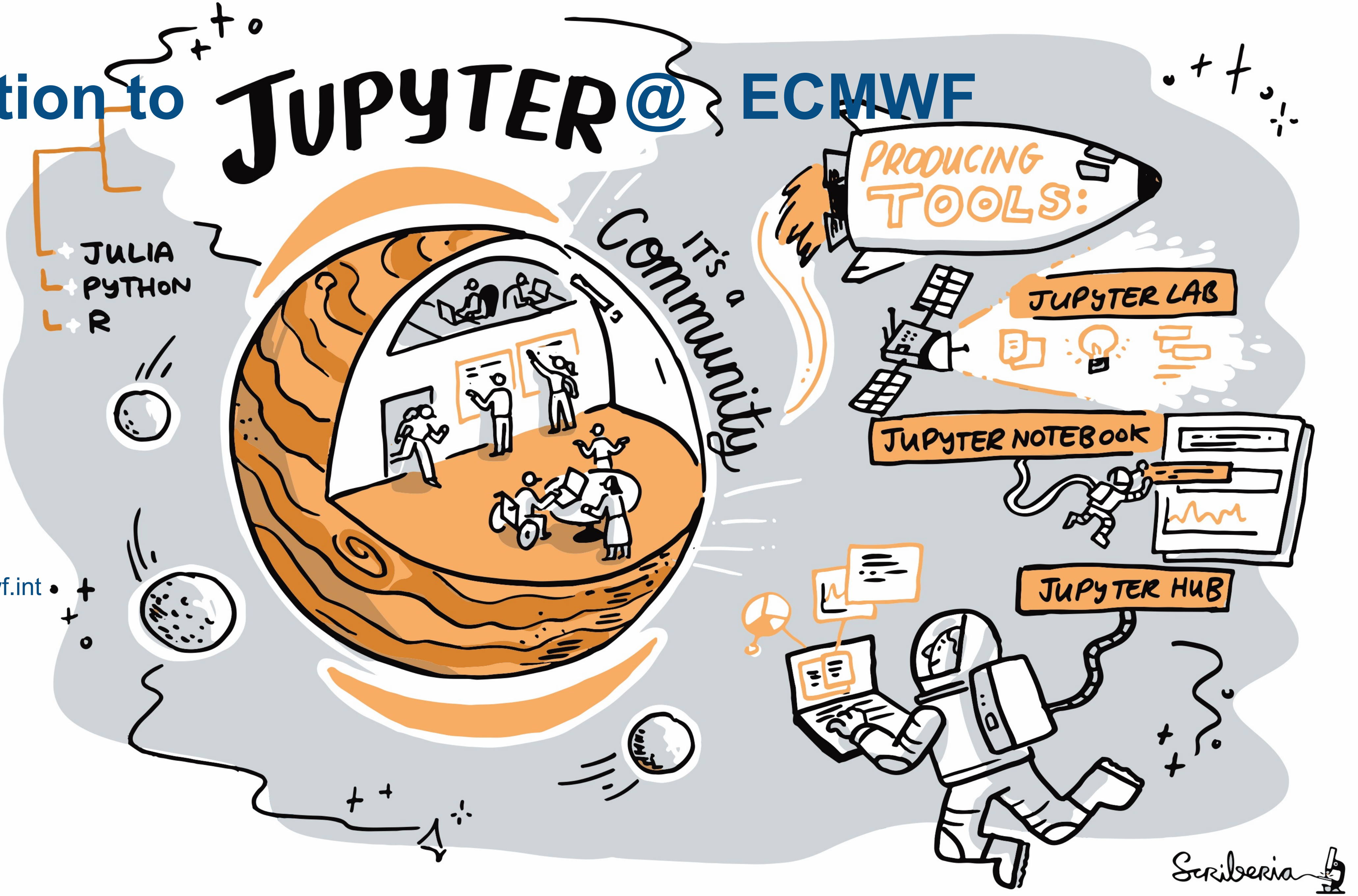
Introduction to JUPYTER@ ECMWF



Milana Vučković

milana.vuckovic@ecmwf.int

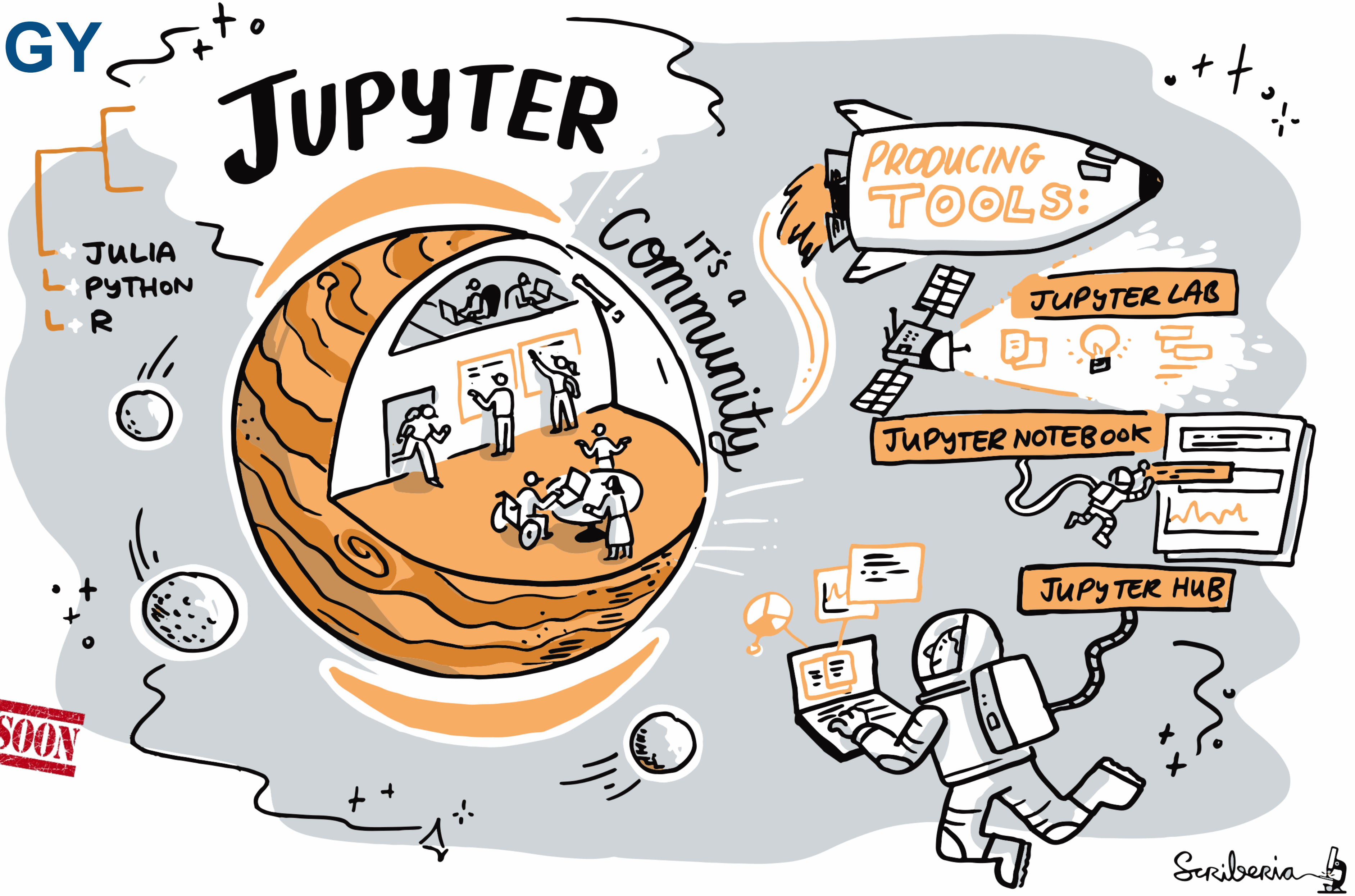
TERMINOLOGY

jupyter

jupyterlab

jupyterhub

COMING SOON

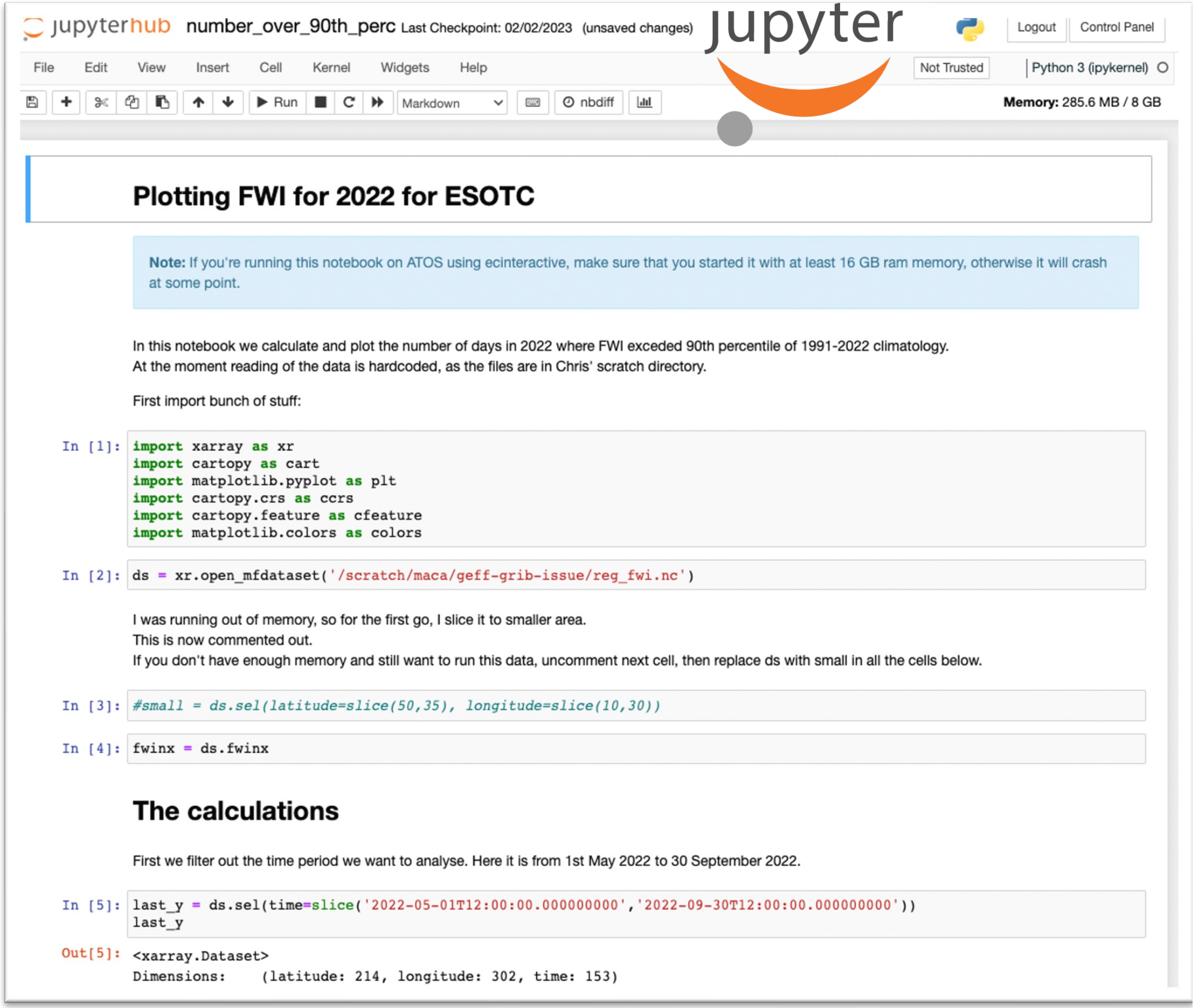


TERMINOLOGY

Jupyter Notebook

A notebook document (file extension **.ipynb**)
is a document that can be rendered in a web browser

- It is a file, which stores your work in JSON format
- Based on a set of open standards for interactive computing
- Allows development of custom applications with embedded interactive computing.
- Can be extended by third parties



Plotting FWI for 2022 for ESOTC

Note: If you're running this notebook on ATOS using ecinteractive, make sure that you started it with at least 16 GB ram memory, otherwise it will crash at some point.

In this notebook we calculate and plot the number of days in 2022 where FWI exceded 90th percentile of 1991-2022 climatology.
At the moment reading of the data is hardcoded, as the files are in Chris' scratch directory.

First import bunch of stuff:

```
In [1]: import xarray as xr
        import cartopy as cart
        import matplotlib.pyplot as plt
        import cartopy.crs as ccrs
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        import matplotlib.colors as colors

In [2]: ds = xr.open_mfdataset('/scratch/maca/geff-grib-issue/reg_fwi.nc')
```

I was running out of memory, so for the first go, I slice it to smaller area.
This is now commented out.
If you don't have enough memory and still want to run this data, uncomment next cell, then replace ds with small in all the cells below.

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In [3]: #small = ds.sel(latitude=slice(50,35), longitude=slice(10,30))

In [4]: fwinx = ds.fwinx
```

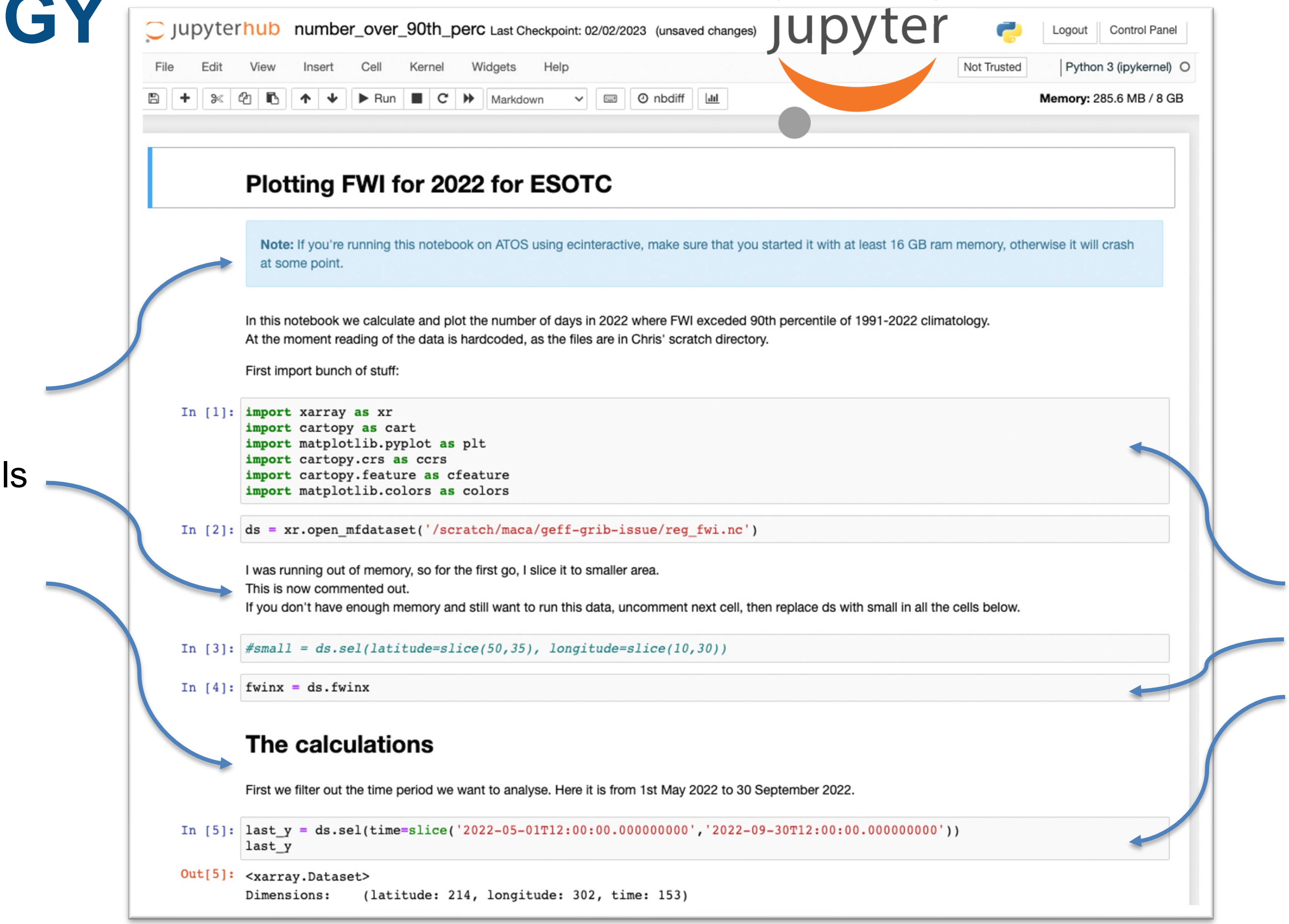
The calculations

First we filter out the time period we want to analyse. Here it is from 1st May 2022 to 30 September 2022.

```
In [5]: last_y = ds.sel(time=slice('2022-05-01T12:00:00.000000000','2022-09-30T12:00:00.000000000'))
        last_y

Out[5]: <xarray.Dataset>
        Dimensions:    (latitude: 214, longitude: 302, time: 153)
```

TERMINOLOGY



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Out[5]: <xarray.Dataset>
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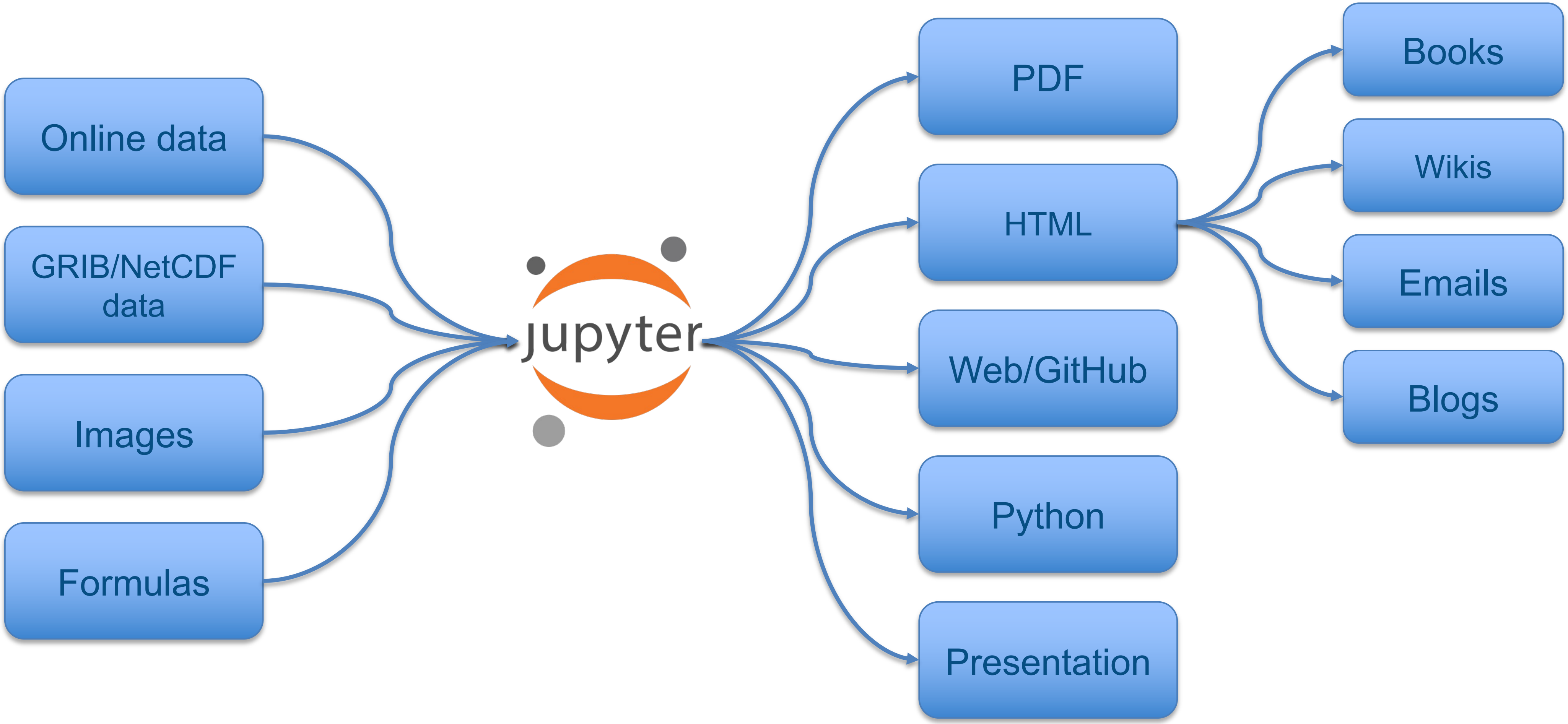
Markdown cells

Code cells

TERMINOLOGY



Online data

GRIB/NetCDF data

Images

Formulas

jupyter

PDF

HTML

Web/GitHub

Python

Presentation

Books

Wikis

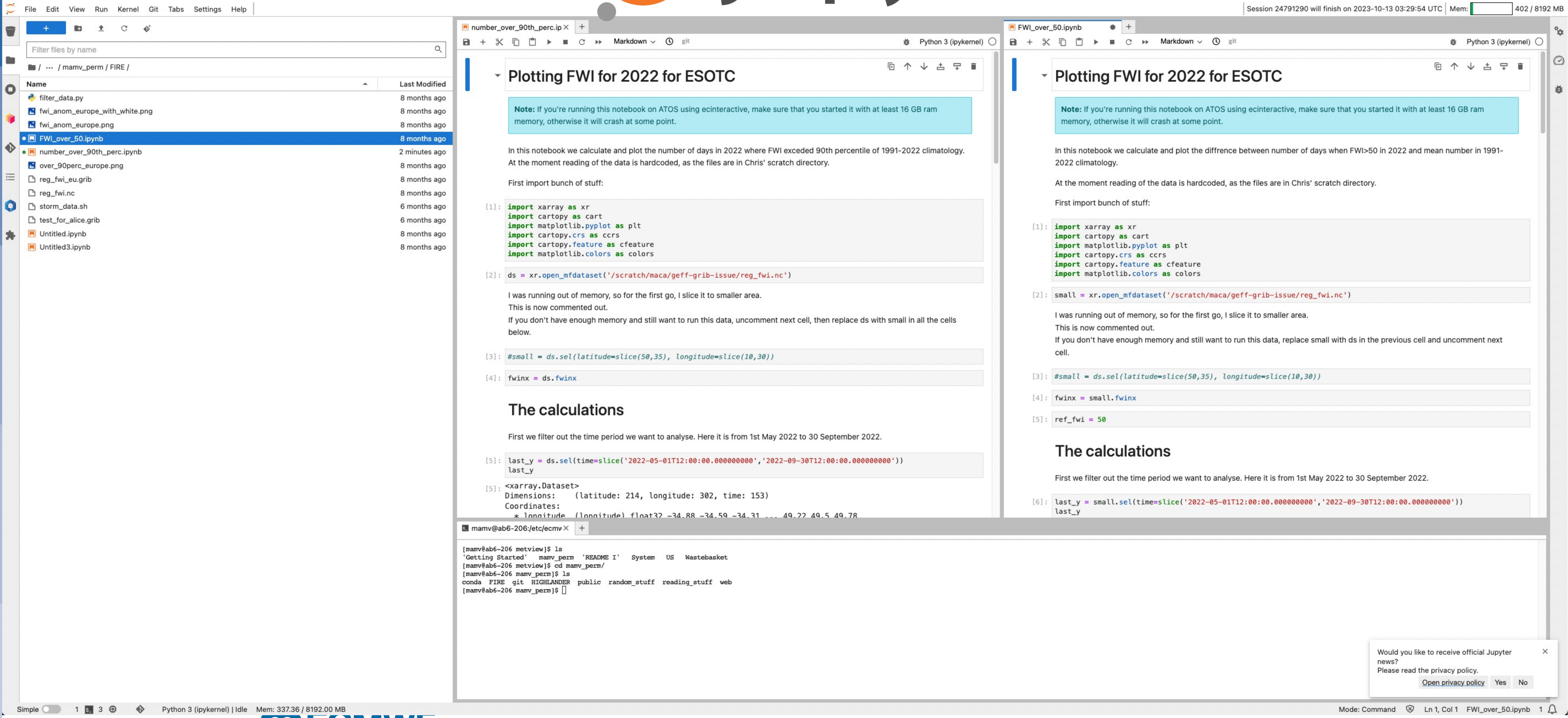
Emails

Blogs

Documentation: https://jupyter-notebook.readthedocs.io/

TERMINOLOGY

jupyterlab



Name	Last Modified
filter_data.py	8 months ago
fwi_anom_europe_with_white.png	8 months ago
fwi_anom_europe.png	8 months ago
FWI_over_50.ipynb	8 months ago
number_over_90th_perc.ipynb	2 minutes ago
over_90perc_europe.png	8 months ago
reg_fwi_eu.grib	8 months ago
reg_fwi.nc	8 months ago
storm_data.sh	6 months ago
test_for_alice.grib	6 months ago
Untitled.ipynb	8 months ago
Untitled3.ipynb	8 months ago

Plotting FWI for 2022 for ESOTC

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```

```
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     last_y
```

```
[5]: <xarray.Dataset>
     Dimensions:     (latitude: 214, longitude: 302, time: 153)
     Coordinates:
       * longitude  (longitude) float32 -34.88 -34.59 -34.31 ... 49.22 49.5 49.78
```

Plotting FWI for 2022 for ESOTC

Note: If you're running this notebook on ATOS using ecinteractive, make sure that you started it with at least 16 GB ram memory, otherwise it will crash at some point.

In this notebook we calculate and plot the diffrence between number of days when FWI>50 in 2022 and mean number in 1991-2022 climatology.

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```

```
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```

```
[5]: ref_fwi = 50
```

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```
[6]: last_y = small.sel(time=slice('2022-05-01T12:00:00.000000000','2022-09-30T12:00:00.000000000'))
     last_y
```

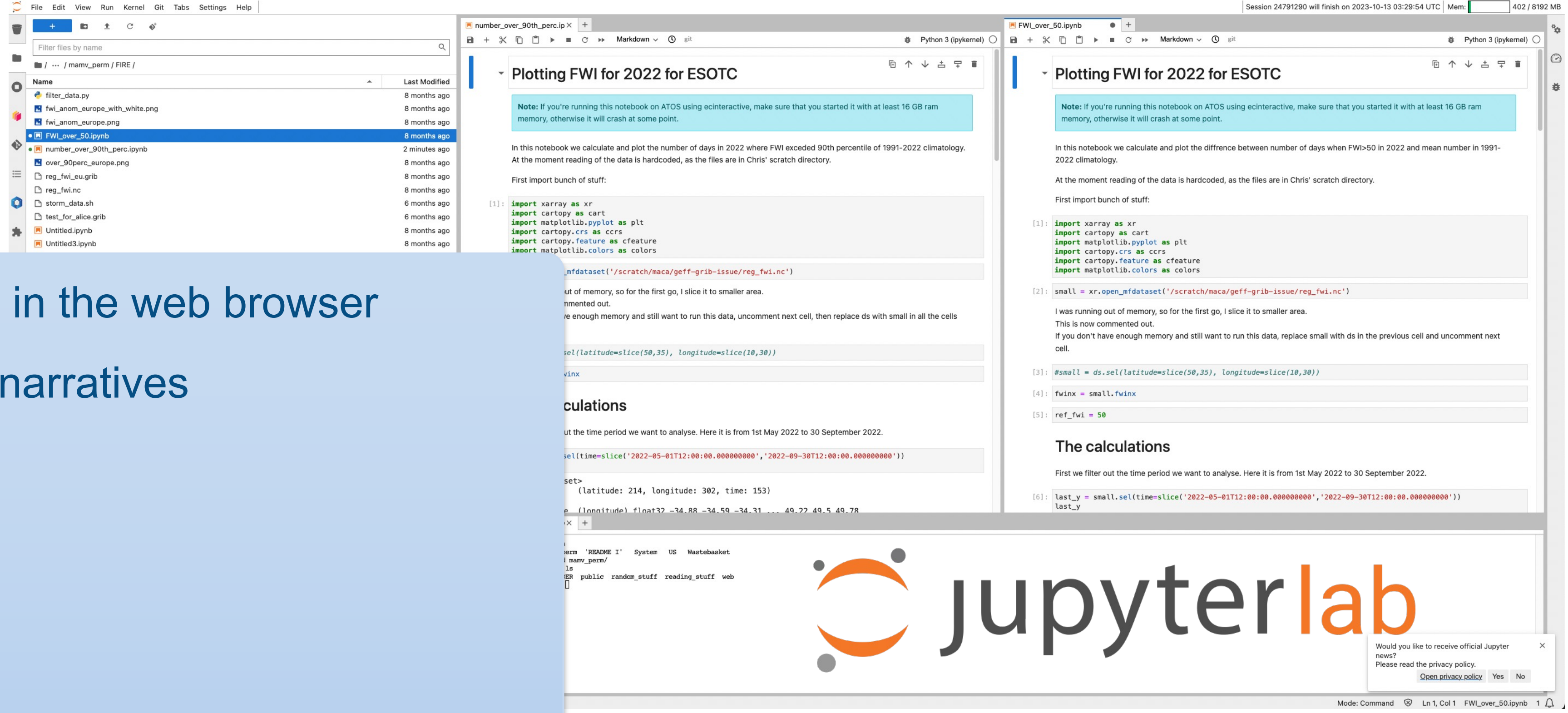
```
[mamv@ab6-206 metview]$ ls
'Getting Started'   mamv_perm  'README I'   System   US   Wastebasket
[mamv@ab6-206 metview]$ cd mamv_perm/
[mamv@ab6-206 mamv_perm]$ ls
conda  FIRE  git  HIGHLANDER  public  random_stuff  reading_stuff  web
[mamv@ab6-206 mamv_perm]$ 
```

Would you like to receive official Jupyter news?
Please read the privacy policy.
Open privacy policy   Yes   No

ECMWF EUROPEAN CENTRE FOR MEDIUM-RANGE WEATHER FORECASTS

Documentation: https://jupyterlab.readthedocs.io/en/latest/getting_started/overview.html

TERMINOLOGY



Session 24791290 will finish on 2023-10-13 03:29:54 UTC   Mem: 402 / 8192 MB

/ … / mamv_perm / FIRE /

Name	Last Modified
filter_data.py	8 months ago
fwi_anom_europe_with_white.png	8 months ago
fwi_anom_europe.png	8 months ago
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```
_mfdataset('/scratch/maca/geff-grib-issue/reg_fwi.nc')
```

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sel(latitude=slice(50,35), longitude=slice(10,30))
```

```
winx
```

culations

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```

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e  (longitude) float32 -34.88 -34.59 -34.31 ... 49.22 49.5 49.78
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erm  'README I'   System   US   Wastebasket
 mamv_perm/
 ls
ER  public  random_stuff  reading_stuff  web
```

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Would you like to receive official Jupyter news?
Please read the privacy policy.

Mode: Command   Ln 1, Col 1   FWI_over_50.ipynb   1

- **Interactive** working environment in the web browser
- For the creation of reproducible narratives
- Jupyter = Julia + Python + R

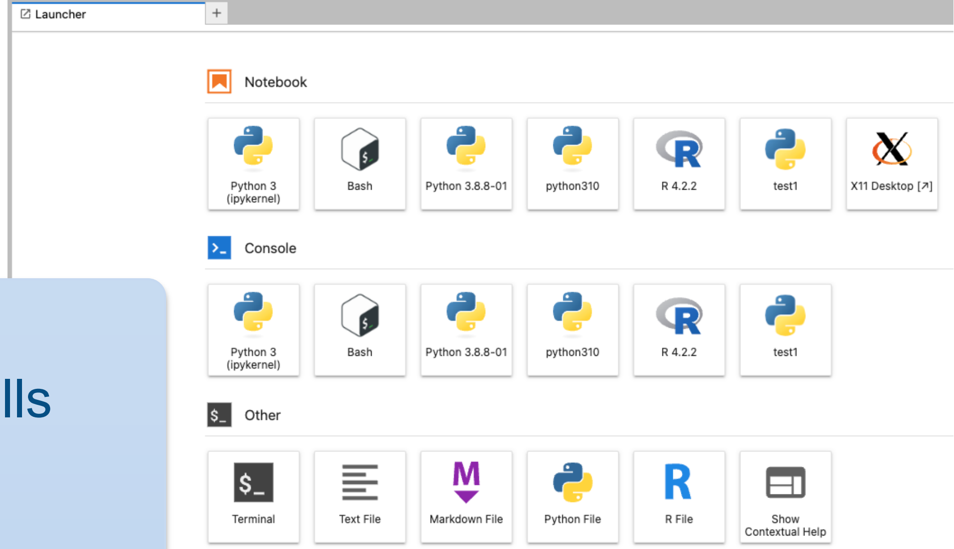
Multi-purpose working environment

- Language agnostic
- Supports execution environments (“kernels”)
  - For dozens of languages: Python, R, Julia, C++, ...
- Extensible software design („extensions“)
  - Many server/client plug-ins available
  - Eg. in-browser-terminal, git, file-browsing, modules

Documentation: https://jupyterlab.readthedocs.io/en/latest/getting_started/overview.html

TERMINOLOGY

What is a Jupyter Kernel?



Jupyter Kernel
A “kernel” refers to the separate process which executes code cells within a Jupyter notebook.

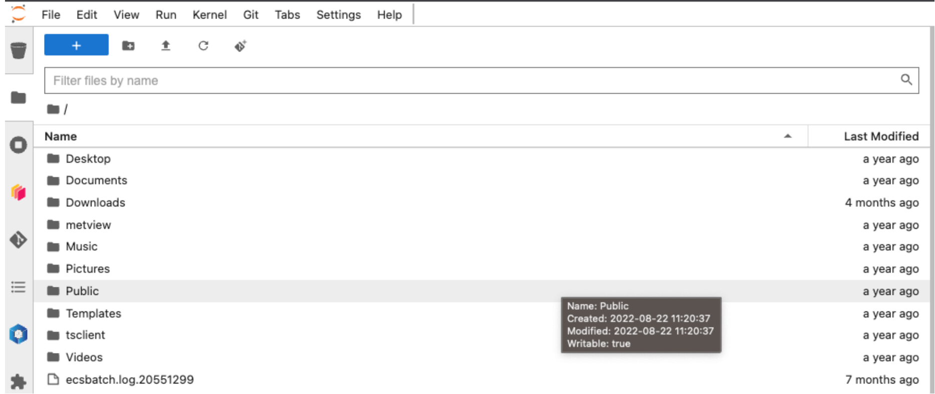
Jupyter Kernel

- **run code** in different programming languages and environments
- can **be connected** to a notebook (one at a time)
- communicates via ZeroMQ with the JupyterLab
- Multiple **preinstalled** Jupyter Kernels can be found on our clusters (Python, R, Bash)
- You can **create your own kernel** which for example runs your specialized virtual Python environment.

Documentation: https://jupyterlab.readthedocs.io/en/stable/user/running.html

TERMINOLOGY

What is a JupyterLab Extension?



Name	Last Modified
Desktop	a year ago
Documents	a year ago
Downloads	4 months ago
metview	a year ago
Music	a year ago
Pictures	a year ago
Public	a year ago
Templates	a year ago
tsclient	a year ago
Videos	a year ago
ecsbatch.log.20551299	7 months ago

Name: Public
Created: 2022-08-22 11:20:37
Modified: 2022-08-22 11:20:37
Writable: true

JupyterLab Extension

JupyterLab extensions can customize or enhance any part of JupyterLab.

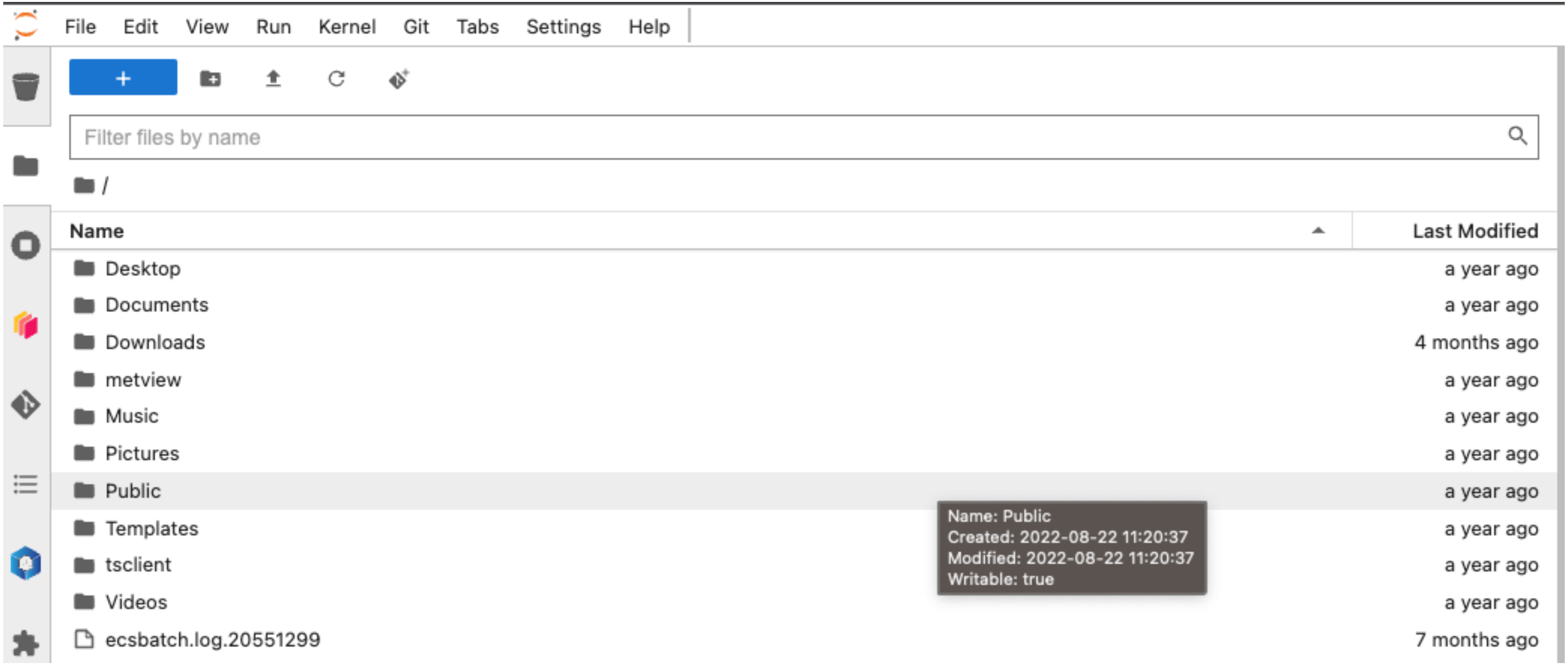
JupyterLab Extensions

- provide new file viewers, editors, themes
- provide renderers for rich outputs in notebooks
- add items to the menu or command palette
- add keyboard shortcuts
- add settings in the settings system
- Extensions can even provide an API for other extensions to use and can depend on other extensions.

The whole JupyterLab itself is simply a collection of extensions that are no more powerful or privileged than any custom extension.

TERMINOLOGY

JupyterLab Extensions at ECMWF



Name	Last Modified
Desktop	a year ago
Documents	a year ago
Downloads	4 months ago
metview	a year ago
Music	a year ago
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Public	a year ago
Templates	a year ago
tsclient	a year ago
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TERMINOLOGY

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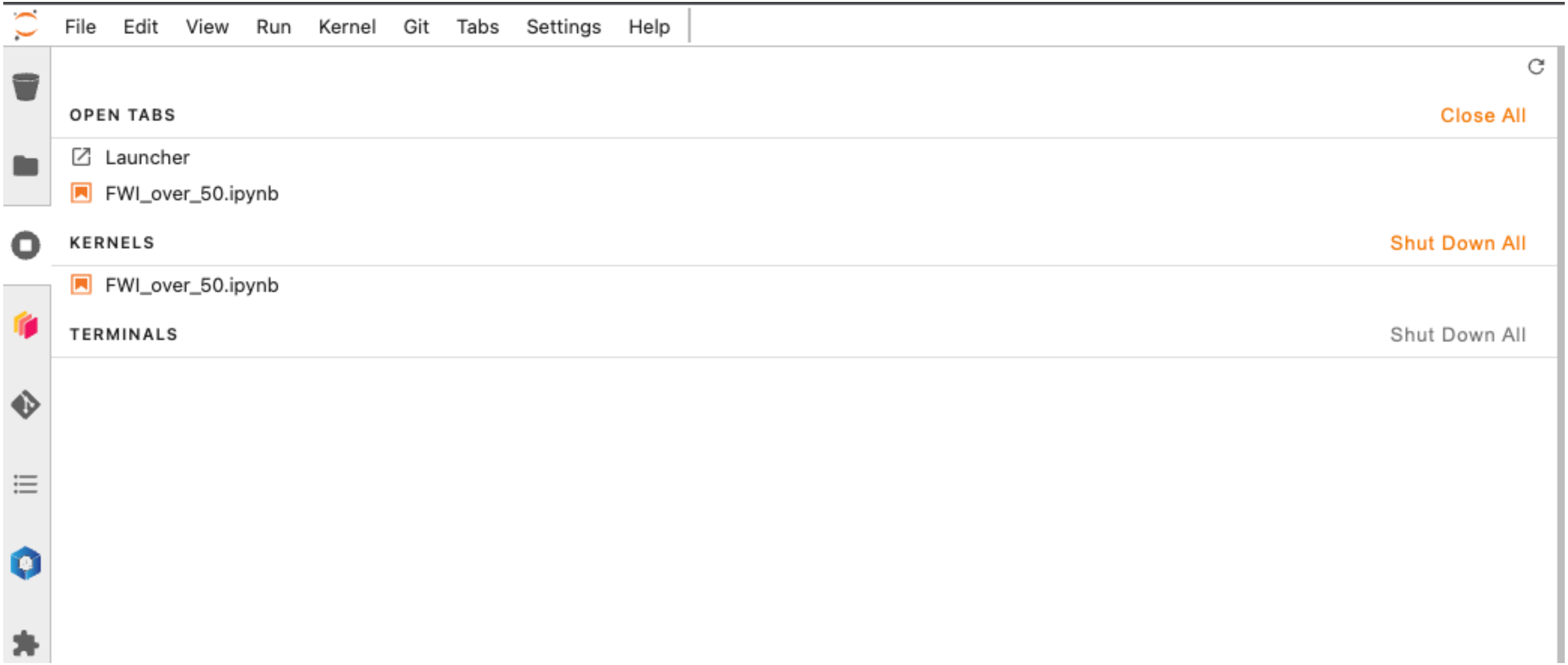


OPEN TABS — Close All

- Launcher
- FWI_over_50.ipynb

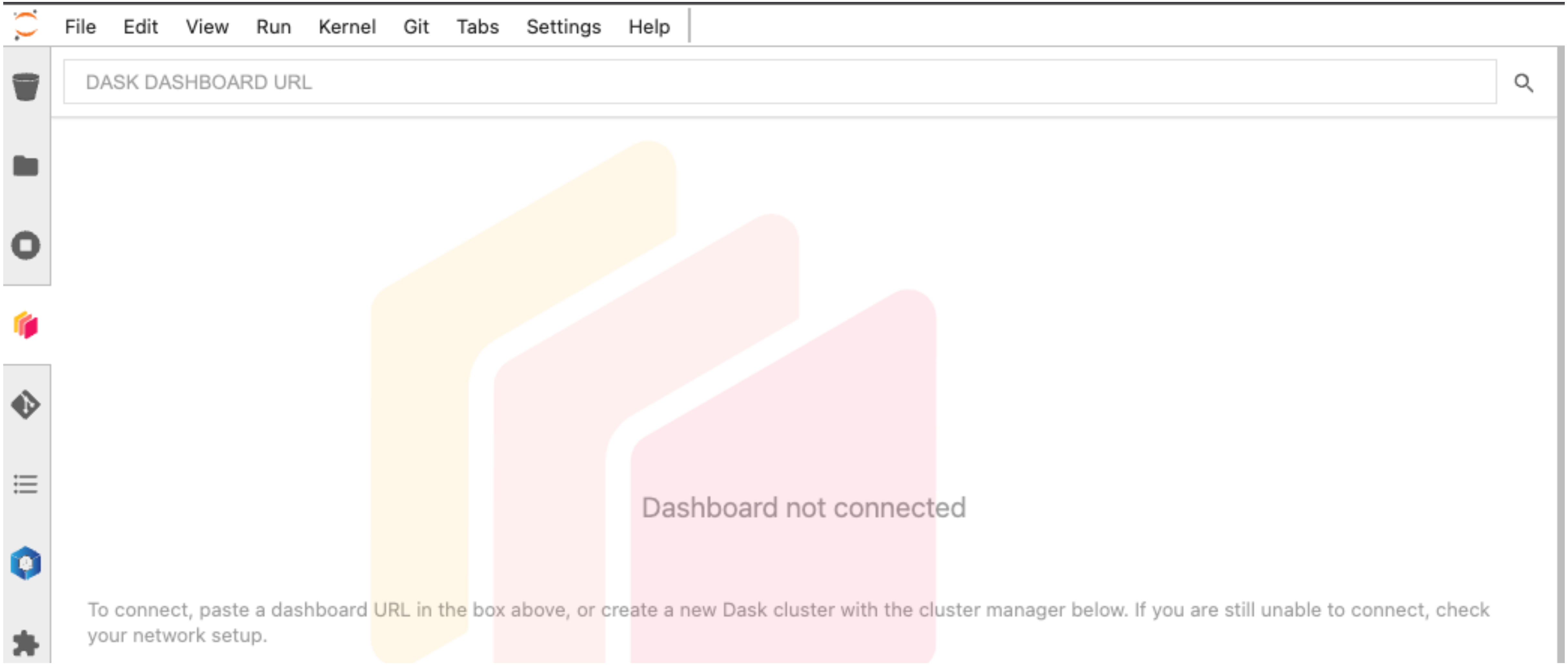
KERNELS — Shut Down All

- FWI_over_50.ipynb

TERMINALS — Shut Down All

TERMINOLOGY

JupyterLab Extensions at ECMWF



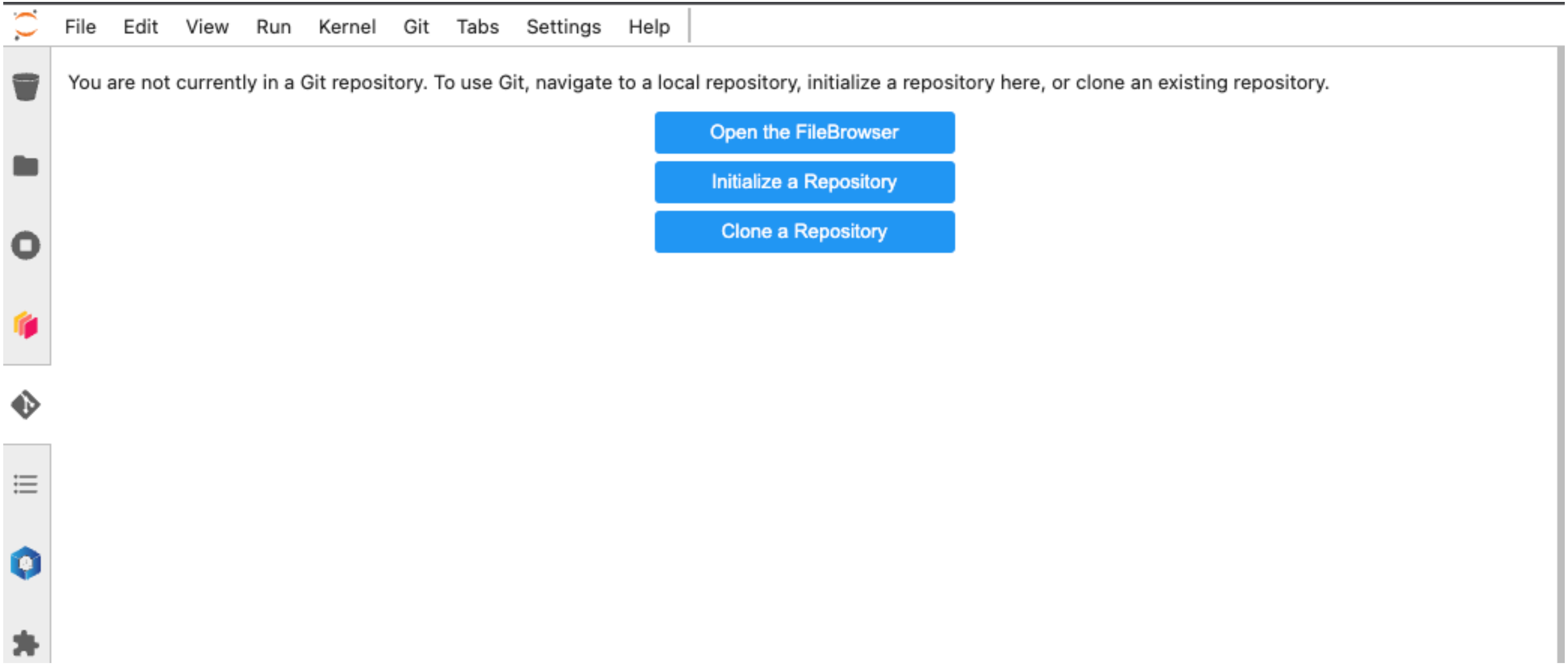
DASK DASHBOARD URL

Dashboard not connected

To connect, paste a dashboard URL in the box above, or create a new Dask cluster with the cluster manager below. If you are still unable to connect, check your network setup.

TERMINOLOGY

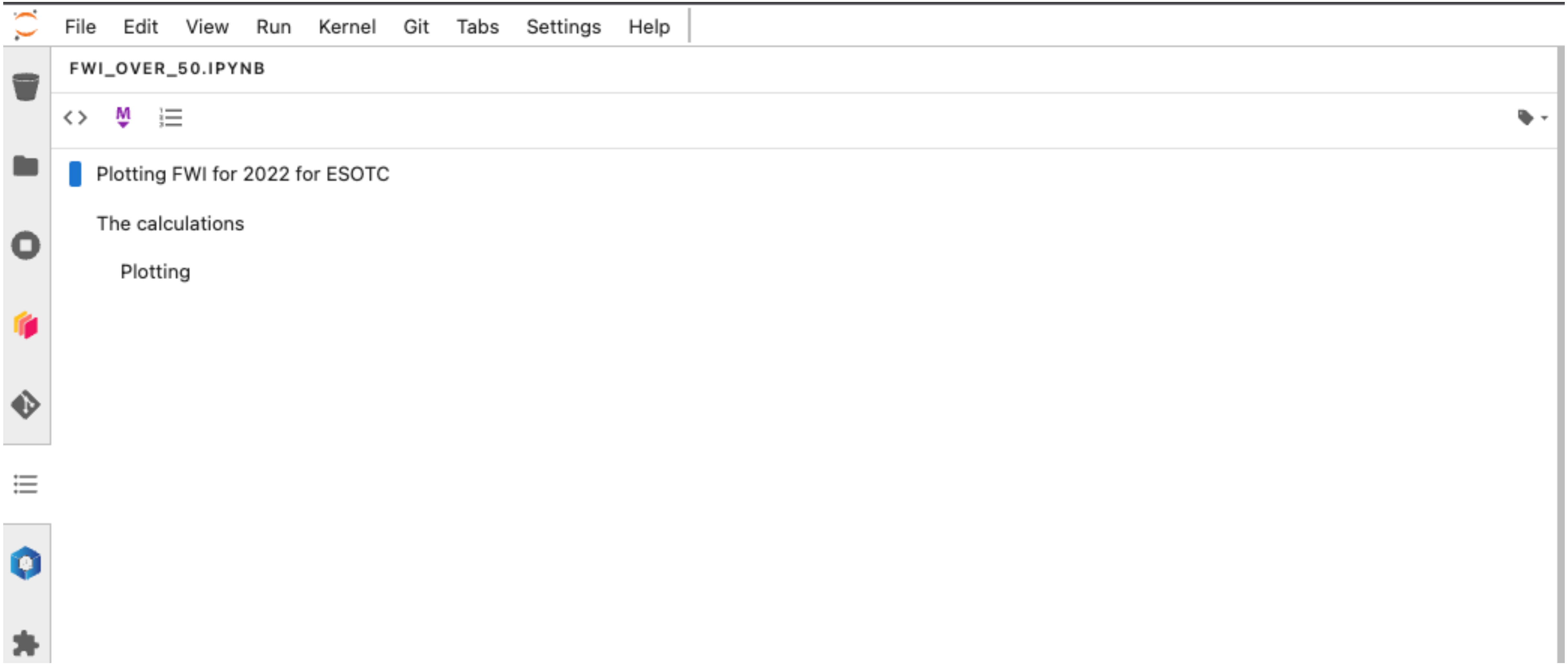
JupyterLab Extensions at ECMWF



You are not currently in a Git repository. To use Git, navigate to a local repository, initialize a repository here, or clone an existing repository.

TERMINOLOGY

JupyterLab Extensions at ECMWF



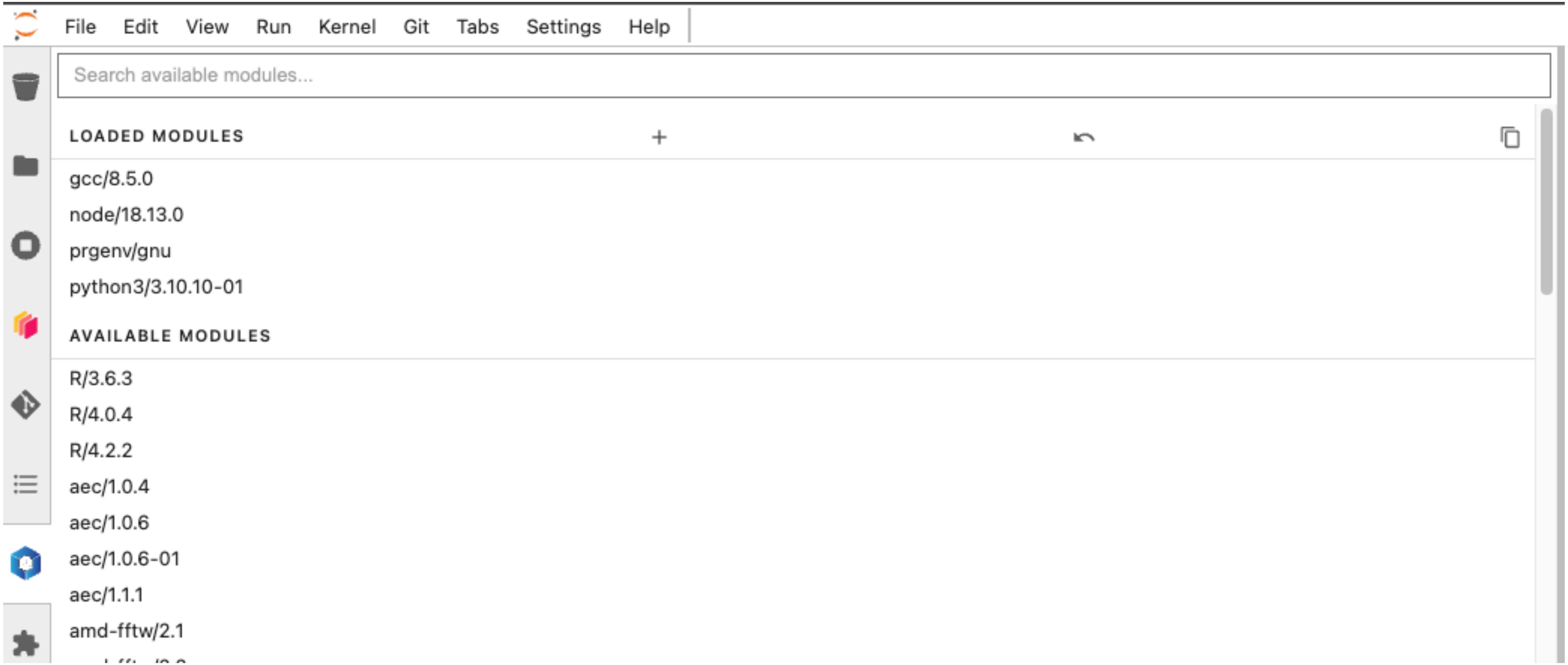
Plotting FWI for 2022 for ESOTC

The calculations

Plotting

TERMINOLOGY

JupyterLab Extensions at ECMWF



LOADED MODULES

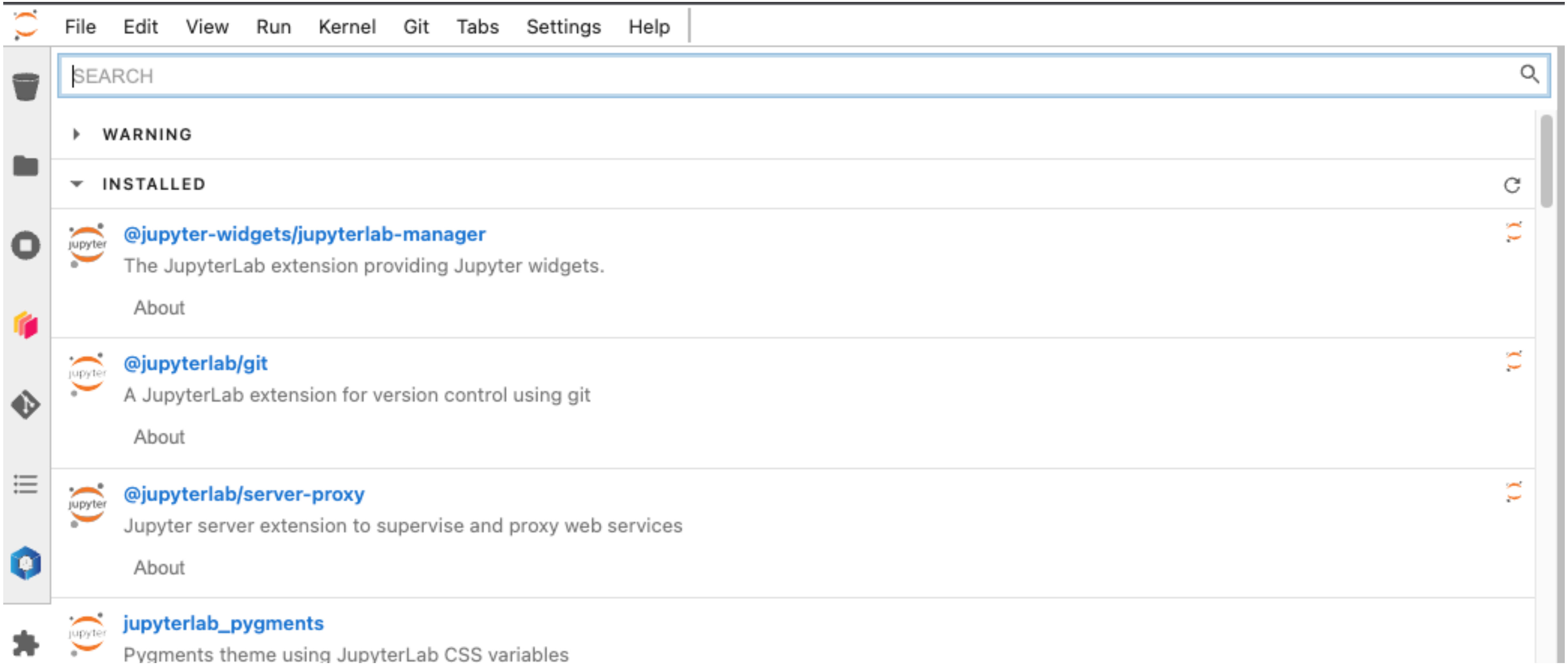
gcc/8.5.0
node/18.13.0
prgenv/gnu
python3/3.10.10-01

AVAILABLE MODULES

R/3.6.3
R/4.0.4
R/4.2.2
aec/1.0.4
aec/1.0.6
aec/1.0.6-01
aec/1.1.1
amd-fftw/2.1

TERMINOLOGY

JupyterLab Extensions at ECMWF



@jupyter-widgets/jupyterlab-manager

The JupyterLab extension providing Jupyter widgets.

About

@jupyterlab/git

A JupyterLab extension for version control using git

About

@jupyterlab/server-proxy

Jupyter server extension to supervise and proxy web services

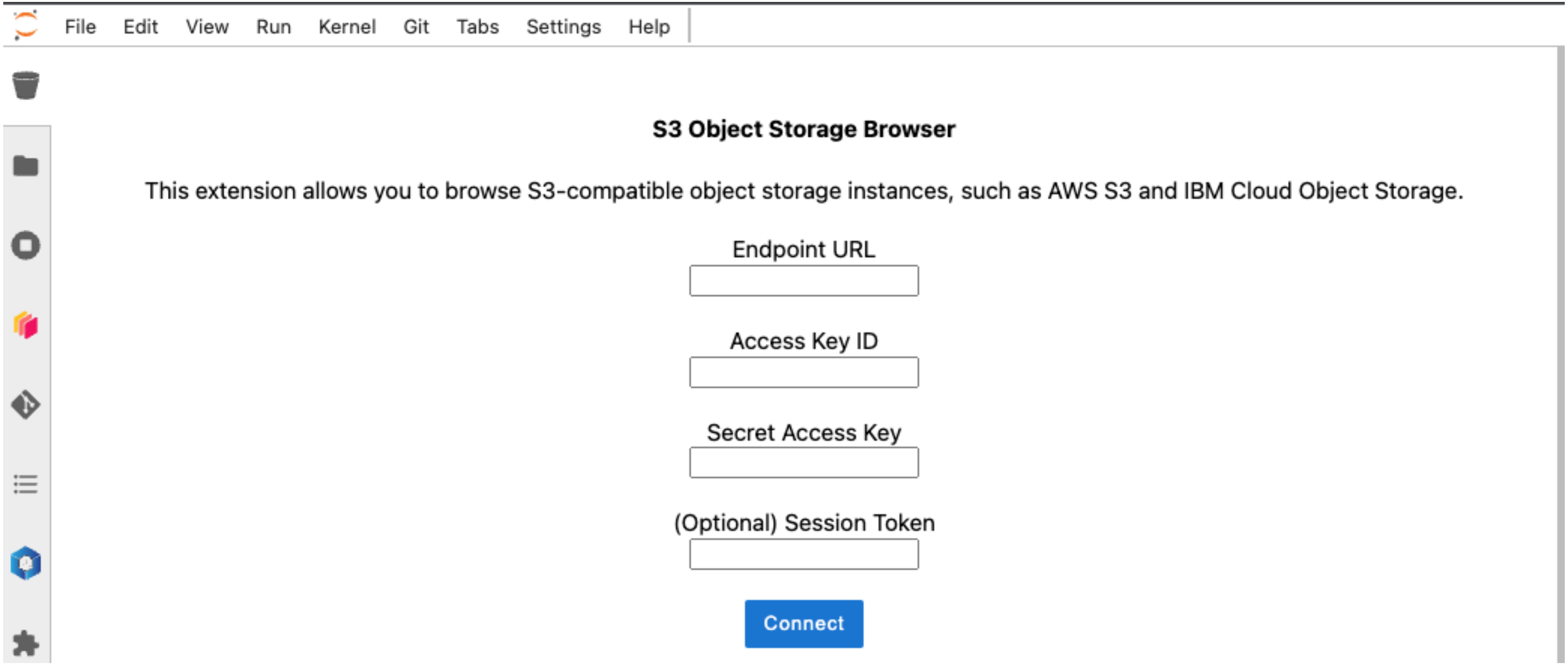
About

jupyterlab_pygments

Pygments theme using JupyterLab CSS variables

TERMINOLOGY

JupyterLab Extensions at ECMWF



S3 Object Storage Browser

This extension allows you to browse S3-compatible object storage instances, such as AWS S3 and IBM Cloud Object Storage.

Endpoint URL

Access Key ID

Secret Access Key

(Optional) Session Token

Useful links

- ECMWF ecinteractive documentation: https://confluence.ecmwf.int/display/UDOC/HPC2020%3A+Persistent+interactive+job+with+ecinteractive
- eccodes grib notebooks: https://git.ecmwf.int/projects/USS/repos/eccodes_notebooks/browse
  notebook to start: **eccodes_api_grib_ex1.ipynb**

Jupyter Documentation:

- Jupyter notebook: https://jupyter-notebook.readthedocs.io/
- JupyterLab interface: https://jupyterlab.readthedocs.io/en/stable/user/interface.html
- Files and outputs in JupyterLab: https://jupyterlab.readthedocs.io/en/stable/user/file_formats.html#