

5<sup>th</sup> Symposium | Accra, Ghana | 24 – 28 October 2022



Training  
Session





**MERCATOR  
OCEAN**  
INTERNATIONAL



**University  
Of Ghana**

# Introduction to open source EO Tools

## Copernicus Marine Service & Jupyter Notebooks

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**Welcome (5')**

**Presentation of the Copernicus Marine Service (10')**

**Group exercise (20')**

**Introduction to the Jupyter Notebook (10')**



Monitoring the Ocean for Europe

# Copernicus Marine Service



PROGRAMME OF  
THE EUROPEAN UNION



implemented by



**MERCATOR  
OCEAN**  
INTERNATIONAL



Implemented by Mercator Ocean International as part of the Copernicus Programme

Resources News Events Contact Register

Services Opportunities Access Data Use Cases User Corner About





## Copernicus Marine Service

Providing free and open marine data and services to enable marine policy implementation, support Blue growth and scientific innovation.

Access Data >

DATA	EXPERTISE	TRENDS	EXPLORATION
<b>OCEAN PRODUCTS</b> A robust ocean data catalogue, to download or visualise data including hindcasts, nowcasts and forecasts.	<b>OCEAN STATE REPORT</b> Extensive annual analysis on the state of the ocean over nearly 20 years and severe/notable annual events.	<b>OCEAN MONITORING INDICATORS</b> Essential variables monitoring the health of the ocean over the past quarter of a century.	<b>OCEAN VISUALISATION</b> Dive into our 4D digital oceans through our visualisation tool in the past, present and future.

Quick Links

 <b>User corner</b> All the info you need as a new or experienced user. Get trained, connect with the forum, get support and more.	 <b>Policy tools</b> Learn about EU and international maritime policies and how the Copernicus Marine Service supports them.	 <b>Services</b> See Copernicus Marine Use Cases, the blue markets we support, and the wide range of free and open support and services we provide.	 <b>User learning services</b> Find all the information you need to harness our service through workshops, trainings and online resources.
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Online catalogue  
[marine.copernicus.eu](https://marine.copernicus.eu)

More than 300  
scientifically  
qualified products

User driven

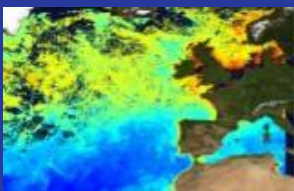
More than  
45 000 users

Open and Free

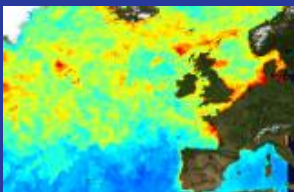
## OBSERVATIONS

### Satellite data

- **L3** – daily composite products, single/multi sensor (Along Track or gridded product)



- **L4** – daily interpolated and weekly/monthly composites



### InSitu data

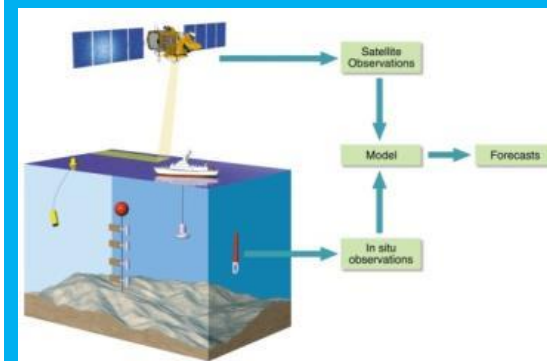
From different networks and platforms

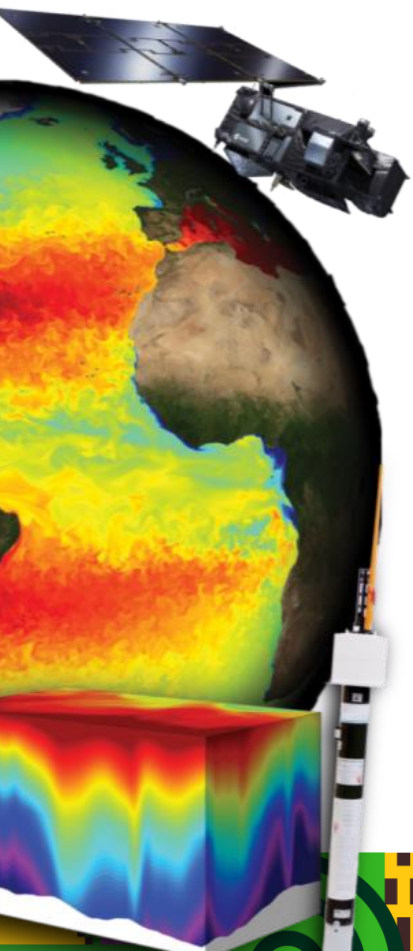


## MODELS

### 3D Model data

From 3D numerical representation of the ocean with an assimilation of « real » data





## DATA SOURCES

INSITU DATA

SATELLITE DATA

MODEL DATA

## TEMPORAL COVERAGE

REANALYSES

~25 years

REAL-TIME

Daily, hourly

FORECAST







5 to 10 days

## GEOGRAPHICAL COVERAGE








- 1 Global
- 2 Arctic
- 3 Baltic
- 4 NWS
- 5 IBI
- 6 Med Sea
- 7 Black Sea








## BLUE OCEAN

-  Temperature
-  Salinity
-  Currents
-  Waves
-  Sea Surface Elevation
-  Wind
- Others

## GREEN OCEAN

-  Primary Production
-  Transparency/Turbidity
-  Reflectance
-  Oxygen
-  Low and mid-trophic levels
-  Nutrients
-  Carbonate System
- Others

## WHITE OCEAN

-  Sea Ice Concentration & Thickness
-  Sea Ice Extent
-  Sea Ice Velocity
-  Snow
-  Ice Surface Temperature
- Others





# User journey

Discover the products



Find the Relevant product(s)



Access the product(s)



Use the product(s)

Information

Product sheets, OMI / Ocean State Report

Notifications

Use Cases

User support (FAQ, tutorials,...)

Tools

MyOcean Viewers

E-Learning material

Catalogue of products

Plugins & API

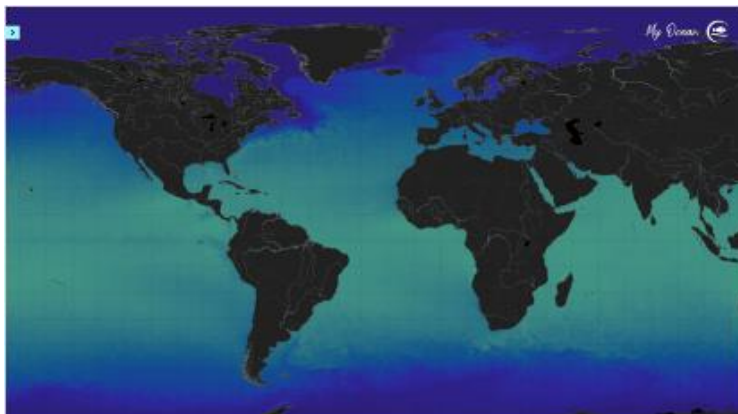
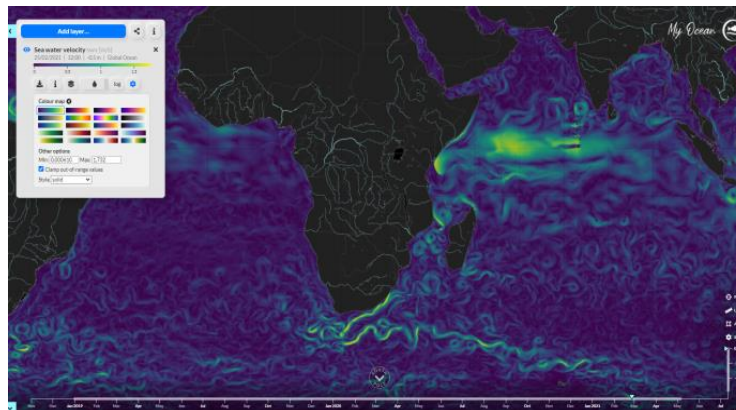
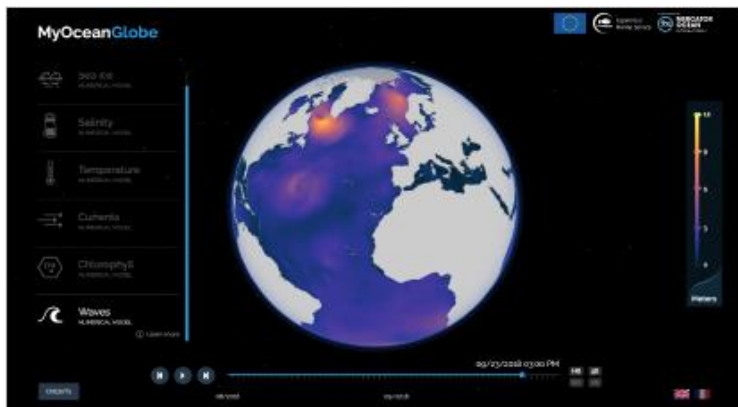
Events

Webinars

Regular Training workshops

Tailored workshops





**MyOceanLEARN** - Understand key variables

**MyOceanLIGHT** - Access key variables

**MyOceanPRO** - Access the full catalogue



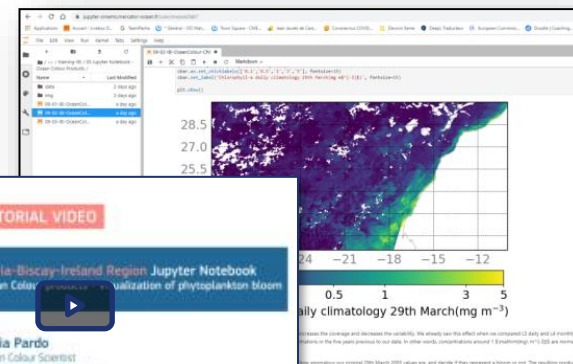
## Organisation of special events

- **2021 #MarineData4Africa training workshop**
  - ✓ Participants 1291 (935 African)
  - ✓ Countries 83 (46 African countries)
  - ✓ **Next session in 2023**
- **2022 #OceanChallenge4Africa hackathon**
  - ✓ Unique registrants 845 (817 African)
  - ✓ Countries 66 (50 African)
  - ✓ **WEkEO Hackathon in 2023**



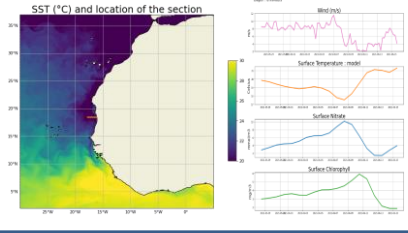
## E-learning material

- Jupyter Notebooks
- Tutorial videos recorded by experts
- Other training videos available (GIS, Service Desk...)
- User manual with all the links

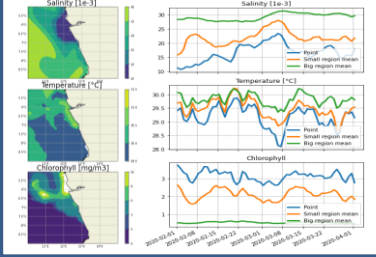


## Jupyter Notebooks

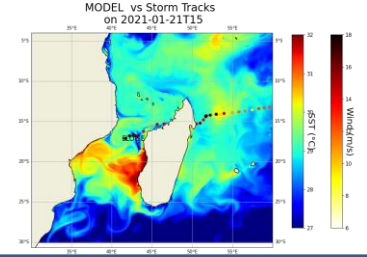
### Upwelling



### River Discharge



### Cyclone



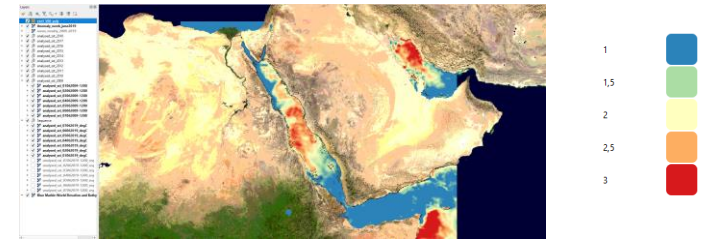
### In Situ

## QGIS Tutorials

### Current, Waves and Maritie Safety



### Marine Heat Waves in the Red Sea

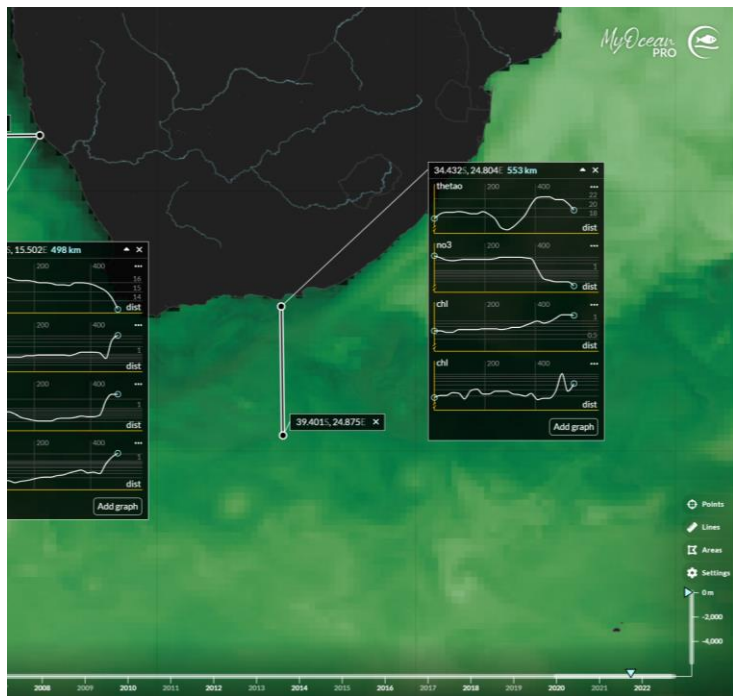


Hands-on exercise

# MyOcean Pro



## Monitoring upwellings on the African coasts (1/4)



**Objectives:** Display the correlation between Nitrate, Temperature and Chlorophyll concentration to characterise the Benguela upwelling. Comparison model and satellite products.

**Details:**

<b>Variables</b>	<b>Chlorophyll, Temperature, Phosphate, pH</b>
<b>Products</b>	GLOBAL_ANALYSIS_FORECAST_BIO_001_028 GLOBAL_ANALYSIS_FORECAST_PHY_001_024 OCEANCOLOUR_GLO_BGC_L4_MY_009_104
<b>Zone</b>	Africa South/South West – Namibia/SA coasts
<b>Date</b>	30/01/2022 - 28/09/2021

[marine.copernicus.eu](http://marine.copernicus.eu)



## Monitoring upwellings on the African coasts (2/4)

### Part 1 – Search and display the variables

1. **Add a new layer** with the daily mean temperature (thetao) between 15 and 30°C from a model product GLOBAL\_ANALYSIS\_FORECAST\_PHY\_001\_024 and select the 30/01/2022 using the time slider.
2. **Add a new layer** with the daily mean chlorophyll concentration (Chl) between 0.05 and 5 mg/m<sup>3</sup> and the mole concentration of nitrate in sea water (nO3) between 0,0001 and 100 mmol/m<sup>3</sup> from the model product GLOBAL\_ANALYSIS\_FORECAST\_BIO\_001\_028

#### Tips #1

Enter the code XXX\_XXX of your product in the free-text search area.

#### Tips #2

After the selection of the product, you have to select a dataset which are sorted mainly by frequency of update (daily, hourly...)

#### Tips #3

To change the boundaries, click on the  icon



## Monitoring upwellings on the African coasts (3/4)

### Part 2 – Plot graphs

1. Define a vertical line from the location 39.4 S/24.8 E to the coast in a South-North direction and plot the graphs for the temperature, the chlorophyll, and the nitrate.
2. Define a horizontal line from the location 27.886 S/10.439 E to the coast in a West-East direction and plot the graphs for the temperature, the chlorophyll, and the nitrate.
3. Analyse the graphs at different depth (0m, 20m, 50m). Making hypothesis about the evolution of the chlorophyll and the temperature in the 2 regions.

#### Tips #4

To draw a line, select the button « Lines » at the bottom right of your screen and then click and drag to draw the line and plot the graph.

#### Tips #5

To add a new graph, select « Add graph » and choose the graph among the selection.





## Monitoring upwellings on the African coasts (4/4)

### Part 3 – Download and share results

1. Change the date 28/09/2021 and **validate/invalidate your hypotheses.**
2. Download a picture with all your graphs. Send me your result on circle!

**To go further:** Compare the chlorophyll mass concentration provided by the model and a satellite observation L4 gap-free multi (OCEANCOLOUR\_GLO\_BGC\_L4\_MY\_009\_104) and see the difference of resolution, particularly on the graphs for the vertical line.

### Tips #6

To change the date, you can use the main time bar or directly on the graphs playing with the blue line representing the date.

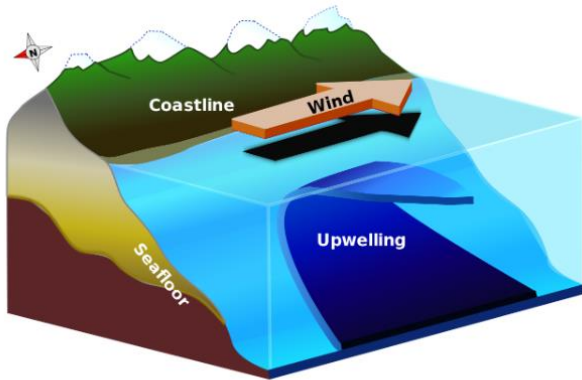


Introduction

# Jupyter Hub



## Understanding the upwelling phenomenon in North-West Africa



Upwelling phenomenon - Wikipedia

**Objectives:** Analyze the upwelling phenomenon through the following physical and biogeochemical parameters :

- The wind, which generates upwellings ;
- The temperature, which significantly decreases on the top layers along the coast during an upwelling event ;
- The nitrate, as such nutrients rise from the ocean bottom to the surface with upwellings of cold waters;
- The chlorophyll, as phytoplankton use it to carry out photosynthesis.

The tutorial video for this Jupyter Notebook : <https://youtu.be/due-3PGwz8M>

Tutorial video to learn how to use the JupyterHub and the Jupyter Notebooks interface:  
<https://www.youtube.com/watch?v=ss9dimqOzc8>



[Go to http://jupyterhub-cmems.mercator-ocean.fr](http://jupyterhub-cmems.mercator-ocean.fr)

The access to the JupyterHub is strictly reserved to the Copernicus Marine Service users.

→ [Click here to register \(it's free\)](#)

or go on <https://resources.marine.copernicus.eu/registration-form>

Enter your  
Copernicus Marine Service  
login/password



Home > Login


## WELCOME TO THE CMEMS DATA ACCESS PORTAL

Fill your login/password and click on **Login** to download data. If you are not registered yet click on **Register**

If you have trouble logging in, make sure your browser is set to accept cookies.

Username

Password

[REGISTER](#) [LOGIN](#) 

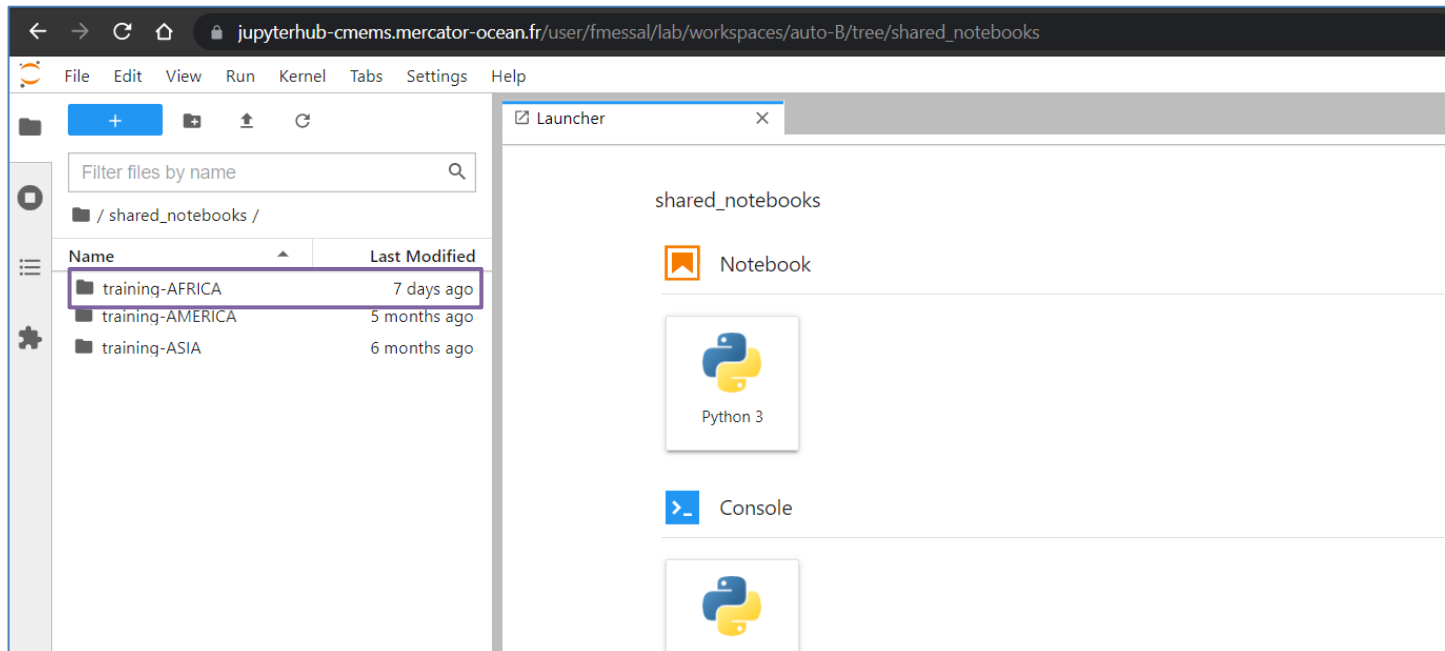
- You are registered but have forgotten your login/password?  
- Any question?  
⇒ **CMEMS Service Desk** : [servicedesk.cmems@mercator-ocean.eu](mailto:servicedesk.cmems@mercator-ocean.eu)

**Thank you for using CMEMS products**

*For security reasons, please Exit your web browser when you quit services requiring authentication!*



## 1 – Visit the “shared\_notebooks”, the public folder and select the training-Africa

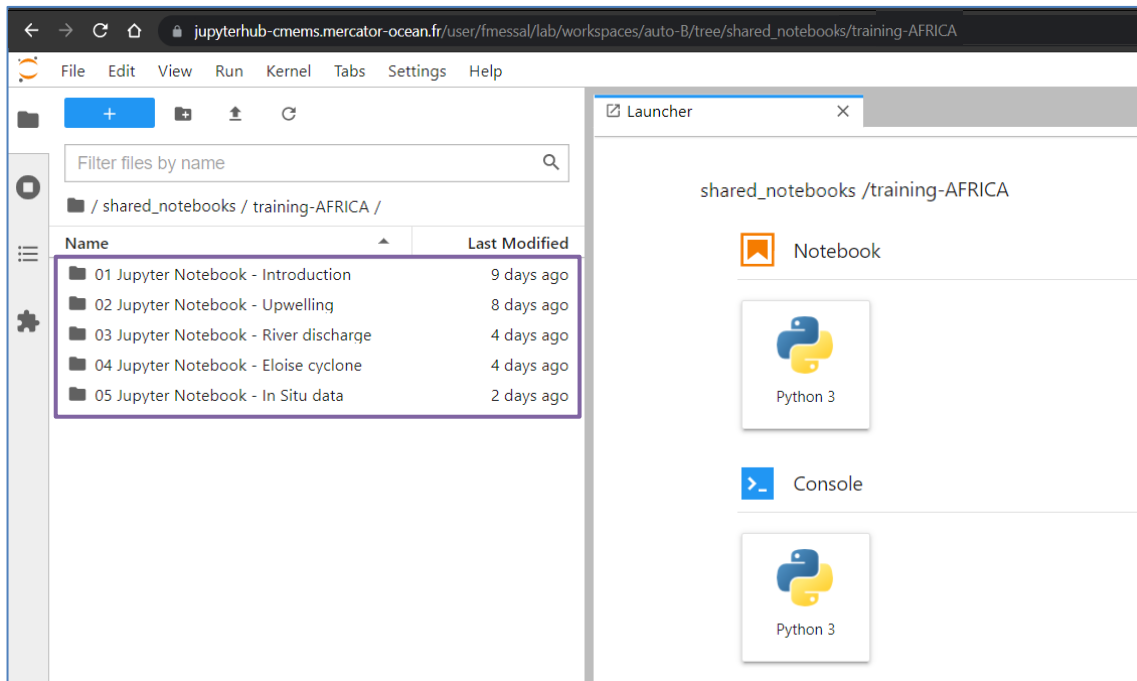


The screenshot displays the Jupyter Hub interface in a web browser. The address bar shows the URL: `jupyterhub-cmems.mercator-ocean.fr/user/fmessal/lab/workspaces/auto-B/tree/shared_notebooks`. The interface includes a menu bar (File, Edit, View, Run, Kernel, Tabs, Settings, Help) and a toolbar with icons for file operations. On the left, a file browser sidebar shows the current directory structure: `/ shared_notebooks /`. A table lists the contents:

Name	Last Modified
training-AFRICA	7 days ago
training-AMERICA	5 months ago
training-ASIA	6 months ago

The `training-AFRICA` folder is highlighted with a purple border. The main area shows the `shared_notebooks` folder contents, including a `Notebook` icon, a `Python 3` kernel icon, and a `Console` icon.

## 2 – Discover the list of the Jupyter Notebooks available and choose Upwelling



The screenshot displays the Jupyter Hub interface. The left sidebar shows a file browser for the path `/shared_notebooks/training-AFRICA/`. It contains a table of files:

Name	Last Modified
01 Jupyter Notebook - Introduction	9 days ago
02 Jupyter Notebook - Upwelling	8 days ago
03 Jupyter Notebook - River discharge	4 days ago
04 Jupyter Notebook - Eloise cyclone	4 days ago
05 Jupyter Notebook - In Situ data	2 days ago

The right sidebar shows the 'Launcher' for the selected notebook, with options for 'Notebook' and 'Console', both using the 'Python 3' kernel.

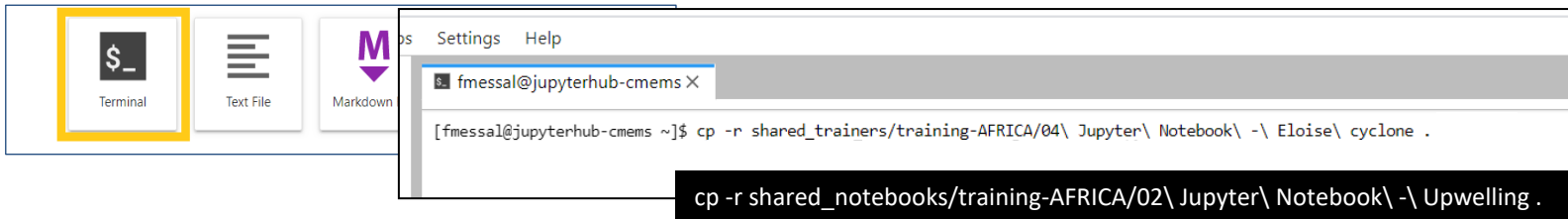


### 3 – Double-click on the file 02-01-Upwelling.ipynb and run the Jupyter Notebook

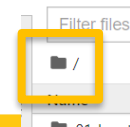
You can play with the Jupyter Notebook but all the changes you will make will not be recorded because you are on the public folder « shared\_notebook ».

If you want to save your modifications, you have to copy the folder of the notebook to your home directory.

### 4 – Launch a terminal and copy the folder



### 5 – Back to your Home Directory to run your Jupyter Notebook.



For any question or further information,  
please contact  
[servicedesk.cmems@mercator-ocean.fr](mailto:servicedesk.cmems@mercator-ocean.fr)





**THANK YOU**

