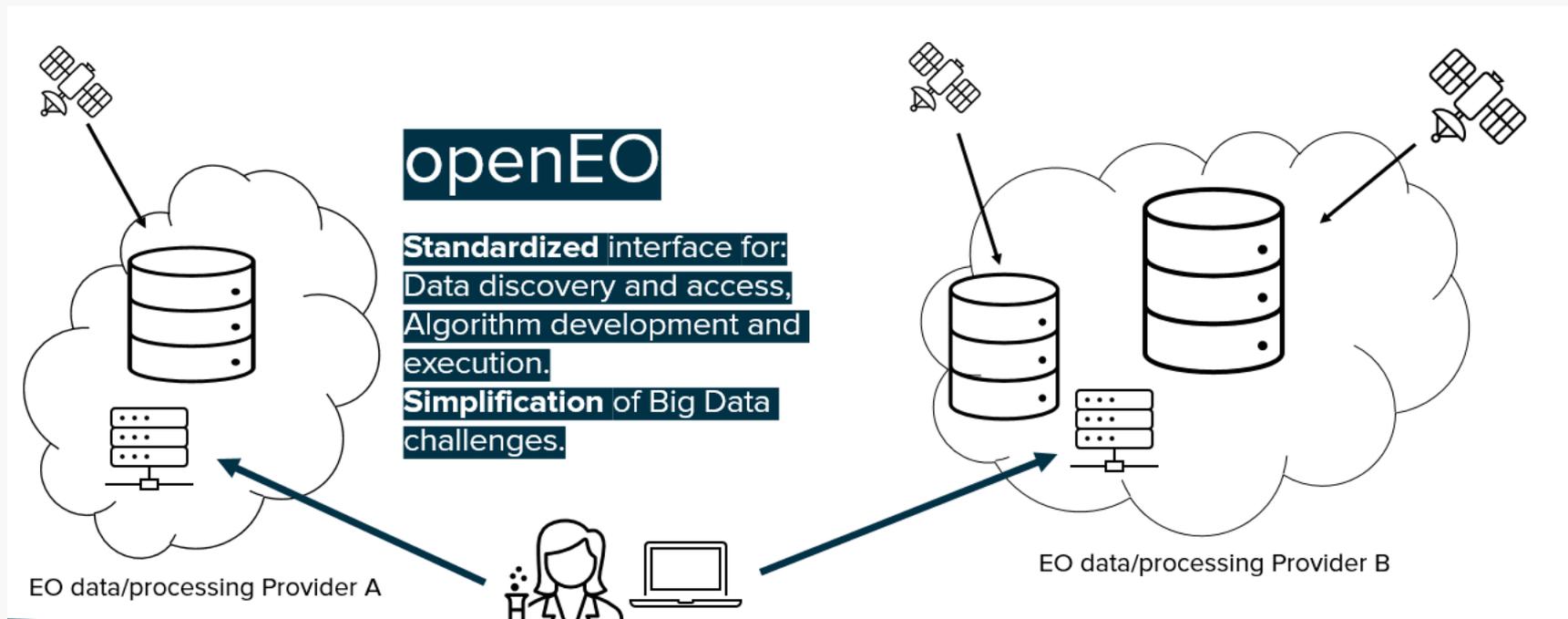
Parameters

data *

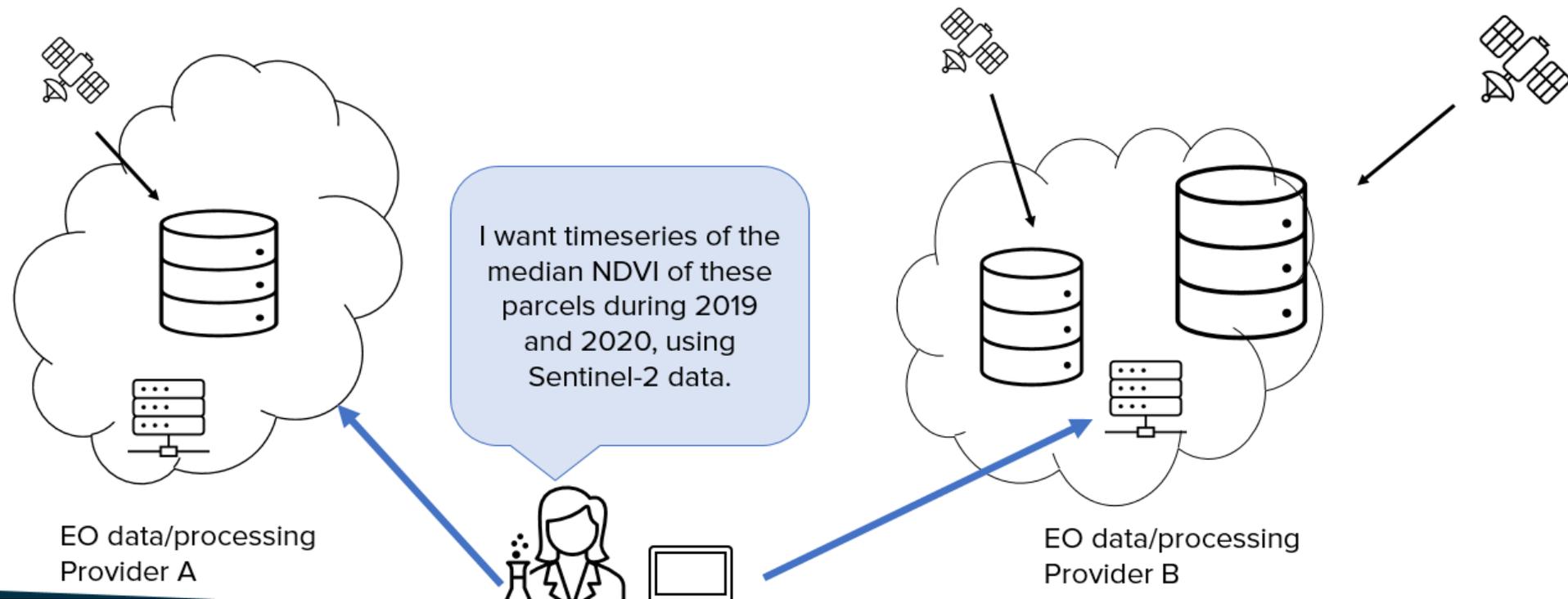
name *

label *

EO Processing with OpenEO



EO Processing with OpenEO





Processes

Search in processes



- Aggregate & Resample (7)
- Arrays (12)
- Climatology (3)
- Comparison (15)
- Cubes (33)
- Development (1)
- Export (1)
- Filter (6)
- Import (5)
- Logic (7)
- Masks (3)
- Math (23)
 - Math > Constants (3)
 - Math > Cumulative (4)
 - Math > Exponential & Logarithmic (6)
 - Math > Image Filter (1)
 - Math > Indices (2)
 - Math > Rounding (4)
 - Math > Trigonometric (14)
- Reducer (18)
- Sorting (3)
- Texts (6)
- Udf (2)
- Vegetation Indices (2)

add_dimension

Version: 1.x

CUBES

DOWNLOAD JSON

Add a new dimension

Description

```
add_dimension(raster-cube:object data, string name, mixed label, ?string type = "other") :  
raster-cube:object
```

Adds a new named dimension to the data cube.

Afterwards, the dimension can be referenced with the specified `name`. If a dimension with the specified name exists, the process fails with a `DimensionExists` error. The dimension label of the dimension is set to the specified `label`.

Parameters

data *

A data cube to add the dimension to.

Data type: `raster-cube (object)`

name *

Name for the dimension.

Data type: `string`

label *

A dimension label.

Data Types:

Data type: `number`

Thank you!



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