The BIOMASS Mission Algorithm & Analysis Platform (MAAP) and related Open-Source developments (BioPAL)

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European Space Agency

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How to make the future of EO users better?

Innovative instrument

Innovative ground segment?

EO User's point of view

"Am I using the latest version of the dataset?"

"My computation takes too much time!"

"I don't like the official dataset but I have a good idea for improving it."

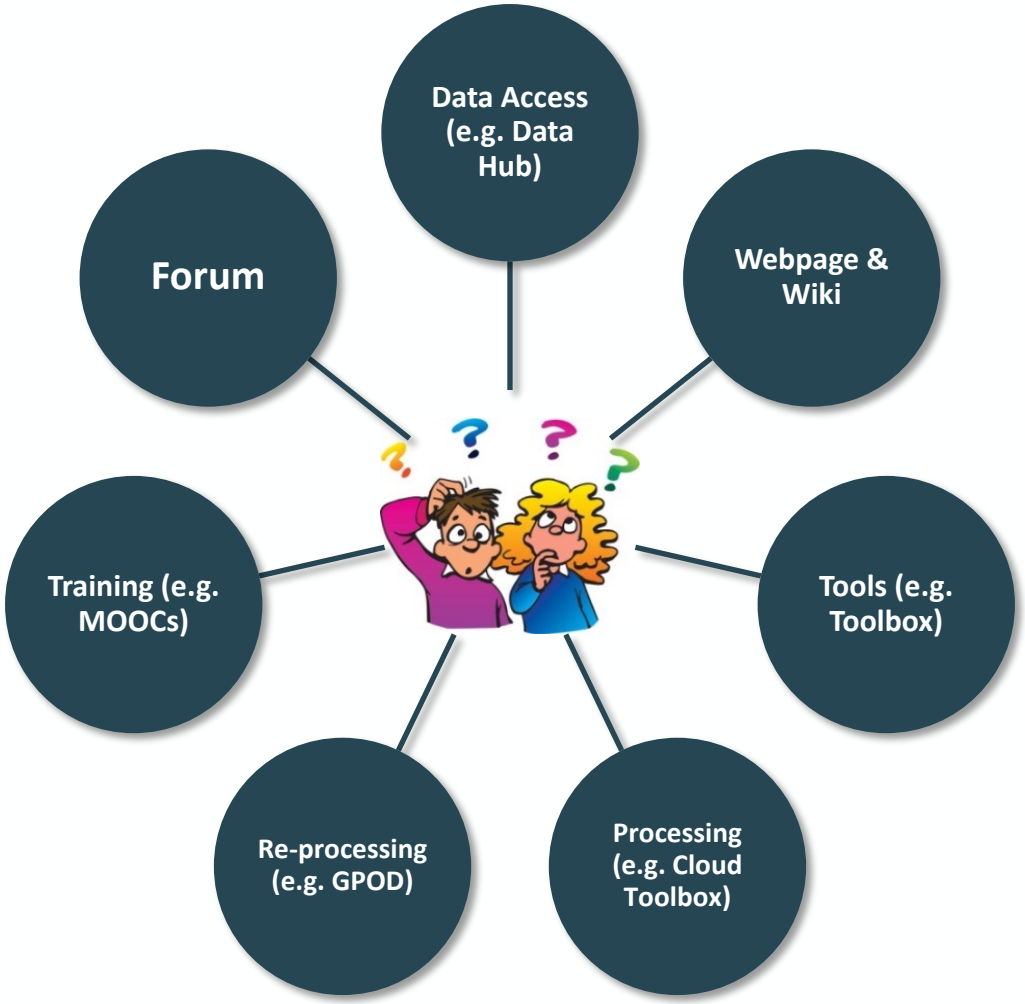
"I cannot do all what I want with the tool box."

"I don't have enough space to store all my TB data."

"How to share my results (few GB of data) with my peers?"

"Where do I find in-situ data to validate my results?"

Today, services to EO mission data users are scattered



“Mission Algorithm and Analysis Platform”

Try the MAAP!
https://scimaap.net

→ ***It’s a Virtual open and collaborative environment that…***

Enables researchers to easily discover, process, visualize, and analyze large volumes of data.

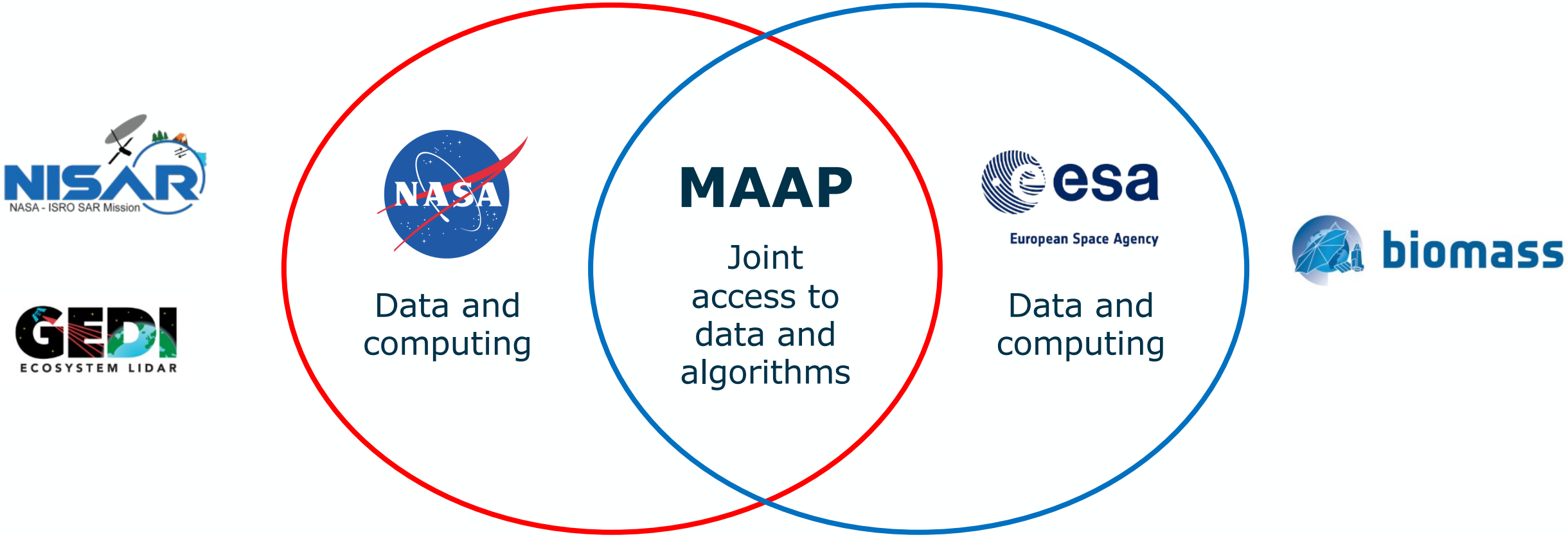
Provides tools and infrastructures to bring data into the same coordinate reference frame to enable comparison, analysis, data evaluation, and data generation.

Provides a version-controlled science algorithm development environment that supports tools, co-located data, and processing resources.

Addresses intellectual property and sharing issues related to collaborative algorithm development and sharing of data and algorithms.

NASA-ESA Multi-Mission Algorithm and Analysis Platform

Unified user access to the functions of joint NASA-ESA MAAP



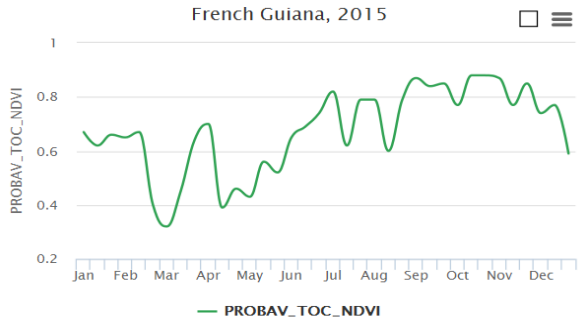
Up to date data and algorithms + Collaborative community

→ Data visualisation

2D data visualisation

- Search, discovery, overlay
- L1, L2, L3

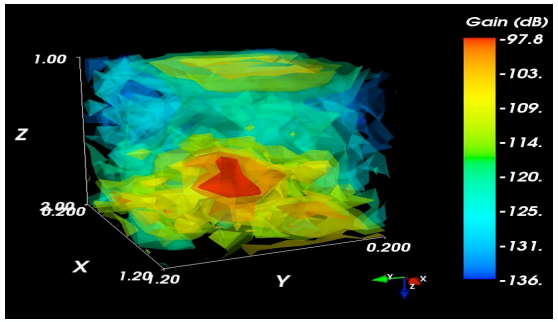
Time series visualisation



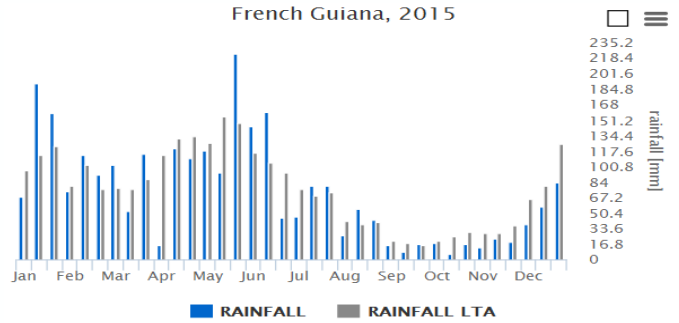
In-situ measurement (e.g. Forest Observation System)

3D data visualisation

- PolinSAR, TomoSAR



Meteorological data



→ Data processing (product generation)

Select existing algorithms

Official L1, L2/3 algorithms

Research L1, L2/3 algorithms

Generate products

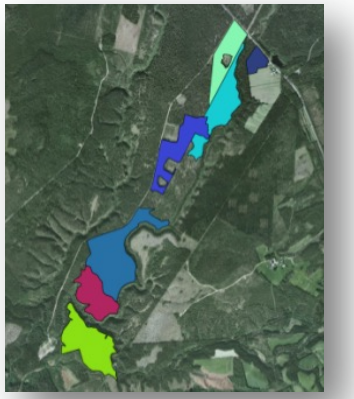
- Systematic generation (every 6 months)
- On demand

Download data

Upload data

- raster, vector, table

Stand id	Biomass [ton/ha]	Biomass error [ton/ha]
1	201.9	25
5	159.6	25
9	218.4	25
10	150.4	25
12	267.1	25
14	52.0	25
15	111.5	25
16	264.8	25
17	142.5	25
18	246.3	25



Share computed data

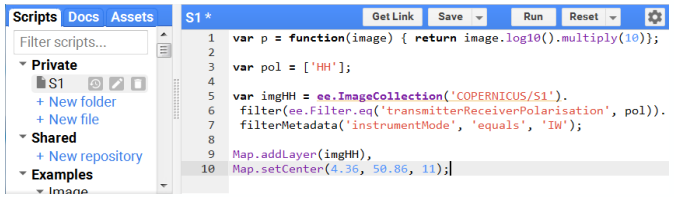
- Share link to give access to the data
- Export figure
- Embedded content in webpages, pdf…

→ Product Algorithm Laboratory

New concept at ESA!

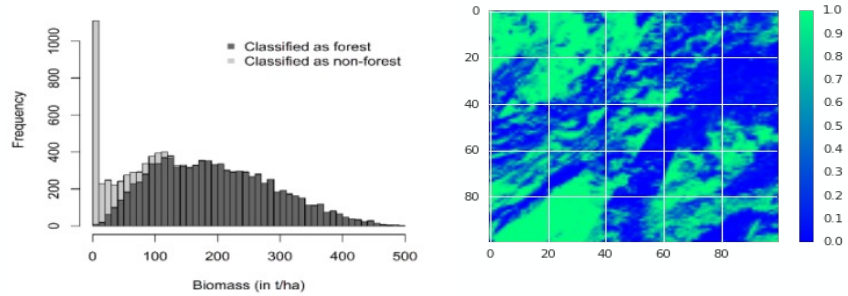
Modify/write processing algorithms

- Modify official L1, L2/3
- Compute own L1, L2/3
- Generate new products



Tools for self validation

Create figures



Share algorithms

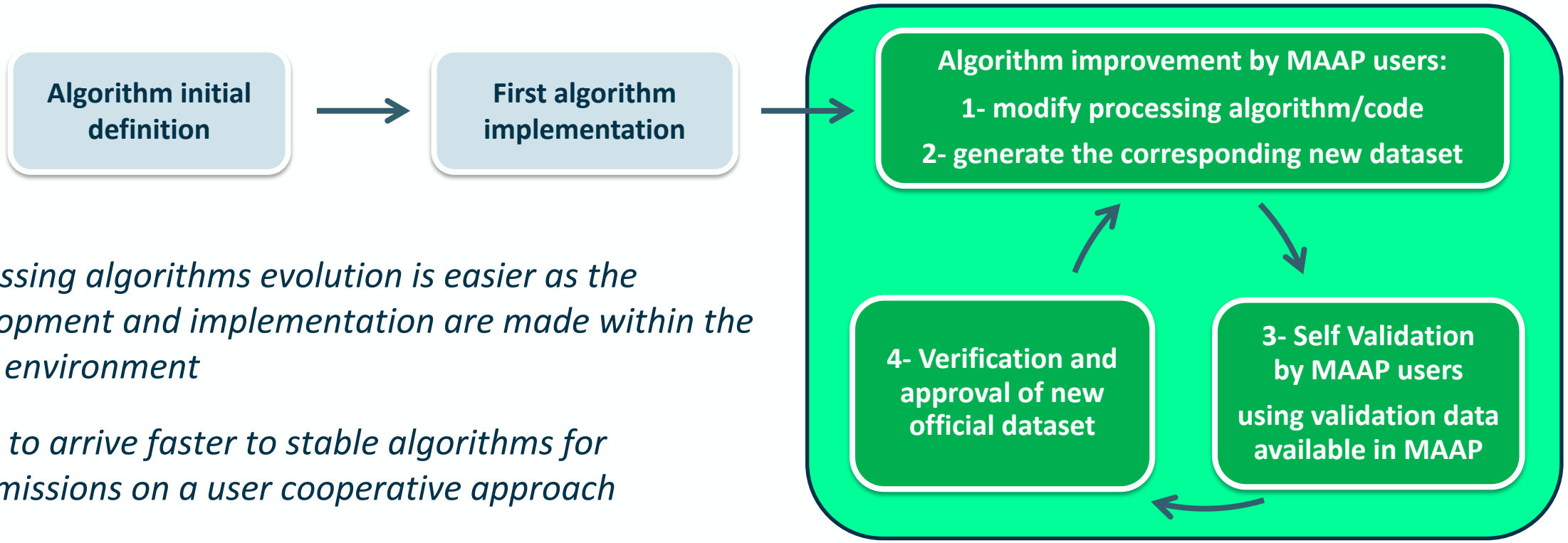
- Share link to give access to the algorithm and/or environment

"Free access to all the functionalities"

- With a limit of processing time and data storage
- Additional resources can be ordered or allowed for specific users

ESA: Product Algorithm Laboratory

New approach!



Mission Algorithm and Analysis Platform (MAAP)

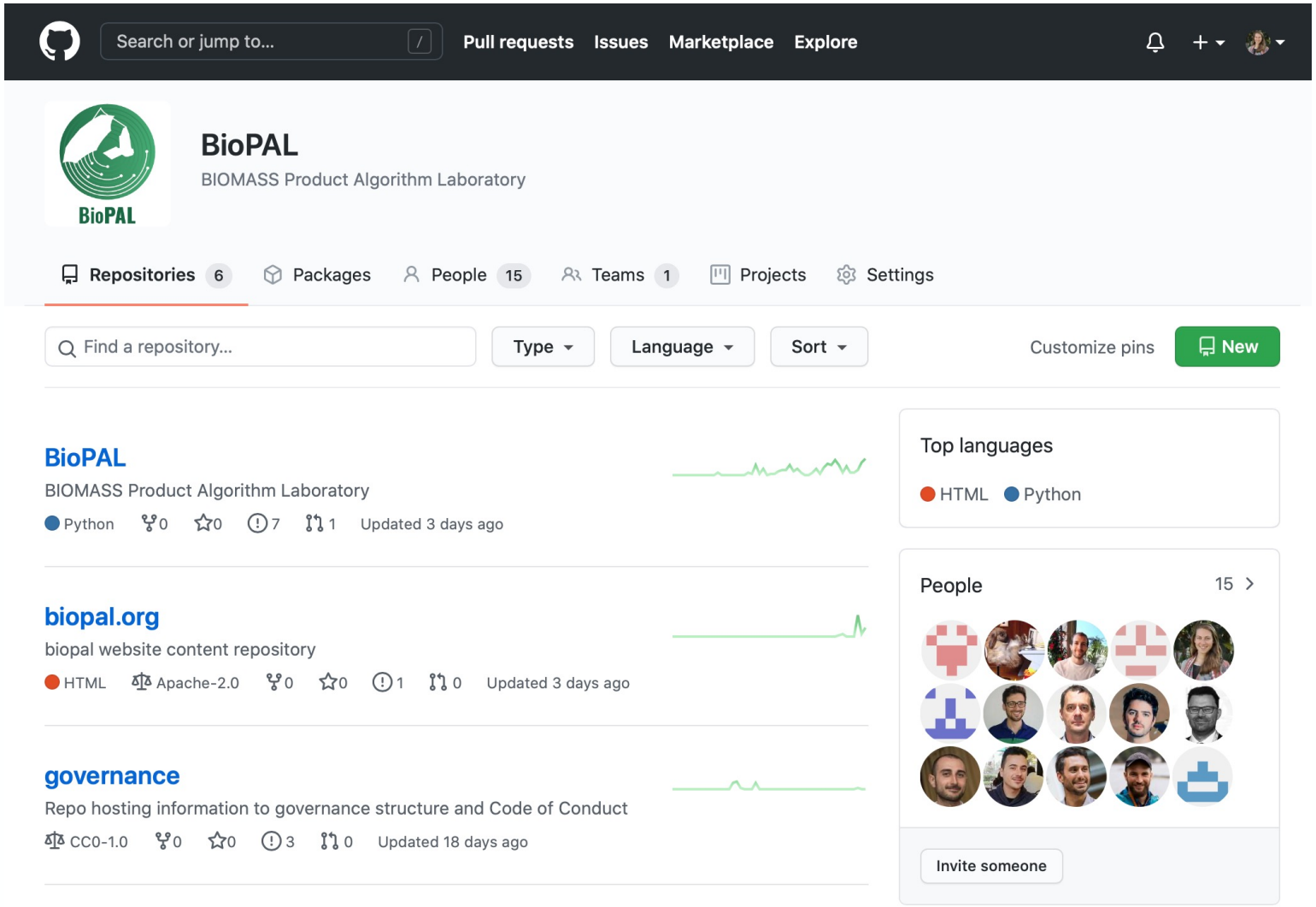
- *Processing algorithms evolution is easier as the development and implementation are made within the same environment*
- *Allow to arrive faster to stable algorithms for R&D missions on a user cooperative approach*
- *People outside the core science team can contribute to the product improvement cycle*

Concepts of "Open Science" → *Well adapted to R&D EO missions*

BIOMASS Product Algorithm Laboratory

New concept at ESA!

esa



Open source

Today:
Level-2 prototype algorithms

Tomorrow:
Level-1 (as much as possible), Level-2 and Level-3 operational algorithms

biopal@esa.int
biopal.org
github.com/BioPAL

python™ git jupyter

→ Information sharing

Forum

- FAQ
- Conversations between users, with the agency…

Link to social networks

- Blogs
- Facebook, Twitter, Research gate…

Wiki

- All the information related to the mission, instrument, data acquisition…

Link to online notebooks

- Write and execute live code (e.g. Jupyter)

MAAP « tour »

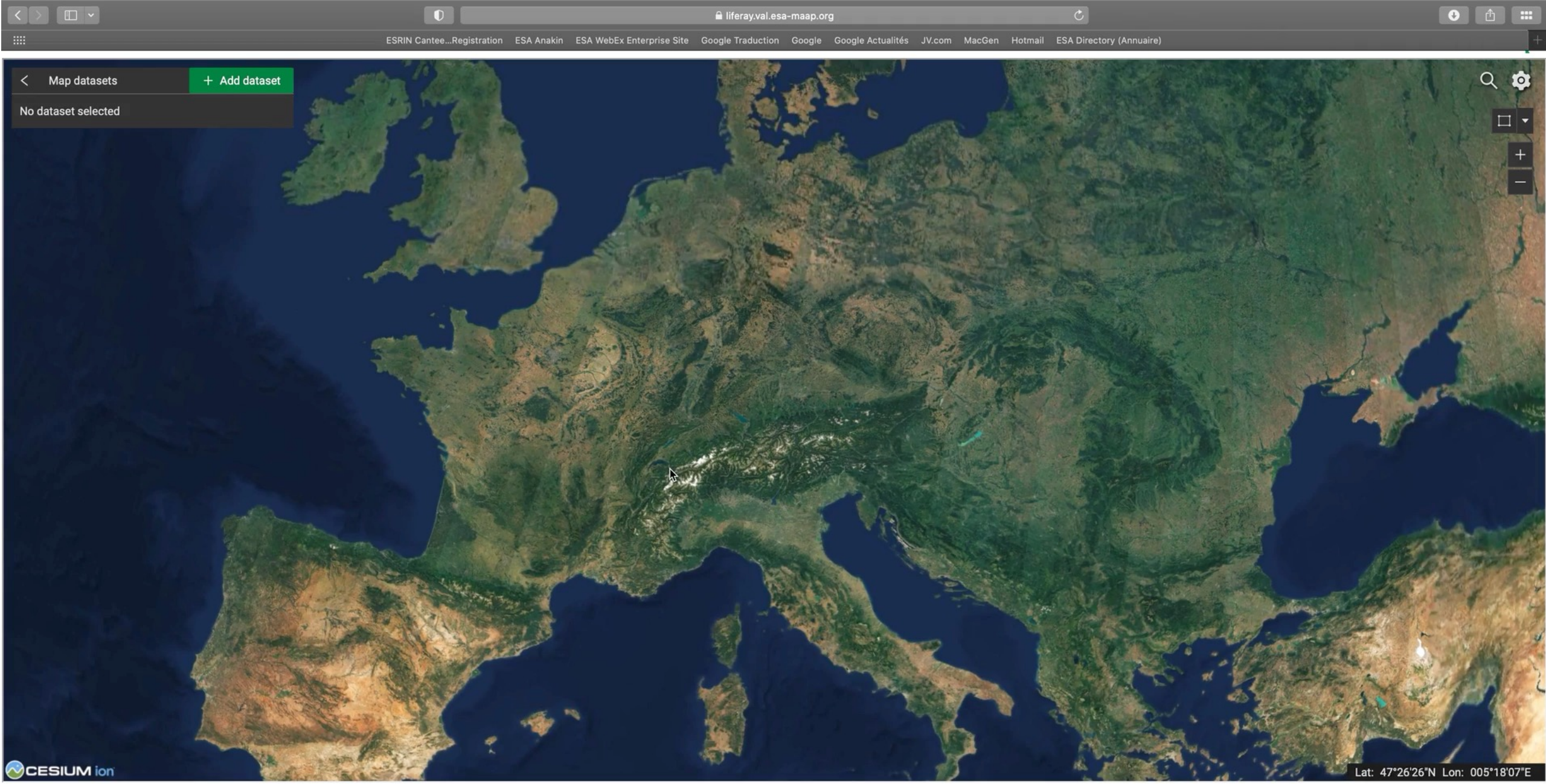
Exemple of the BRIX-2

(2nd Biomass Retrieval Inter-Comparison eXercise)

MAAP is a collaboration between NASA and ESA.

NASA MAAP

Sentinel-1



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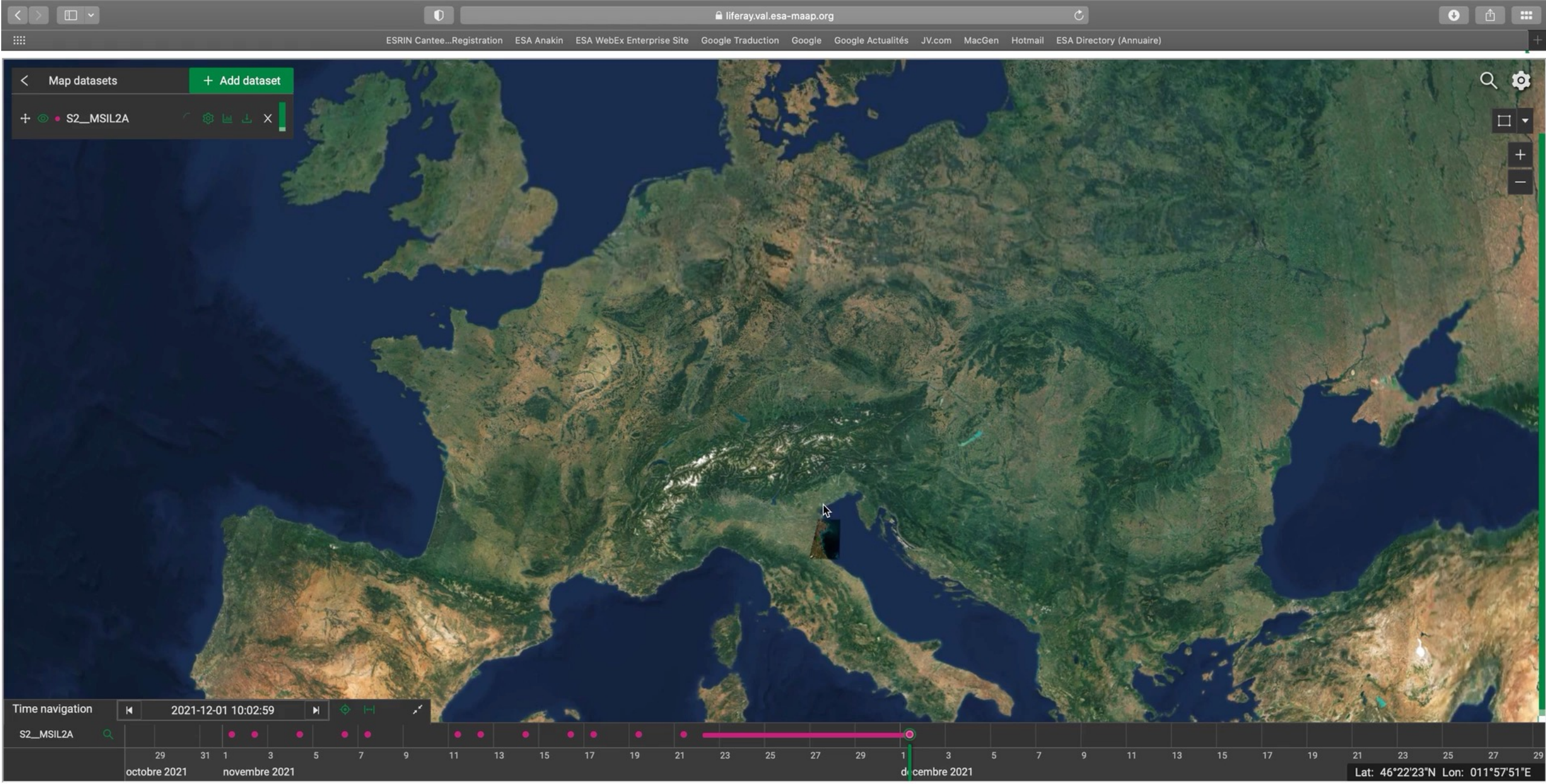
NASA MAAP

Sentinel-2



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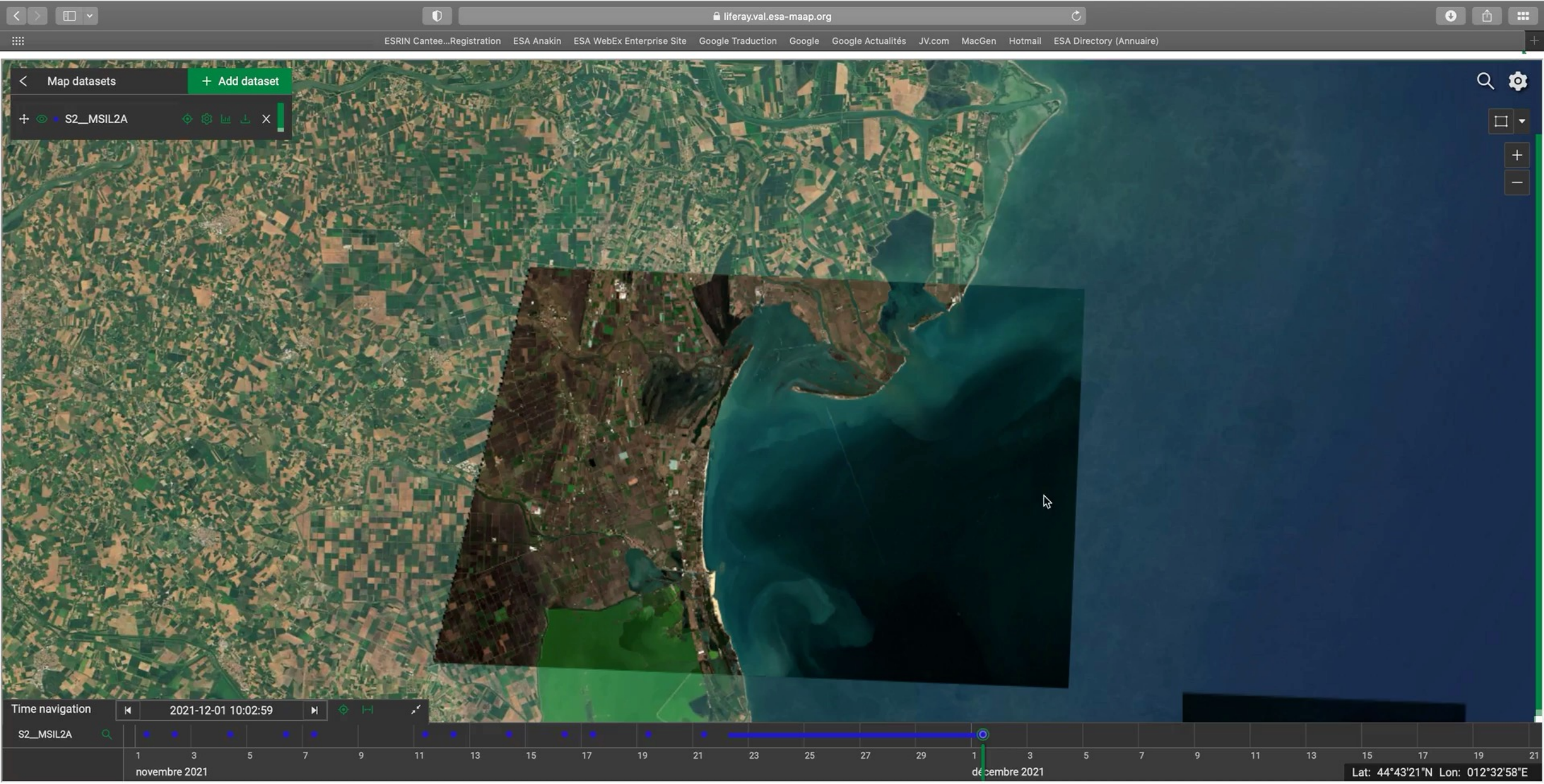
Sentinel-2



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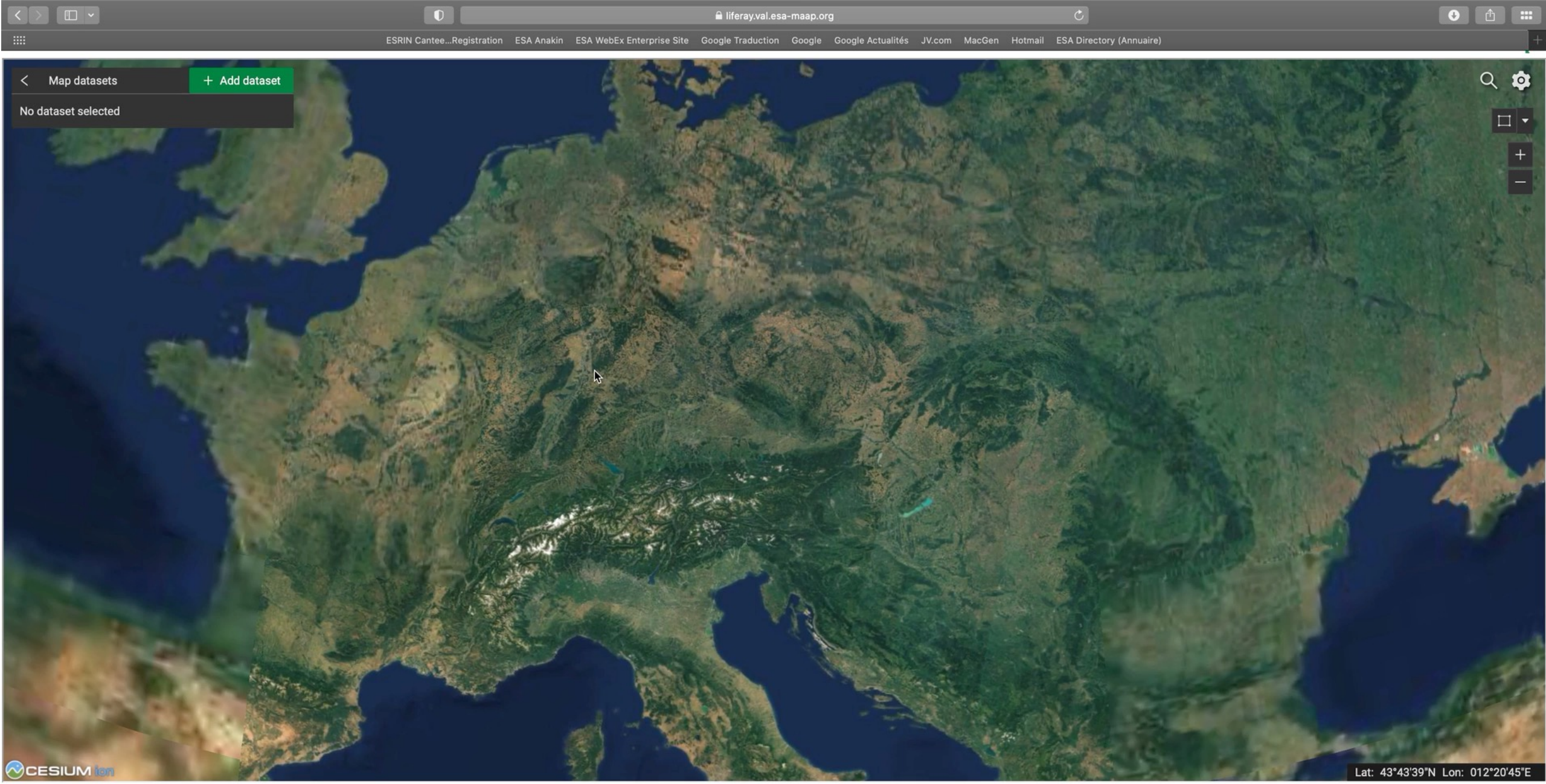

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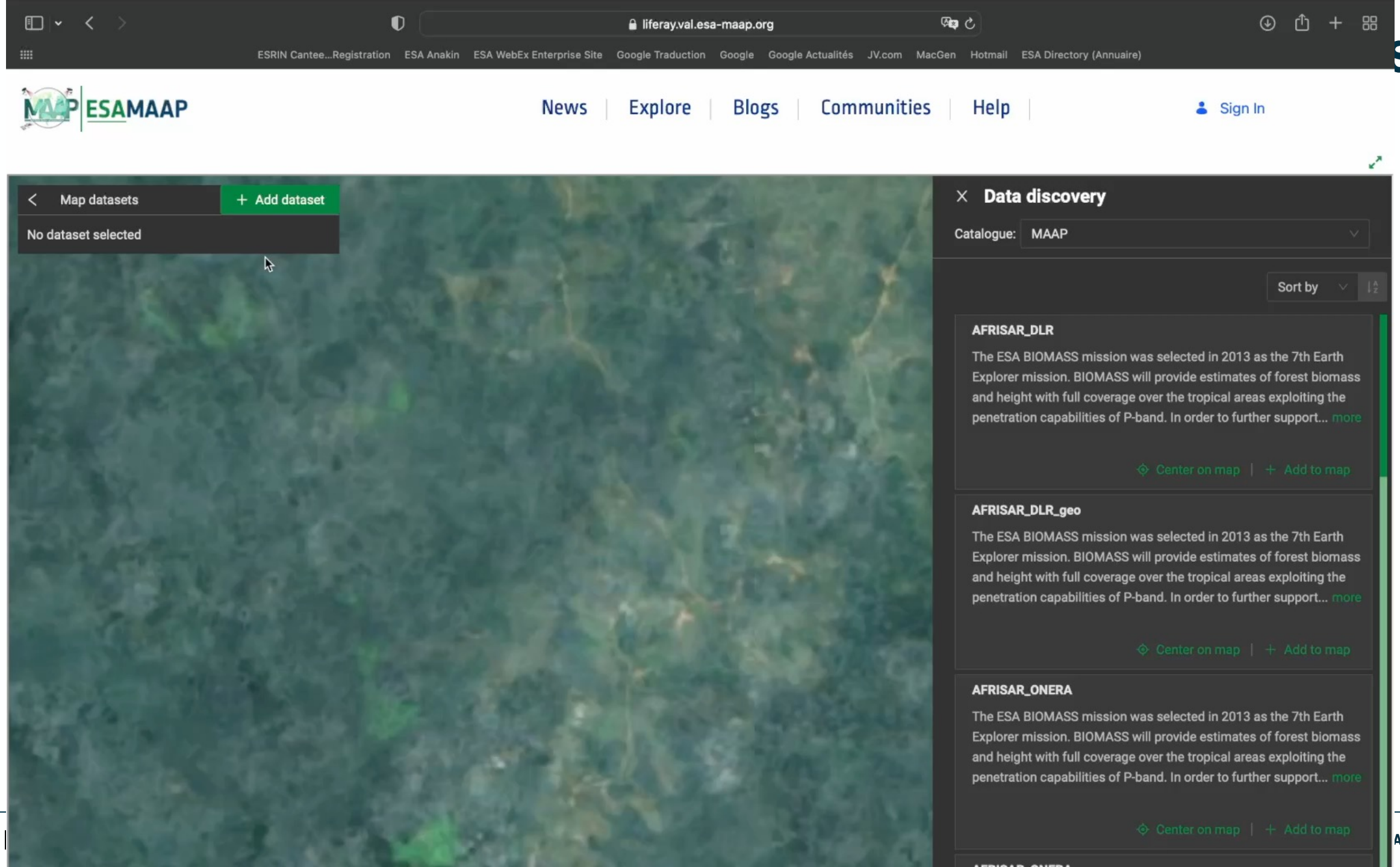
NASA MAAP

ALOS


Map datasets
Add dataset
No dataset selected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ESA WebEx Enterprise Site
Google Traduction
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AFRISAR_DLR
The ESA BIOMASS mission was selected in 2013 as the 7th Earth Explorer mission. BIOMASS will provide estimates of forest biomass and height with full coverage over the tropical areas exploiting the penetration capabilities of P-band. In order to further support... more
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AFRISAR_DLR_geo
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AFRISAR_ONERA
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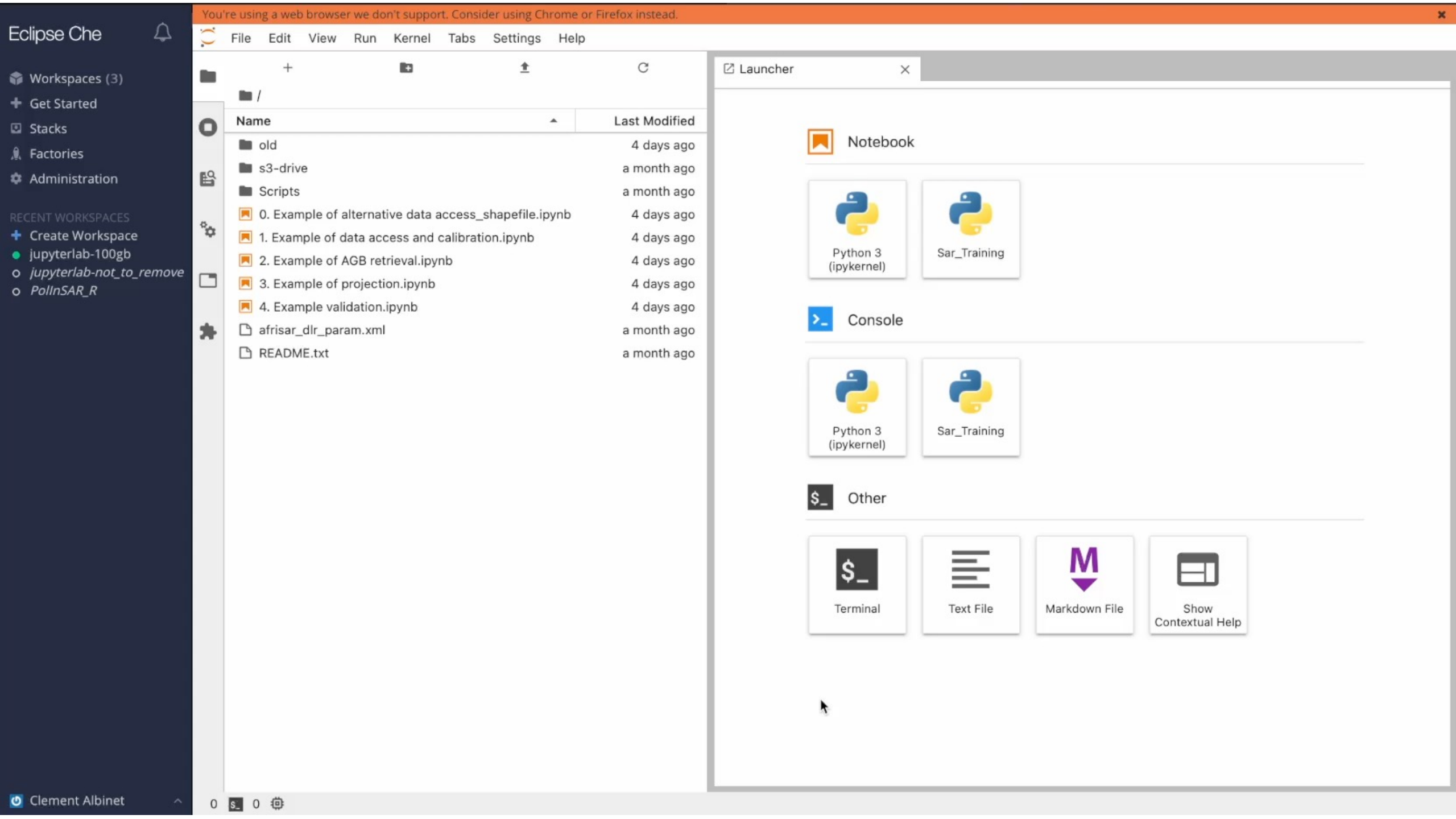
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Sar_Training
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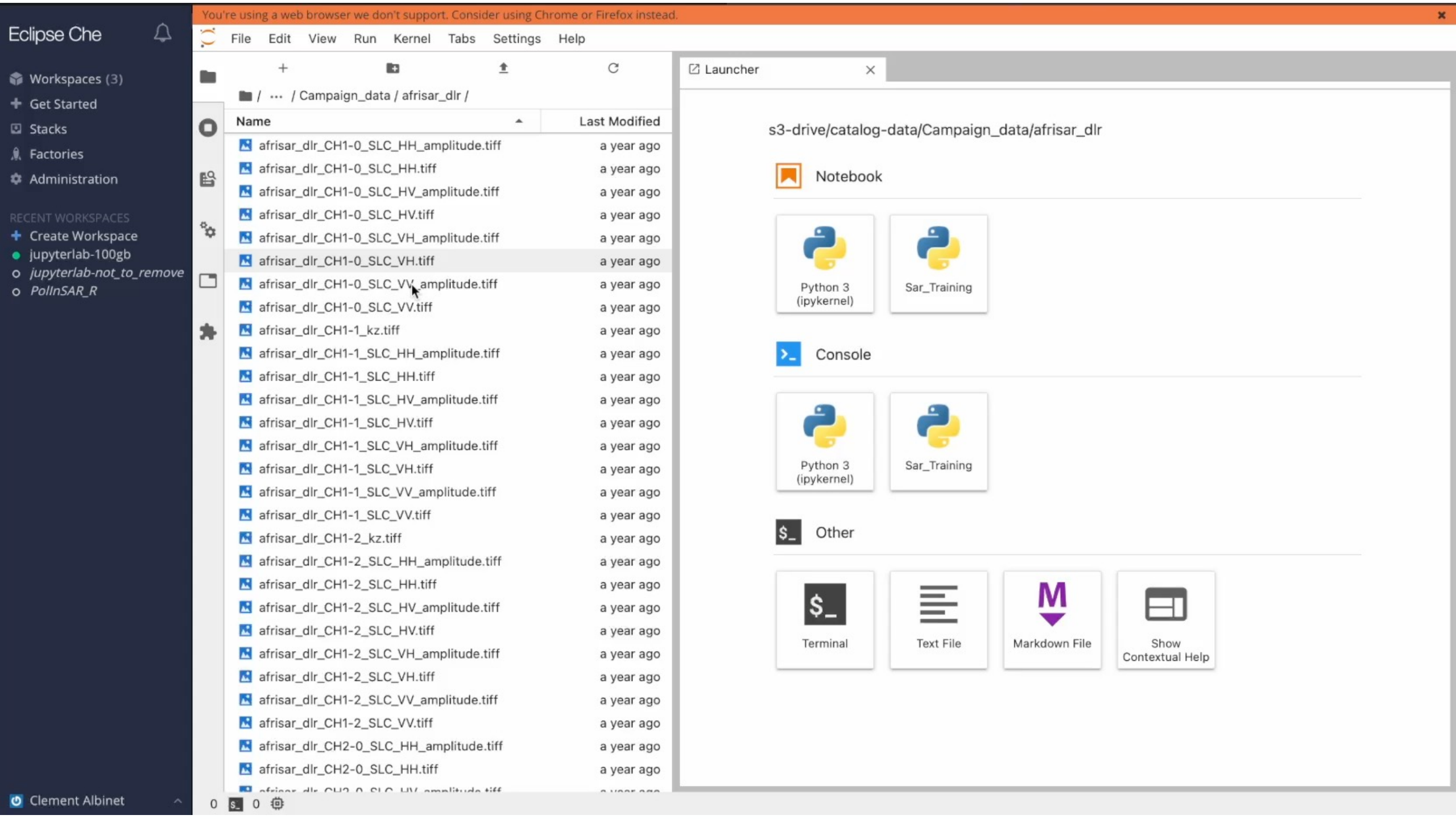
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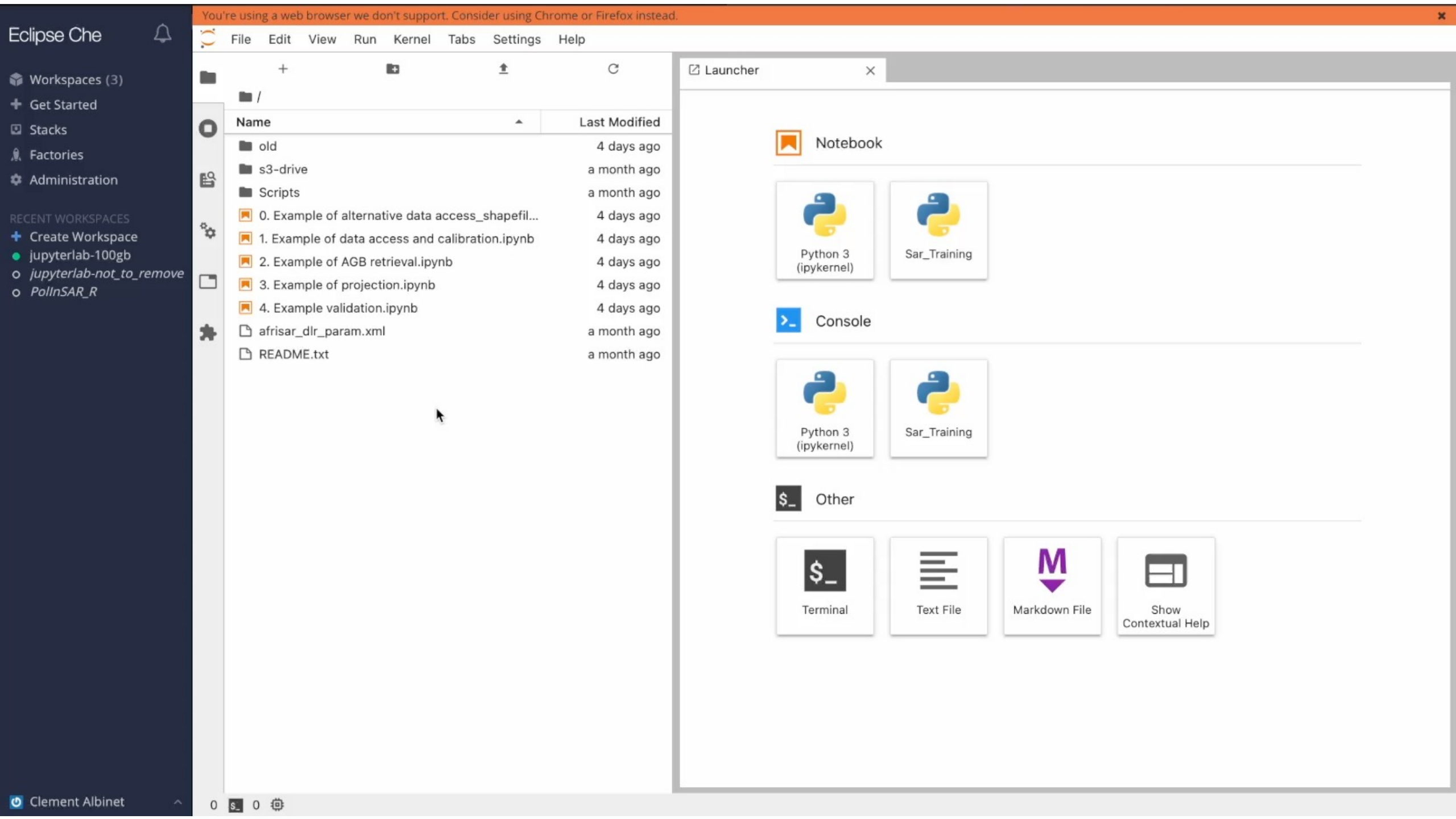
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README.txt	a month ago

Launcher | 1. Example of data access a

Code | Sar_Training

Example of data access via the s3 bucket and data calibration

Example of data access and calibration of P-band SAR data on the NASA MAAP.

Load the libraries

[1]:
```
from osgeo import gdal
from gdalconst import GA_ReadOnly
import numpy as np
import matplotlib.pyplot as plt
import scipy.signal as sg
import sys
sys.path.insert(0, '/projects/Scripts')

# Increase figure size (can be modified for bigger or smaller figures):
plt.rcParams["figure.figsize"] = 20,20
```

1. Open a P-band SAR image

Open SAR image (HV polarisation) in slant range geometry

[2]:
```
inputFilename = '/projects/s3-drive/catalog-data/Campaign_data/afrisar_dlr/afrisar_dlr_T2-0_SLC_HV.t
input_image_driver = gdal.Open(inputFilename, GA_ReadOnly)
input_image = input_image_driver.ReadAsArray()
RasterXSize = input_image_driver.RasterXSize
RasterYSize = input_image_driver.RasterYSize
input_image_driver = None
```

Display SAR image in slant range geometry

[3]:
```
imgplot = plt.imshow(np.absolute(input_image))
```

0 1 Sar_Training | Busy

Mode: Command Ln 1, Col 1 1. Example of data access and calibration.ipynb

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sigma0.tiff	3 minutes ago

2. Example of AGB retrieval

Code Sar_Training

ple Level-2 Above Ground Biomass algorithm

port necessary libraries

```
geo import gdal
lalconst import GA_ReadOnly
matplotlib.pyplot as plt
import scipy.signal as sg
import sys
sys.path.insert(0,'/projects/Scripts')

# Increase figure size (can be modified for bigger or smaller figures):
plt.rcParams["figure.figsize"] = 20,20
```

1. Open Sigma0 product

Open SAR image (HV polarisation) in slant range geometry

[ ]:
```
inputFilename = '/projects/sigma0.tiff'
input_image_driver = gdal.Open(inputFilename, GA_ReadOnly)
sigma0 = input_image_driver.ReadAsArray()
```

2. Compute the AGB product

Apply linear model:

$$y = A.x + B$$

[ ]:
```
A = 12.850826574881816
B = 311.8969972706446

# generate biomass map
estimatedBiomasses = A*sigma0 + B
estimatedBiomasses[estimatedBiomasses < 0] = 0
```

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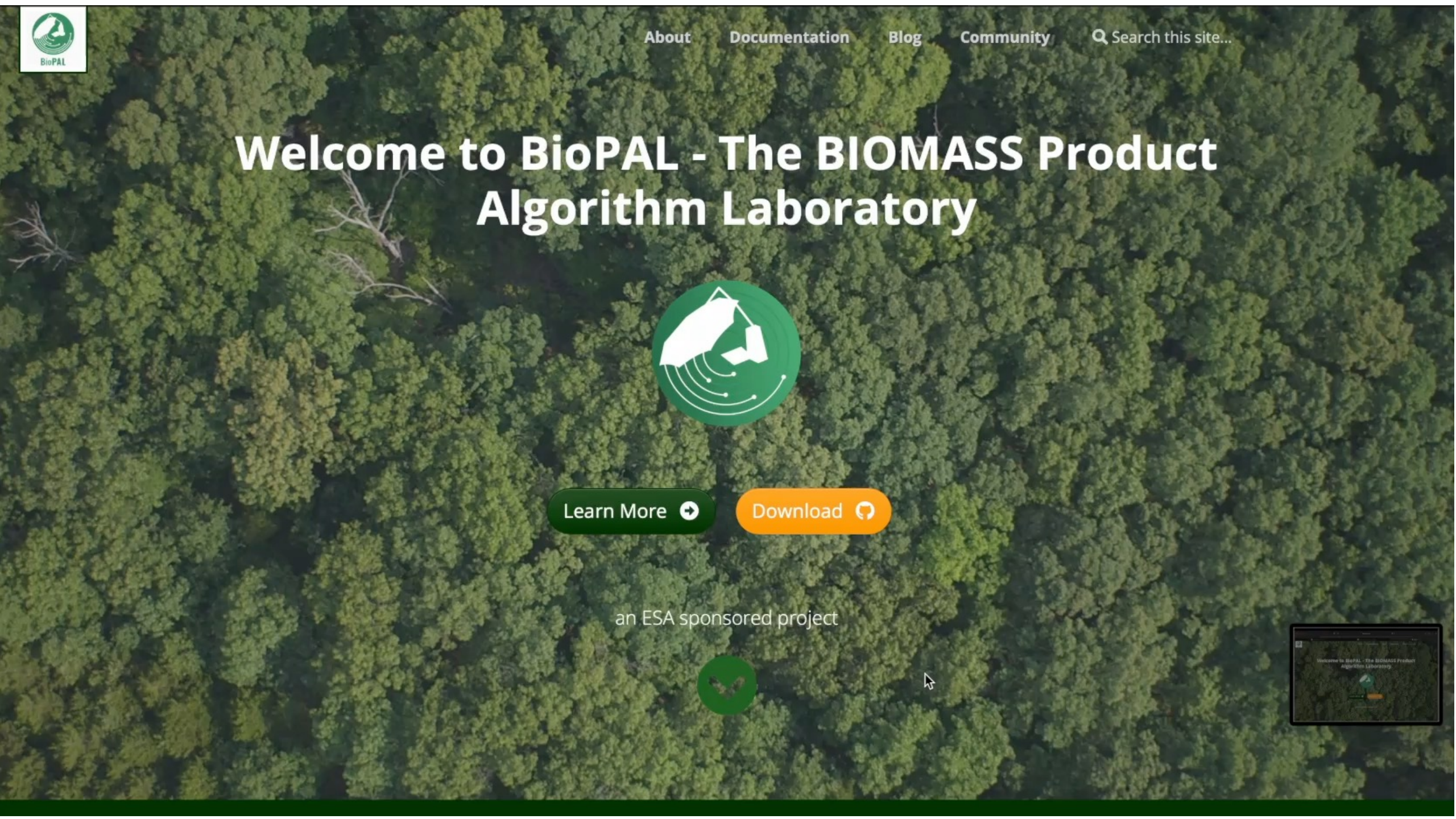
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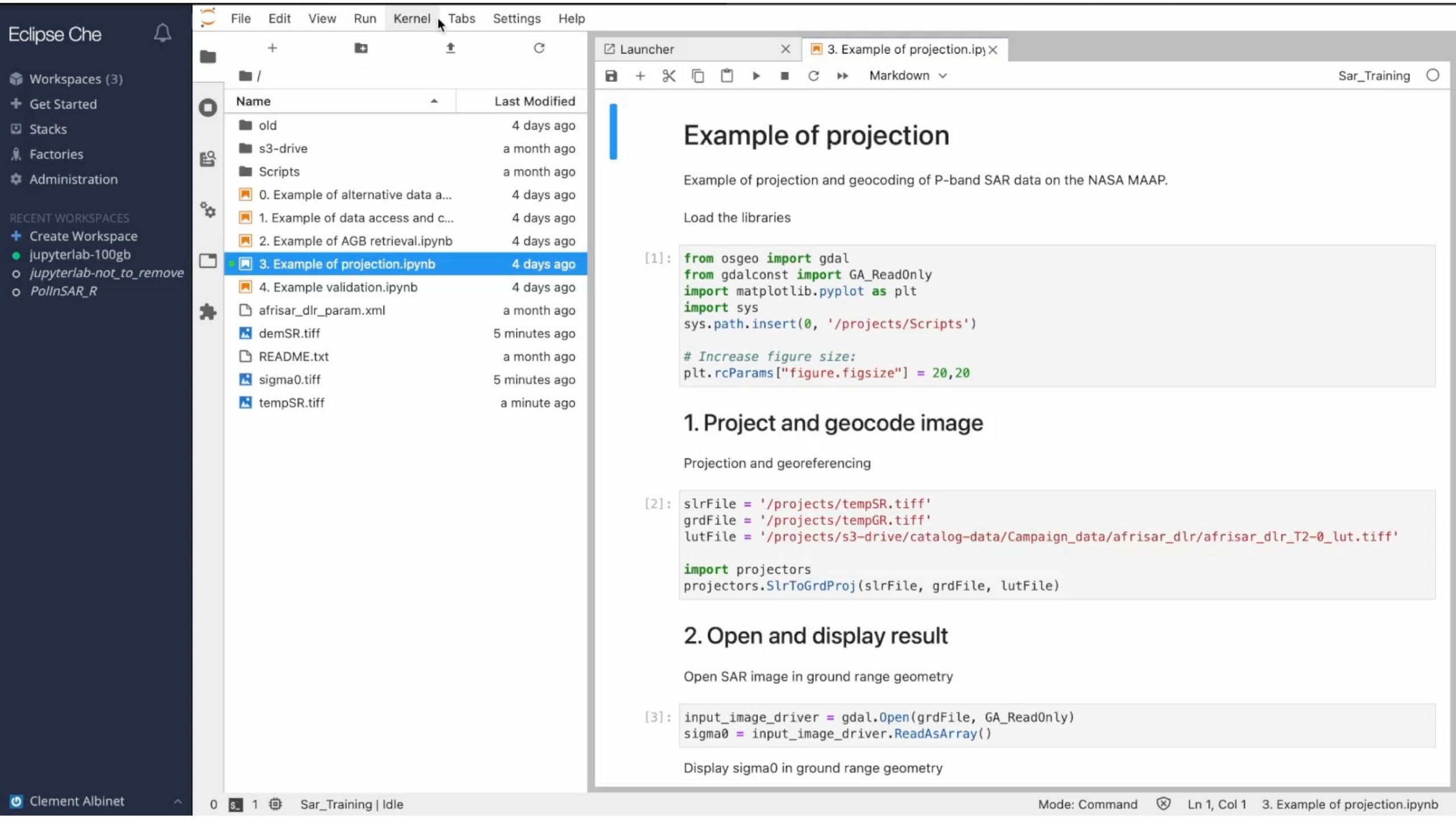
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3. Example of projection.ipy
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Sar_Training
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Example of projection and geocoding of P-band SAR data on the NASA MAAP.
Load the libraries
[1]:
from osgeo import gdal
from gdalconst import GA_ReadOnly
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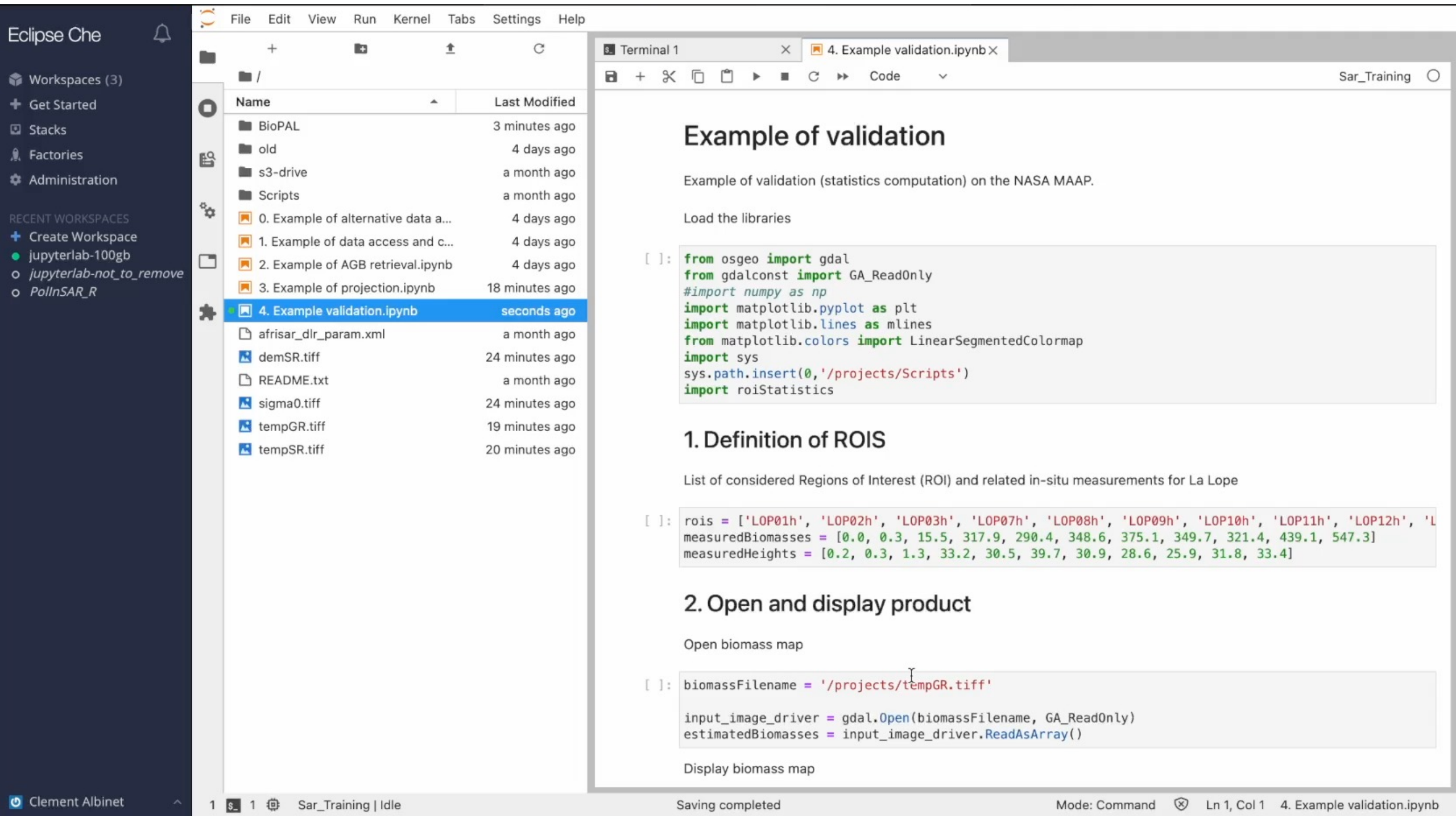
import sys
sys.path.insert(0, '/projects/Scripts')
# Increase figure size:
plt.rcParams["figure.figsize"] = 20,20
1. Project and geocode image
Projection and georeferencing
[2]:
slrFile = '/projects/tempSR.tiff'
grdFile = '/projects/tempGR.tiff'
lutFile = '/projects/s3-drive/catalog-data/Campaign_data/afrisar_dlr/afrisar_dlr_T2-0_lut.tiff'
import projectors
projectors.SlrToGrdProj(slrFile, grdFile, lutFile)
2. Open and display result
Open SAR image in ground range geometry
[3]:
input_image_driver = gdal.Open(grdFile, GA_ReadOnly)
sigma0 = input_image_driver.ReadAsArray()
Display sigma0 in ground range geometry
0 1 Sar_Training | Idle
Mode: Command
Ln 1, Col 1
3. Example of projection.ipynb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3. Example of projection.ipynb 18 minutes ago
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demSR.tiff 24 minutes ago
README.txt a month ago
sigma0.tiff 24 minutes ago
tempGR.tiff 19 minutes ago
tempSR.tiff 20 minutes ago
Terminal 1
4. Example validation.ipynb
Code
Sar_Training
Example of validation
Example of validation (statistics computation) on the NASA MAAP.
Load the libraries
[ ]:
from osgeo import gdal
from gdalconst import GA_ReadOnly
#import numpy as np
import matplotlib.pyplot as plt
import matplotlib.lines as mlines
from matplotlib.colors import LinearSegmentedColormap
import sys
sys.path.insert(0,'/projects/Scripts')
import roiStatistics
1. Definition of ROIS
List of considered Regions of Interest (ROI) and related in-situ measurements for La Lope
[ ]:
rois = ['LOP01h', 'LOP02h', 'LOP03h', 'LOP07h', 'LOP08h', 'LOP09h', 'LOP10h', 'LOP11h', 'LOP12h', 'L
measuredBiomasses = [0.0, 0.3, 15.5, 317.9, 290.4, 348.6, 375.1, 349.7, 321.4, 439.1, 547.3]
measuredHeights = [0.2, 0.3, 1.3, 33.2, 30.5, 39.7, 30.9, 28.6, 25.9, 31.8, 33.4]
2. Open and display product
Open biomass map
[ ]:
biomassFilename = '/projects/tempGR.tiff'
input_image_driver = gdal.Open(biomassFilename, GA_ReadOnly)
estimatedBiomasses = input_image_driver.ReadAsArray()
Display biomass map
1 1 Sar_Training | Idle
Saving completed
Mode: Command
Ln 1, Col 1
4. Example validation.ipynb

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Under update

1

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NASA esa

MAAP is a collaboration between NASA and ESA.

NASA MAAP

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portal.dev.esa-maap.org/portal-dev/ESA/home

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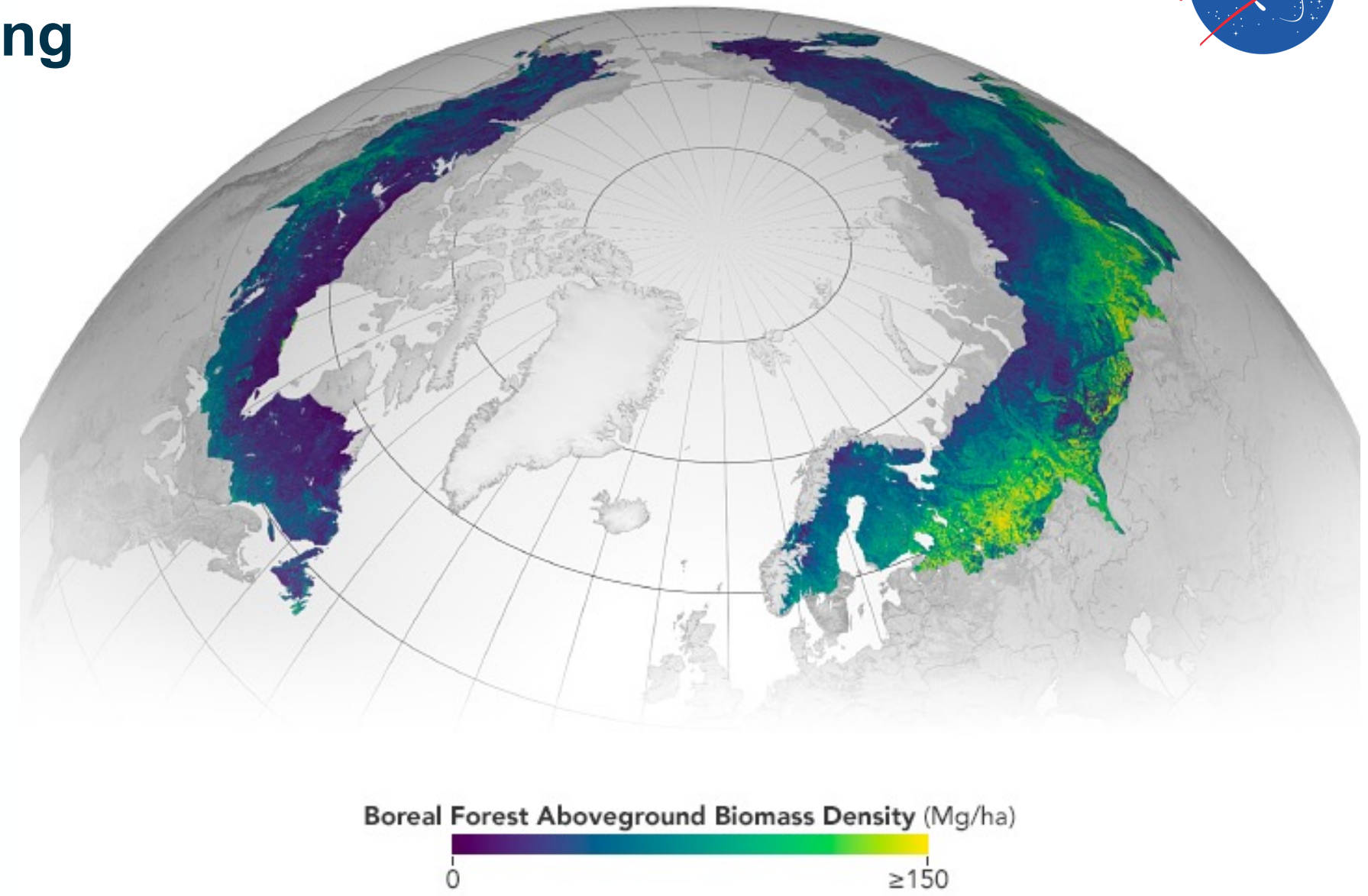
Latest News

NASA: ICESat-2 data fill GEDI's northern data gap for global lidar mapping

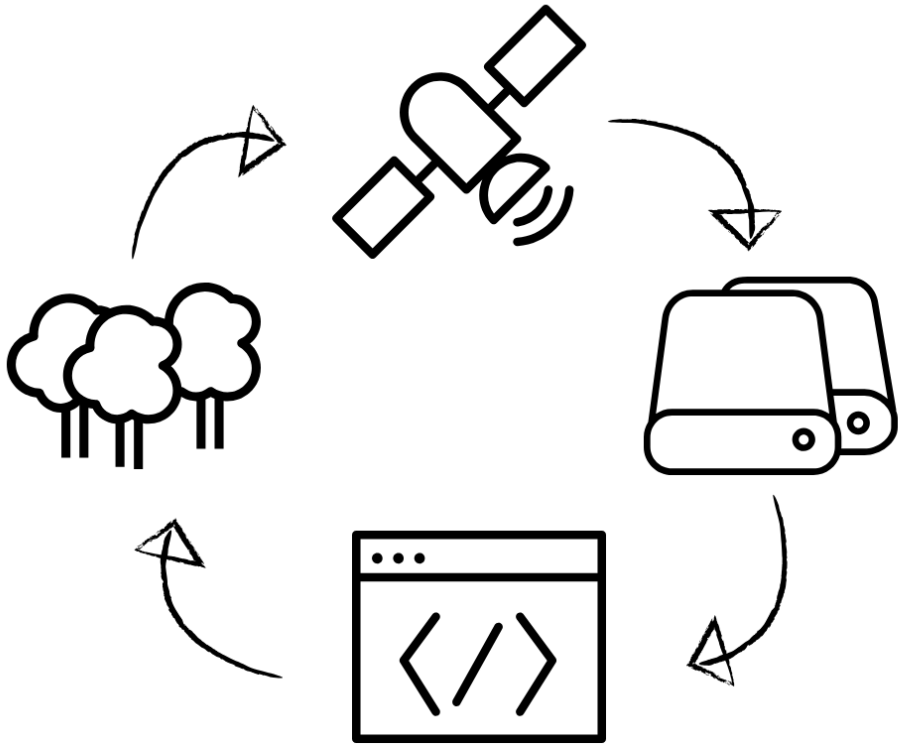
Open science product created on the ESA-NASA MAAP.

Explore this map here: **https://earthdata.nasa.gov/maap-biomass**



Conclusion

- The MAAP will make connections between data, algorithms, software and results.
- The MAAP brings together data from various spaceborne missions from various organizations to support development of global biomass maps.
- BioPAL and the Concept of the Product Algorithm Laboratory make it easier to reproduce results and build from existing work.
- The concept of MAAP will become the baseline for all the future ESA missions.



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