



Funded by  
the European Union

**From  
environmental  
data**

**to Galaxy for Earth  
System**

 **eosc**

**FAIR-EASE**



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Jérôme Detoc**

# Agenda

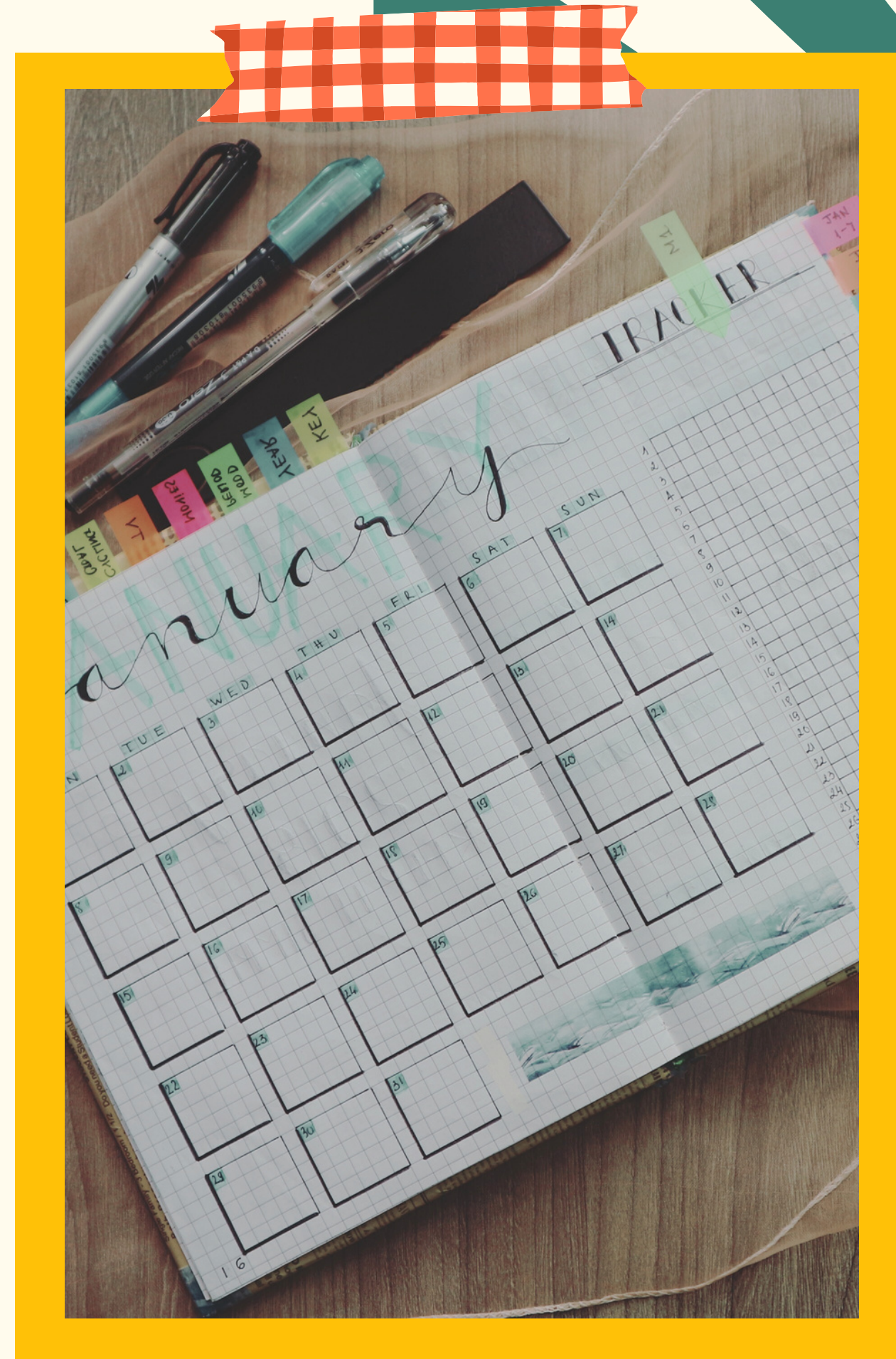
Fair-Ease an EOSC project

An Earth System Sandbox

An efficient cooperation

An earth-system.usegalaxy.eu

An Earth Analytical Lab

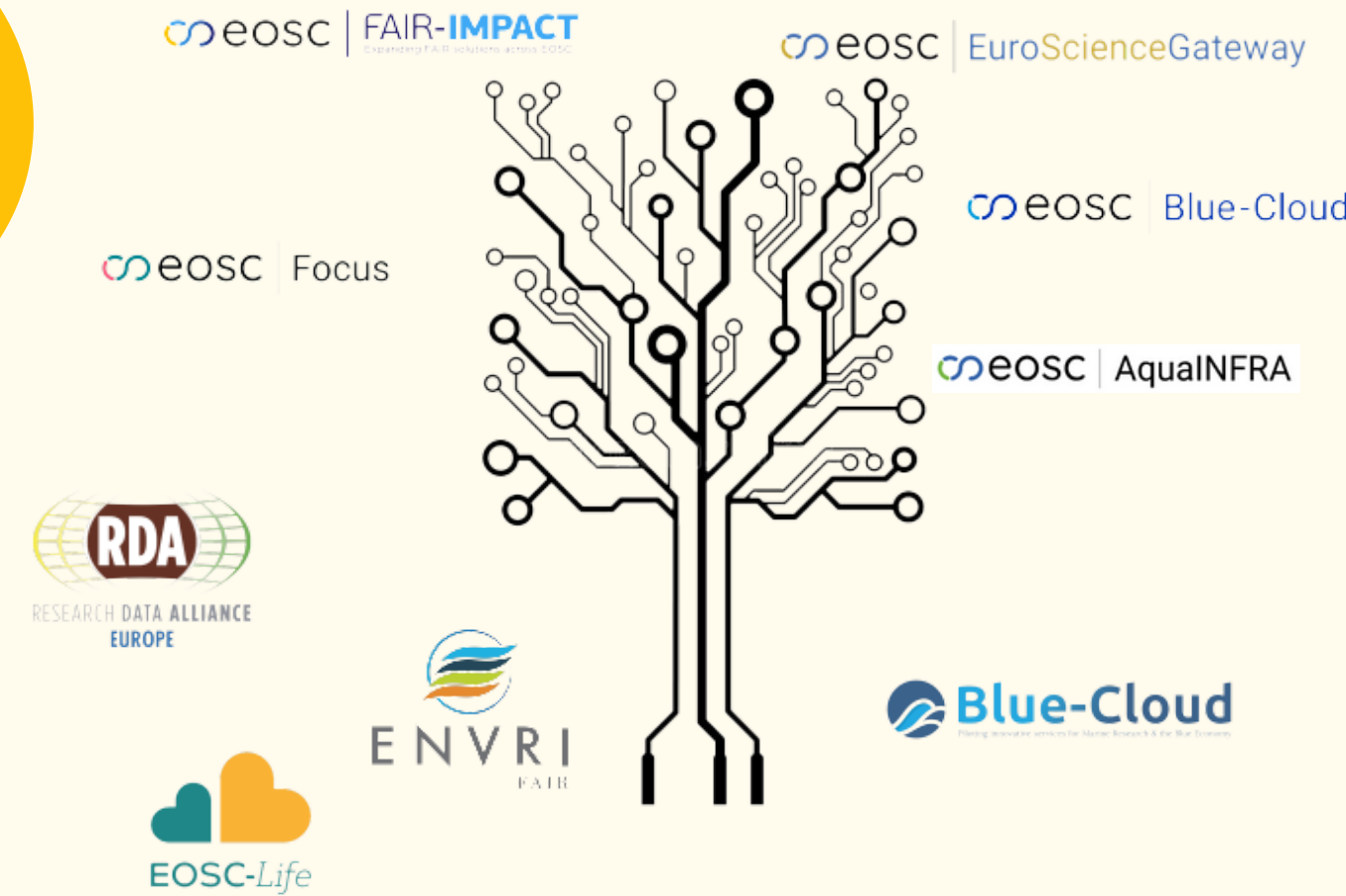




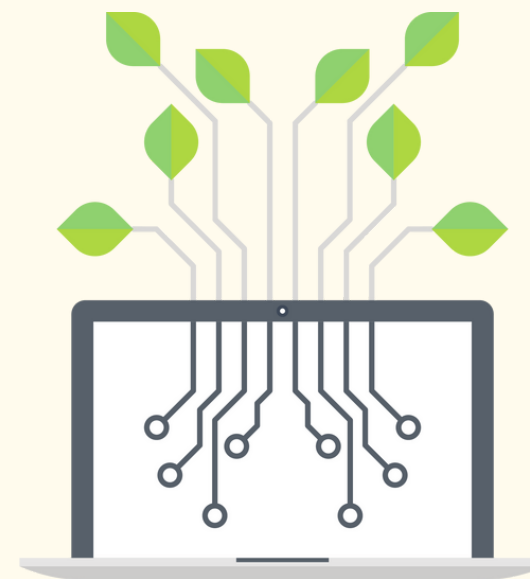


# Fair-Ease Overview

SHORT BRIEF



Building an interdomain digital architecture for integrated use of environmental data



FAIR-EASE Data Discovery and Access **Interdisciplinary** Service



FAIR-EASE Earth Analytic Lab



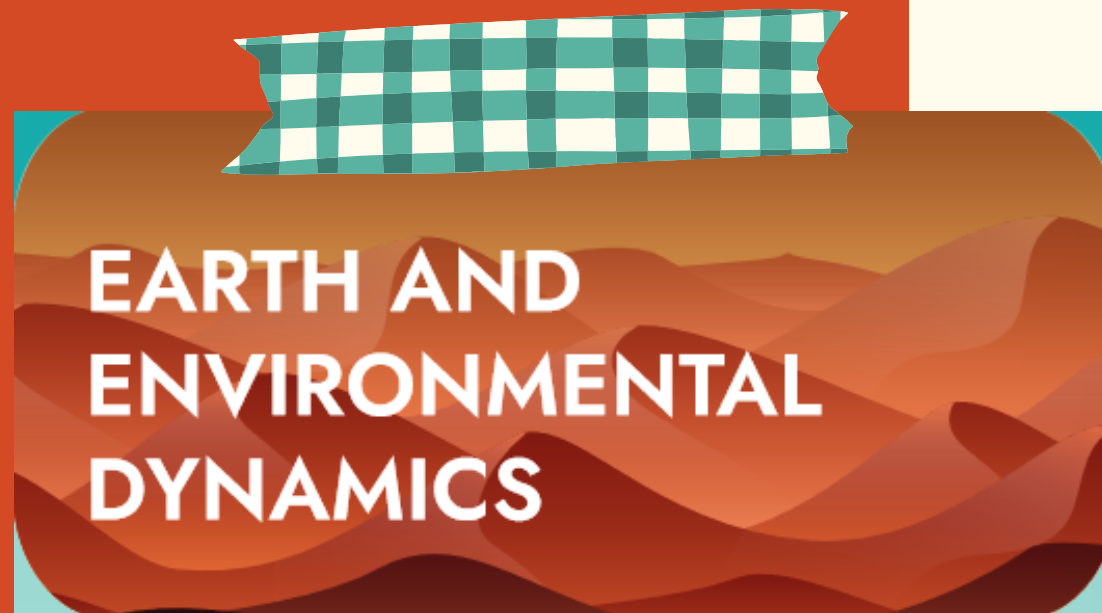


# Fair-Ease

## Overview



5 pilots to build this interdomain digital architecture for integrated use of environmental data  
Galaxy as an important technical brick of the architecture



- ✦ Coastal Water Dynamics
- ✦ Earth Critical Zone
- ✦ Volcano

✦ Bio-GeoChemical observations

✦ Marine omics observations





# FE & ESG

## 2-days Galaxy training

Teach to Fair-Ease partners how and why use Galaxy with the help and experience of ESG

colleagues

A hands on day to integrate tools with the attendants

The collaboration of 2 EOSC projects to efficiently get cross-discipline workflows by creating sharing and re-using tools and workflows on Galaxy





# Coastal Water Dynamics

## Northern Adriatic / Po Estuary

Highly dynamic system, affected by variety of processes: river runoff, meteorology, ocean currents, marine bio-geochemical processes.

- Scientific and socio-economic impacts:
  - a. Biological productivity and fish stocks
  - b. Uptake of atmospheric CO<sub>2</sub> and effect on marine carbon cycle
  - c. Input and off-shore transport of suspended material and hazardous substances
- Well monitored



## Improvement

- Correlate satellite chlorophyll data with Po river discharge
- Improve gridded climatologies by incorporating ocean circulation
- Facilitate model/data comparison and skill assessment



Combine 3 tools in analytics workflows to have a complete overview

# Coastal Water Dynamics

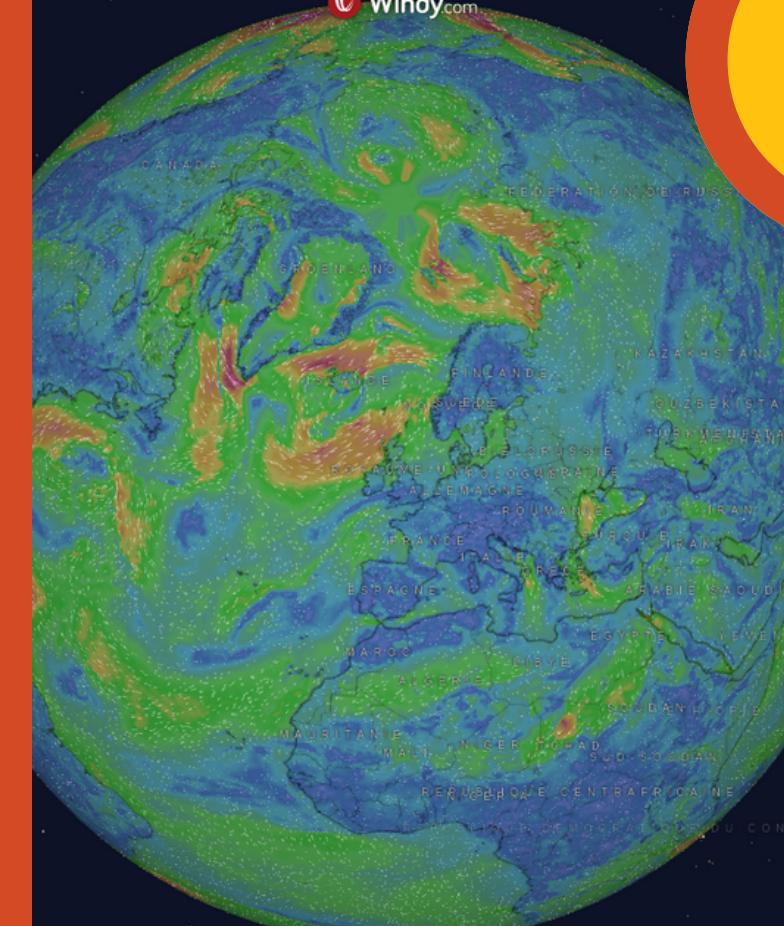
1



2



3



## SOURCE

Calibrates and validates various ocean models within a selected spatial domain using in-situ observations.



## ODV

Human-in-the-loop analysis and visualization of input and output coming from the two other tools



## DIVAnd

Built new products as an n-dimensional variational analysis/gridding from arbitrarily located observations coming from the two other tools





## New tool on Galaxy Europe

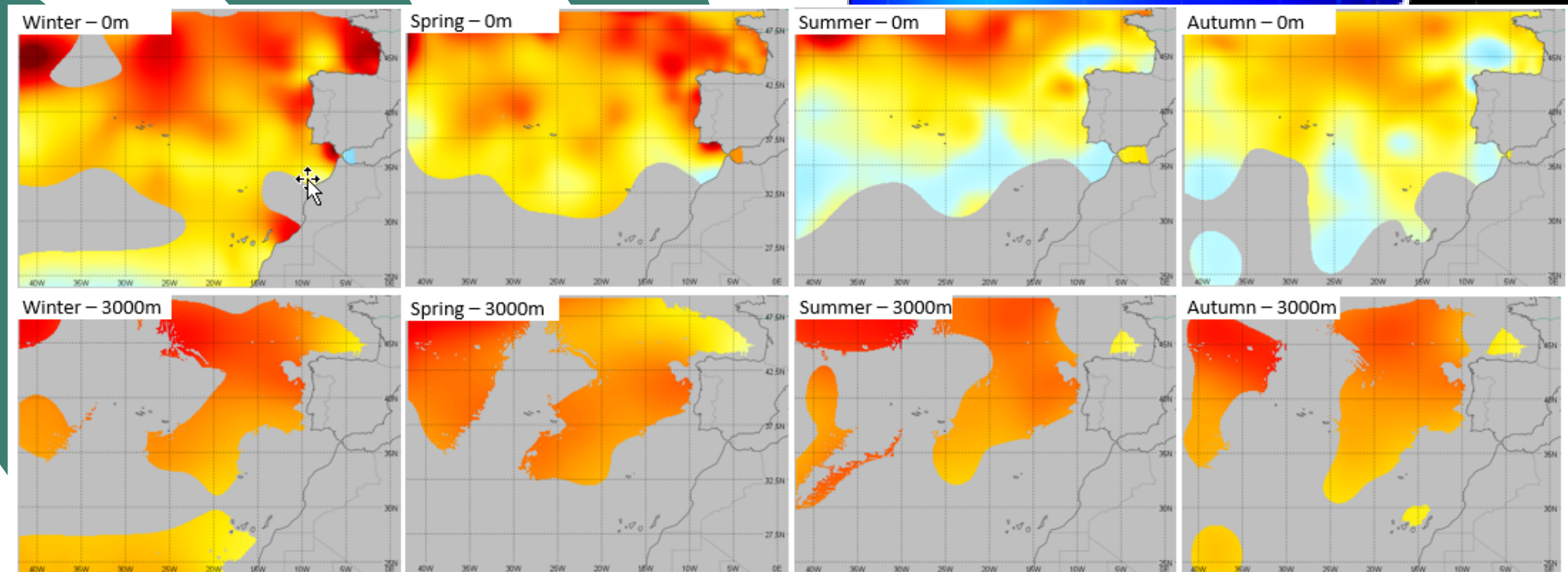
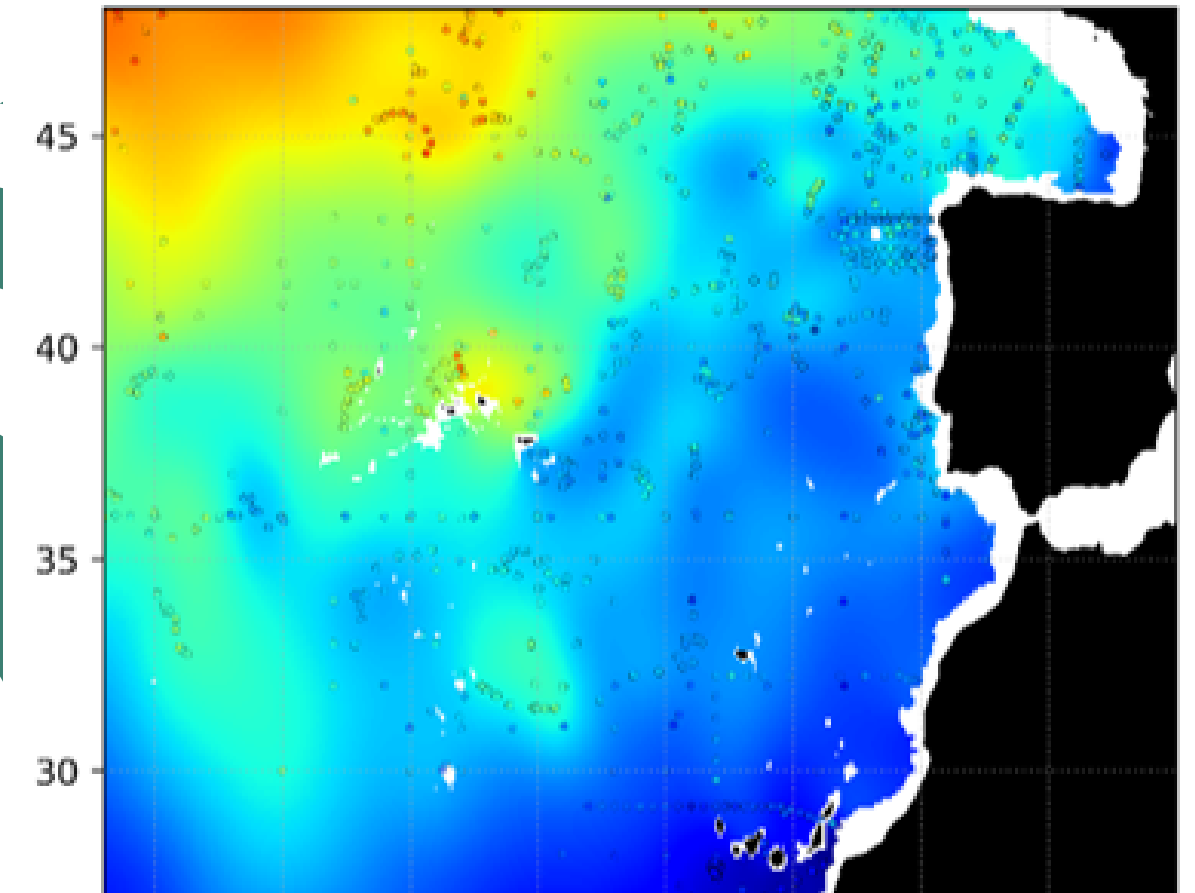
# DIVAnd

### Key Features

- Scattered data
- Noise allowed
- Physical and inequality constraints can be added
- Topological constraints are handled naturally (barriers, holes)
- Analysis error maps can be estimated
- Periodicity in selected directions can be enforced

Performs an n-dimensional variational analysis/gridding of arbitrarily located observations.

DIVAnd output (error < 0.5)



Water body dissolved oxygen concentration masked using relative error threshold: 0.5 [umol/l]  
150.0 180.0 210.0 240.0 270.0 300.0





# New tool on Galaxy Europe

## SOURCE

Sea Observations Utility

for Reprocessing, Calibration and Evaluation

### Key Features

- Calibrates and validates ocean models within a selected spatial domain using in-situ observations
- Performs a secondary quality check
- Measure the ability of numerical models to reproduce observed Essential Ocean Variables (EOV)

#### Buoy Time Series

Instrument: All instruments  
Variable: Temperature  
1st datasource: in situ daily mean centered  
2nd datasource: MedRea16 reanalysis dai  
3rd datasource: None

Compute datasources difference

Note 1: all data must have the same sampling to compute differences.

Note 2: differences will not work for current transport.

Organisation: All organizations

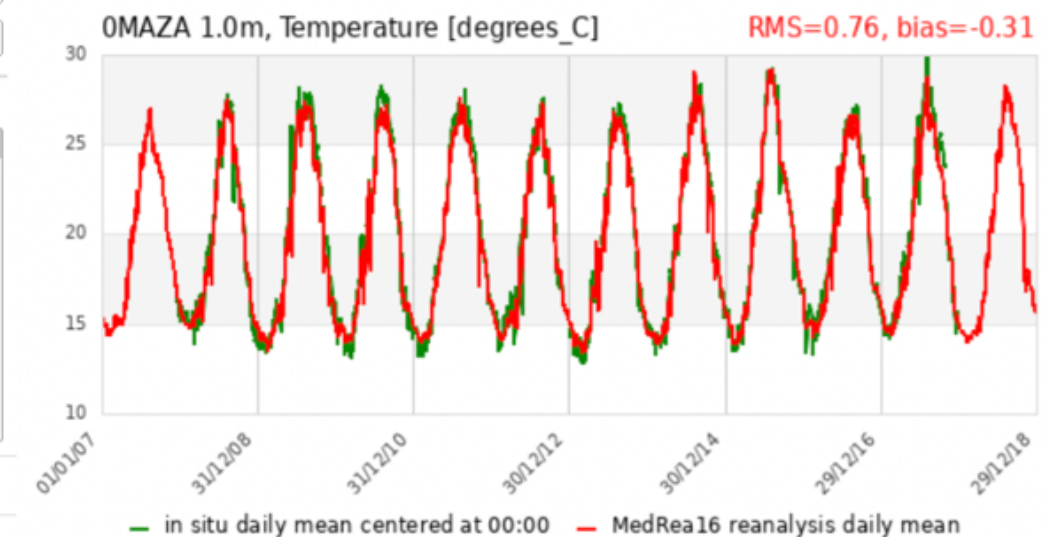
Start: Year 2007 Month None

End: Year None Month None

Buoys: Cagliari, Canal De Ibiza, Cap Ferret, Capdepera, Capo Mele, Cascais, Catania, Cetraro, Ceuta, Cies buoy, Ciutadella

Depth, m: 1.0

#### Buoy Profiles



#### OMAZA

land/onshore structure

Institution: IEO/ Spanish Oceanographic Institute (Spain)

SOURCE platform\_code: 353-SI29200001010\_OMAZA\_H11  
WMO: unknown

Longitude: -2° 45' 47" E  
Latitude: 37° 34' 37" N

Recorded fields:  
Temperature: 1.0m

#### Information on field

Temperature :

Begin: 1999-04-10 00:00:00  
End: 2017-12-31 00:00:00  
Sampling time: 001 00:00:00 ddd hh:mm:ss

Quality controls:

PARTIAL

Notes:

*duplicated and reversed records*

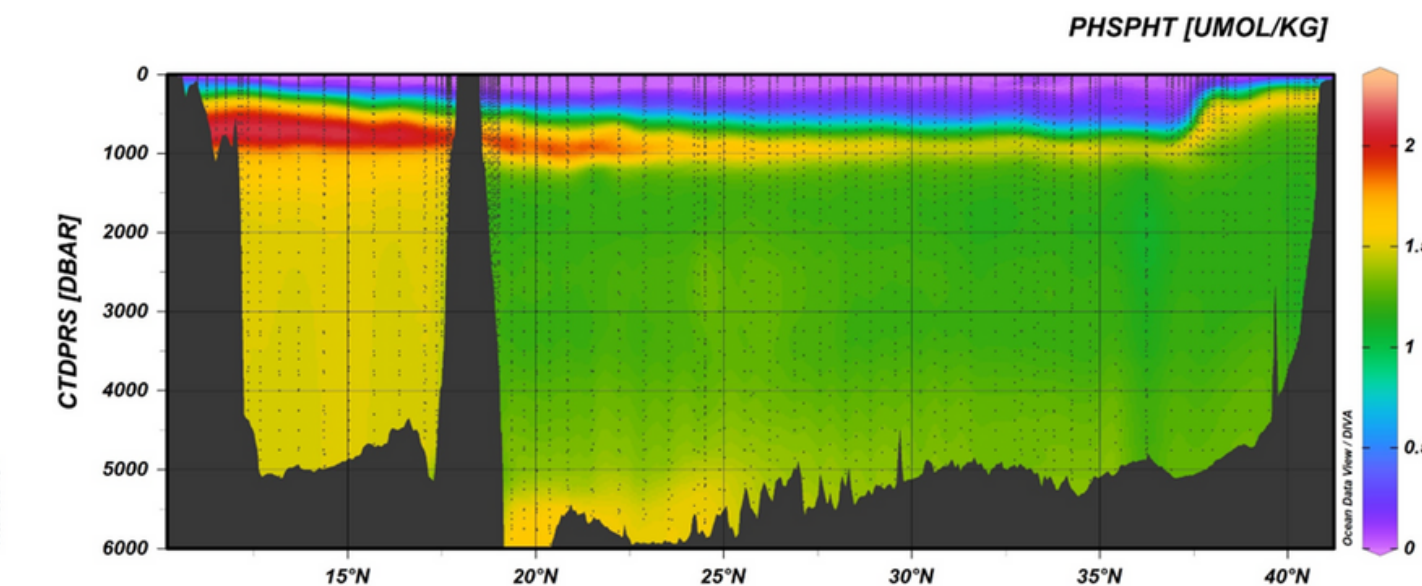
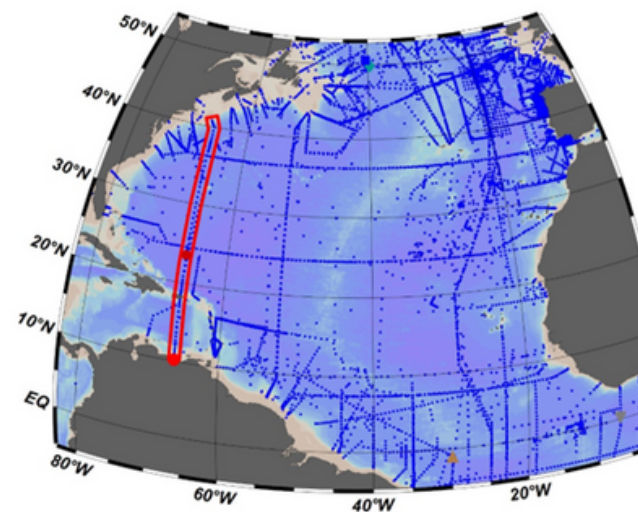
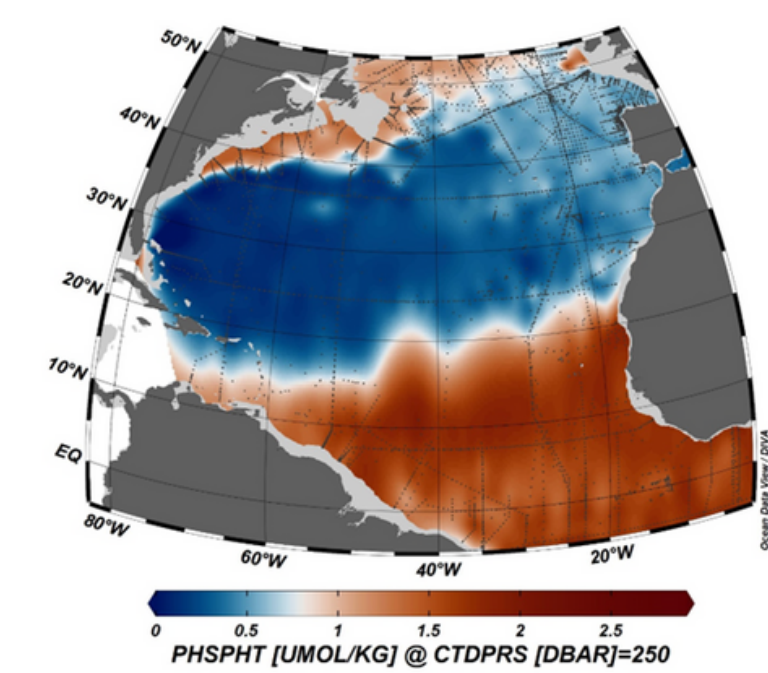
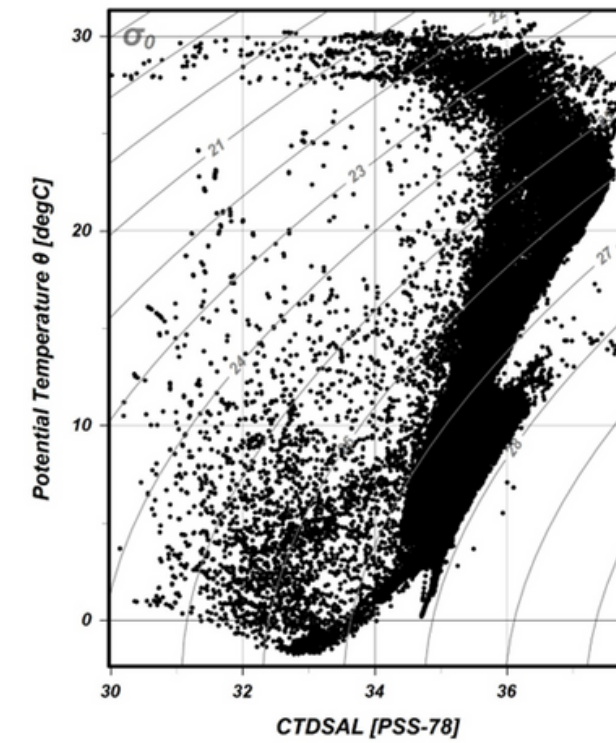
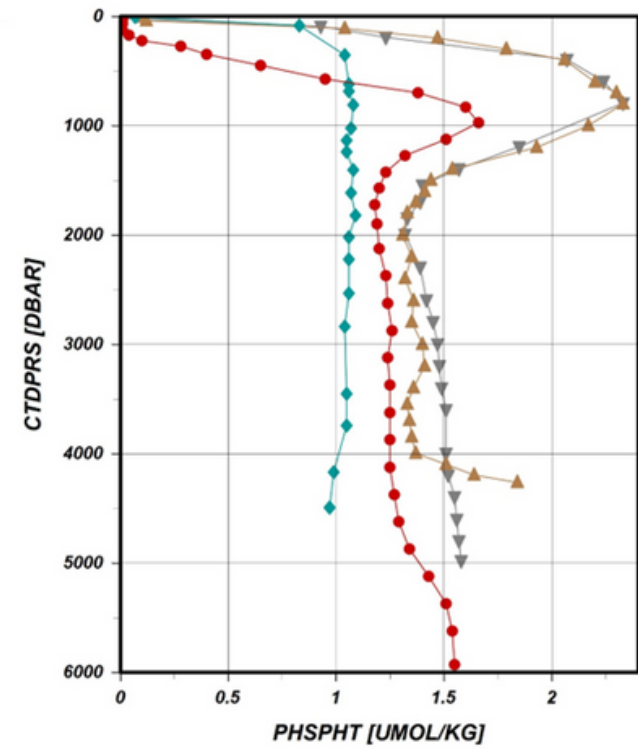


# New tool on Galaxy Europe

## Ocean Data View

### Key Features

- Supports profile, time-series, trajectory and underway data (native ODV collection format and netCDF)
- Subsetting and filtering features; data export in various formats
- Calculated parameters (physical, chemical, carbon cycle, ...)
- Rich interactive feature set and variety of graphic types





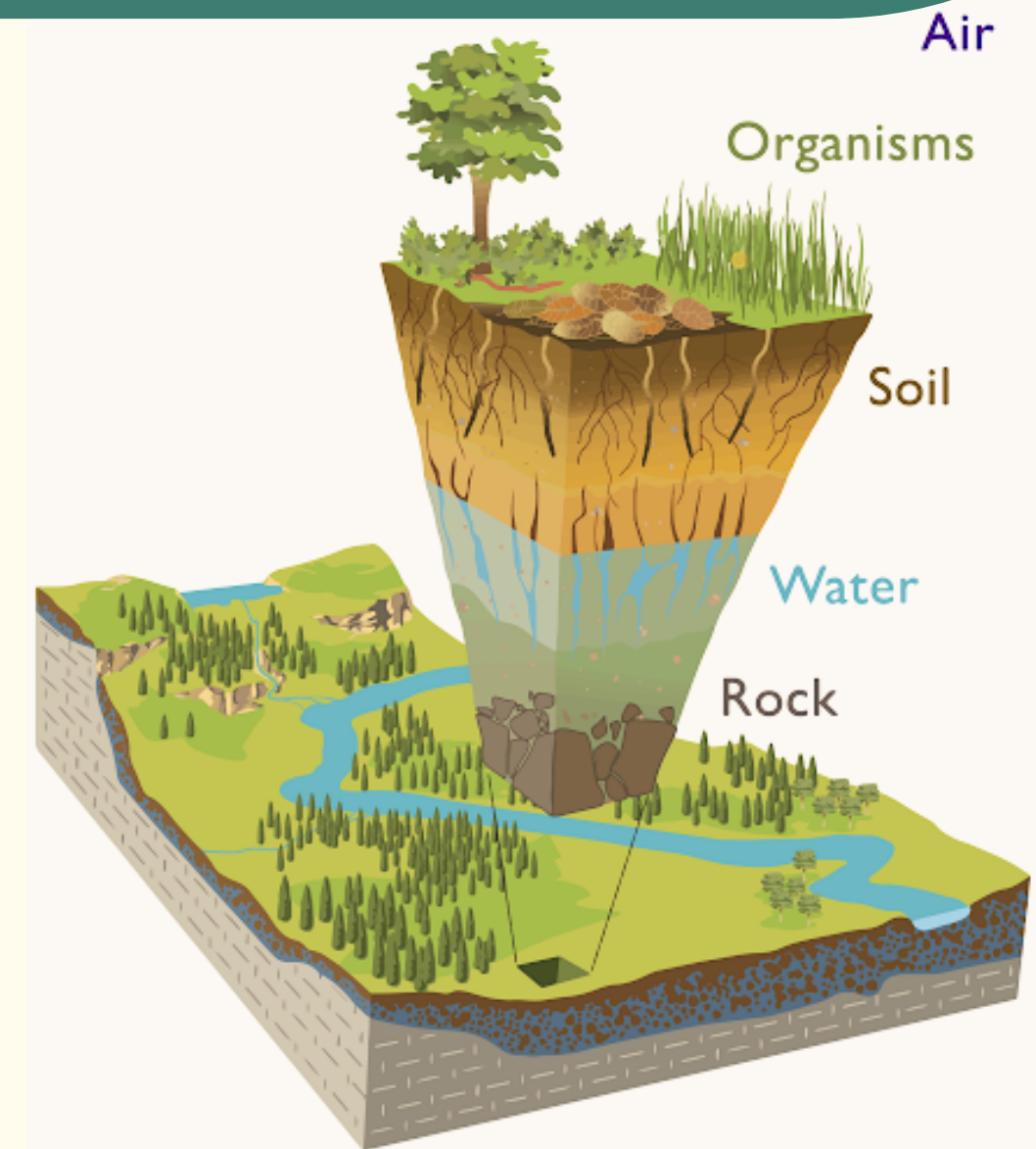
# Earth Critical Zone

Proportion of land that is degraded over total land area

CONTEXT

Methodology proposed by UNCCD (United Nations Convention to Combat) provides three sub-indicators

- Land Cover/Land Use Change
- Soil Organic Carbon Status and Trends
- Land Productivity Status and Trends



The integration of these sub-indicators is done following the one-out all-out rule, this means that if an area was identified as potentially degraded by any of the sub-indicators, then that area will be considered potentially degraded for reporting purposes.



# Earth Critical Zone

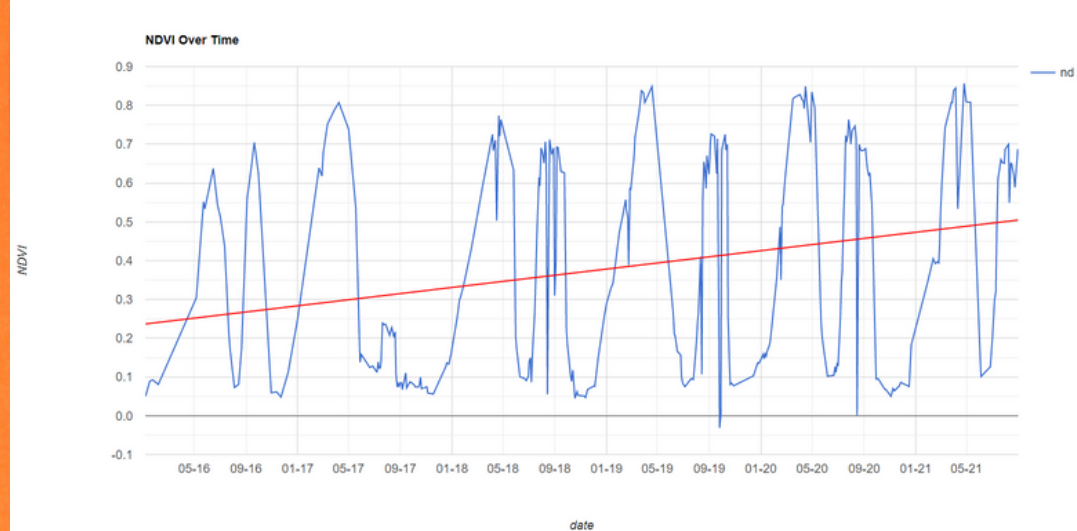
Make outputs more representative of ground truth by:

- Implementing other indicators coming from remote sensing (leaf area index, soil moisture, water use efficiency, ...)
- Establishing new thresholds for determining degraded, stable or improving areas
- Enable sub-national scale calculations

PURPOSE

Example  
from  
cropland

```
81 // Create an NDVI chart.  
82 var ndviChart = ui.Chart.image.series(NDVICollection, point, ee.Reducer.mean(), 100);  
83 ndviChart.setOptions({  
84   title: 'NDVI Over Time',  
85   axes: {title: 'NDVI'},  
86   axes: {title: 'date', format: 'MM/yy', gridlines: {count: 20}},  
87   trendlines: {titles: 'exponential', fillColor: 'FF0000'}, visibleLegend: true,  
88 });  
89 panel.widgets().set(0, ndviChart);  
90 Map.setStyle({set: 'crosshair'});  
91 // Add the panel to the ui.root.  
92
```



Aims :

- A new land degradation tool
- Enhanced access to data
- Efficient update of algorithms embedded in the geospatial modeling pipeline (change data and/or modify model code)



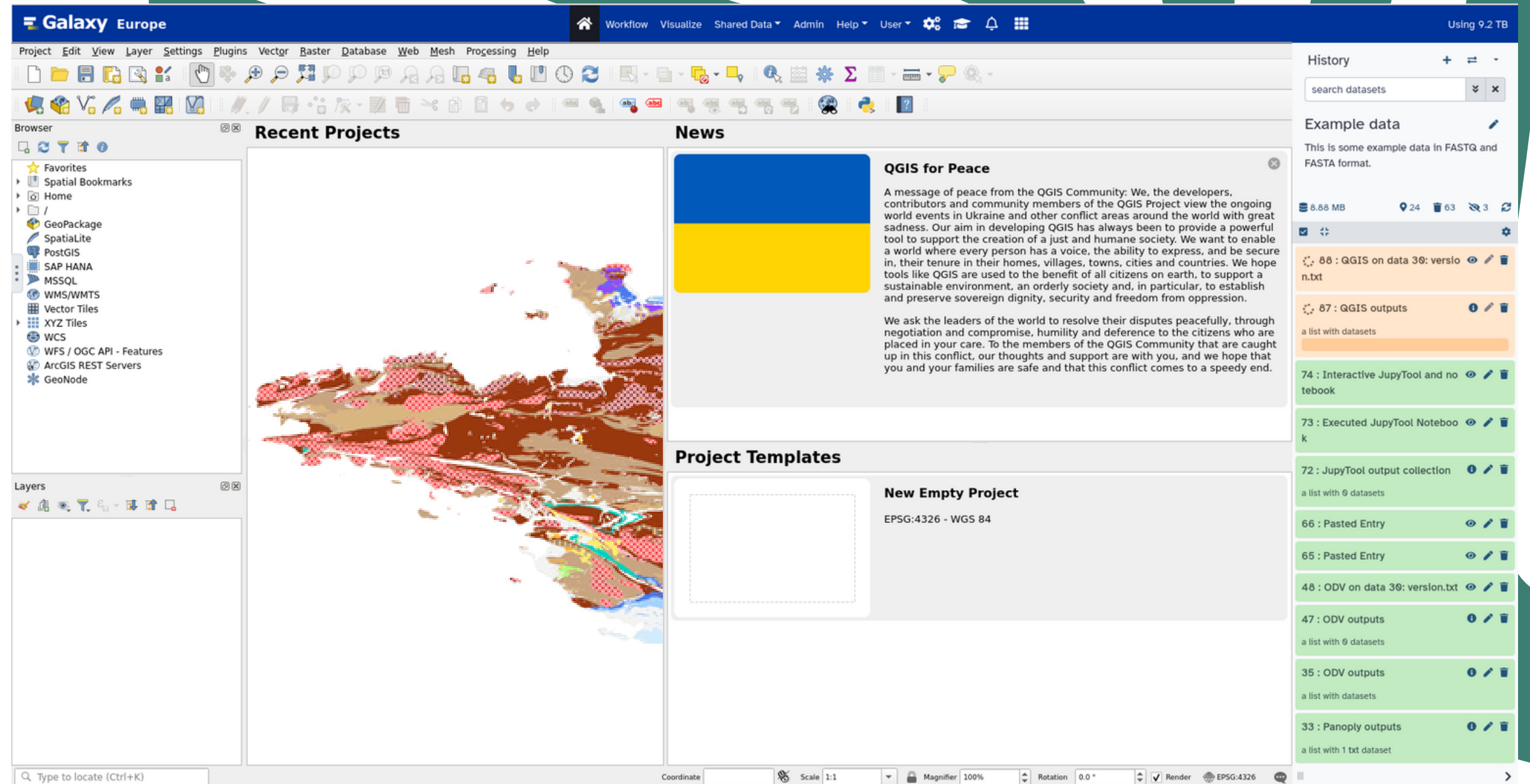
# New tool on Galaxy Europe

# QGIS

Geographic Information System software package.

## Key Features

- provides a continuously growing number of capabilities provided by core functions and plugins.
- visualize, manage, edit, analyse data design maps.
- support for numerous file formats and databases as well as web services.





# Volcano purpose

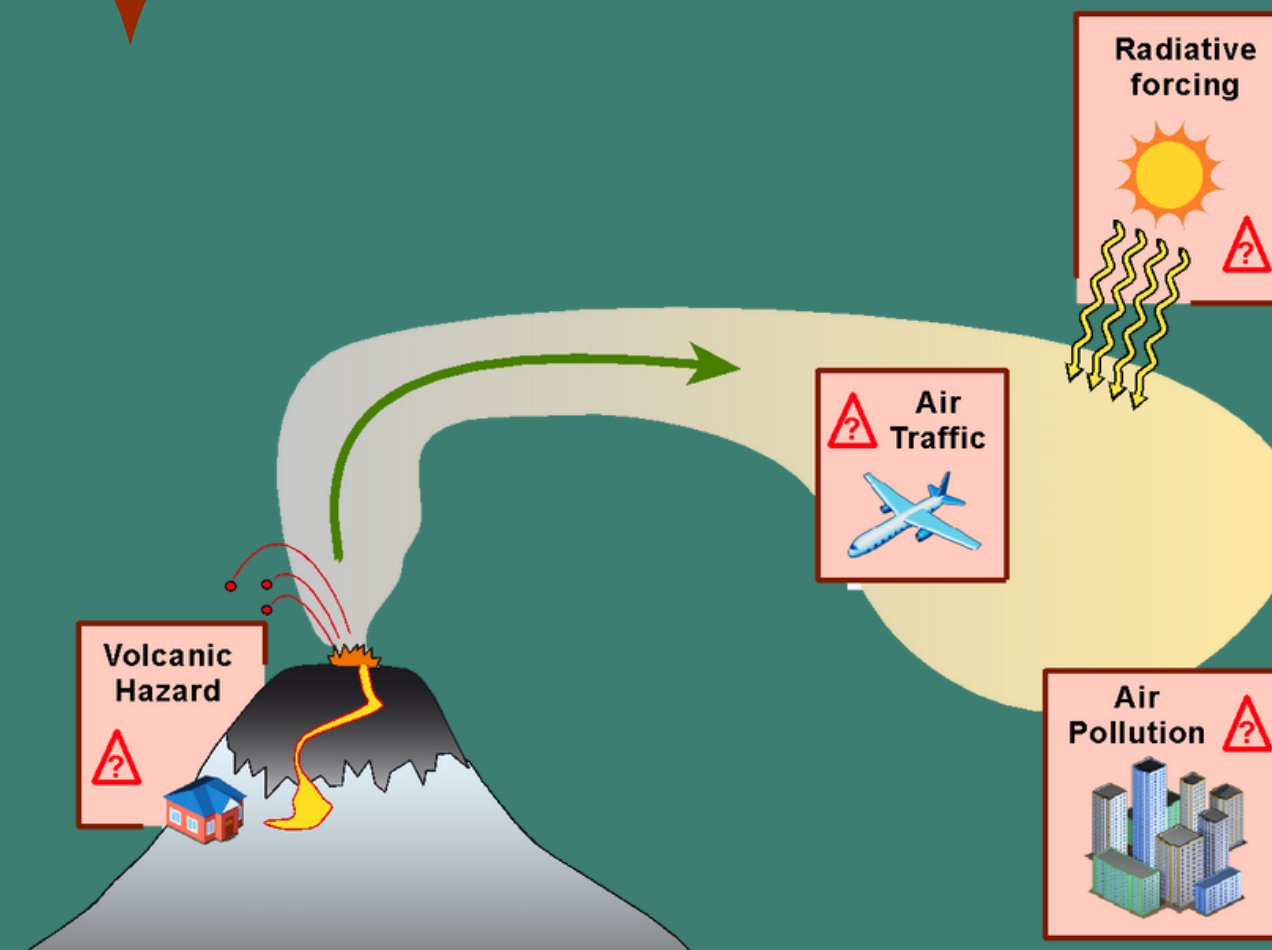
Provide tools for aggregating and jointly analysing satellite observations from Solid Earth and Atmospheric Science communities for the near-real-time monitoring of volcanic activity.

## Explanation

Tools will be of interest for :

- **Scientists** by facilitating data exploration and analysis.
- **Volcano observatories** worldwide to help **hazard assessment**, especially during explosive eruptions that may destroy ground instruments

## Schematics



## Photo

Holuhraun eruption (Iceland)





# Volcano purpose

Aim:  
coupling **gas-particle emissions** &  
ground deformation

## Ground deformation

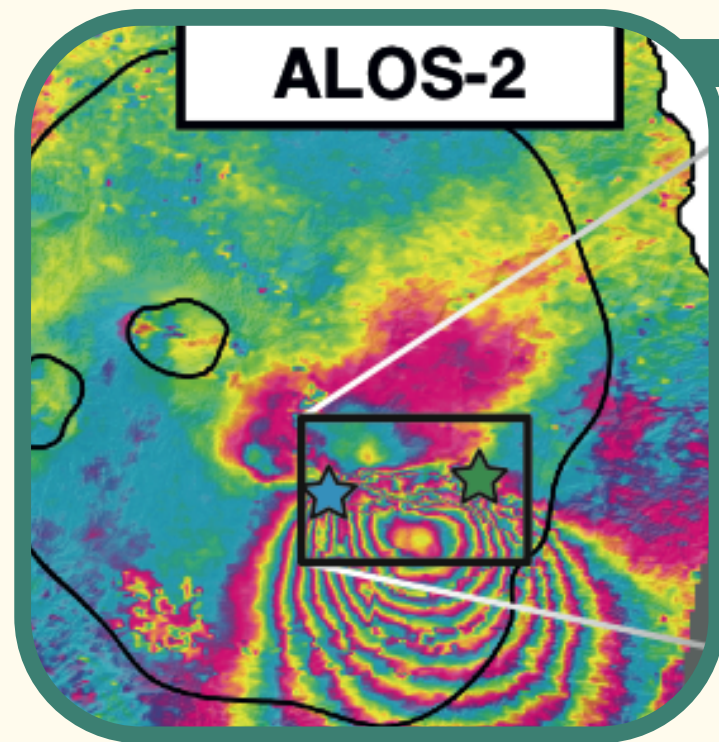
Access to:

- Transport & magma storage
- Volume budget

## InSAR

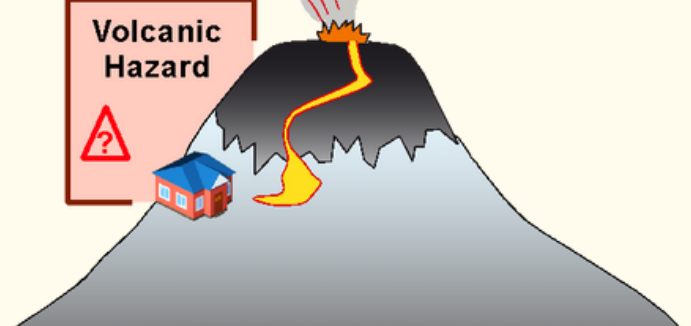
**ALOS-2**

pixel size =  
1-100 m



Revisit time: ~ 6 days

## Topography



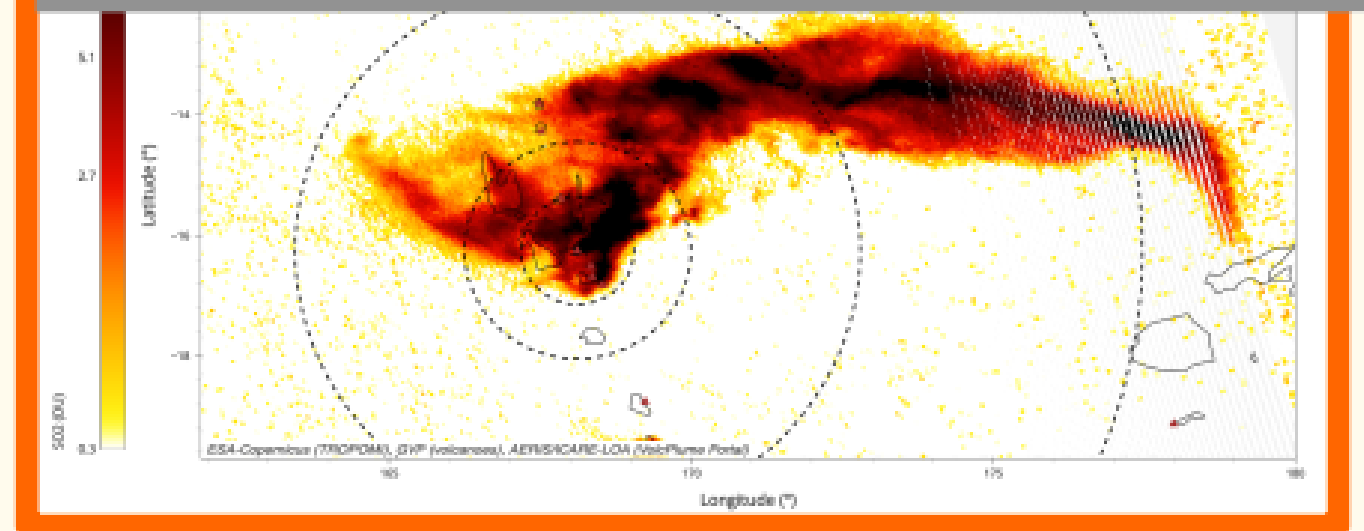
## Gas-particle emissions

Access to:

- Magma composition, depth
- mass budget
- flux

## TROPOMI/IASI/OMPS – SO2

## VolcPlume, AERIS/ICARE-LOA

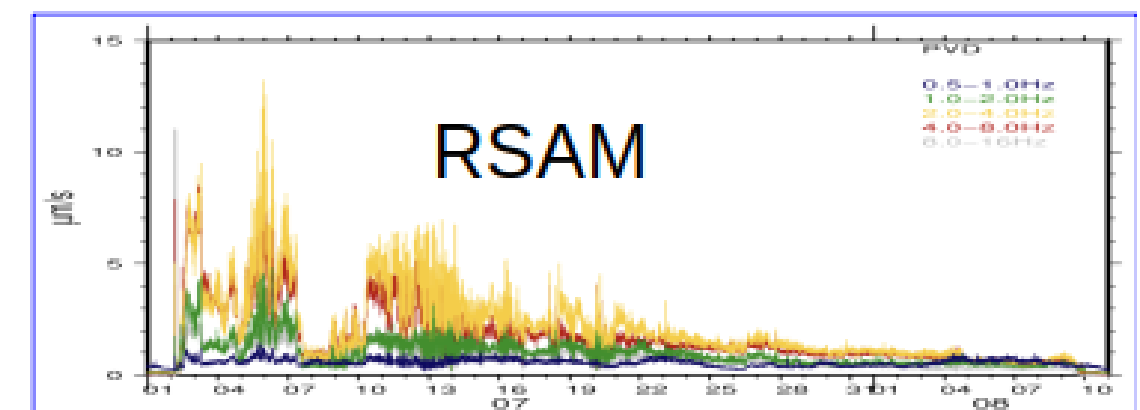
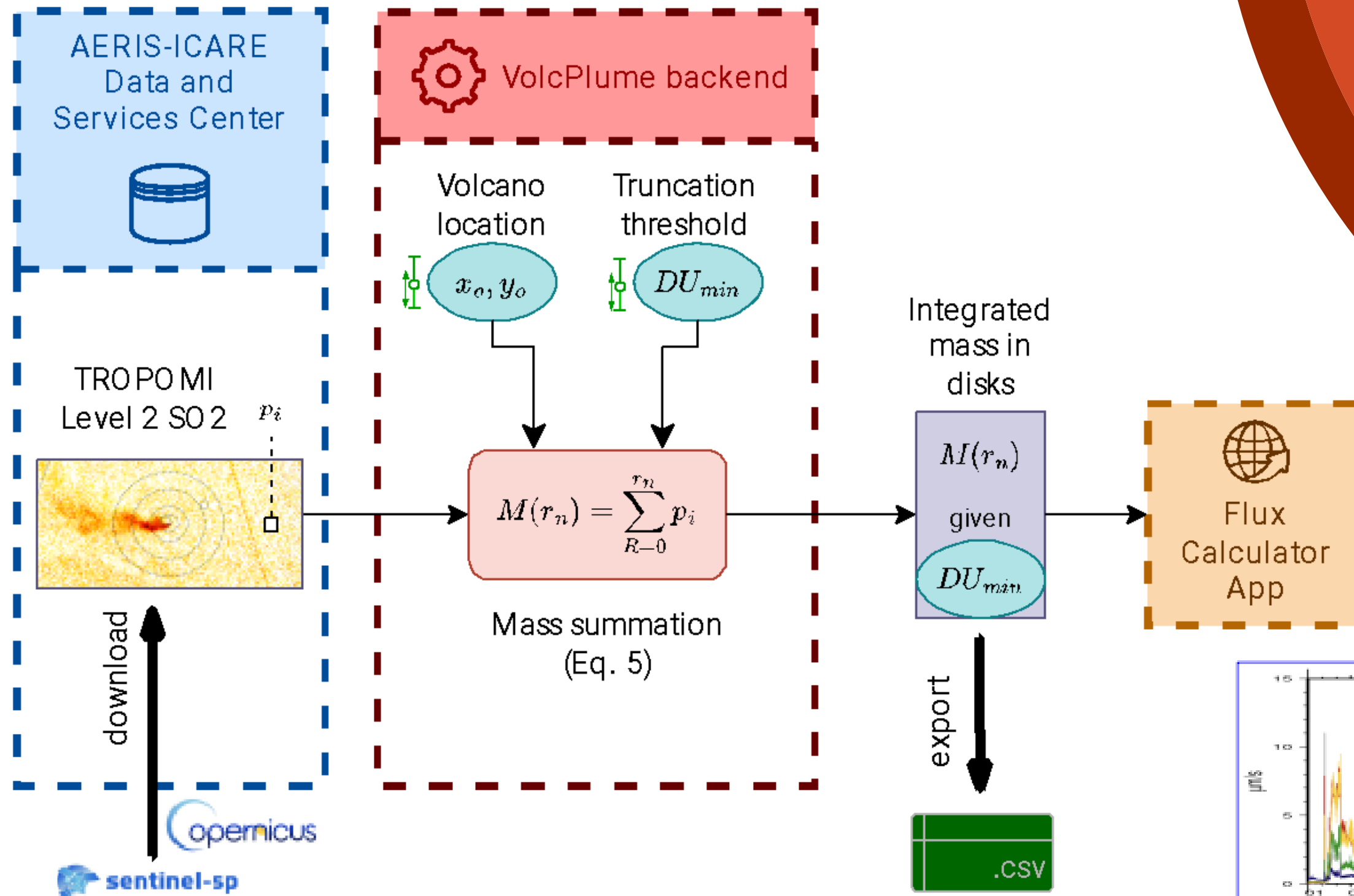


pixel size = 5-25 km

Revisit time: 12 or 24 hours (LEO) - 20 min (GEO)

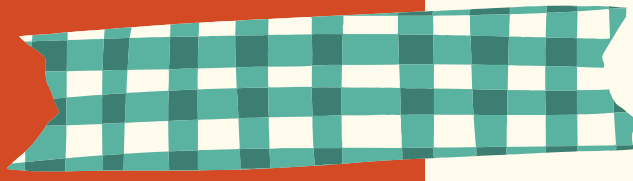


# Volcano Workflow



Timeseries of volcanic SO2 flux at any degassing volcano in the world





# New tool on Galaxy Europe HDFview

Interactive tool, suitable for  
browsing and editing  
Hierarchical Data Format

## Key Features

- Manage HDF-4 and HDF-5
- Create new files, add or delete groups and datasets
- View and modify the content of a dataset
- Add, delete and modify attributes

HDFView 3.3.1

File Window Tools Help

Recent Files: [Path] Clear Text

Object Attribute Info

Name: BT\_Real  
Path: /  
Type: netCDF3 Dataset  
Tag\_Ref: 1811441878

Dataset Dataspace and Datatype

Table Import/Export Data Data Display

0-based  
5.3 = -32768

	0	1	2	3	4	5	6	7	8
29	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
30	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
31	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
32	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
33	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
34	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
35	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
36	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
37	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
38	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768
39	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768	-32768

Lineplot - /BT\_Real - by column

Y-axis: 1783, 1672, 15492, 18947, 22402, 25857, 29312, -32768

X-axis: 0, 277, 555, 833, 1111, 1389, 1667, 1945, 2223, 2501, 2779

Close

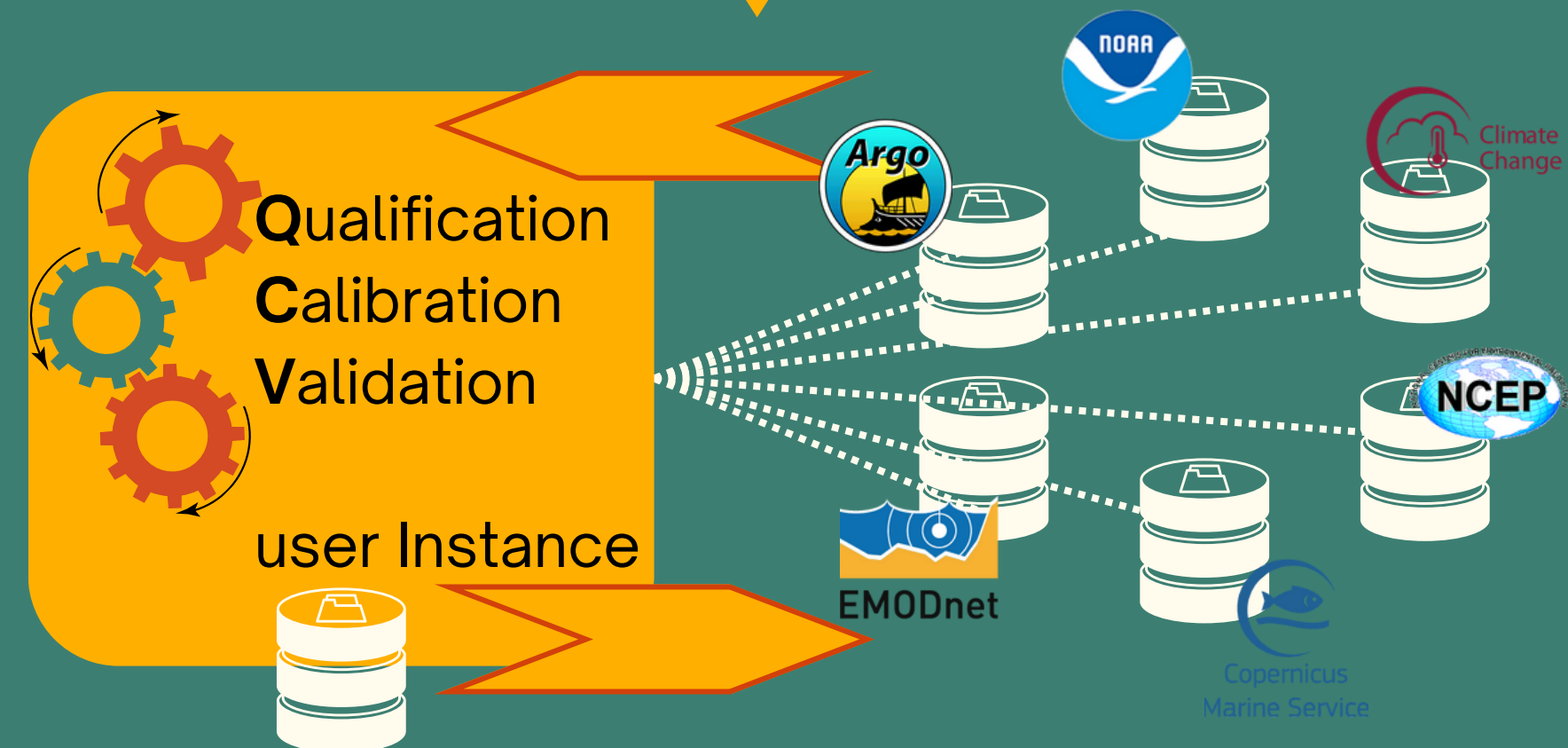
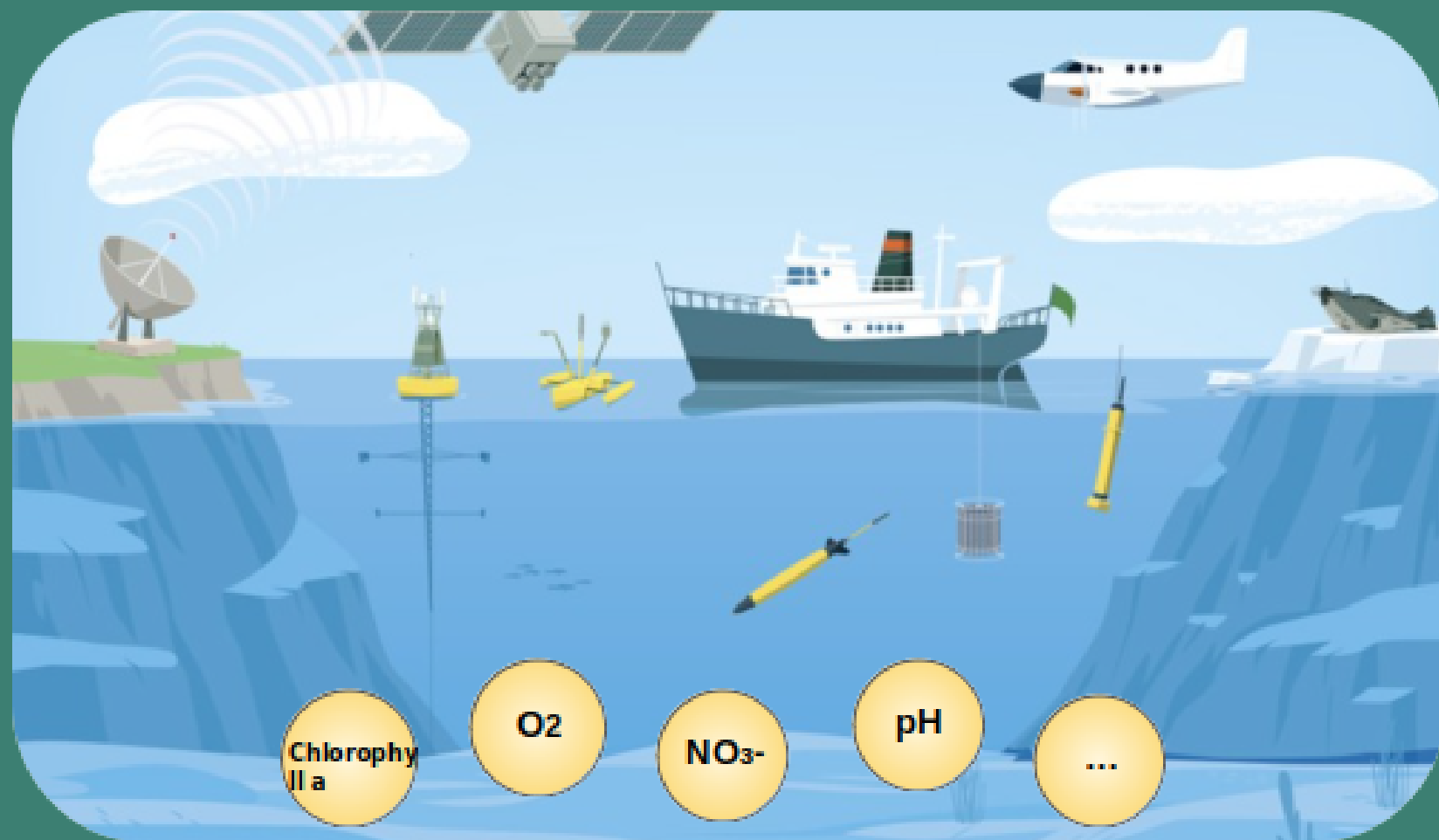
HDFView root - C:\Users\jdetoc\AppData\Local\HDFView  
User property file - C:\Users\jdetoc\hdfview3.3.1  
BT\_Real at / [SM\_OPER\_MIR\_C\_F1\_A\_20170503T004653\_20170503T014051\_301\_001\_7].DBL in Y:\catds\M35220\datarmor\L1\CSM\_OPER\_MIR\_C\_F1\_A\_20170503T004653\_20170503T014051\_301\_001\_7] [di





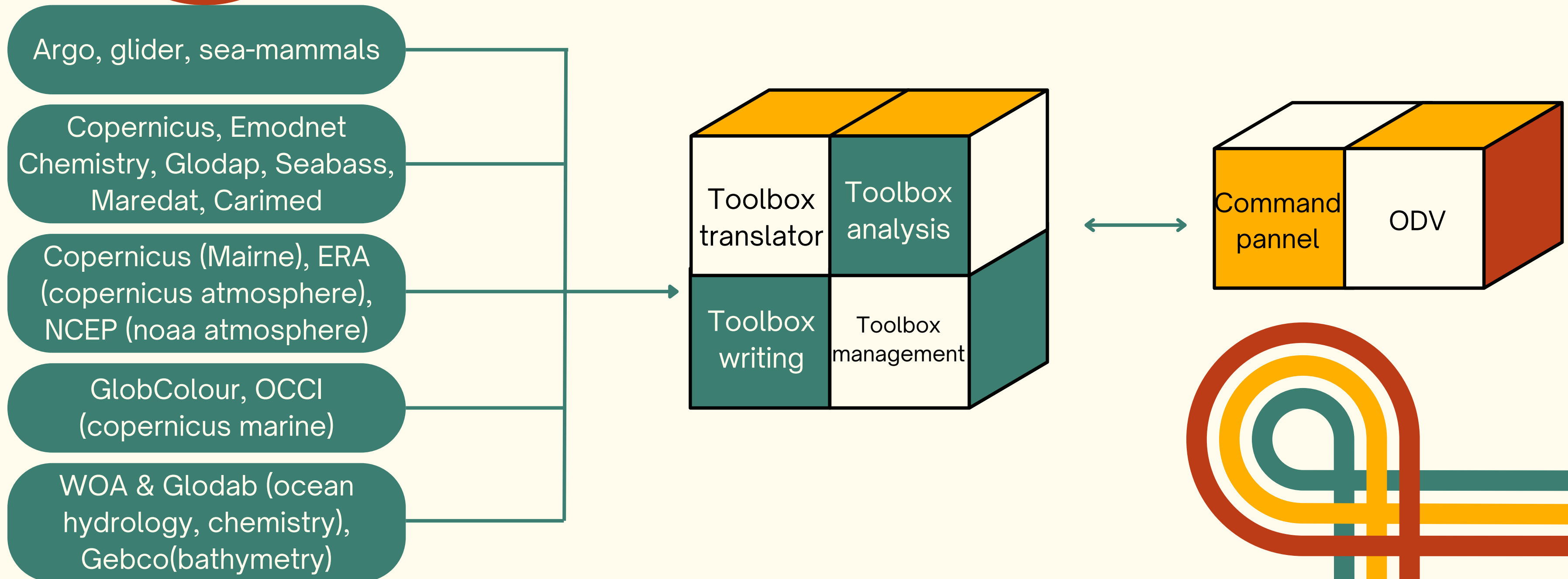
# Bio-GeoChemical Goal

A single and efficient access to ancillary sources used by a series of common tools to help with delivering high qualified biogeochemical data that will be made FAIR.





# Bio-GeoChemical Workflow



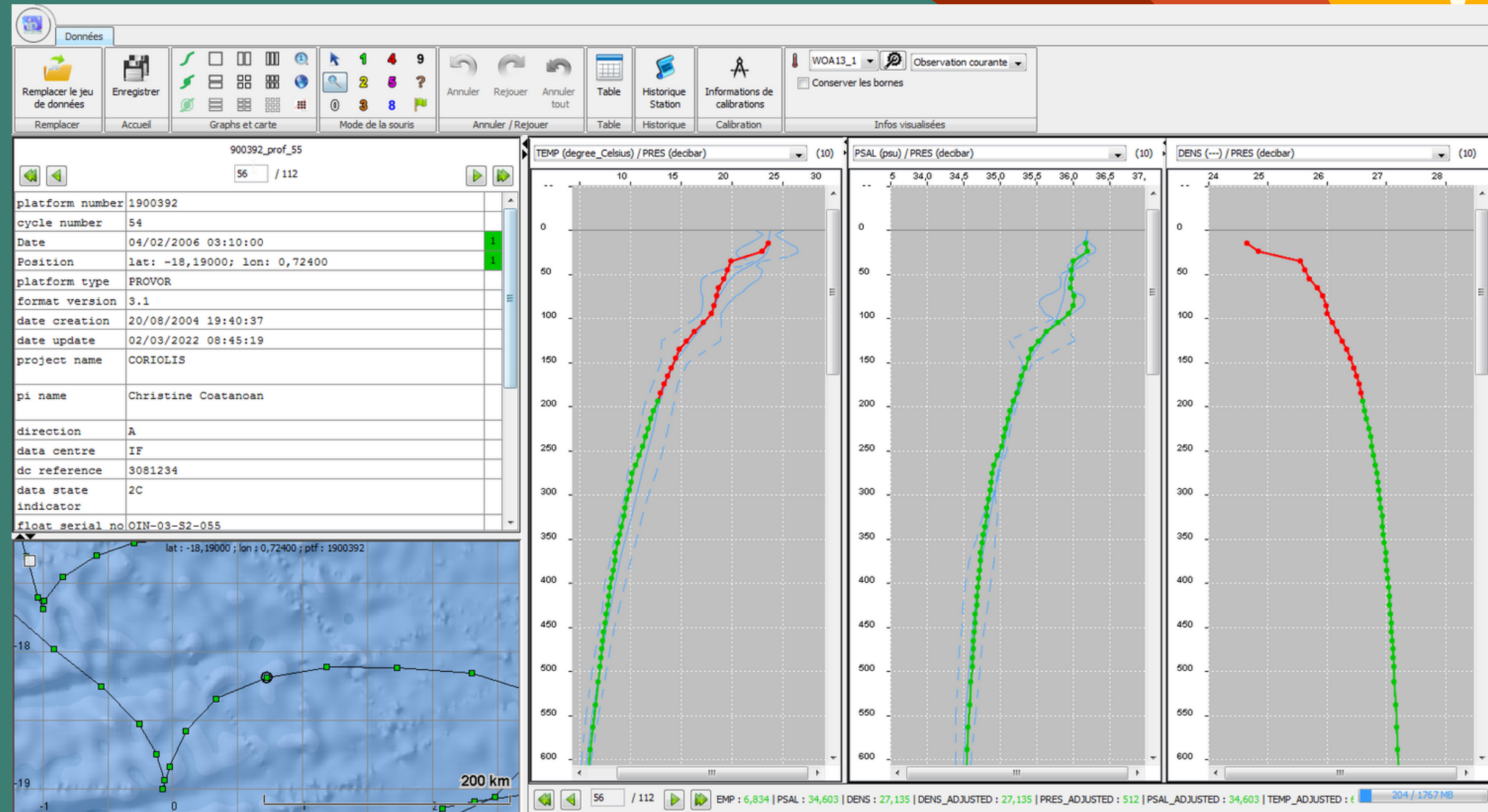


# New tool on Galaxy Europe

## Scoop Argo

### Key features

- Visualises a series of Argo floats NetCDF cycle files.
- The data are displayed in interactive graphics, with bathymetry, climatology and geographic maps environmental informations.
- Quality Control flags are graphically changed by the User.
- The history section is updated with the list of performed changes.





# Marine Omics

**Understand how marine ecosystem services are supported by microorganisms**

**Available** Data products: raw and assembled sequences, taxonomic inventories, and community gene function profiles

From samples of microbial marine biodiversity (eDNA) the pilot aims to implement computational workflows using/producing Essential Biodiversity Variables (EBV) and Essential Ocean Variables (EOV).

## **Workflows examples :**

- Bioprospecting workflow (identifying and classifying biosynthetic gene clusters)
- Ecological strategies workflow (characterising ecological communities among marine environments)



**EMBRC**  
EUROPEAN  
MARINE  
BIOLOGICAL  
RESOURCE  
CENTRE





# A new sub-domain : Galaxy - Earth System

NEW TOOLS, NEW WORKFLOWS, NEW TUTORIALS AND NEW DATA ACCESS

An environment for each subject to access and process their data

COFES  
Tos  
eosc

Galaxy Earth System Europe

Workflow Visualize Shared data Help User

Tools

search tools

Upload Data

Get Data

Send Data

Collection Operations

GENERAL TEXT TOOLS

Text Manipulation

Filter and Sort

Join, Subtract and Group

Convert Formats

Coastal Water Dynamics

Earth Critical Zone

Volcano observations

BioGeoChemical

Marine Omics

History

Rechercher des données

Unnamed history

This history is empty. You can load your own data or Charger des données depuis une source externe.

The first interdomain digital architecture for integrated use of environmental data

eosc | FAIR-EASE

The Environmental BioGeochemical Asset

Earth and Environmental Dynamics

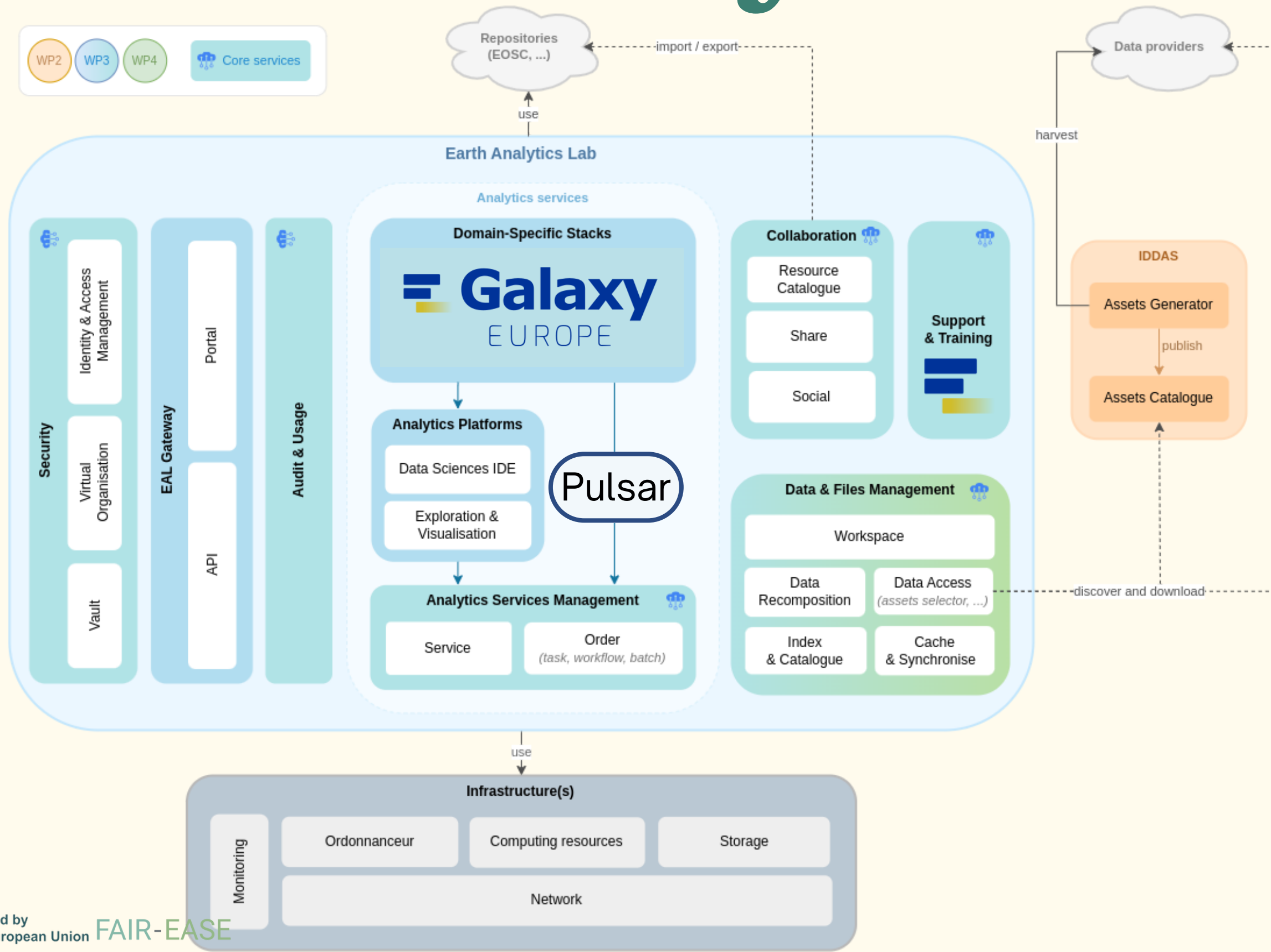
Biodiversity Observation

Galaxy EUROPE

EuroScienceGateway



# Earth Analytical Lab



- An easy way to visualise, analyse and process environmental and biodiversity data on-demand
- Improve data access both in terms of data harmonisation and in terms of technical efficiency of data access.
- Galaxy a main component of the EAL





With environmental data build together

Galaxy for Earth System

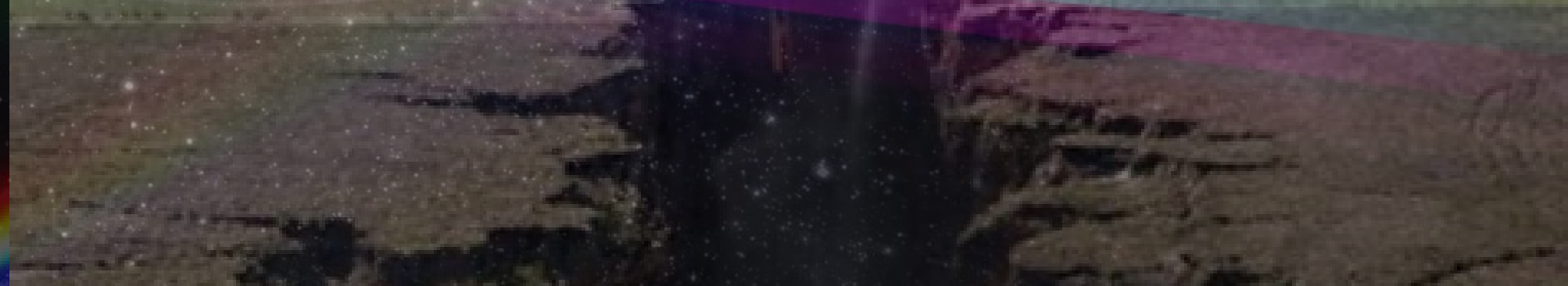


**G** **W**ater  
**A** nalytics workflows for

**L** **A**tmosphere

**A** **L**and

**X** **L**ife  
**Y**



THANKS FOR YOUR ATTENTION DO YOU HAVE ANY QUESTIONS ?

jerome.detoc@ifremer.fr