



CDSE

COPERNICUS
DATA SPACE
ECOSYSTEM

Cloud optimized way to explore access analyze and visualize Copernicus data sets

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ESA LPS 2025, Vienna, Austria

dataspace.copernicus.eu



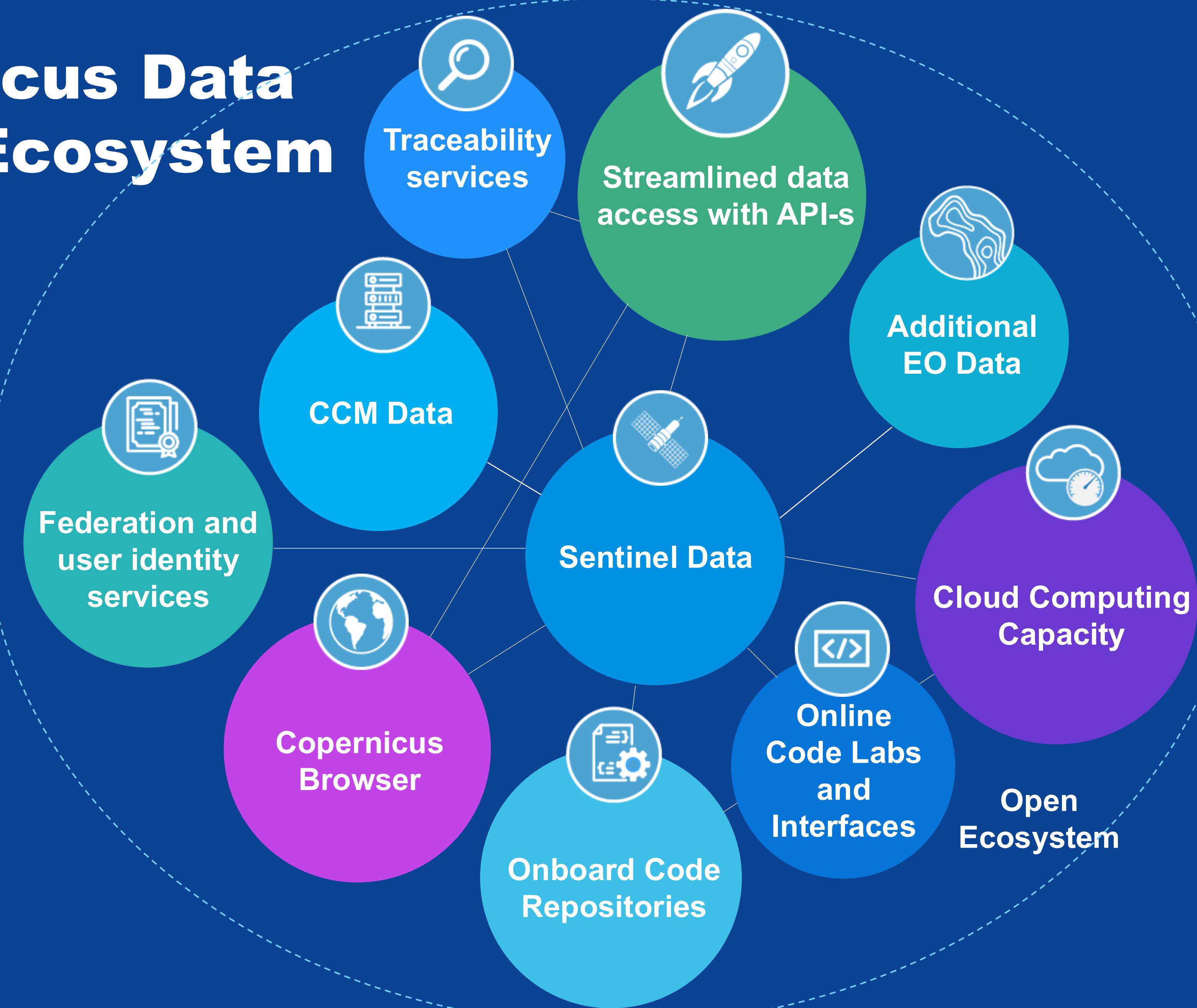
Copernicus

Copernicus Data Space Ecosystem (CDSE)

- The **authoritative source** for full and up-to-date archives of Sentinel user data, digitally traced for a permanent record of authenticity
- **Immediately available, free and open data**
 - Currently ~ 92 PB
- Governed by a Service Level Agreement, ensuring continuity and trust (up to **December 2028** with optional extension until **December 2032**)
- **Open ecosystem** of advanced services (e.g. API Access, Cloud processing, Code Repository, third-party data and services)



Copernicus Data Space Ecosystem



EO processing is complex...

- You need to understand of lot of things:
 - Data formats and management
 - Map projections
 - Satellite image generation and spectral analysis
 - Raster-vector integration
 - Data visualization
- CDSE turns this into a series of **incremental steps**
 - Data management is done by the backend
 - Visualization is done by the Browser and Jupyter
 - You can focus on the core part



Download vs API access

The legacy way – download-based data access

- Data is available in pre-defined tiles
- Rolling archive: current data is immediately accessible, but archive data has to be queried and made available
- Raw data storage on the client side needed
- Data has to be moved to servers or virtual machines
- Requires heavy investment
- Difficult to scale up

The new way – API based direct server-side processing

- Data available for your Area of Interest
- All datasets immediately available, no delay for requesting current or archive data
- No need to store raw data on the client side
- Virtual machines can be used that already have the data on board
- Much less investment needed
- Can be scaled dynamically

Data access and processing APIs

- **Streamlined access** (Sentinel Hub, OpenEO)
 - Catalogue APIs → *return list of datasets*
 - Visualisation (OGC) → *returns a map*
 - Process (instant, batch) → *returns raster product*
 - Statistical (instant, batch) → *returns calculation results*
 - Bring your own data (COG, zarr) → *makes your own data compatible with the online datasets*
 - openEO → *Format and language-independent scalable processing*



Sentinel-1 VH decibel gamma, Banana plantations near Machala,
Ecuador

Data access and processing APIs

- Streamlined access (Sentinel Hub, OpenEO)
 - Catalogue APIs (return list of images)
 - OData
 - STAC
 - OpenSearch
 - Sentinel Hub
 - Visualisation (OGC)
 - Process (instant, batch)
 - Statistical (instant, batch)
 - Bring your own data (COG, zarr)
 - openEO



Sentinel-2, Agricultural growth stage custom script, Ludwigshafen, Germany

New STAC Catalogue

- Latest 1.1 version
- Authorisation
- Direct download
- Exposed S3 paths
- STAC API extensions:
 - Sort
 - Filter
 - Query
 - Fields
 - Collections
 - CQL

Copernicus Data Space Ecosystem (CDSE) - STAC API

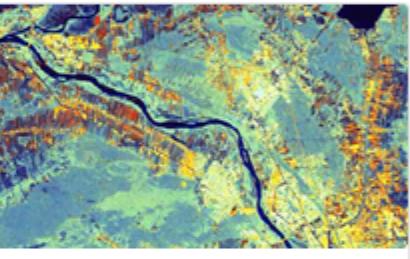
[Browse](#) [Search](#) [Log in](#)

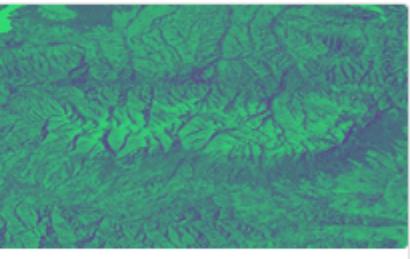
PROGRAMME OF THE EUROPEAN UNION Copernicus  esa

Description
A comprehensive and searchable catalog of Earth observation and scientific datasets that is actively maintained and updated by the Copernicus Data Space Ecosystem. The integrated STAC (SpatioTemporal Asset Catalog) API, which follows the open STAC specification, enables users to access detailed asset-level metadata, including spatial information, temporal coverage, and data specifications. This standardized interface facilitates efficient data discovery and retrieval across the extensive collection of environmental and scientific resources. More information: <https://documentation.dataspace.copernicus.eu/>

Catalogs 120 [Tiles](#) [List](#) [Ascending](#) [Descending](#)

Filter catalogs by title, description or keywords Select keywords

Sentinel-1 Global Mosaics
[COG](#) [ZIP](#) Sentinel-1 monthly mosaics are generated from monthly stacks of Sentinel-1 GRD data by calculating the weighted sum of the terrain corrected backscatter observations. Two different Sentinel-1 mosaics are being produced for each month: IW mosaic and DH mosaic.
2020-01-01 00:00:00 UTC until present 

Sentinel-1 Ground Range Detected (GRD)
[COG](#) [ZIP](#) Level-1 Ground Range Detected (GRD) products consist of focused SAR data that has been detected, multi-looked and projected to ground range using the Earth ellipsoid model WGS84. The ellipsoid projection of the GRD products is corrected using the terrain height specified in the product general annot...
2014-10-04 03:12:47 UTC until present 

Sentinel-2 Global Mosaics
[GeoTiff](#) [ZIP](#) The mosaics have four bands of data (Red (B04), Green (B03), Blue (B02) and wide band Near Infrared (B08)). First, cloud masking based on the scene classification layer of the Sentinel-2 level 2 algorithm was applied, then for each pixel and band, within three-month time periods, the first quartile ...
2020-01-01 00:00:00 UTC until present 

Sentinel-2 Level-1C
[JPEG 2000](#) [ZIP](#) The Level-1C product is composed of 110x110 km² tiles (ortho-images in UTM/WGS84 projection). Earth is subdivided on a predefined set of tiles, defined in UTM/WGS84 projection and using a 100 km step. However, each tile has a surface of 110x110 km² in order to provide large overlap with the neighbour...
2015-06-27 10:25:31 UTC until present 

Extensive metadata model

- Generic model to fit all satellites
- No need for platform-specific STAC extension
- Wide range of STAC extensions
- Federation-ready

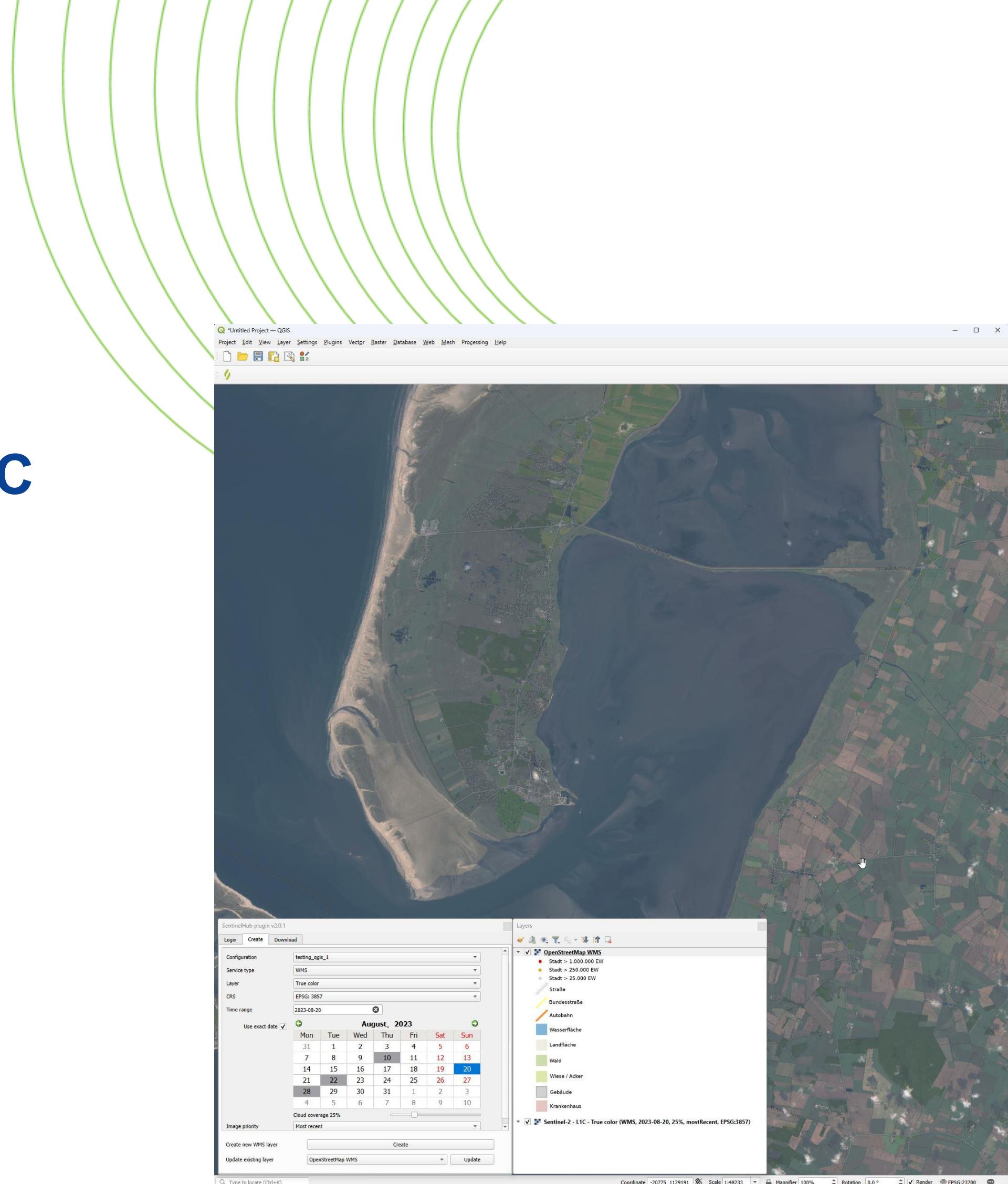
The screenshot displays a detailed view of a Sentinel-2 Level-2A product page. At the top, there is a map showing a specific location in Poland with a zoomed-in inset. Below the map, the word "Assets" is visible, followed by a list of aerosol optical thickness (AOT) datasets: "Aerosol optical thickness (AOT) - 10m" and "Aerosol optical thickness (AOT) - 20m". Each dataset has "DATA", "GSD:10M", and "JPEG 2000" buttons. Below these, there are tabs for "HTTPS" and "S3", with "HTTPS" being active. Under "HTTPS", there is a "JPEG 2000 image" section with "Download" and "Copy URL" buttons. The main content area is divided into several sections: "General", "Projection", "Alternative Access Methods", "File", "Raster Imagery", "Electro-Optical", "View Geometry", and "Gridded Data". Each section contains various metadata fields. For example, the "General" section includes "GSD: 20 m", "No-Data Values: 0", and "Data Type of Values: uint16". The "Projection" section shows "Code: EPSG:32633" and "Image Dimensions: 5 490 x 5 490". The "Raster Imagery" section shows "Scale: 0,0001" and "Offset: -0,1". The "Electro-Optical" section shows "Snow/Ice Cover: 0 %" and "Cloud Cover: 83,91 %". The "View Geometry" section shows "Viewing Azimuth: 288,1361556026 °", "Sun Azimuth: 169,9596570595 °", "Sun Elevation: 14,3414420575 °", and "Incidence: 7,2567297315 °". The "Gridded Data" section is currently empty.

Collection	
Sentinel-2 Level-2A	
JPEG 2000 ZIP The Sentinel-2 Level-2A Collection 1 product provides orthorectified Surface Reflectance (Bottom-Of-Atmosphere: BOA), with sub-pixel multispectral and multitemporal registration accuracy. Scene Classification (including Clouds and Cloud Shadows), AOT (Aerosol... 2015-06-27 10:25:31 UTC until present	

Metadata	
General	
GSD	10 m
Created	2023-12-29 13:15:02 UTC
Updated	2024-03-13 13:18:15 UTC
Time of Data	2023-12-29 10:14:31 UTC
Platform	sentinel-2a
Published	n/a
Statistics	Water: 0,310062 Nodata: 2,005212 Dark Area: 0,40559 Vegetation: 5,678235 Thin Cirrus: 45,623171 Cloud Shadow: 0,00884 Unclassified: 0,539949 Not Vegetated: 9,146699 High Proba Clouds: 3,093362 Medium Proba Clouds: 35,193819 Saturated Defective: 0
Product	S2MSI2A
Timeliness	24 hours
Timeliness Category	NRT
Processing	
Level	L2
Processor	05.10
Version	
Processing Time	2023-12-29 12:22:50 UTC
Facility	ESA
Satellite	
Orbit State	descending
Abs. Orbit Number	44 492
Rel. Orbit Number	22
Int. Designator	2015-028A
View Geometry	
Viewing Azimuth	288,1361556026 °
Sun Azimuth	169,9596570595 °
Sun Elevation	14,3414420575 °
Incidence	7,2567297315 °
Electro-Optical	
Snow/Ice Cover	0 %
Cloud Cover	83,91 %
Gridded Data	

Data access and processing APIs

- Streamlined access (Sentinel Hub, OpenEO)
 - Catalogue APIs
 - **Visualisation and integration in web maps (OGC API)**
 - **WMS Web Mapping Service**
 - **WCS Web Coverage Service**
 - **WFS Web Feature Service**
 - **WMTS Web Mapping Tile Service**
 - Process (instant, batch)
 - Statistical (instant, batch)
 - Bring your own data (COG, zarr)
 - openEO

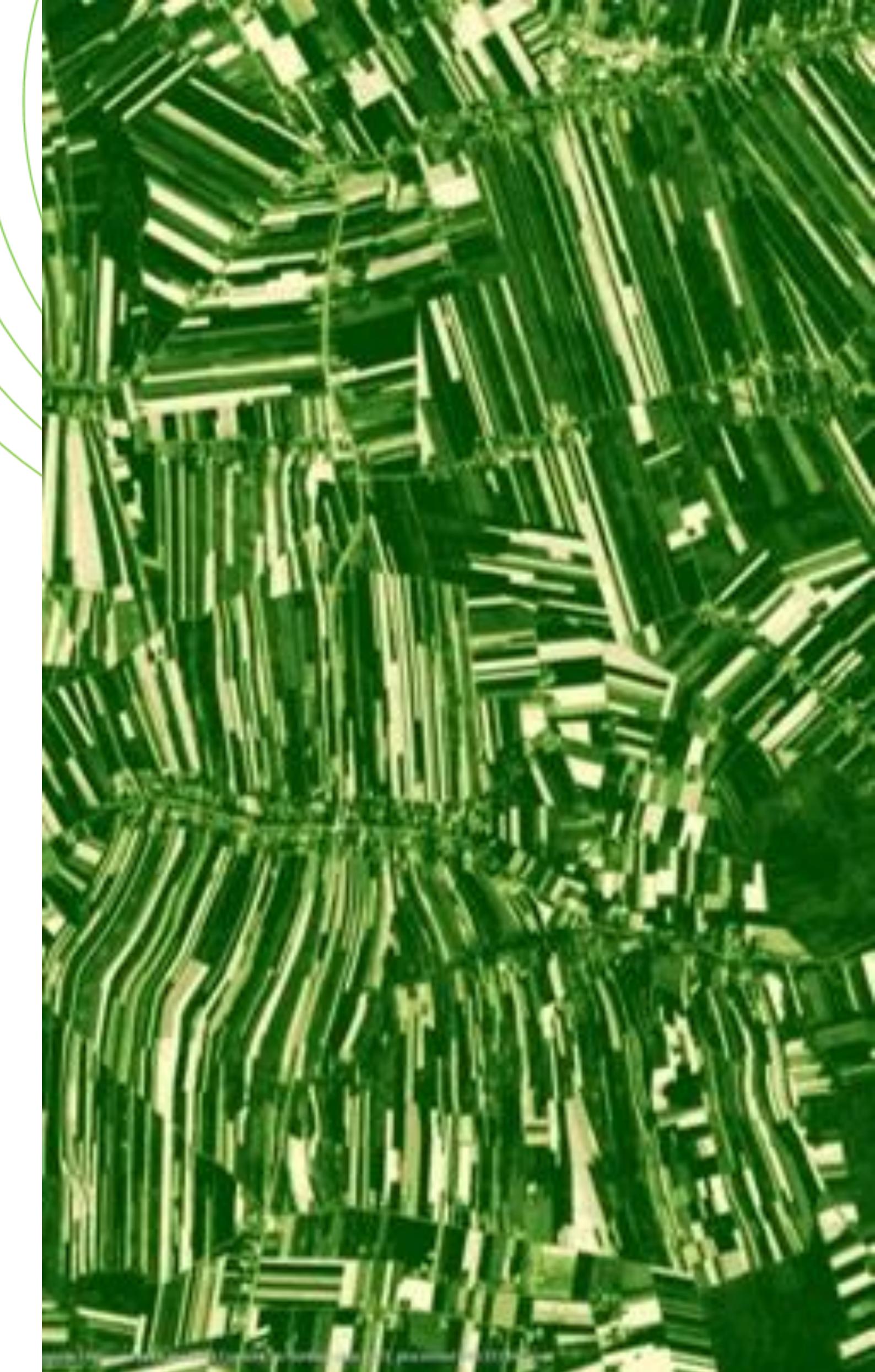


Explore the QGIS Plugin!

Sentinel-2, True Color – visualized in QGIS, Romø, Denmark

Data access and processing APIs

- Streamlined access (Sentinel Hub, OpenEO)
 - STAC Catalogue
 - Visualisation (OGC)
 - **Sentinel Hub Processing (instant, batch)**
 - Provides images based on satellite data collections
 - Allows filtering by quality, date, AOI
 - Supports direct calculation of pixel operations in evalscripts
 - Batch process API enables asynchronous processing for large areas with high performance
 - Statistical (instant, batch)
 - Bring your own data (COG, zarr)
 - openEO



Sentinel-2, kNDVI, near Lublin, Poland

Data access and processing APIs

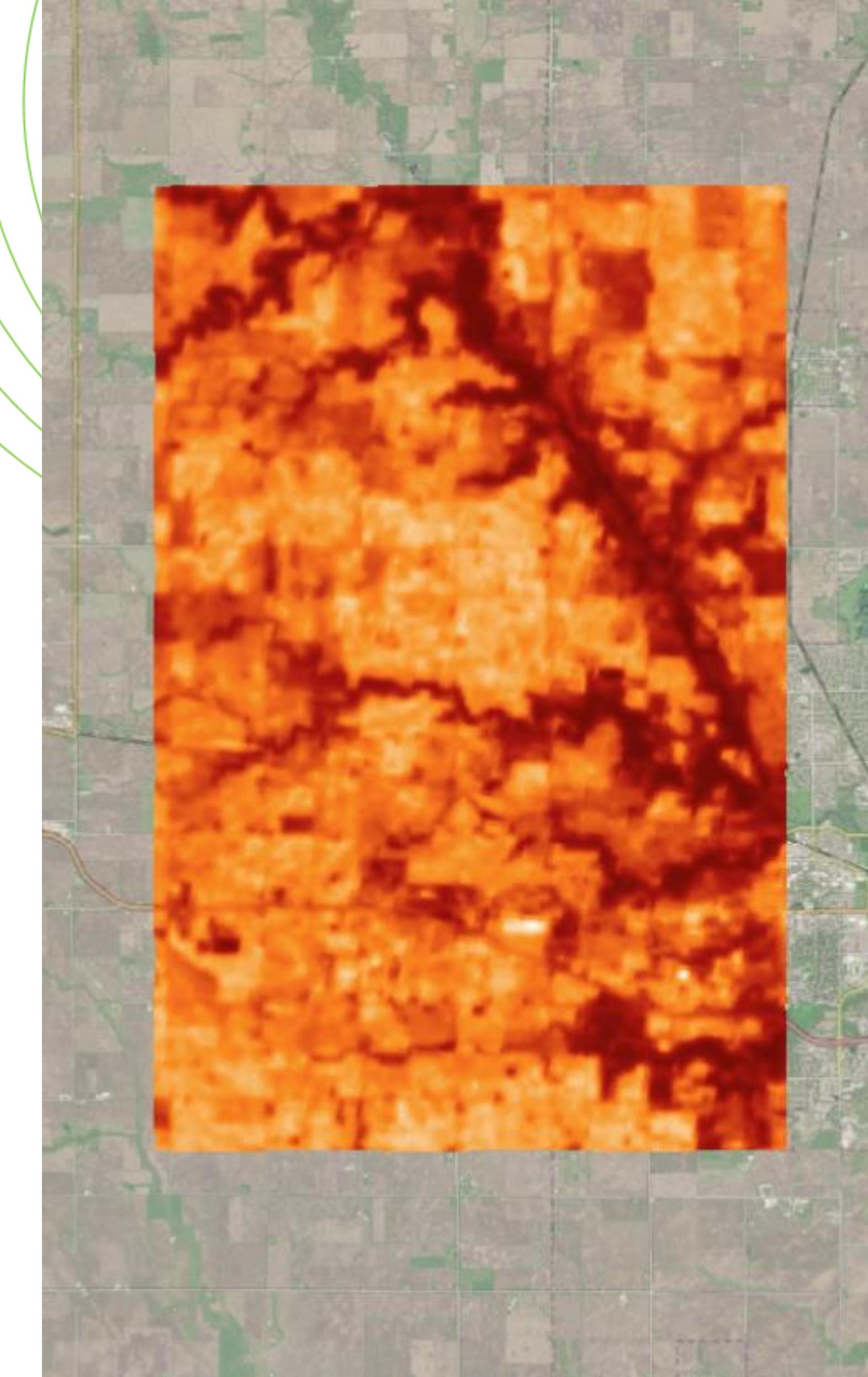
- Streamlined access (Sentinel Hub, OpenEO)
 - STAC Catalogue API
 - Visualisation (OGC)
 - Process (instant, batch)
 - **Sentinel Hub Statistical API (instant, batch)**
 - Returns an array of pixel statistics within an area of interest
 - Histograms, quantiles, ranges
 - Time series by predefined steps
 - Batch Statistical API enables asynchronous processing for large areas with high performance
 - Bring your own data (COG, zarr)
 - openEO



Sentinel-2, Moisture index time series near Knoxville, Tennessee, USA

Data access and processing APIs

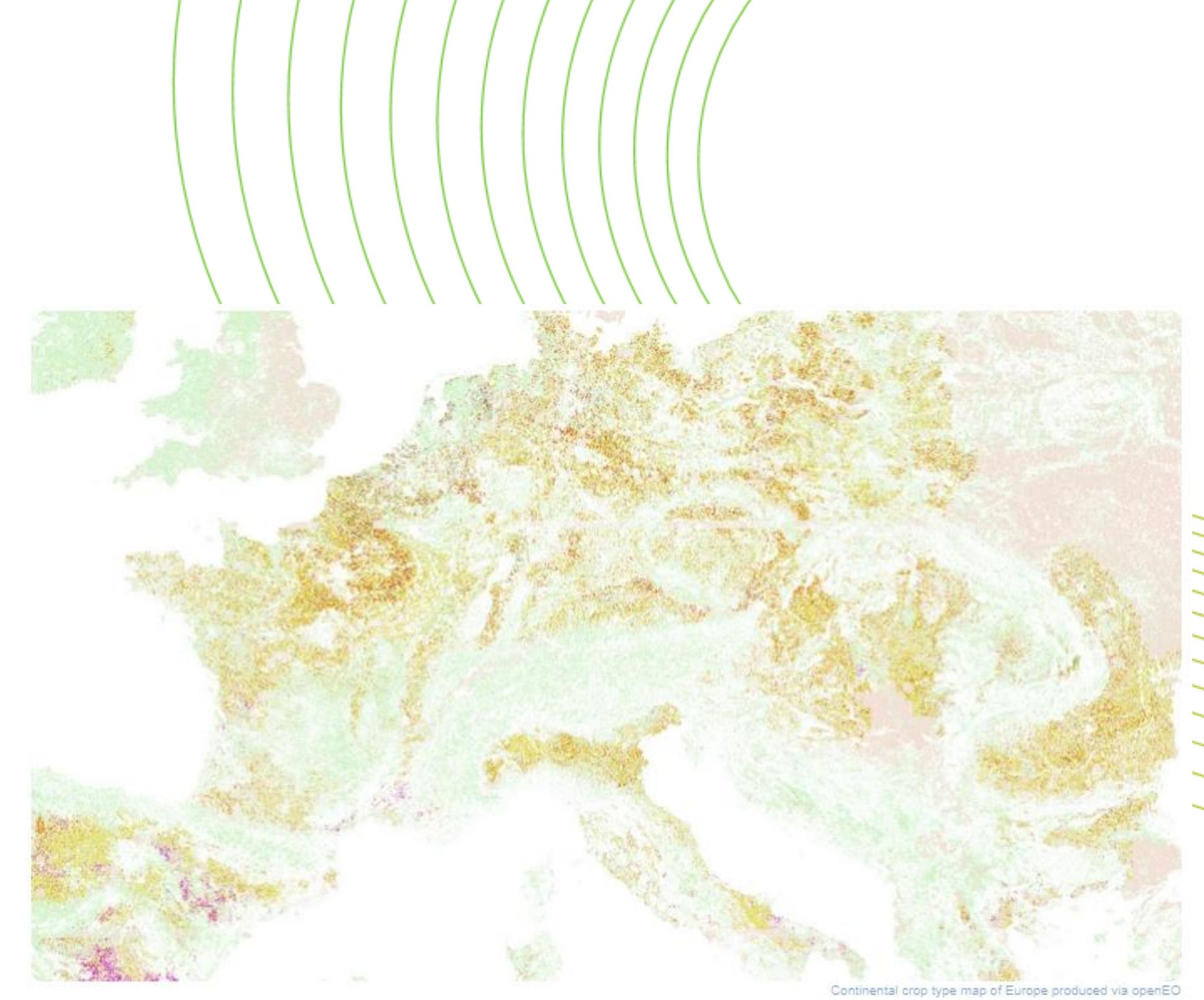
- Streamlined access (Sentinel Hub, OpenEO)
 - Catalogue APIs
 - Visualisation (OGC)
 - Process (instant, batch)
 - Statistical (instant, batch)
 - **Sentinel Hub Bring your own data API (COG, zarr)**
 - **Self-serve for COG and ZARR – customizable for other formats**
 - **Import your own raster data and access it with other APIs**
 - **Data resides on CDSE cloud – CloudFerro or Open Telekom Cloud**
 - **Satellite imagery**
 - **Labels**
 - **Derived Products**
 - **openEO**



ConstellIR test data with Sentinel-2 mosaic background, Ames, USA

Data access and processing APIs

- Streamlined access (Sentinel Hub, OpenEO)
 - Catalogue APIs
 - Visualisation (OGC)
 - Process (instant, batch)
 - Statistical (instant, batch)
 - Bring your own data (COG, zarr)
 - **openEO API**
 - Unified and straightforward access to multiple Earth observation datasets
 - Scalable and efficient processing capabilities
 - A standardized system that works across different platforms
 - Independence from underlying technologies and software libraries
 - Reproducibility through transparent workflows, supporting principles of FAIR data and Open Science



Continental crop type map of Europe produced via openEO

openEO suite

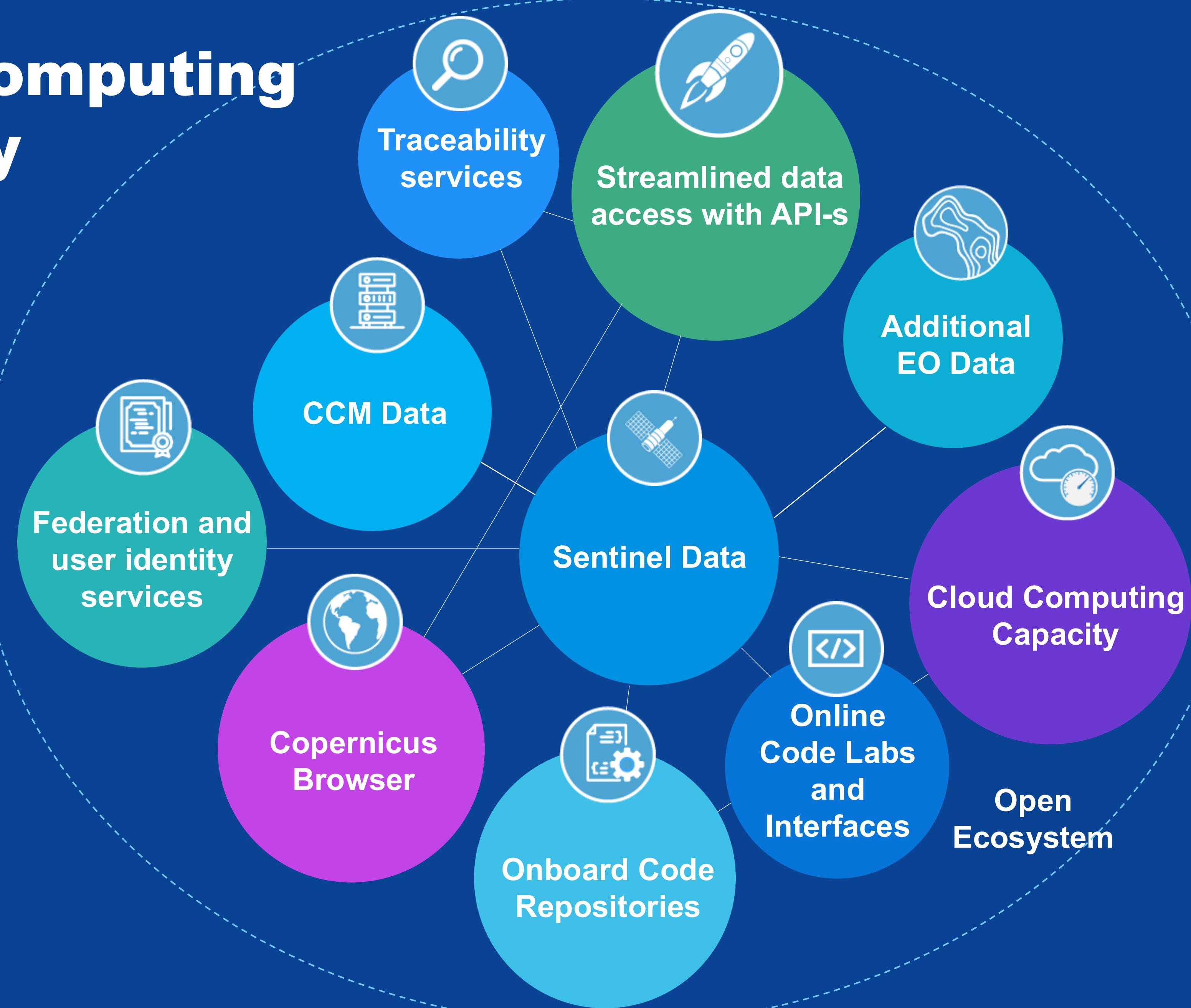


The screenshot shows the OpenEO Web Editor interface. On the left, there's a sidebar with 'Collections' (e.g., COPERNICUS_30, LANDSAT_2, SENTINEL_2, etc.) and a 'Batch Job' table. The main area displays a map of Europe with various land cover categories. A code editor window on the right shows a Python script for applying a neural network to NDVI images.

This screenshot shows a Jupyter notebook cell with Python code for applying a neural network to satellite imagery. The output cell displays a grayscale map of a city area with labeled regions, indicating the results of the segmentation process.

The screenshot shows the esa Marketplace interface. It features a search bar and a grid of service cards. Services listed include BIOPAR, CropSAR, MSI, NBR, NDII, NDWI, and various phenology models like Croptype, MSI, and NBR.

Cloud Computing Capacity



CDSE General Users quota



Copernicus General Users

Limitations	S3, OData, STAC	Data Workspace API	openEO API / Algorithm plaza	Sentinel Hub APIs ⁸	Direct HTTP access to COGs
Requests per month	-	-	-	10 000	50 000 ^{7 9}
Requests per minute	2000 ¹⁴	-	12 ^{11 13}	300	-
Processing units (PU) per month	-	-	-	10 000	-
Processing units (PU) per minute	-	-	-	300	-
Bandwidth limit per connection (MB/s) (IAD ¹)	20	-	-	-	-
Number of concurrent connections limit	4	-	-	-	-

On this page

Copernicus General Users

- [Welcome](#)
- [Roadmap](#)
- [Annual Reports](#)
- [User registration and authentication](#)
- [Data APIs](#)
- [Applications](#)
- [Ecosystem](#)
- [Quotas and Limitations](#)
- [Access through Research Network](#)
- [Jupyter Notebook Samples](#)
- [FAQ](#)
- [Support](#)
- [Catalog APIs news](#)

<https://documentation.dataspace.copernicus.eu/Quotas.html>

Facilitating the move from open to commercial and back



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dataspace.copernicus.eu



commercial offering by 3rd parties

- Open and Free to use for all users
- All public services available via self-registration
- Pre-configured and adjustable service quotas
 - Based on user-type: e.g. General users, Copernicus Services, Collaborative and International partners
- Copernicus data and open data
- Dedicated support and on-boarding for Copernicus Services and EU national public services



- Federated identity
Single entry point for collaboration
Synced data offering
Consistent APIs

- Ecosystem services registry
- 3rd party services
- Transparent commercial offers
 - e.g. pay-per use, free trials, packaged subscriptions, credits for research and pre-commercial exploitation.
- Complementary EO data
 - e.g. commercial data, user data

EU* includes participating states

Public utility with configurable free-to-the-user services under fair-use policy
Seamless expansion for large-scale use under commercial models by 3rd party operators

dataspace.copernicus.eu



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CREODIAS 2.0 – first commercial element of the Copernicus Data Access Ecosystem

- Immediate access to EO DATA
- User friendly tools
- Cloud services for data processing
- Serverless processing
- Competitive pricing
- Premium support

The screenshot shows the CREODIAS website homepage. At the top, there's a navigation bar with links for Data, Data Explorer, Cloud, Pricing, Knowledgebase, Support, News, and About Us. A search bar and a "Go to Explore" button are also present. The main headline reads "Your easy access to EO data exploration". Below it, a sub-headline says "CREODIAS – immediate access to Earth Observation satellite data and user friendly tools for its processing in the cloud. No need to download. Explore and enjoy!". There are three buttons at the bottom: "Explore EO DATA", "Check EO DATA", and "Try cloud for free". On the right side, there's a section titled "Sen4CAP on CREODIAS" with a sub-headline "Take agricultural monitoring to a higher level Software as a Service based solution now available." and a "Learn more" link. Below that is a thumbnail image of a tractor in a field. At the bottom, there are two cards: one for "Sentinel-1 L1 SLC" products and another for "Remote Transfer for EO DATA via S3".

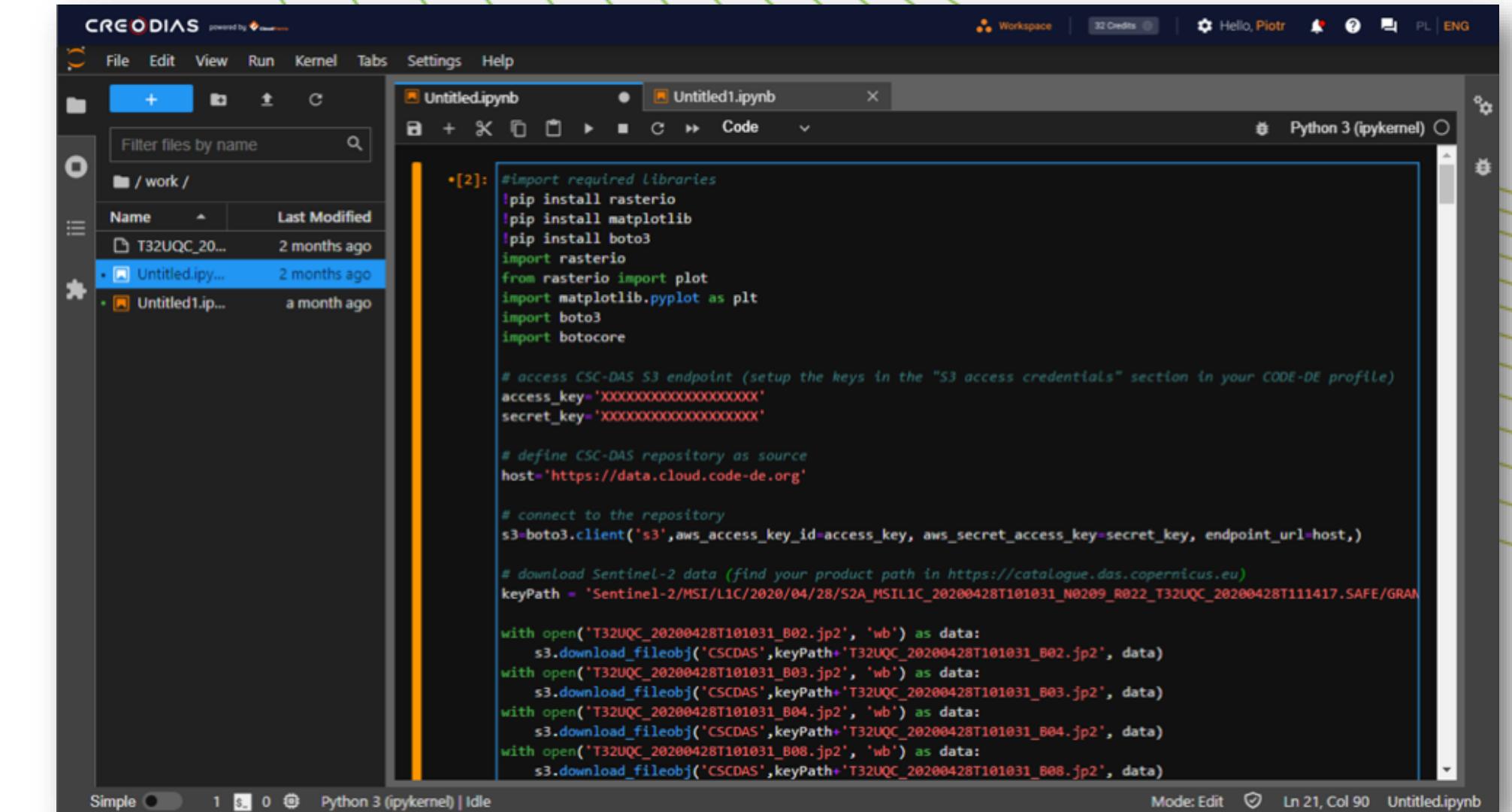
CREODIAS provides commercial services from CloudFerro and Open Telekom Cloud

- Computing Services
- Data Storage
- Kubernetes Clusters
- GPU Servers

The screenshot shows the CREODIAS platform interface. At the top, there is a dark header with the CREODIAS logo, a 'Free trial' button, and a 'Sign In' button. Below the header, a section titled 'Choose a service provider' is displayed. It states: 'CREODIAS provides commercial services for Copernicus Data Space Ecosystem, offered by a Consortium consisting of: T-Systems, CloudFerro, Sinergise, VITO, DLR, ACRI-ST, and RHEA. Choose a provider from whom you want to order services.' Two service providers are listed in cards: 'CloudFerro' and 'T-Systems'. Each card has an orange circular icon with a gear and checkmark, the provider's name, a description, and a 'More' or 'T-Systems product' link. At the bottom of the page, a note states: 'This functionality requires that you log into the account that is assigned to a tenant that has EU VAT properly configured. To register, go to the [customer portal](#). Please note that CloudFerro's services within Creodias are commercial offerings exclusively intended for business entities, not for individual customers. Individuals interested in accessing Copernicus data should use the CDSE services instead.'

Computing environments

- **JupyterHub – free & commercial**
 - Python SDK
 - Integrated with all APIs (OpenEO, Sentinel Hub, S3, STAC, ...)
 - Integrated ML libraries
- **Infrastructure as a Service (IaaS) - commercial**
 - Compute nodes (VMs, dedicated servers, containers)
 - Object storage
 - Software images (OS, OSGeoLive, QGIS, ArcGis, Sen4CAP)
 - Managed Kubernetes
 - CloudFerro and Open Telekom Cloud



The screenshot shows the CREODIAS JupyterHub interface. On the left, there is a file browser window titled 'work /' showing files like 'T32UQC_20...', 'Untitled.ipynb', and 'Untitled1.ipynb'. On the right, there is a code editor window titled 'Untitled.ipynb' with the following Python code:

```
# Import required Libraries
!pip install rasterio
!pip install matplotlib
!pip install boto3
import rasterio
from rasterio import plot
import matplotlib.pyplot as plt
import boto3
import botocore

# access CSC-DAS S3 endpoint (setup the keys in the "S3 access credentials" section in your CODE-DE profile)
access_key='XXXXXXXXXXXXXXXXXXXX'
secret_key='XXXXXXXXXXXXXXXXXXXX'

# define CSC-DAS repository as source
host='https://data.cloud.code-de.org'

# connect to the repository
s3=boto3.client('s3',aws_access_key_id=access_key, aws_secret_access_key=secret_key, endpoint_url=host)

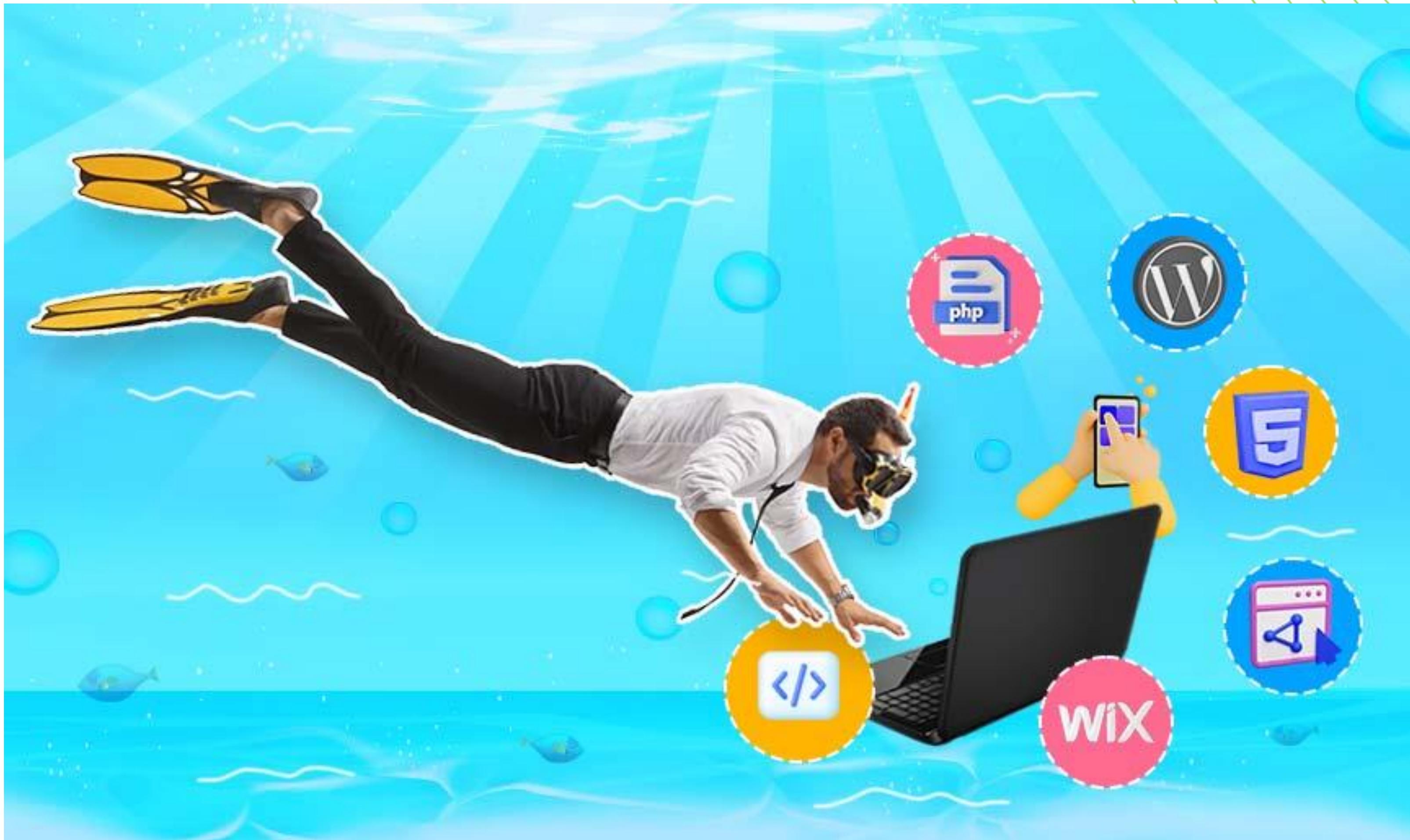
# download Sentinel-2 data (find your product path in https://catalogue.das.copernicus.eu)
keyPath = 'Sentinel-2/MSI/2020/04/28/52A_MSIL1C_20200428T101031_N0209_R022_T32UQC_20200428T111417.SAFE/GRAN'

with open('T32UQC_20200428T101031_B02.jp2', 'wb') as data:
    s3.download_fileobj('CSCDAS',keyPath+'T32UQC_20200428T101031_B02.jp2', data)
with open('T32UQC_20200428T101031_B03.jp2', 'wb') as data:
    s3.download_fileobj('CSCDAS',keyPath+'T32UQC_20200428T101031_B03.jp2', data)
with open('T32UQC_20200428T101031_B04.jp2', 'wb') as data:
    s3.download_fileobj('CSCDAS',keyPath+'T32UQC_20200428T101031_B04.jp2', data)
with open('T32UQC_20200428T101031_B08.jp2', 'wb') as data:
    s3.download_fileobj('CSCDAS',keyPath+'T32UQC_20200428T101031_B08.jp2', data)
with open('T32UQC_20200428T101031_B09.jp2', 'wb') as data:
    s3.download_fileobj('CSCDAS',keyPath+'T32UQC_20200428T101031_B09.jp2', data)
```



<https://github.com/eu-cdse/presentations>

Let's dive into the world of CDSE cloud computing



Streamlined (cloud) optimized data formats

To stream a data file its structure must allow for accessing only a part of it without reading an entire file.

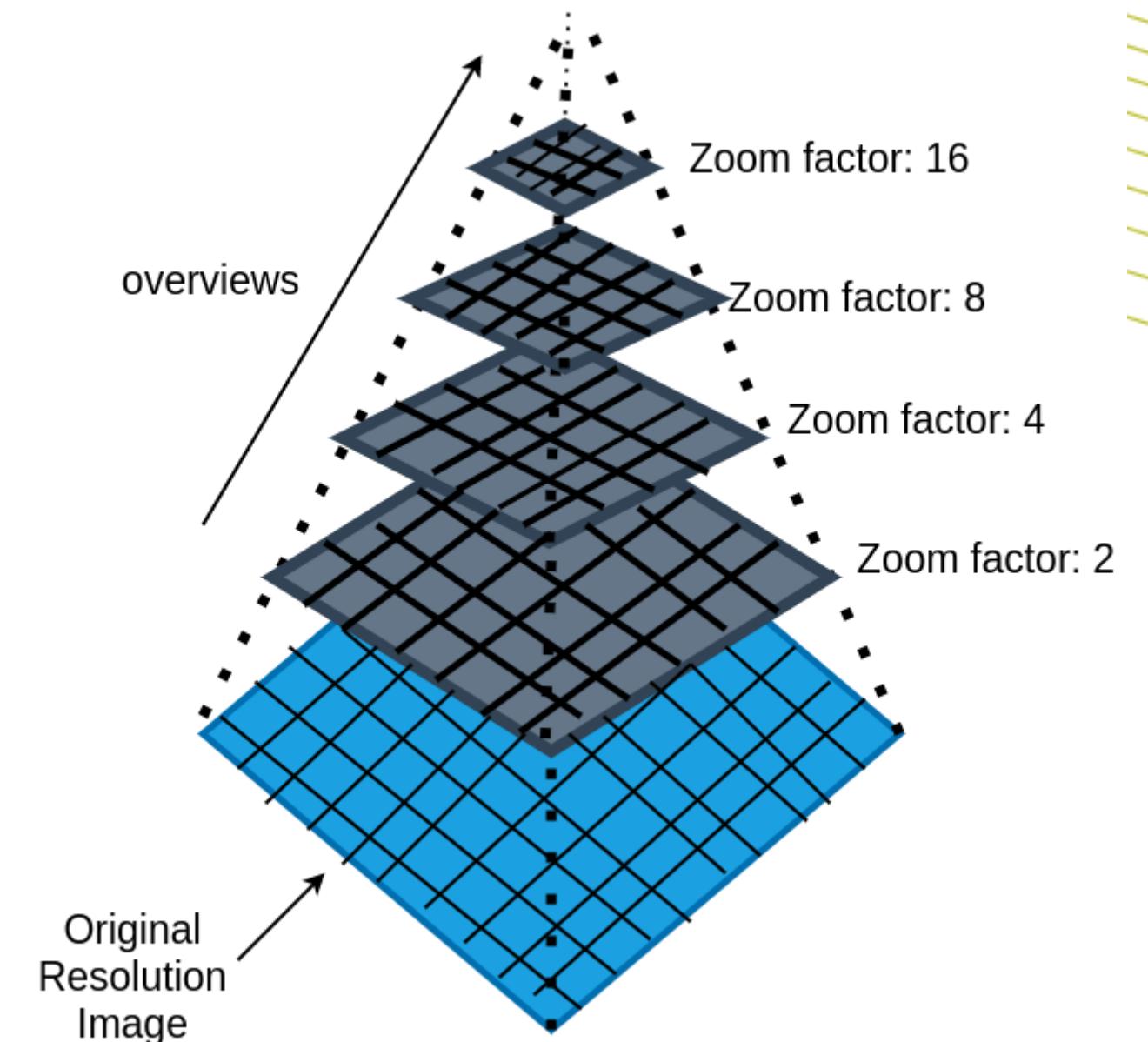
Thus, the data file has to be stored in specific format such as:

- Cloud Optimized Geotiff (**COG**)
- JPEG2000 (**jp2**)
- **ZARR** (to replace NetCDF, HDF5 storing n-dimensional data)

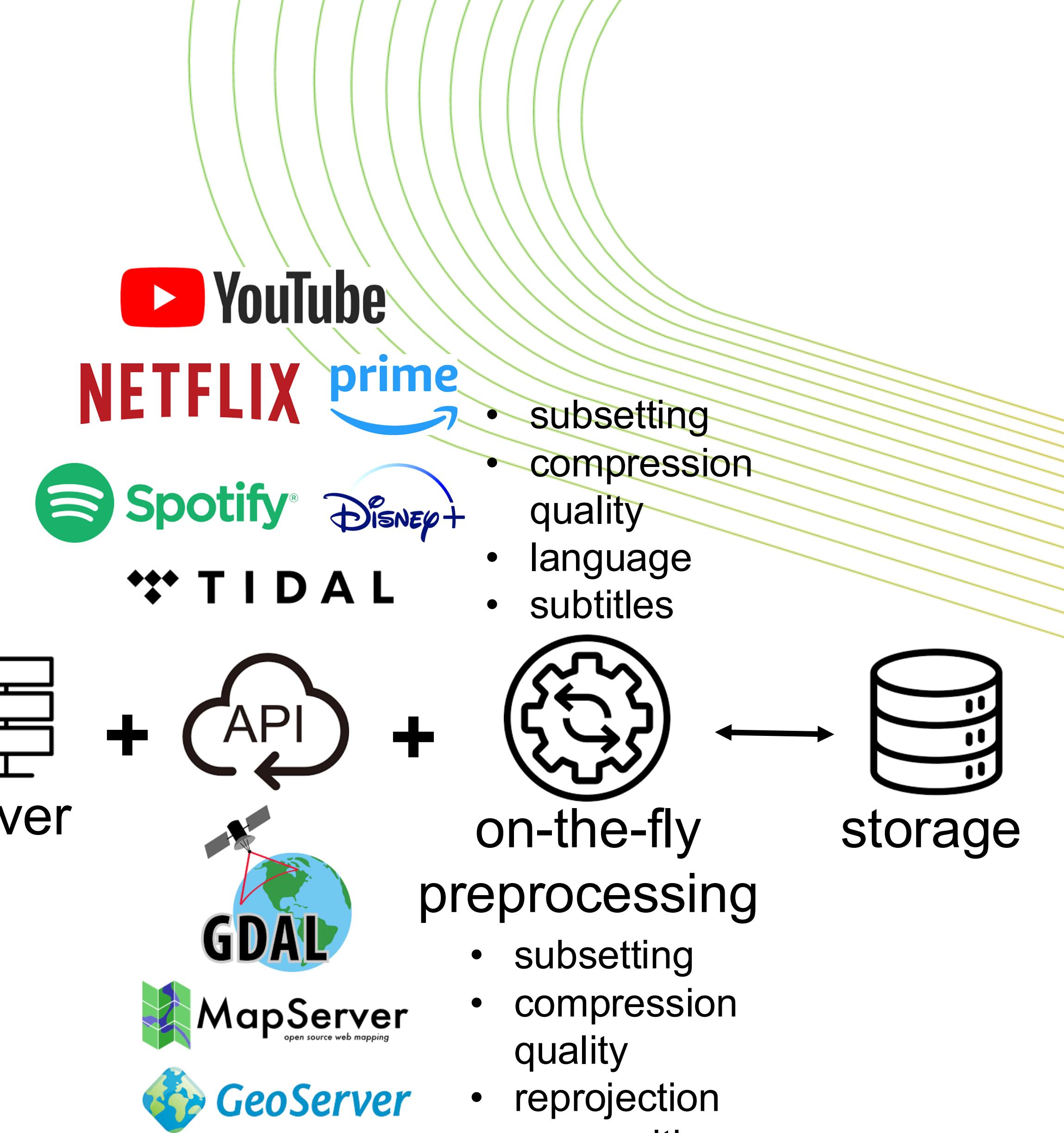
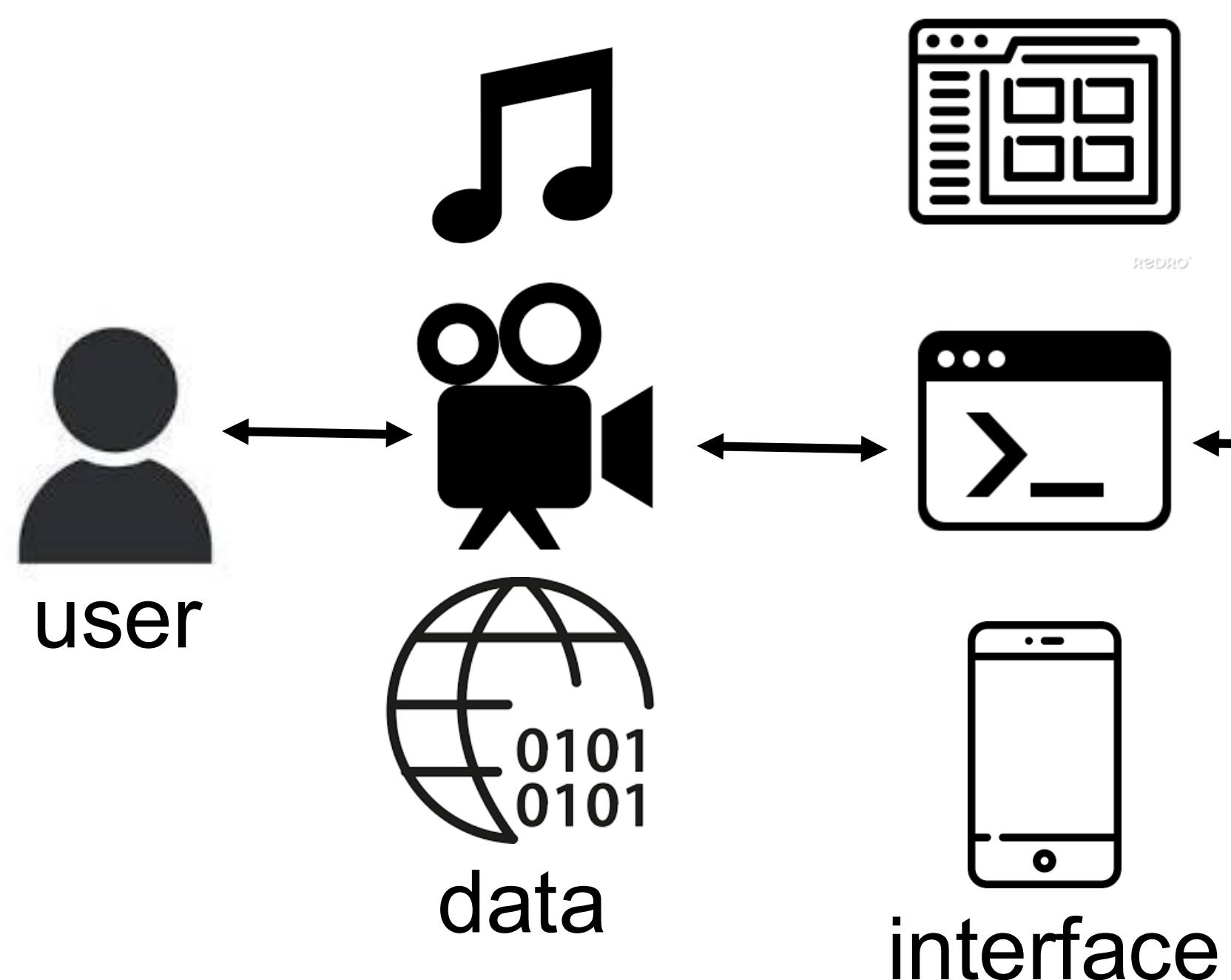
Cloud optimized formats has to store **overviews** (pyramids) to be 'zoom-able'.

ZIP format used to pack/compress products **does not allow for partial reads**.

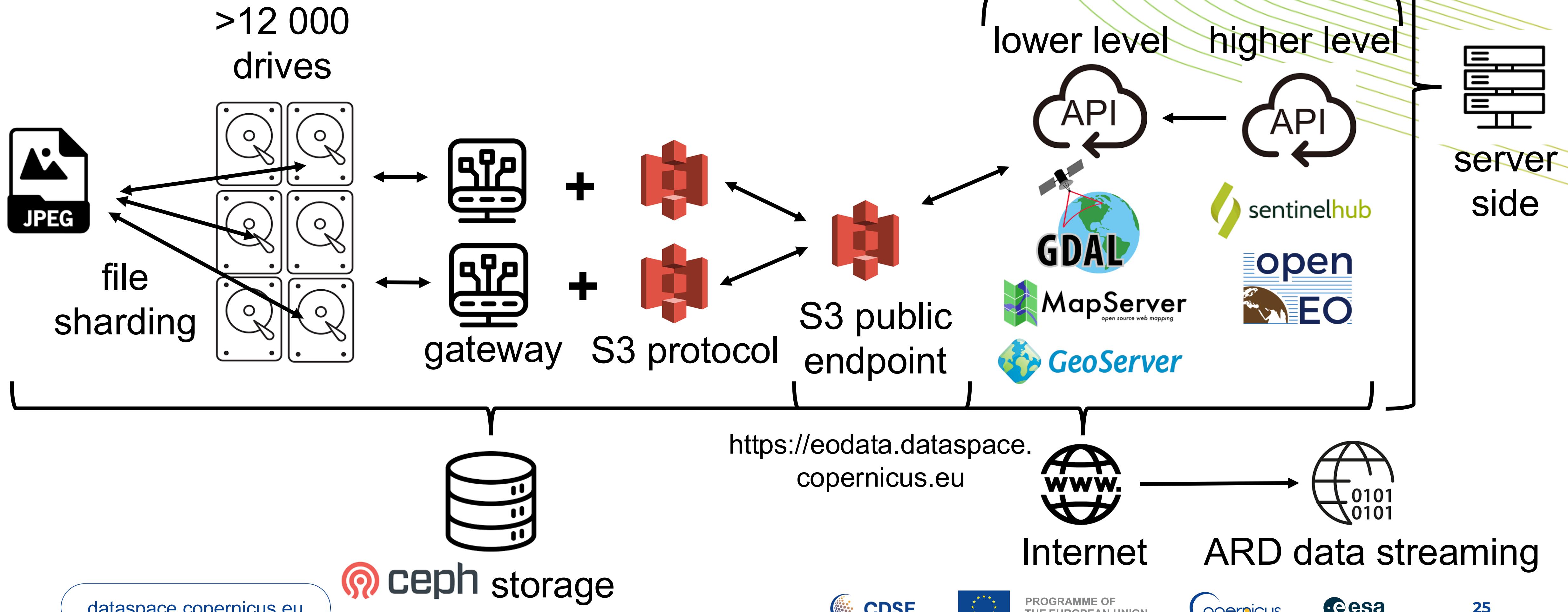
Seek Optimized ZIP (SOZip) should be used to allow accessing a single file without reading an entire ZIP.



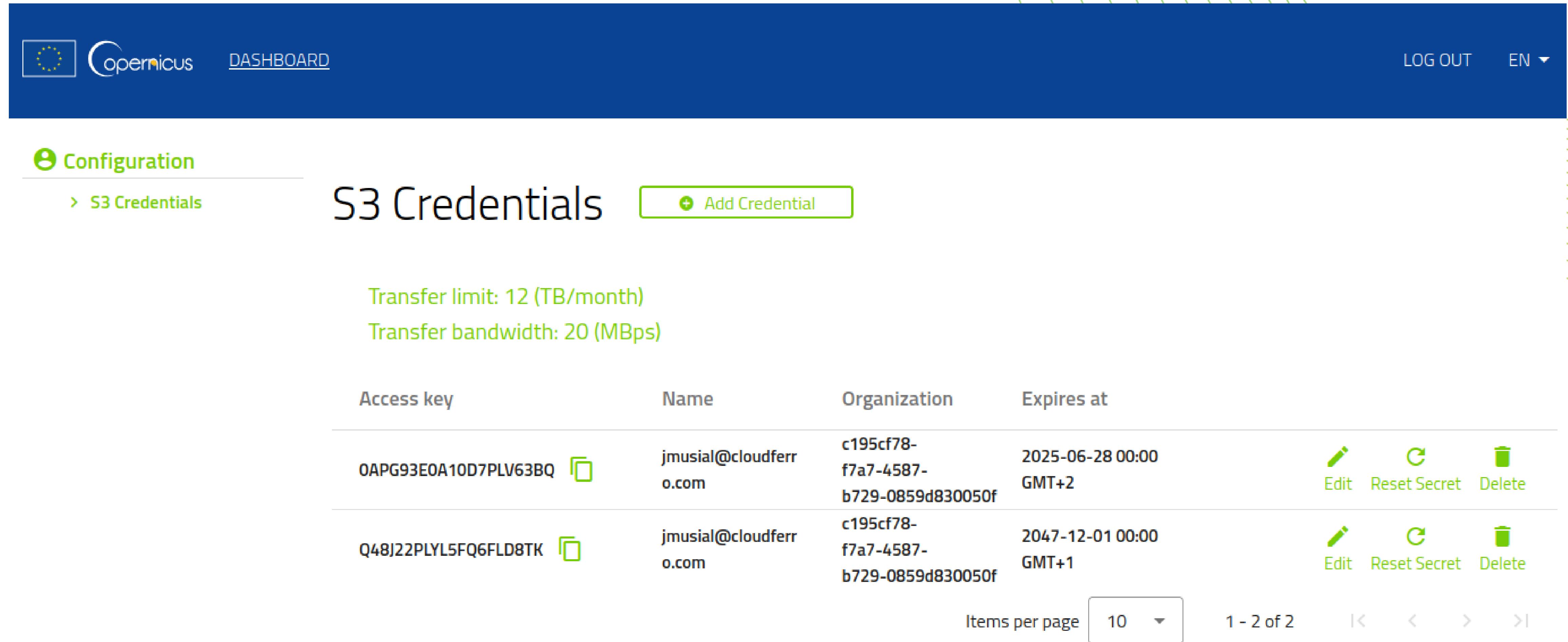
Data streaming. Case 2.



Copernicus Data Space Ecosystem



Prerequisites: CDSE S3 interface access



The screenshot shows the Copernicus Configuration interface for managing S3 credentials. The top navigation bar includes the Copernicus logo, DASHBOARD, LOG OUT, and language selection (EN). The left sidebar has a Configuration section with an S3 Credentials link. The main content area is titled "S3 Credentials" with a "Add Credential" button. It displays two existing credentials:

Access key	Name	Organization	Expires at	Action
OAPG93EOA10D7PLV63BQ	jmusial@cloudferr o.com	c195cf78- f7a7-4587- b729-0859d830050f	2025-06-28 00:00 GMT+2	Edit Reset Secret Delete
Q48J22PLYL5FQ6FLD8TK	jmusial@cloudferr o.com	c195cf78- f7a7-4587- b729-0859d830050f	2047-12-01 00:00 GMT+1	Edit Reset Secret Delete

Below the table are transfer limits: Transfer limit: 12 (TB/month) and Transfer bandwidth: 20 (MBps). Navigation controls include items per page (10), page 1 - 2 of 2, and navigation arrows.

<https://eodata-s3keysmanager.dataspace.copernicus.eu/>

CDSE STAC items have S3 path as the main href



```
JSON Raw Data Headers
Save Copy Collapse All Expand All Filter JSON
id: "Sentinel-2_mosaic_2025_Q1_60WWS_0_0"
bbox:
  0: -64.92413839494883
  1: 0.8850100075107434
  2: -64.01165775297616
  3: 3.000422919222842
type: "Feature"
links: [...]
assets:
  B02:
    href: "s3://eodata/Global-Mosaics/Sentinel-2/S2MSI_L3__MCQ/2025/01/01/Sentinel-2_mosaic_2025_01_60WWS_0_0/B02.tif"
    type: "image/tiff; application=cloud-optimized"
    bands:
      0:
        description: "Blue (band 2)"
        eo:center_wavelength: 0.493
        eo:full_width_half_max: 0.267
        name: "B02"
        eo:common_name: "blue"
      roles:
        0: "data"
    alternate:
      https:
        href: "https://zipper.dataspace...0\)/Nodes\(B02.tif\)/\$value"
```

https://stac.dataspace.copernicus.eu/v1/collections/sentinel-2-global-mosaics/items/Sentinel-2_mosaic_2025_Q1_60WWS_0_0

GDAL /vsis3 virtual file system

/vsis3/ (AWS S3 files)

/vsis3/ is a file system handler that allows on-the-fly random reading of (primarily non-public) files available in AWS S3 buckets, without prior download of the entire file. It requires GDAL to be built against libcurl.

It also allows sequential writing of files. No seeks or read operations are then allowed, so in particular direct writing of GeoTIFF files with the GTiff driver is not supported, unless, if, starting with GDAL 3.2, the `CPL_VSIL_USE_TEMP_FILE_FOR_RANDOM_WRITE` configuration option is set to `YES`, in which case random-write access is possible (involves the creation of a temporary local file, whose location is controlled by the `CPL_TMPDIR` configuration option). Deletion of files with `VSIUnlink()` is also supported. Starting with GDAL 2.3, creation of directories with `VSIMkdir()` and deletion of (empty) directories with `VSIRmdir()` are also possible.

Recognized filenames are of the form `/vsis3/bucket/key`, where `bucket` is the name of the S3 bucket and `key` is the S3 object "key", i.e. a filename potentially containing subdirectories.

The generalities of `/vsicurl/` apply.

The following configuration options are specific to the /vsis3/ handler:

- `AWS_NO_SIGN_REQUEST=[YES/NO]`: Determines whether to disable request signing.
- `AWS_ACCESS_KEY_ID=value`: Access key ID used for authentication. If using temporary credentials, `AWS_SESSION_TOKEN` must be set.
- `AWS_SECRET_ACCESS_KEY=value`: Secret access key associated with `AWS_ACCESS_KEY_ID`.
- `AWS_SESSION_TOKEN=value`: Session token used for validation of temporary credentials (`AWS_ACCESS_KEY_ID` and `AWS_SECRET_ACCESS_KEY`)
- `CPL_AWS_CREDENTIALS_FILE=<filename>`: Location of an AWS credentials file. If not specified, the standard location of `~/.aws/credentials` will be checked.
- `AWS_DEFAULT_PROFILE=value`: Defaults to `default`. Name of AWS profile.
- `AWS_PROFILE=value`: (GDAL >= 3.2) Defaults to `default`. Name of AWS profile.
- `AWS_CONFIG_FILE=value`: Location of a config file that may provide credentials and the AWS region. if not specified the standard location of `~/.aws/credentials` will be checked.
- `AWS_ROLE_ARN=value`: (GDAL >= 3.6) Amazon Resource Name (ARN) specifying the role to use for authentication via the [AssumeRoleWithWebIdentity API](#).
- `AWS_WEB_IDENTITY_TOKEN_FILE=<filename>`: (GDAL >= 3.6)
Duplicate explicit target name: "assumerolewithwebidentity api".
Path to file with identity token for use for authentication via the [AssumeRoleWithWebIdentity API](#).

https://gdal.org/en/stable/user/virtual_file_systems.html#vsis3-aws-s3-files

Remote S3 access to /eodata repository

```
export GDAL_HTTP_TCP_KEEPALIVE="YES"  
export AWS_S3_ENDPOINT="eodata.dataspace.copernicus.eu"  
export AWS_ACCESS_KEY_ID="your_CDSE_public_key"  
export AWS_SECRET_ACCESS_KEY="your_CDSE_secret_key"  
export AWS_HTTPS="YES"  
export AWS_VIRTUAL_HOSTING="FALSE"
```

```
gdalinfo /vsis3/eodata/Sentinel-  
2/MSI/L2A/2025/06/21/S2C_MSIL2A_20250621T032531_N0511_R018_T55XEH_20250621T055959.SAFE/GRANULE/L2A_T  
55XEH_A004135_20250621T032533/IMG_DATA/R10m/T55XEH_20250621T032531_AOT_10m.jp2
```

```
s5cmd --endpoint-url "https://\${AWS\_S3\_ENDPOINT}" head s3://eodata/Sentinel-  
2/MSI/L2A/2025/06/21/S2C_MSIL2A_20250621T032531_N0511_R018_T55XEH_20250621T055959.SAFE/GRANULE/L2A_T  
55XEH_A004135_20250621T032533/IMG_DATA/R10m/T55XEH_20250621T032531_AOT_10m.jp2
```

```
s5cmd --endpoint-url "https://${AWS_S3_ENDPOINT}" ls s3://eodata/Sentinel-  
2/MSI/L2A/2025/06/21/S2C_MSIL2A_20250621T032531_N0511_R018_T55XEH_20250621T055959.SAFE/GRANULE/L2A_T  
55XEH_A004135_20250621T032533/IMG_DATA/R10m/
```

Remote S3 access to /eodata repository

The screenshot shows the QGIS interface with the 'Settings' menu open, indicated by a red arrow. The 'System' options dialog is displayed, showing environment variables for AWS S3 access:

Variable	Value
GDAL_HTTP_TCP_KEEPALIVE	YES
AWS_S3_ENDPOINT	eodata.dataspace.copernicus.eu
AWS_ACCESS_KEY_ID	your_CDSE_public_key
AWS_SECRET_ACCESS_KEY	your_CDSE_secret_key
AWS_HTTPS	YES
AWS_VIRTUAL_HOSTING	FALSE

Below the 'System' dialog, the 'Data Source Manager | Raster' dialog is shown. A red arrow points to the 'Source' field, which contains the URL: "/vsis3/eodata".

"/vsis3/eodata" instead of "s3://eodata"

QGIS

dataspace.copernicus.eu



PROGRAMME OF
THE EUROPEAN UNION



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Mounting S3 buckets into your filesystem

Pros

- Buckets appear as folders with files inside in your filesystem
- Applications using those files do not have to support S3 protocol.
- Complexity of folder mapping is hidden from a user. This is convenient when setting up a computing environment (e.g. virtual machine)

Cons

- Filesystem must handle all requests that puts additional unnecessary load on CPU
- If mount is badly configured filesystem will try to keep-up with all changes made within the S3 buckets. This leads to massive recursive **listing operations and additional costs** (for every listing operation i.e. "ls" **you have to pay**)
- Some applications assume that files are stored on a performant ssd/nvme drives. Their default access patterns (e.g. many small request) are not good for network storage (such as S3)
- If S3 mount has problems, then entire filesystem may be unresponsive which lead to stalled virtual machine, laptop, etc.

Some libraries use S3 inefficiently

Excessive range requests for JP2 files with openjpeg

<https://lists.osgeo.org/pipermail/gdal-dev/2024-November/059807.html>

```
# tile at the beginning
$ LD_LIBRARY_PATH=$PWD/openjpeg/build-enabled-fix/bin
gdal_translate -srcwin 0 0 500 500 "$url" o.tif 2>&1 | grep ^Range: |
wc -l
122
$ LD_LIBRARY_PATH=$PWD/openjpeg/build-disabled-fix/bin
gdal_translate -srcwin 0 0 500 500 "$url" o.tif 2>&1 | grep ^Range: |
wc -l
2
```

JP2OpenJPEG multi-threaded RasterIO floods the server with duplicate requests

<https://github.com/OSGeo/gdal/issues/8041>

JPEG2000 is it cloud optimized?

<https://github.com/vincentsarago/awspds-benchmark>

pds	CBERS	LANDSAT	S2 (JP2OpenJPEG)	S2 (JP2KAK)	S2 (JP2ECW)
HTTP call (Z12)	5	5	118	64	115
Bytes transferred (Z12)	53 035	1 722 986	3 920 804	1 310 720	2 741 156
HTTP call (Z10)	6	5	128	74	121
Bytes transferred (Z10)	57 992	934 156	14 390 180	1 196 032	2 053 028
HTTP call (tile)	3	3	113	13	105
Bytes transferred (tile)	49 236	16 915	1 889 188	16 384	1 725 348

pds	CBERS	LANDSAT	S2
HTTP call (COG)	5	5	3
Bytes transferred (COG)	34 527	706 810	801 176
HTTP call (WEB)	3	3	3
Bytes transferred (WEB)	18 733	513 583	412 451

CBERS & Landsat & Sentinel-2 = COG

CBERS & Landsat = TIF
Sentinel-2 = JPEG2000

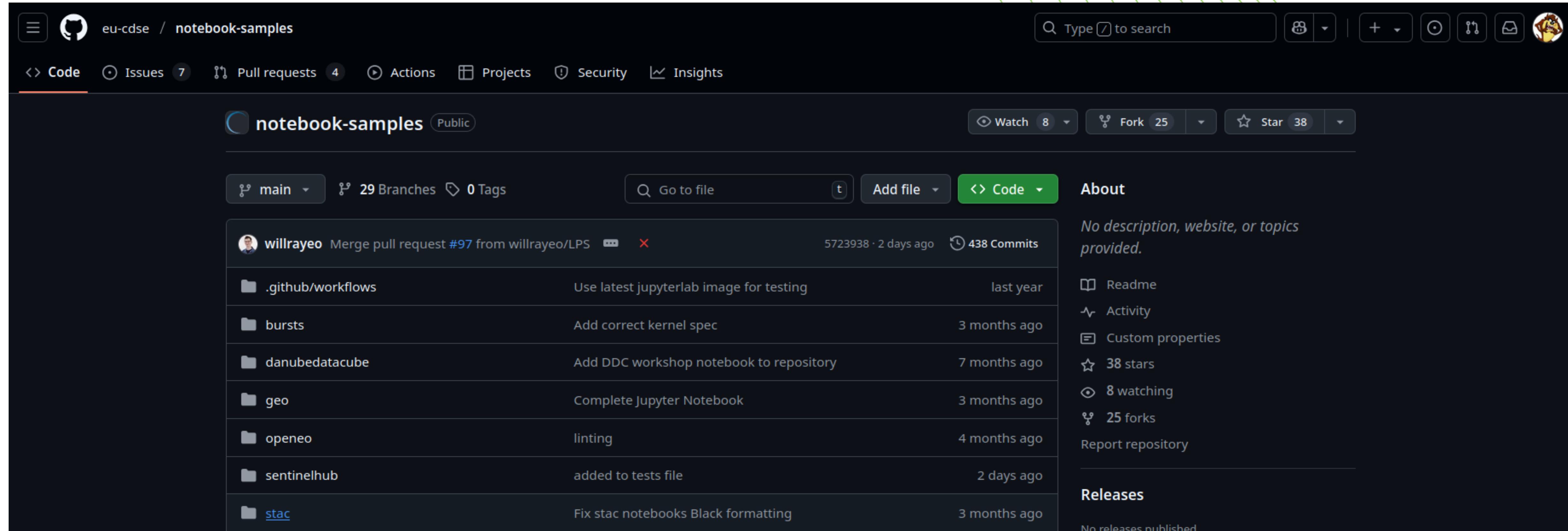
Improving remote access to Sentinel-2

<https://github.com/Kayrros/sentinel-2-jp2-tlm>

Format	Time Taken	Bandwidth Used	Number of Requests
JP2 without TLM	4325ms	~3MB	110
JP2 with TLM	391ms	~1MB	3
COG	389ms	~1.5MB	2

<https://kakadusoftware.com/>

Prerequisites: eu-cdse GitHub



The screenshot shows a GitHub repository page for 'eu-cdse/notebook-samples'. The repository is public, has 8 watchers, 25 forks, and 38 stars. It contains 29 branches and 0 tags. The main branch is selected. The repository has 438 commits from various contributors, with the most recent being a merge pull request from willrayeo. The repository also includes sections for .github/workflows, bursts, danubedatacube, geo, openeo, sentinelhub, and stac. The 'About' section notes that there is no description, website, or topics provided. The 'Releases' section indicates that no releases have been published.

eu-cdse / notebook-samples

Type ⌘ to search

Code Issues 7 Pull requests 4 Actions Projects Security Insights

notebook-samples Public

Watch 8 Fork 25 Star 38

main 29 Branches 0 Tags Go to file Add file Code About

willrayeo Merge pull request #97 from willrayeo/LPS 5723938 · 2 days ago 438 Commits

.github/workflows Use latest jupyterlab image for testing last year

bursts Add correct kernel spec 3 months ago

danubedatacube Add DDC workshop notebook to repository 7 months ago

geo Complete Jupyter Notebook 3 months ago

openeo linting 4 months ago

sentinelhub added to tests file 2 days ago

stac Fix stac notebooks Black formatting 3 months ago

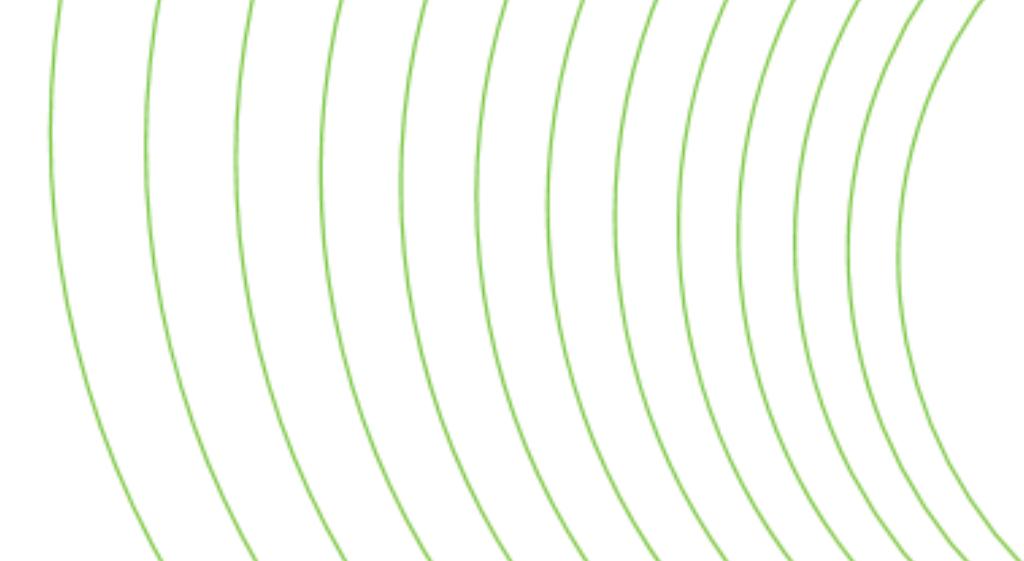
No description, website, or topics provided.

Readme Activity Custom properties 38 stars 8 watching 25 forks Report repository

Releases No releases published

<https://github.com/eu-cdse/notebook-samples/tree/main/stac>

Prerequisites: CDSE JupyterLab



News Dashboard Cases Events Gallery Videos About Contact

DATA ANALYSIS SERVICES ECOSYSTEM Explore Data SUPPORT MY ACCOUNT

APIs
Use APIs like openEO for advanced data interaction.

Data Workspace
Create EO products on demand with a user-friendly interface.

Traceability
Track product integrity and availability from origin to download.

JupyterLab
Work with CDSE data instantly—no download required.

openEO
Build, run, and monitor EO workflows through a visual dashboard.

Sentinel Hub
Access and analyze Earth observation data without the need to develop or maintain their own infrastructure.

processing and data access possibilities. Delve into the data immediately via the Copernicus Browser or register to create an account and have an even better comprehensive exploration experience.

<https://dataspace.copernicus.eu/>

CDSE JupyterLab



Server Options

- Small server

Spawns small notebook server with 2 CPU cores and 4GB RAM

- Medium server

Spawns medium notebook server with 2 CPU cores and 8GB RAM

- Large server

Spawns large notebook server with 4 CPU cores and 16GB RAM

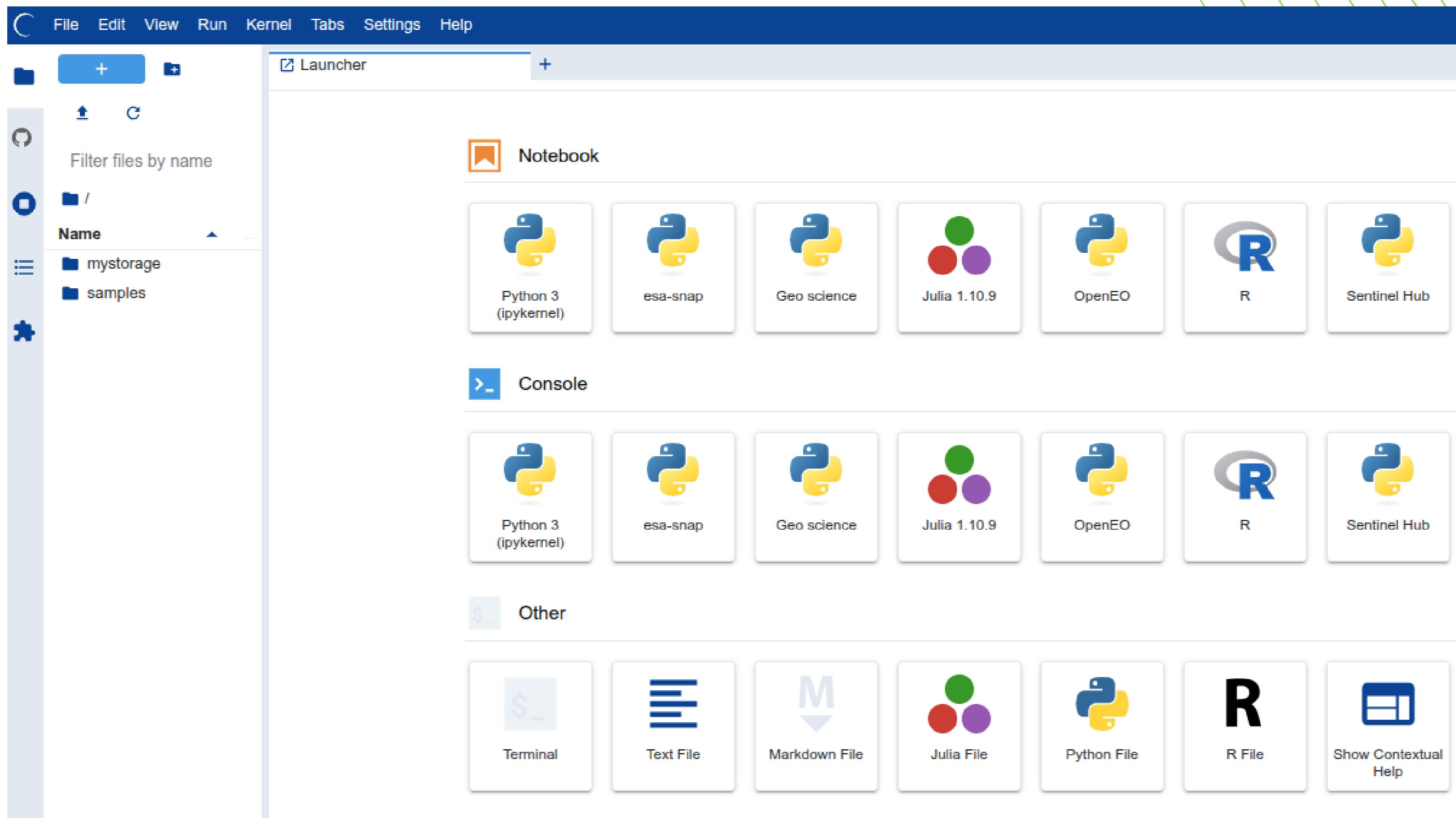
I am human

FriendlyCaptcha 

START

<https://jupyterhub.dataspace.copernicus.eu/hub/spawn>

CDSE JupyterLab



CREODIAS Cloud Computing

CREODIAS

My Account X

Cloud Projects
List of your Openstack Cloud projects.

Wallets
Manage wallets for Your services.

Billing
Check and control your billing for services.

Support Tickets
Create tickets and manage them.

My Profile
Edit details of Your profile.

Logout
Click here to log out of the site.

<https://creodias.eu/#my-account>

CREODIAS Cloud Computing



<https://new.cloudferro.com/panel/profile/organization>

CREODIAS Cloud Computing

The screenshot shows the CREODIAS Cloud Computing interface. The top navigation bar includes links for DASHBOARD, DATA OFFER, PRICING, KNOWLEDGE BASE & FAQ, ECOMMERCE, FREE TRIAL, and LOG OUT (with a notification count of 153). The left sidebar contains sections for Services (Active services), Billing and Reporting (Wallets/Contracts, Payments, Cloud projects/Wallets), Invoicing (My invoices), Configuration (My profile, Organization, Sub-accounts, Invitations), Support (Notifications, Tickets), and Management Interfaces (WAW/FRA Cloud Panel, CF2 Cloud Panel, CloudFerro e-Commerce, DATA EXPLORER). The main content area is titled 'Accounts' and features a 'Note' section about the closure of the CF2 region. It also lists important dates and actions. Below this is another 'Note' section about activating cloud projects and attaching wallets. The main table displays account details for 'root account: CloudFerro', showing Name, Location, Projects, and Wallet/Contract. Projects listed are openstack_waw4_1, openstack_cf2, and openstack_fra1_2. A status message indicates the current wallet is CloudFerro. The URL <https://new.cloudferro.com/panel/accounts> is displayed at the bottom.

CREODIAS Cloud Computing

CloudFerro cloud_00335 • cloud_00335_1 • WAW4-1

Project API Access Compute Overview Instances Images Key Pairs Server Groups Volumes Container Infra Network Orchestration DNS Object Store Share Identity

Project / Compute / Overview

Overview

Limit Summary

Compute

Resource	Used	Total	
Instances	Used 3 of 15	VCPUs	Used 97 of 200
RAM	Used 361.5GB of 500GB	Volume Snapshots	Used 0 of 10
Volume Storage	Used 0B of 1000GB	Volume Backups	Used 0 of 10
Networks	Used 1 of 100	Ports	Used 8 of 500
Routers	Used 1 of 10	Floating IPs	Allocated 3 of 50
Security Groups	Used 2 of 10	Security Group Rules	Used 9 of 100

Volume

Resource	Used	Total	
Volumes	Used 0 of 10	Volume Snapshots	Used 0 of 10
Volume Storage	Used 0B of 1000GB	Volume Backups	Used 0 of 10

Network

Resource	Used	Total	
Networks	Used 1 of 100	Ports	Used 8 of 500
Routers	Used 1 of 10	Floating IPs	Allocated 3 of 50
Security Groups	Used 2 of 10	Security Group Rules	Used 9 of 100

Usage Summary

Select a period of time to query its usage:
The date should be in YYYY-MM-DD format.

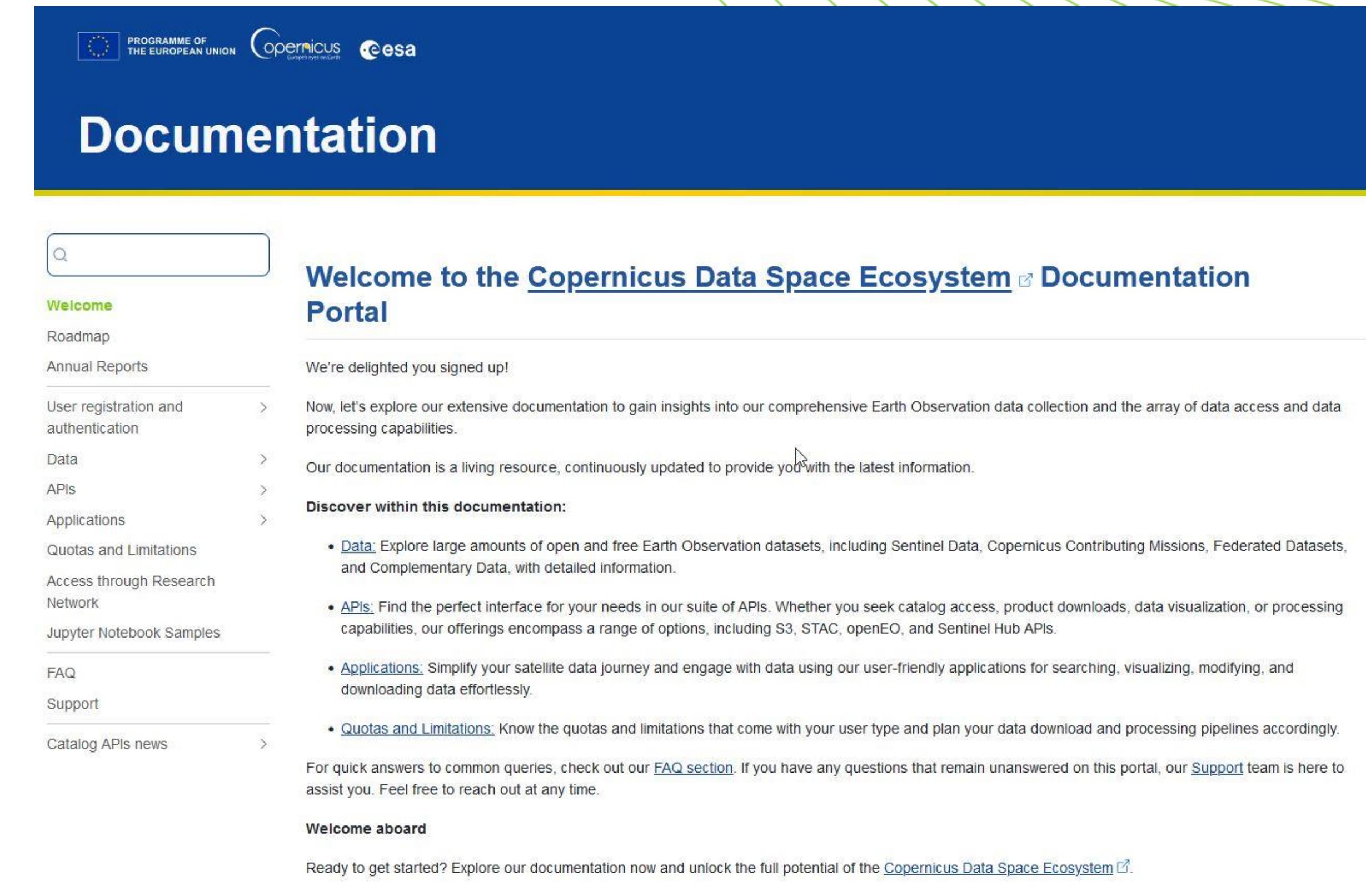
dataspace.copernicus.eu

Management Interfaces

- WAW/FRA Cloud Panel
- CF2 Cloud Panel
- CloudFerro e-Commerce
- DATA EXPLORER

Where to find more information

- Documentation
- Community Forum
- Youtube Channel
- Online webinars



The screenshot shows the homepage of the Copernicus Data Space Ecosystem Documentation Portal. At the top, there are logos for the European Union Programme, Copernicus (Europe's eyes on Earth), and esa. Below the header, the word "Documentation" is prominently displayed in white text on a dark blue background. To the left, a sidebar contains a search bar and a navigation menu with links to Welcome, Roadmap, Annual Reports, User registration and authentication, Data, APIs, Applications, Quotas and Limitations, Access through Research Network, Jupyter Notebook Samples, FAQ, Support, and Catalog APIs news. The main content area features a welcome message: "Welcome to the [Copernicus Data Space Ecosystem](#) Documentation Portal". It includes a note about signing up, a brief description of the documentation as a living resource, and a section titled "Discover within this documentation:" with bullet points about Data, APIs, Applications, and Quotas and Limitations. At the bottom, there are links to the FAQ and Support sections.

Where to find more information

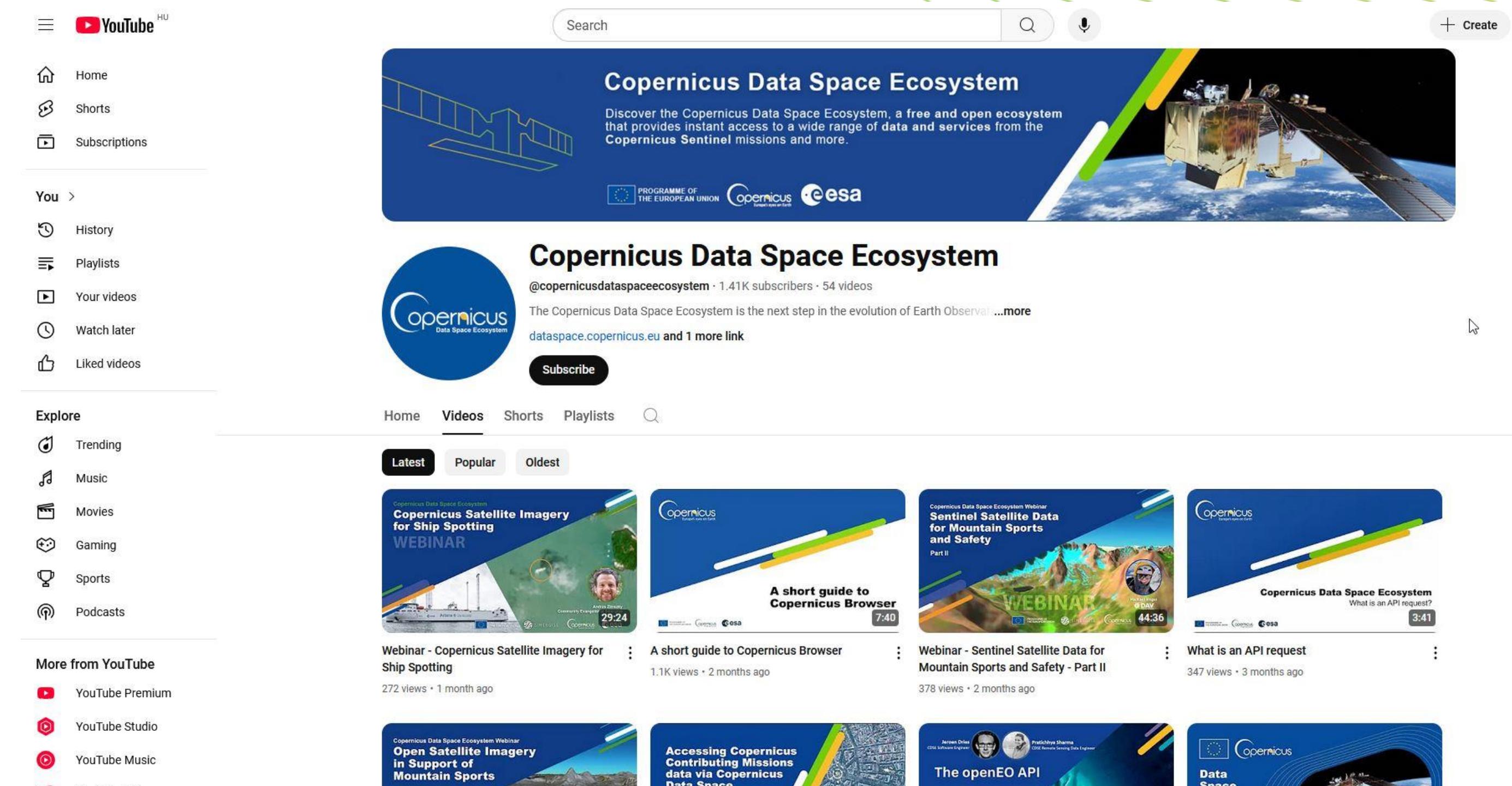
- Documentation
- **Community Forum**
- Youtube Channel
- Online webinars

The screenshot shows a forum interface with a dark blue header featuring the European Union flag, 'PROGRAMME OF THE EUROPEAN UNION', 'Copernicus Europe's eyes on Earth', and 'eesa'. The header also includes a search bar and a user icon. The left sidebar has a 'Topics' section with links for 'My Posts', 'More', 'Categories' (expanded to show 'News', 'Community Contributions', 'Copernicus Browser', 'APIs', 'openEO', 'Data Collections', 'JupyterLab', 'Data Workspace', 'Traceability', 'QGIS Plugin', and 'All categories'), 'Messages' (expanded to show 'Inbox'), and a '+ New Topic' button. The main content area displays a list of topics with columns for 'Topic', 'Replies', 'Views', and 'Activity'. The topics listed are:

Topic	Replies	Views	Activity
Release of preliminary Copernicus Sentinel-1C sample dataset • News	0	4	1h
Unable to view layers older than Nov '24 (Sentinel-5P, SO2) • Copernicus Browser	4	12	2h
How to get raster values (DEM) for set of points in lat,long coords? • openEO	5	30	3h
load_stac: Method not allowed • openEO	0	3	4h
Downloading Intersection of Sentinel2 L1C and Sentinel5P L1B data via OData API • OData	1	17	5h
download S1 GRD data • openEO	1	9	21h
Processing baseline Sentinel-2A/B L2A • Data Collections	1	39	21h
We want your feedback on the openEO Web Editor • openEO	3	35	1d

Where to find more information

- Documentation
- Community Forum
- Youtube Channel
- Online webinars



Where to find more information

- Documentation
- Community Forum
- Youtube Channel
- **Online webinars**



CDSE Webinar: Unlocking Machine Learning Potential Using openEO

Details

The openEO API instance offered in the Copernicus Data Space Ecosystem allows to creation of large-scale maps using time series pixel classification at a relatively low operational cost. On top of that, the workflows remain simple and maintainable as all the complexity is handled by the backend.

In this webinar, we will showcase how multiple mapping projects have already succeeded in adopting this technology and even managed to integrate foundation models, allowing them to build classification pipelines that are increasingly generic without sacrificing accuracy.

Moreover, more examples of machine learning notebooks will be showcased, along with additional links for further exploration. If you have more questions about openEO when working with machine learning-based applications, this could be an excellent opportunity to find answers.

Details

- Tue 18 Feb
- 14:00 - 15:00 CET
- Online

Register

Summary

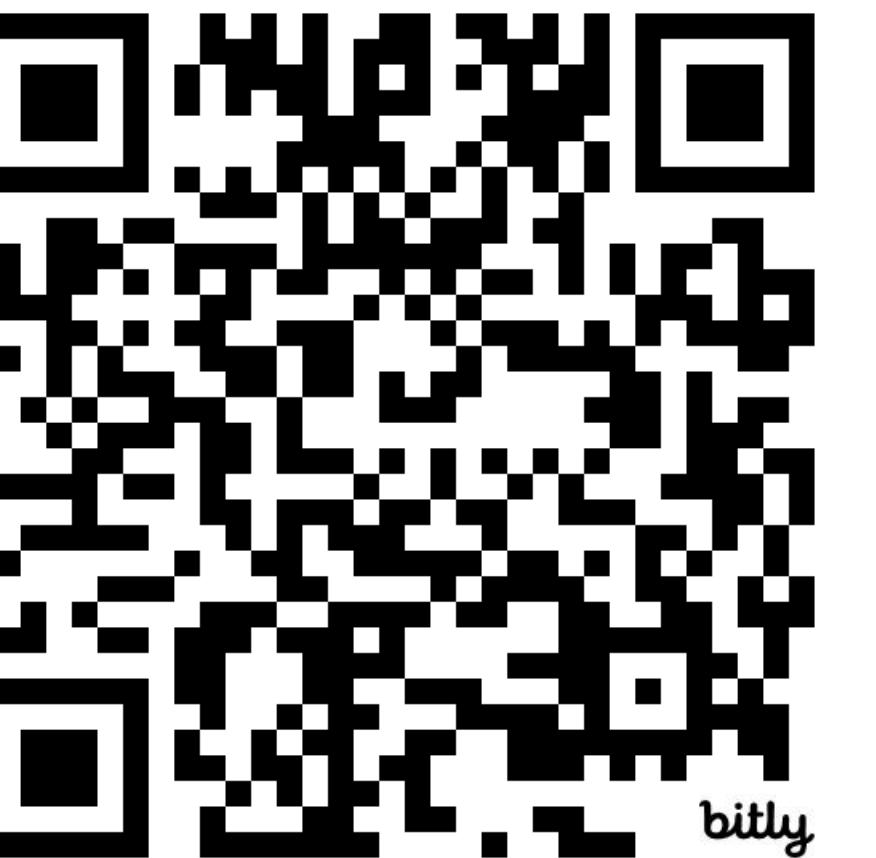
API access and data streaming has revolutionized a way how we **access multimedia**. The same **inevitable revolution** is now taking place for the **Big EO data**. What **benefits** data streaming brings?:

- **Users** can obtain **on-the-fly Analysis Ready Data (ARD)** over specific **AOI** at specific **time** without knowing of data formats, calibration issues, compositing, reprojection, resampling, pre-processing (cloud masking).
- Thanks to this **users have more time** for "real work" i.e. algorithm **prototyping**.
- Most of the **data processing** is moved from a client to a **SERVER SIDE** where the **EO data repository** is located. Thus, the **user does not have to purchase** and maintain **costly computing infrastructure**.
- **Streaming** allows for **massive computational parallelization** and significantly **reduces I/O operation time**.
- **Copernicus Data Space Ecosystem** offers **FOR FREE** up to **some predefined quotas** an advanced **data streaming protocols (S3) and APIs**.

Thank you

Jan Musiał

jmusial@cloudferro.com



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esa

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