eosc | Blue-Cloud2026

Blue-Cloud 2026 in a seashell

October 2024

Funded by the European Union

A federated European FAIR and Open Research Ecosystem for oceans, seas, coastal and inland waters

Blue-Cloud 2026 **builds upon the pilot Blue-Cloud project** to further evolve its **pilot ecosystem into a Federated European Ecosystem to deliver FAIR & Open data, analytical services, instrumental for deepening research of oceans, EU seas, coastal & inland waters.**

It develops a **thematic marine extension to EOSC** for open web-based science, & serves needs of the EU Blue Economy, Marine Environment and Marine Knowledge agendas.

Budget: € 8 845 420,00
Funding: HORIZON-INFRA-2022-EOSC-01 | RIA - Research and Innovation action
https://cordis.europa.eu/project/id/101094227
Length: 42 months
Starting date: 1 January 2023
Consortium: 40 partners from 14 countries

Blue-Cloud 2026 in a nutshell - The Goal

Develop a Federated European Ecosystem to deliver FAIR & Open data and analytical services, instrumental for deepening research of oceans, EU seas, coastal & inland waters. It also aims to develop a thematic marine extension to EOSC for open web-based science, serving the needs of the EU Blue Economy, Marine Environment and Marine Knowledge agendas.

All in all, Blue-Cloud 2026 will expand the federated approach of the previous Blue-Cloud, involving more aquatic data stakeholders, and interacting with EOSC developments, in support of the EU Green Deal, UN SDG, EU Destination Earth, and the EU Mission Starfish on healthy oceans, seas, coastal and inland waters, ultimately to provide a core data service for the Digital Twin of the Ocean.

Blue-Cloud 2026 in a nutshell - The Consortium

Consiglio Nazionale delle Ricerche
Scientific and Administrative Coordinator

Trust-iT services communicating to markets
Project Coordinator

MARIS
Technical Coordinator

VLIZ

seascape BELGIUM

Ifremer

NERSC

ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

COMMpla Communication Platforms and Online Solutions

nubisware BRIGHT SOLUTIONS

EMBRC EUROPEAN MARINE BIOLOGICAL RESOURCE CENTRE

POKaPOK

OCEANSCOPE

EMBL

hcmr ΕΛΚΕΘΕ

Institute of Oceanology Polish Academy of Sciences

HUB Ocean

EuroGOOS European Global Ocean Observing System

IEEE France Section

LIÈGE université

National Oceanography Centre | British Oceanographic Data Centre

MERCATOR OCEAN INTERNATIONAL

egi

SORBONNE UNIVERSITÉ

CINECA

OGS National Institute of Oceanography and Applied Geophysics

Koninklijk Nederlands Meteorologisch Instituut Ministerie van Infrastructuur en Waterstaat

IRD Institut de Recherche pour le Développement

FORTH INSTITUTE OF COMPUTER SCIENCE

cmcc Centro Euro-Mediterraneo sui Cambiamenti Climatici

AWI ALFRED-WEGENER-INSTITUT HELMHOLTZ-ZENTRUM FÜR POLAR- UND MEERESFORSCHUNG

SOCIB Balearic Islands Coastal Observing and Forecasting System

hidrográfico marinha·portugal

SMHI

grnet

SIOS

emso ERIC

UNIVERSITEIT VAN AMSTERDAM

ETH zürich

ETT

Blue-Cloud 2026 in a nutshell - The outputs

MISSION: To develop further the European federation of marine and inland water data management infrastructures & high quality services

A1. DD&AS

A FAIR compliant Data Discovery & Access Services > access to 10+ million open data sets & products by 13 major BDIs

A2. VRE

An Open Science Virtual Research Environment (VRE) federating multiple e-infrastructures > supporting Analytical Big Data Workbenches & VLabs

A3. EOVs

3 EOV Workbenches for highly qualified data collections

3.000 DATA ANALYTICS SESSIONS PER MONTH - 5,000 HTC DATA ANALYTICS JOBS PER MONTH

A4. VLABs - FIVE DOMAIN-BASED VIRTUAL LABS

Coastal Ocean observations along Europe

Coastal currents from observations

Carbon-Plankton Dynamics

Marine Environmental Indicators

Global Fisheries Atlas

A7. COMMUNITY

- **All EU countries** engaged
- **3k+** engaged Blue- Cloud community users
- **5k+** followers across all the platforms
- **10+** External Stakeholders

OUTREACH

- **1** Blue-Cloud Hackathon
- **1** Blue-Cloud TV
- **18** Newsletter issues
- **11** Webinars on Blue-Cloud VRE, DDAS & EOV Workbenches
- **3** Blue-Cloud Annual Impact Events
- **3** Ocean Literacy Webinars
- Videos & Interviews

A6. TRAINING ACADEMY & CATALOGUE

- **3** Online training course on Best Practices for FAIR data principles
- **3** Info session & course on the EOV Workbenches
- **2** online webinars dedicated to the BlueCloud VRE
- **2** dedicated to the DDAS and the innovations introduced
- A series of training sessions on how to use the VLabs

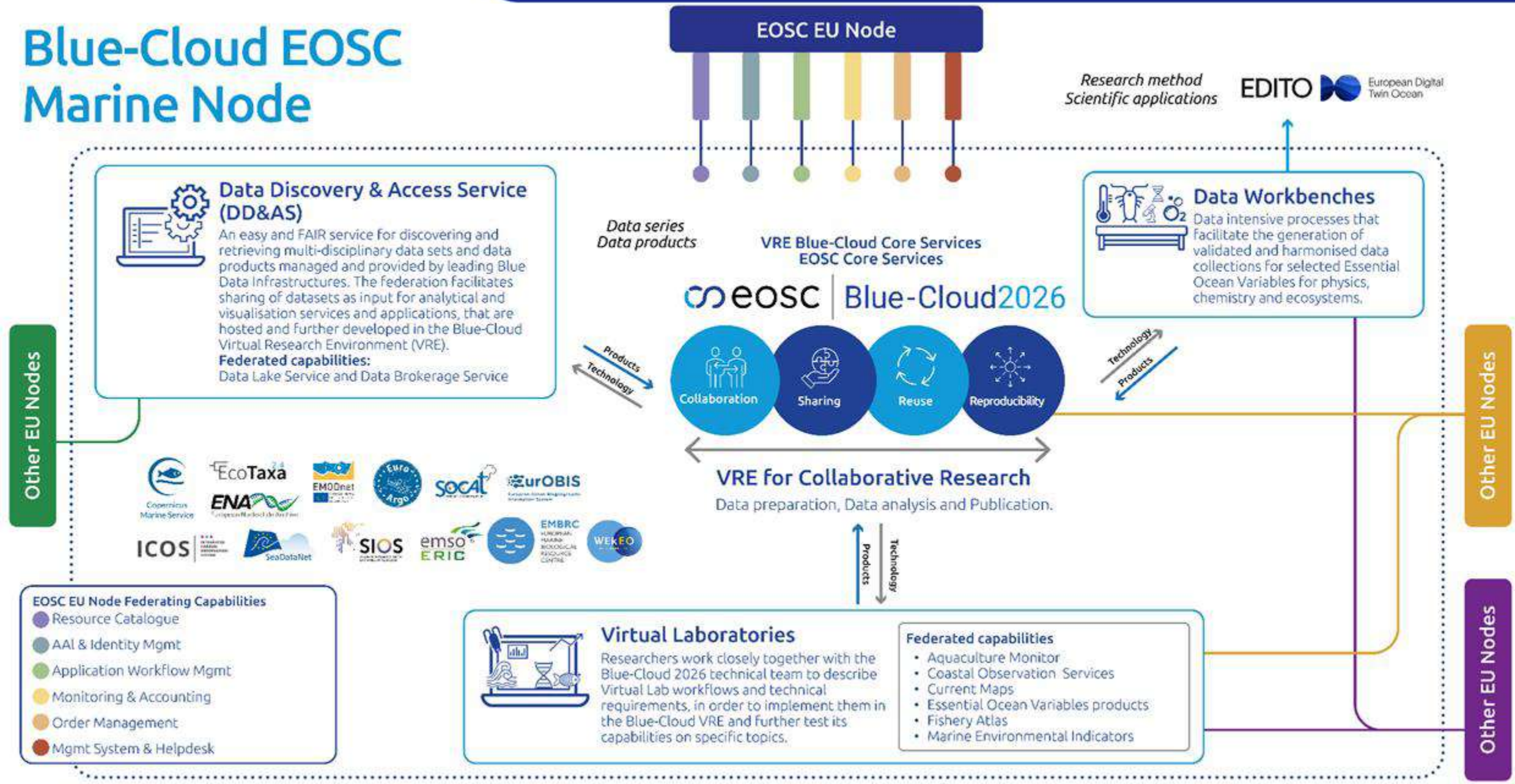
POLICY

- Scientific papers & articles
- Restoring healthy oceans, seas, coastal & inland waters in Europe
- Strategic Roadmap 2030 A5. ROADMAP
- Cross-domain expansion factsheets
- Sustainability Business model

DTO Task Force

Blue-Cloud federation: towards an EOSC thematic node for marine research

Blue-Cloud EOSC Marine Node



Assessing Blue-Cloud as an EOSC Node

Blue-Cloud as a pilot thematic EOSC as a role model for the development of other thematic clouds and a best practice for Data federation within the EOSC community

EC Commissioner **Micheal Aredtof,** Head of Unit, *"Open Science and Research Infrastructures", DG RTD at the 2nd 2023 Coordination meeting of EOSC-related projects funded under Horizon Europe*
June 2023

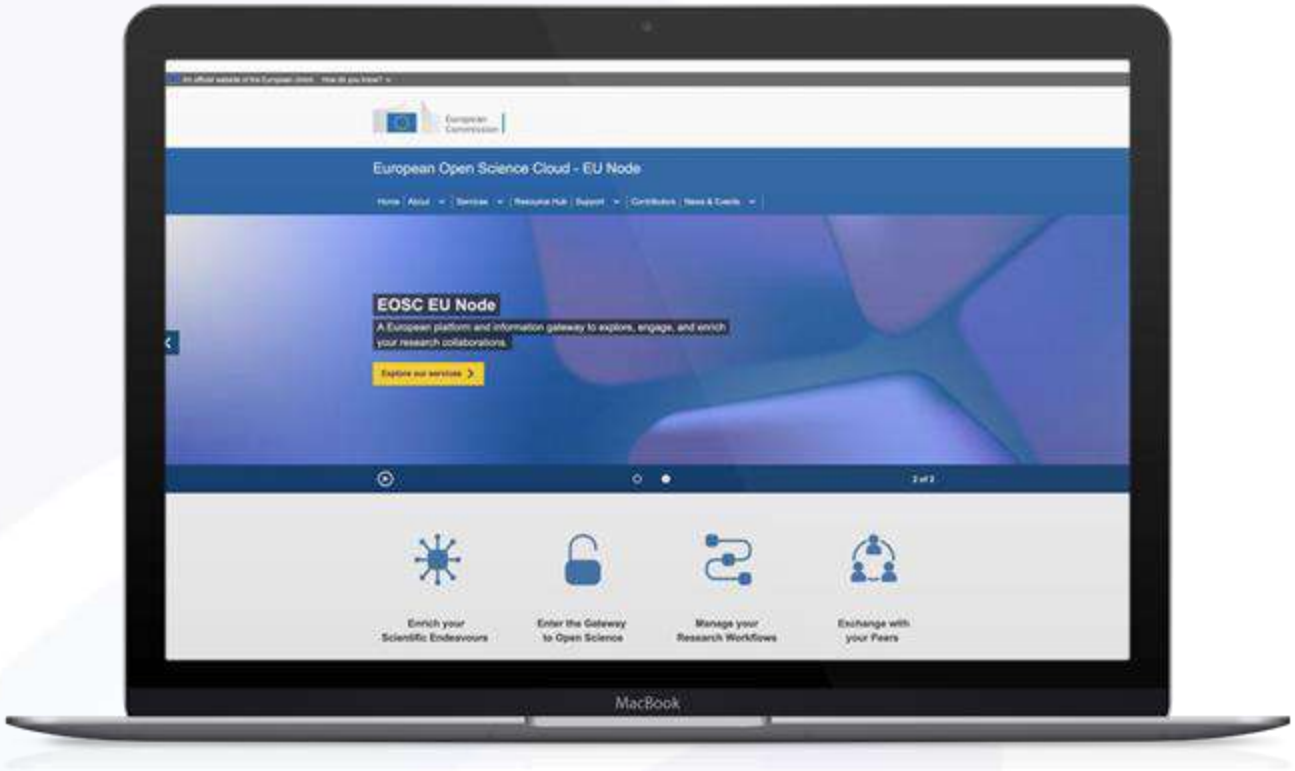

EOSC Tripartite Event Belgium
16 April 2024

The European Open Science Cloud (EOSC) aims to achieve a federation of infrastructures providing seamless access to interoperable research objects and value-added services for the whole research data cycle, from discovery to storage, management, analysis, and reuse.

The EOSC Procurement is to build and deploy **an operational, secure, cloud-based EOSC EU Node**, that includes both the core and exchange service components, offering high quality managed services and superior user experience for a large number of users, with the functionalities available 24/7.

The EOSC EU Node will provide access to a rich portfolio of FAIR (Findable, Accessible, Interoperable, Reusable) data and professional quality interoperable services in all relevant domains from data handling to computing, processing, analysis and storing.

The procurement also covers operations, maintenance, and support of the EOSC EU Node for 36 months.

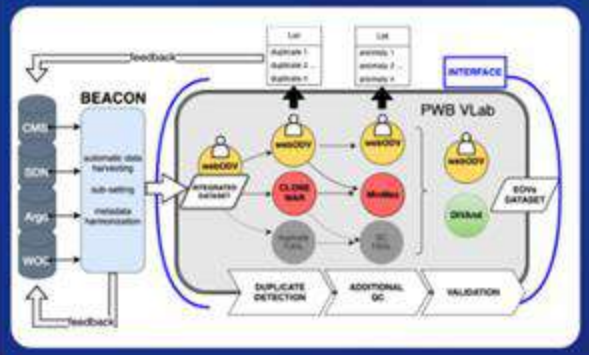


Federating BDIs in the Blue-Cloud Data Discovery and Access service

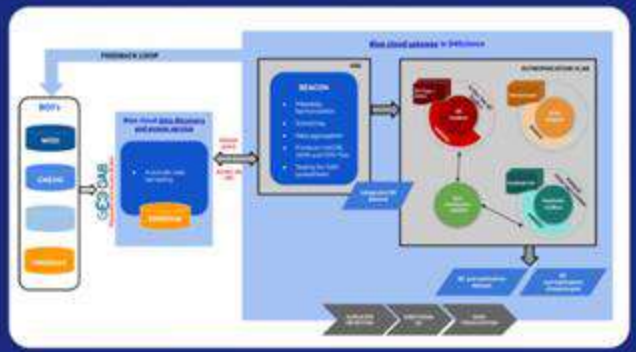
Blue Data Infrastructure	Types of data sets	Logo and link
SeaDataNet CDI service	Marine physics, bathymetry, chemistry, geology, geophysics, and biology observation data sets	
EMODnet Chemistry data products	Marine chemistry data collections and interpolated map products	
EurOBIS - EMODnet Biology	Marine biogeographic data collections with taxonomy and distribution	
Euro-Argo and Argo GDAC	Ocean physics and marine biogeochemistry observation data from Argo floats	
ELIXIR- European Nucleotide Archive (ENA)	Nucleotide sequencing data and information on marine species	
EcoTaxa	Taxonomic annotation data of images on planktonic biodiversity	
SeaDataNet data products	Aggregated marine data collections and climatologies, such as for Temperature & Salinity	
ICOS-Marine	Long-term oceanic observations of carbon uptake and fluxes for understanding the global carbon cycle	
SOCAT - Surface Ocean CO2 Atlas	SOCAT version 2020 with quality-controlled surface ocean fCO2 measurements from 1957 to 2020	
EMODnet Bathymetry	EMODnet Bathymetry World Base Layer is used as base map in the interface	
EMSO		
SIOS		

Use is made of web services and APIs, following protocols such as CSW, OAI-PMH, ERDDAP, or otherwise, as provided and maintained by the BDIs. These are used to deploy M2M interactions for harvesting metadata, submitting queries, and retrieving resulting metadata, data sets and data products.

Beacon
The Beacon software system comes with a unique indexing system that can, on the fly, extract specific data based on the user's request from millions of observational data files. . Beacon exposes a REST API so that clients can query data via a simple JSON request, integrated in Jupyter notebooks. The system returns one single harmonised file as output, regardless of whether the input contains many different data types or dimensions. In practice, Beacon functions as a data lake bringing together millions of e.g. NetCDF files from multiple repositories, and after initial indexing (taking several hours), allowing extraction of subsets and exporting these in one coherent NetCDF file in seconds.



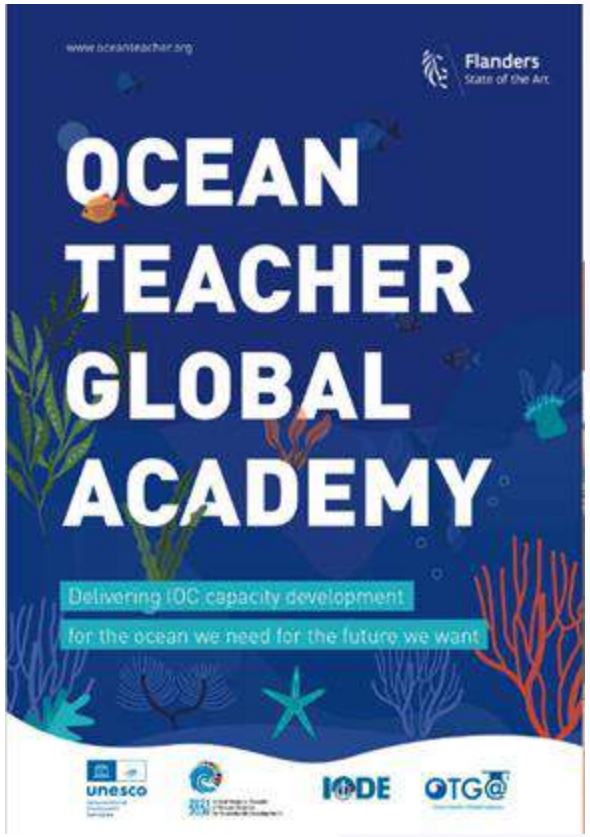
WorkBenches
Blue-Cloud is establishing three big data processing WorkBenches to facilitate the generation of validated and harmonised data collections for selected Essential Ocean Variables (EOVs), namely for Physics, Chemistry and Ecosystems. Several datasets from different EU and non-EU BDIs will be integrated, harmonised and validated. The resulting high-quality EOVs datasets and analytical workflows will be instrumental to EU operational services and the Digital Twins of the Oceans (DTO).
WorkBenches are looking for an easy and efficient way to get their input organised of large amounts of data sets for selected parameters from multiple data repositories and preferably already in a homogeneous way considering formats, parameters, units and other core metadata. The Figures illustrates a schematic overview of the Physical andEutrophication WorkBenches with Beacon integrated in the workflow.



Blue-Cloud for Ocean restoration

VRE and VLab services illustrate the wide range of subjects that can be addressed using Blue-Cloud resources, from genomics to wildlife as well as environmental data coming from multiple disciplines and repositories, and all together demonstrate Blue-Cloud 2026's potential In different fields of marine research, ranging from biodiversity to environmental science, as well as fisheries and aquaculture.

Training Academy & dissemination material



blue-cloud.org/training-academy

Webinar FAIR Data Principles 2 | Making Marine Data FAIR: FAIR assessment of marine data & information

23 April 2024 Online

Ocean Data Quality Assessment through Outlier Detection-enhanced Active Learning

29 January 2024 Online

Optimising FAIRness of federated Blue Data Infrastructures webinar

6 December 2023 Online

FAIR Data Principles 1: Foundational components, best practices and standards

26 September 2023 Online

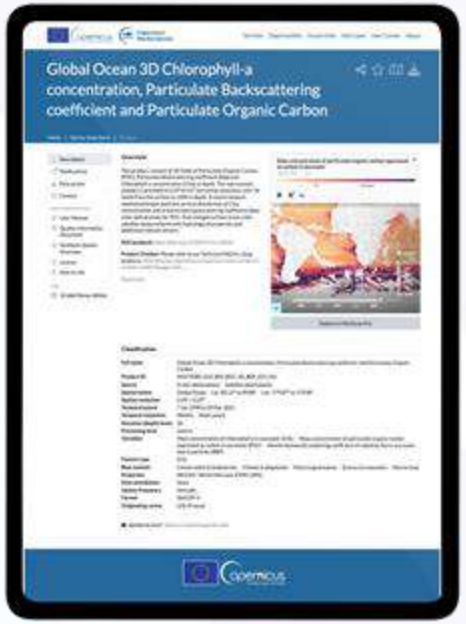
Blue-Cloud an an incubator for the DTO

Wildlife Tracker for Oceans: real-time assessment for marine fauna habitat with Phytoplankton hotspots

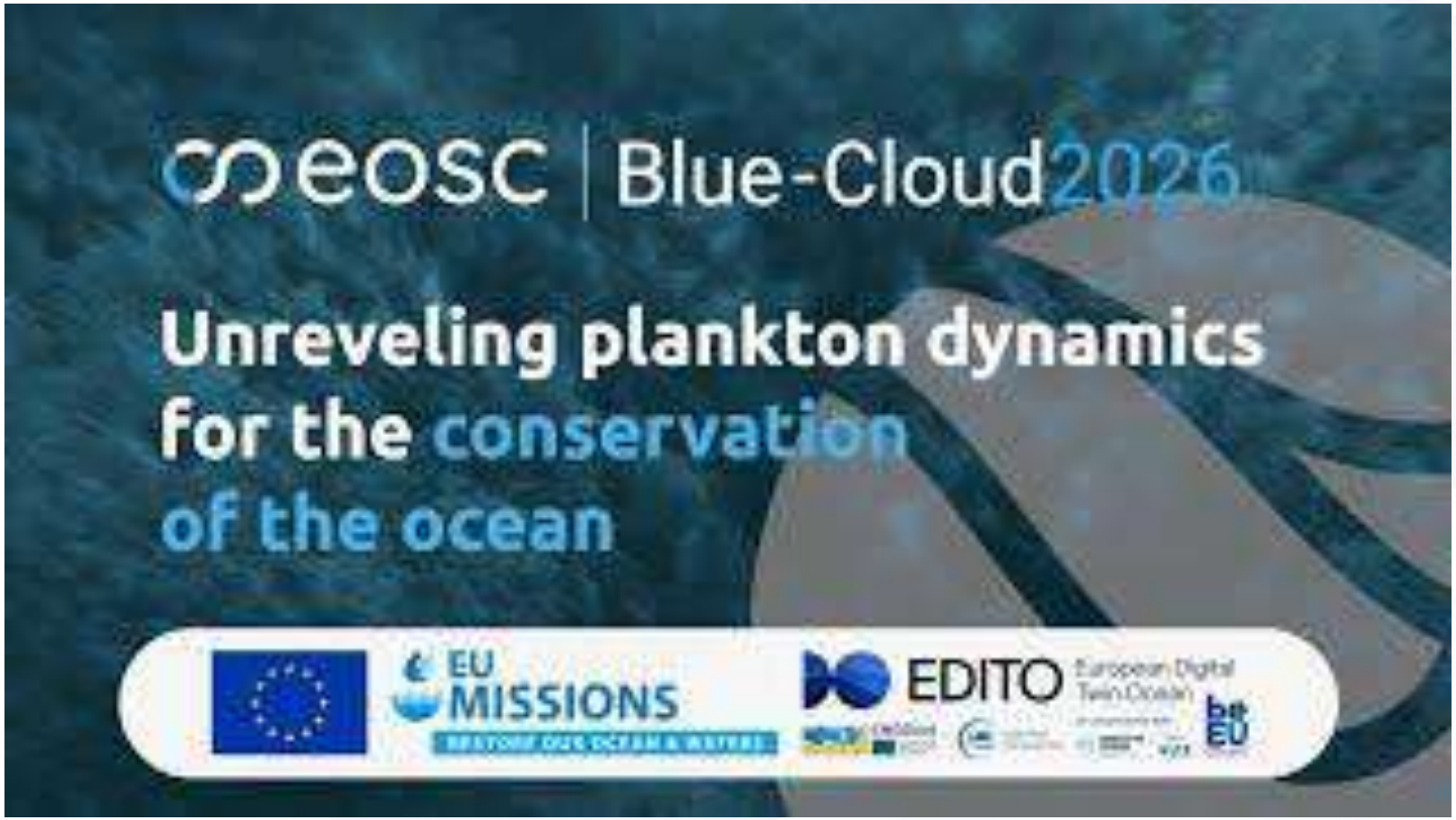
Blue-Cloud VLab demonstrator presented at the Digital Ocean Forum High Level Event on 13 June 2024

Phytoplankton Essential Ocean Variable

Phytoplankton EOV generates global open ocean 3D gridded products of (1) chlorophyll a concentration (Chla), which is a proxy of the total phytoplankton biomass, and (2) Phytoplankton Functional Types (PFT), as a proxy for phytoplankton diversity, based on temperature and salinity in situ data matched up with ocean color satellite products.



Blue-Cloud an an incubator for the DTO



Unravelling plankton dynamics for the conservation of the ocean

Blue-Cloud demo at DOF 2024

Photo credits: ©Bernal Revert/BR&U

https://blue-cloud.org/events/digital-ocean-forum-2024

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Blue-Cloud 2026 core services

VRE & Data Discovery & Access Services - status today

Funded by the European Union

Blue-Cloud 2026 core services: Data Discovery & Access Services - status today

Facilitates users:

- Federated search for discovering interesting data sets (currently more than 10 million) in a two step approach
- Federated retrieval of identified data sets using a shopping basket mechanism
- Download of data sets or push to Blue-Cloud VRE

Facilitates managers of Blue Data Infrastructures:

- Wider outreach to potential users
- Stay informed about data requests and users for their repository
- Periodic reporting of downloads from their repository

Expanding and Optimising the Blue-Cloud Data Discovery & Access service (DD&AS) and its FAIRness by:

- harmonising and expanding functionality of web services as operated by each BDI for discovery and access of managed data resources, and as used in DD&AS, following FAIRness review
- developing and deploying semantic brokering as part of DD&AS interface
- federating additional BDIs into the DD&AS (**EMSO, SIOS, EMODnet Physics, MGnify)**
- reviewing, and if missing, developing and deploying data sub-setting and extracting services, operated by each BDI, for feeding Blue-Cloud 'raw data' Data Lakes,
- developing and deploying Blue-Cloud Data Lakes for storing and maintaining 1) 'raw data' extracted from BDIs and 2) harmonised and validated data collections for selected data types, as resulting from the WP3 EOV Work Benches

Blue-Cloud 2026 core services: Virtual Research Environment - status today

Support researchers and scientists in doing science

Without
- forcing specific approaches and technologies
- asking to focus on matters other than their science

By
- enriching their activities with the information that enables sharing and reuse of their scientific workflows
- making their research objects ready for publication

Virtual Laboratories

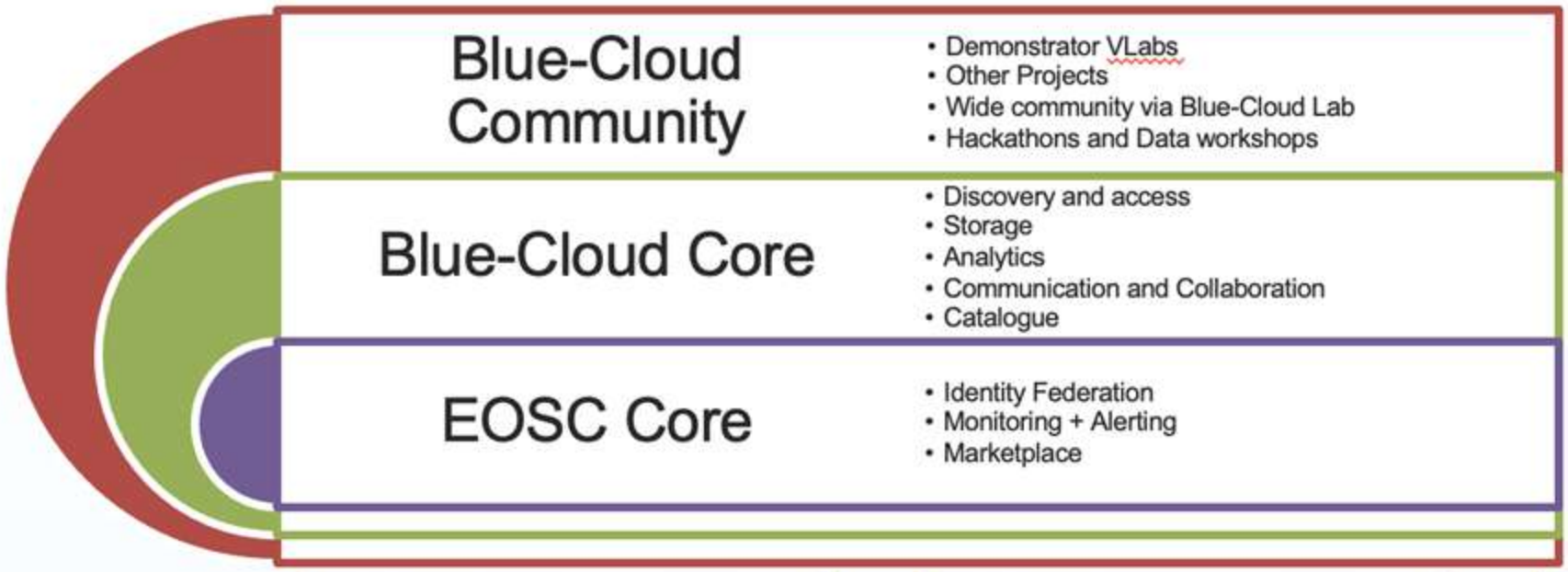
Data sharing
- Workspace
- Dataspace
- Repositories

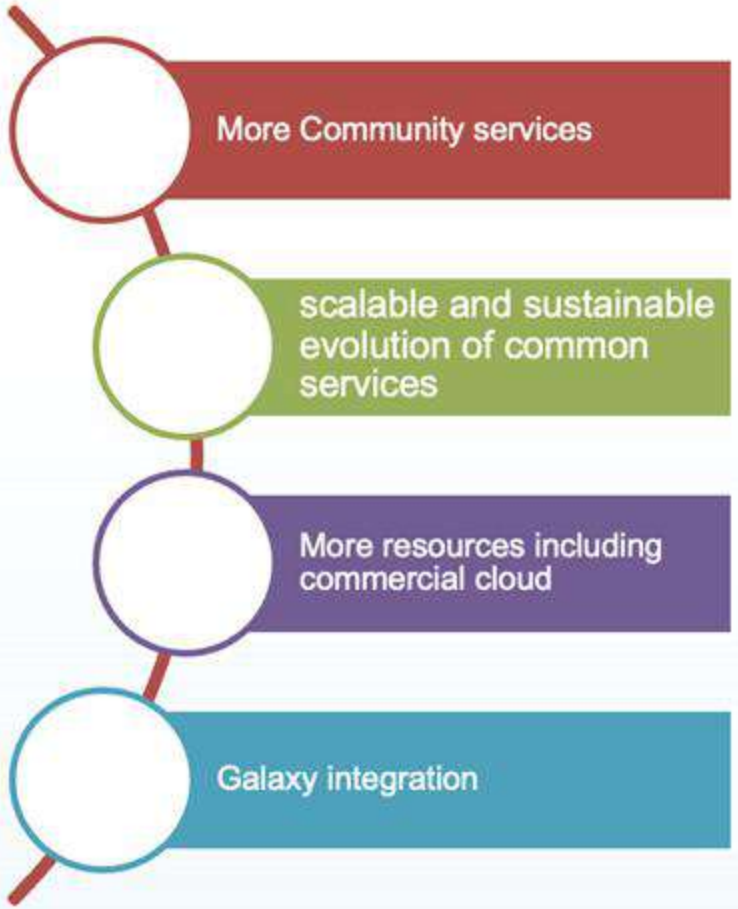
Data analytics
- High Throughput Computing
- Notebook
- RStudio

Social networking
- Messages
- Posts and replies
- User profiling

Research Object Publishing
- Catalogue
- Thredds
- GeoNetwork

It is implemented as a System of Systems promoting Open Science





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Blue-Cloud 2026 WorkBenches

Funded by the European Union

physical workbench for temperature, salinity

chemical workbench, linked to eutrophication: nutrients, chlorophyll, oxygen

ecosystem workbench for plankton biomass and diversity

The objective is to obtain **highly qualified datasets** for some chosen Essential Ocean Variables (EOVs) combining different and various sources as inputs.
→ The results will be 1 highly qualified dataset per EOV

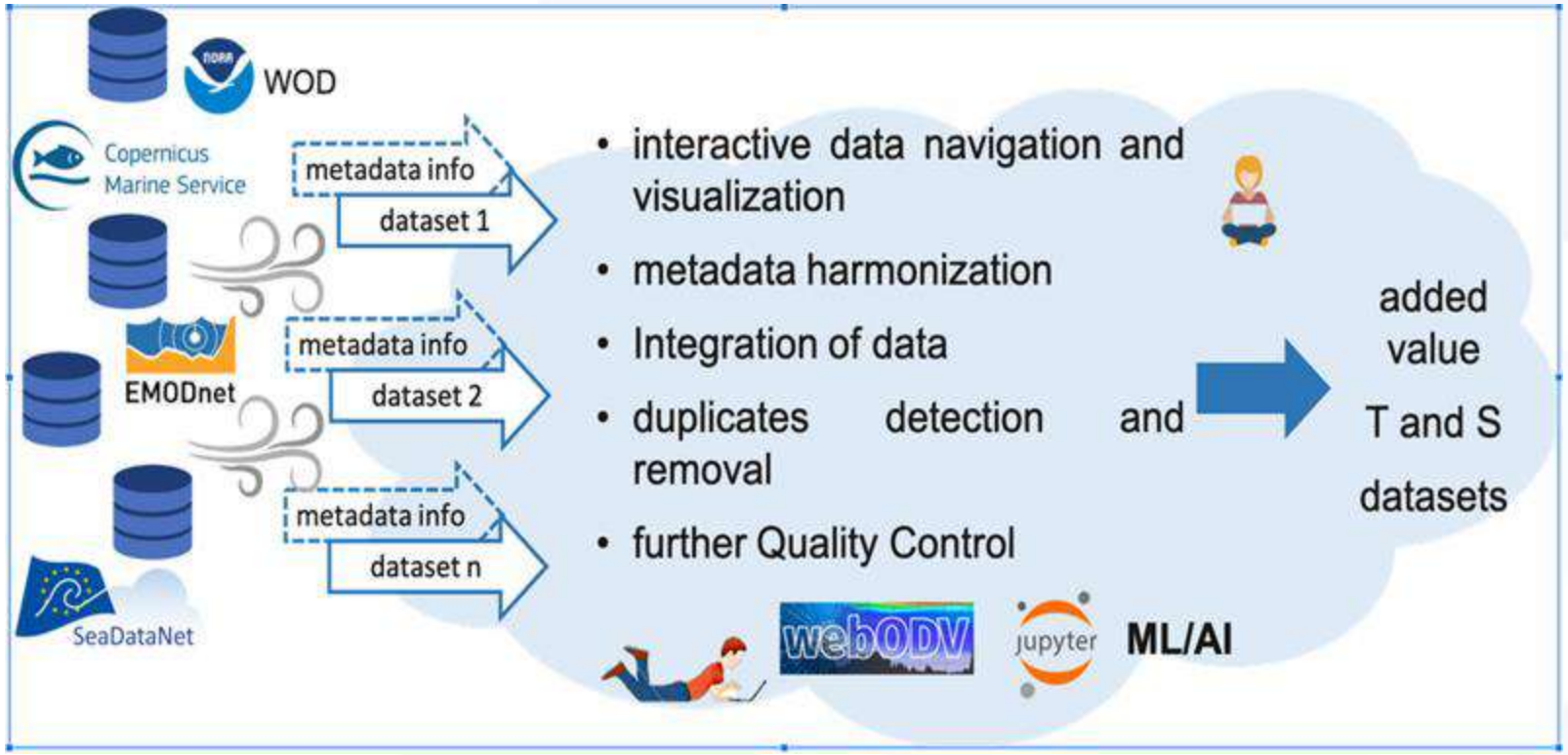
Workbenches or pipelines will be built to obtain the highly qualified datasets that can use other data sources or be adjusted depending on expert needs

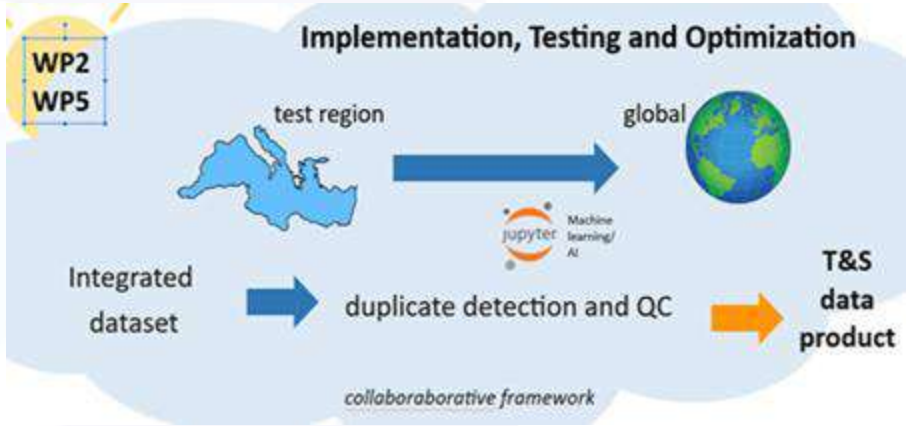
The challenge is to deal with large in situ datasets, i.e. to both access the relevant data and make developments on it. Blue-Cloud 2026 will allow this thanks to the high level performance D4science VRE based on cloud computing associated with big data technology, a large datasets repository (datalake) and an expert data management.

Example for the physical workbench:

physical workbench for temperature, salinity

Speed up the process of * interactive data navigation/visualisation, * metadata harmonisation, * integration of data, * duplicate detection and * further QC thanks to IT technological advancement (cloud computing, VRE, big data)

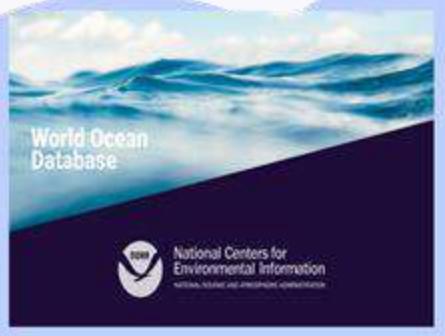




Example for the chemical workbench:

chemical workbench, linked to eutrophication: nutrients, chlorophyll, oxygen

- **workflow that will merge multi-source datasets** to obtain an integrated and most complete dataset for the North East Atlantic to the global ocean; **provide a set of QC procedures** and **handling of potential duplicate observations**



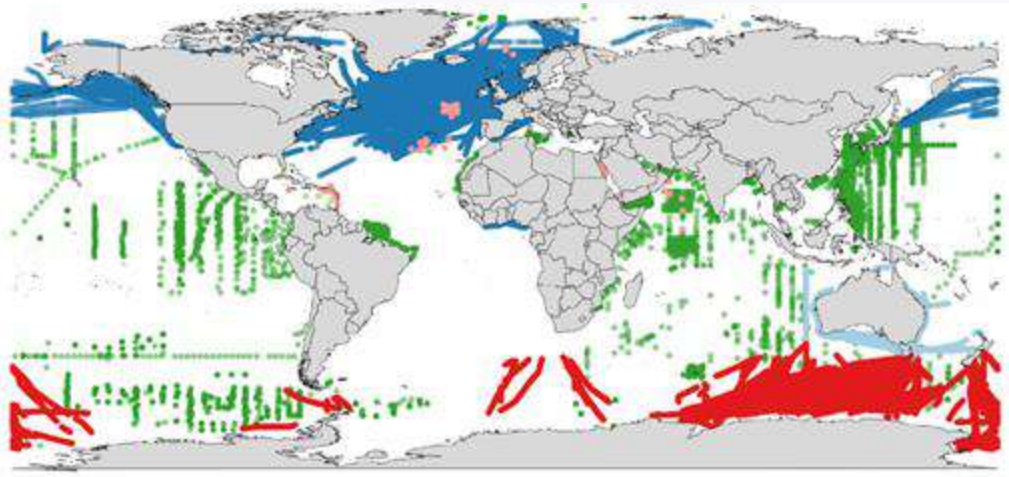
SeaDataNet

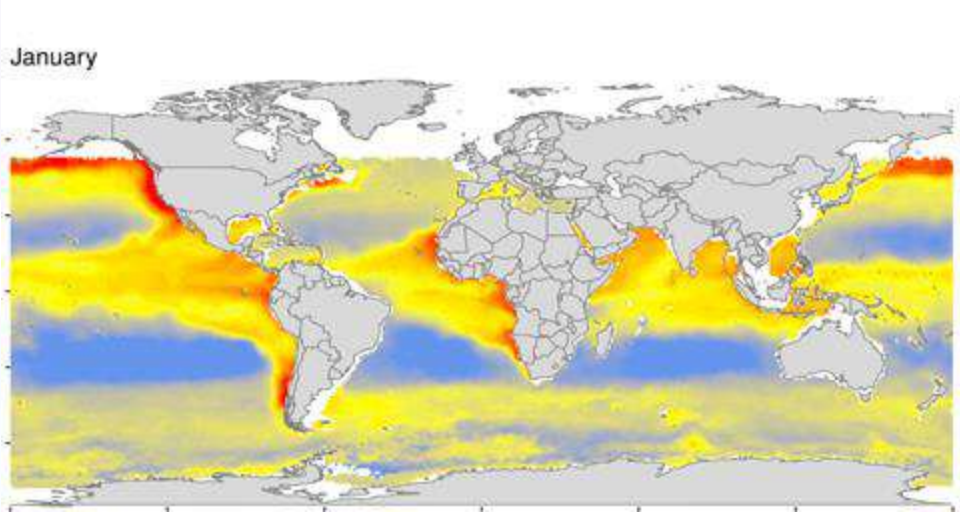
Blue Cloud Eutrophication data products

Example for the ecosystem workbench:

ecosystem workbench for plankton biomass and diversity

A rigorously quality-controlled, automatized modelling (machine learning) pipeline that integrates data from multiple European data repositories to produce **phyto- and zooplankton biomass and biodiversity products for the past, present and future ocean**





Data
(raw foraminifera biomass observations, multiple sources)

Knowledge
(integrated, quality- and bias-corrected biomass fields)

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Blue-Cloud 2026 Virtual Labs

Funded by the European Union

Coastal Ocean observations along Europe

new!

Coastal currents from observations

Carbon-Plankton Dynamics

Marine Environmental Indicators

Global Fisheries Atlas

Blue Data Infrastructures

Copernicus Marine Service

EurOBIS
European Ocean Biodiversity Information System

SeaDataNet

EMODnet
CENTRAL PORTAL
Your gateway to marine data in Europe

SOCAT
SURFACE OCEAN CO2 ATLAS

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EcoTaxa 2.5

ICOS
Integrated Carbon Observation System

MGnify

ENA
European Nucleotide Archive

emso ERIC

SIOS

Euro-Argo

JERICO RESEARCH

DEMONSTRATING OPEN SCIENCE VIA VIRTUAL LABS

MARIS · VLIZ · cmcc · FORTH · hidrografico · IEEE France Section · IRD · OGS · LIÈGE université · SOCIB

Blue Cloud VRE

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Home /

Data Catalogue

eosc

zenodo

Coastal Ocean observations along Europe

Integration of European coastal observations in 3 thematic services: **Transboundary Processes and Connectivity**, Extreme Events & Ocean Glider

hidrográfico marinha·portugal

SOCIB Balearic Islands Coastal Observing and Forecasting System

IEEE Advancing Technology for Humanity

JERICO RESEARCH INFRASTRUCTURE

- HF Radar Currents
- Current Profile in MP Buoys
- T in Wave Buoys
- T,S in MP Buoys
- T,S Glider profiles
- SSH at coastal tide gauges

Copernicus Marine Service

- SST fields
- NEMO 3D T,S, SSH, Current
- ERA5 Surface Meteo Params

SeaDataNet

- Physics, BGC, Biology

EMODnet

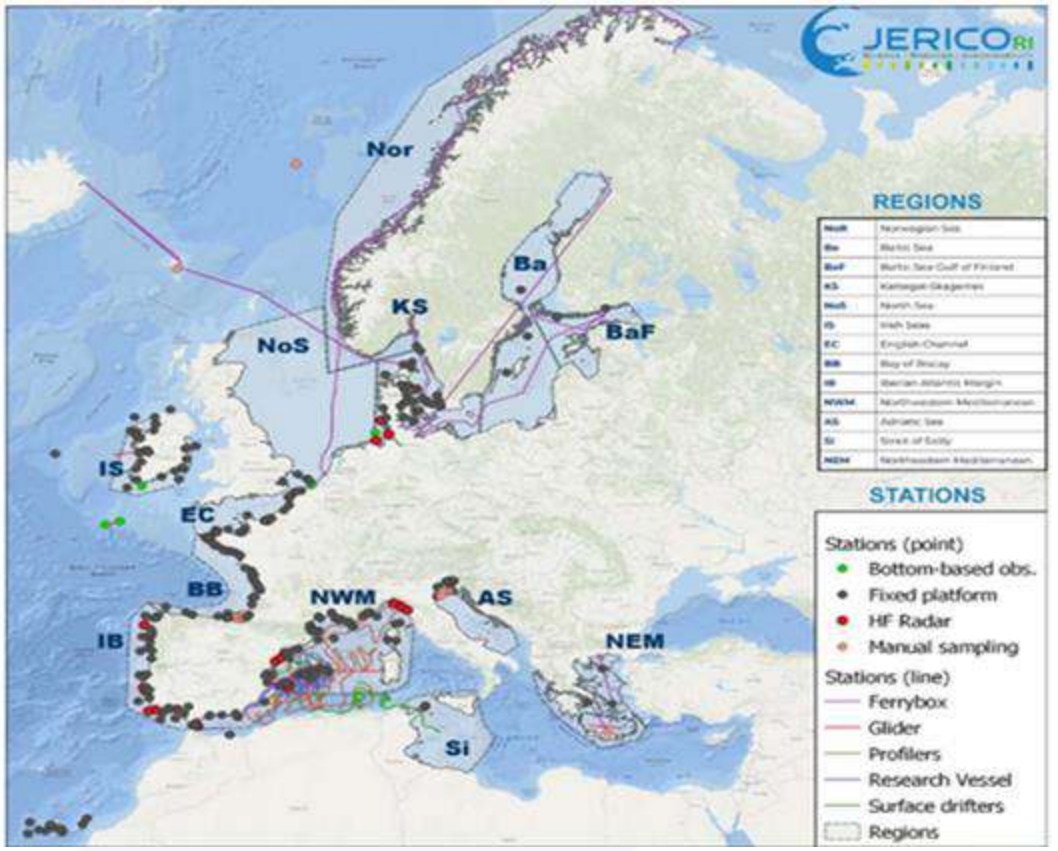
- Physics, Chemistry, Biology, Bathymetry

GEBCO

- Bathymetry

NETCDF

Shiny



Coastal currents from observations

Integration of direct and indirect currents data from different sources, and application to run an oil spill model

LIÈGE université GHER
SOCIB Balearic Islands Coastal Observing and Forecasting System
cmcc

Copernicus Marine Service

In Situ - Global Ocean- Delayed Mode Observations of surface (drifters, HFR) and satellite altimetry

EMODnet
GEBCO

Bathymetry

OpenStreetMap

Coastline

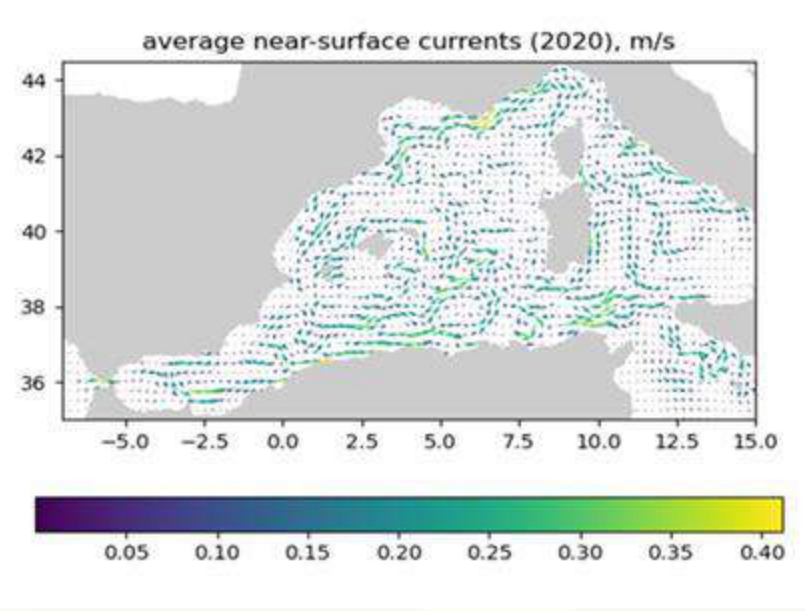
ECMWF

Wind speed

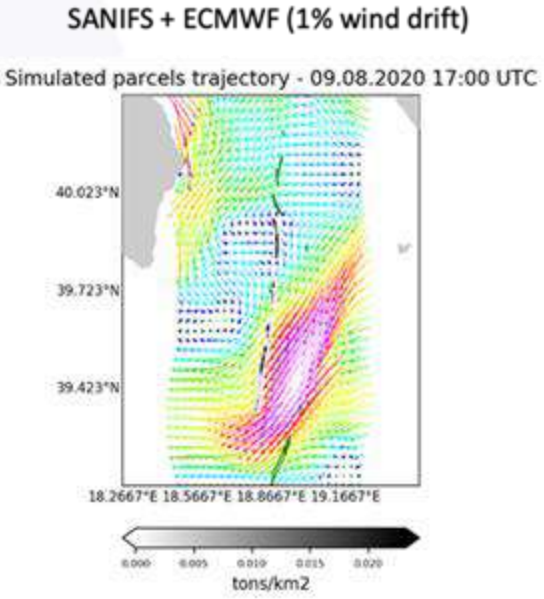
Jupyter notebooks
DIVAnd analysis

Gridded surface currents

Initialise the oil spill forecasting model (MEDSLIK-II)



jupyter
julia
NETCDF



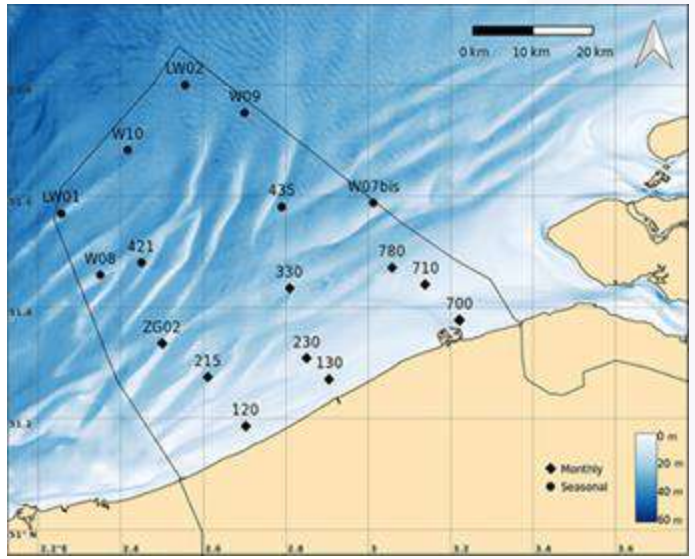
Carbon-Plankton Dynamics

Nutrient-Phytoplankton-Zooplankton-Detritus (NPZD) Model, i.e. a mechanistic model, to identify the contribution of the drivers in phytoplankton dynamics and carbon dynamics.

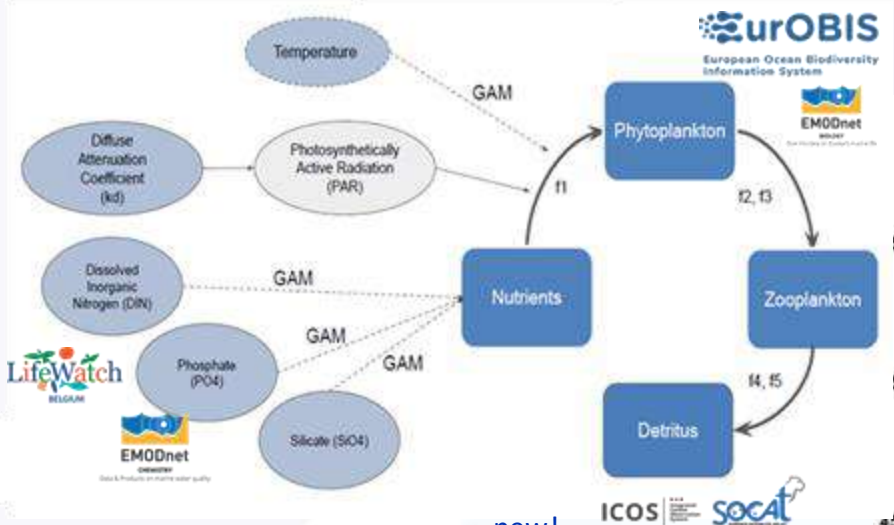
VLIZ OGS

Seasonal and monthly records from 2011-2022

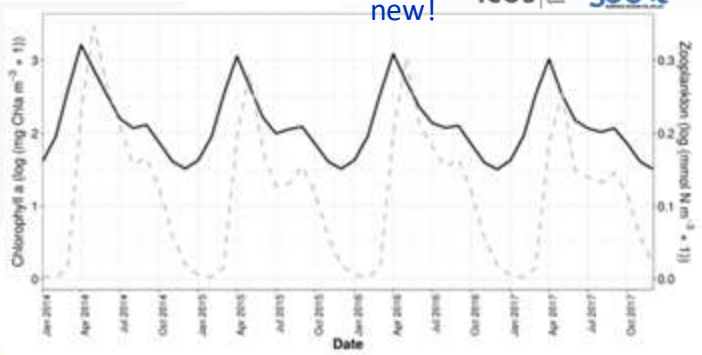
Train and validate the NPZD model for the Adriatic

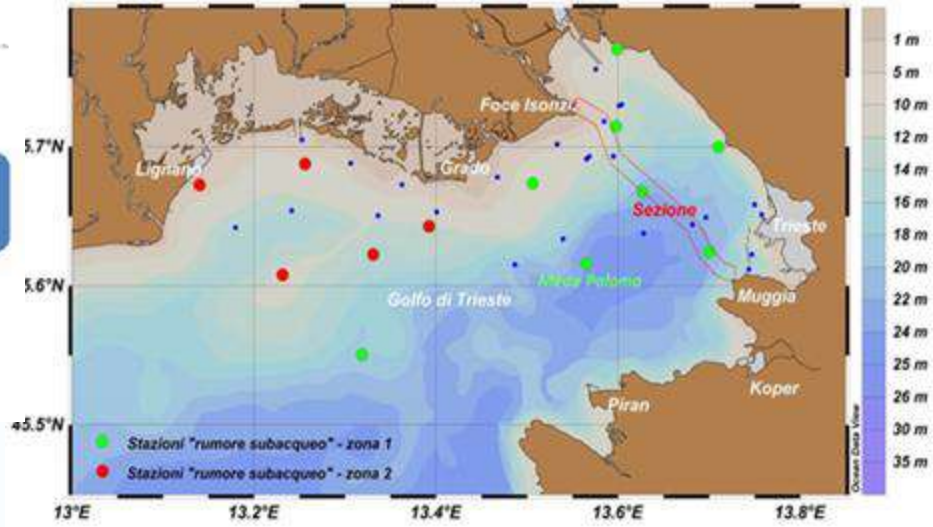


Mortelmans et al. (2019)



new!





ogs.it

Marine Environmental Indicators

Web app for cloud computation of new added-value data to monitor the environmental status of marine areas.

SERVICES

- Marine Environmental indicator (MEI) generator
- Ocean patterns and ocean regimes indicators
- Storm severity index
- Easy access to carbon data
- Ocean heat content
- Enhance Storm Severity Index (SSI v2)

new!

- Trophic Index (TRIX)
- Marine heat wave

Copernicus Marine Service

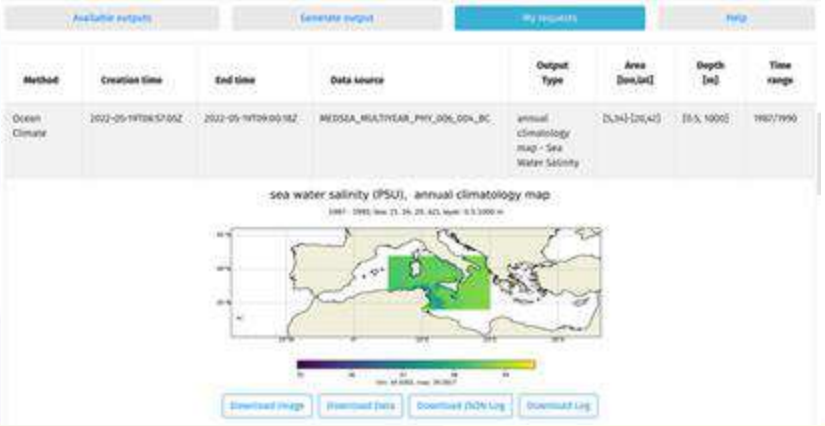
WEKEO

EMODnet CHEMISTRY

- Temperature and salinity Historical Data
- Mediterranean Sea Physics Reanalysis
- Global Ocean Physics Reanalysis
- Wind speed
- Wind (ERA5) reanalysis
- Global in-situ observation
- Other environmental variables

jupyter

Cloud Computing Platform (CCP)



Global Fisheries Atlas

Discovery & Access of Global Record of Stocks and Fisheries, and Fisheries Atlas datasets

GRSF Catalog
(Knowledge level)

Fetch
Transform

RDF Format

Data curation & validation

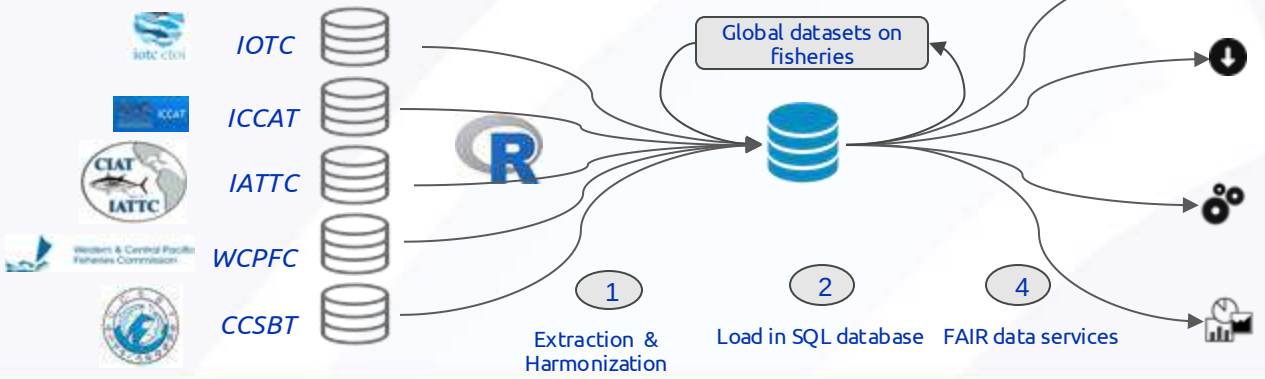
Data processing: records cleaning, standardization, dissection & merging

new!

Workflows merging

Fisheries Atlas
(data level)

(*eg* Tuna) RFMOs



Discover available data
What datasets exist?
How they were built?

Access the data and code
Different protocols and formats ?

Process the data
How to customize a fisheries atlas?

Visualize the data
How to easily create maps, plots?

GeoNetwork
GeoServer
zenodo
GitHub
RStudio
doi
OpenLayers
Shiny

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Blue-Cloud 2026 Training Academy & Outreach

Funded by the European Union

Our network is further expanding beyond Europe and the Atlantic, with an increased presence at events and via new synergies.

Key events

- 9-12 November 2023 - DITTO Summit **China**
- 14-15 November 2023 - EU-Caribbean Workshop on Marine Scientific Cooperation **Barbados**
- 29-30 November 2023- EMODnet Open Conference **Belgium**
- 11-15 December - AGU 2023 **USA**
- 10-12 April 2024 - Ocean Decade Conference **Spain**
- 14-19 April 2024 - EGU 24 **Austria**
- 27-29 May 2024 - IMDIS **Norway**
- 30-31 May 2024 **-** EMD **Denmark**

The **Training Academy** offers comprehensive lessons and materials that guide users and marine researchers in utilising Blue-Cloud services. In addition, a dedicated series of webinars focuses on FAIR data management for marine science.

Also thanks to new international partners, our content is reaching specialist audiences in extra-EU countries more than in the previous project.

Blue-Cloud Training Academy

26 September - 16:00 CEST

Webinar 1 - FAIR Data Principles 1: Foundational components, best practices and standards

6 December – 10.00 CET

Webinar 2 - Optimising FAIRness of federated Blue Data Infrastructures webinar

Past webinars

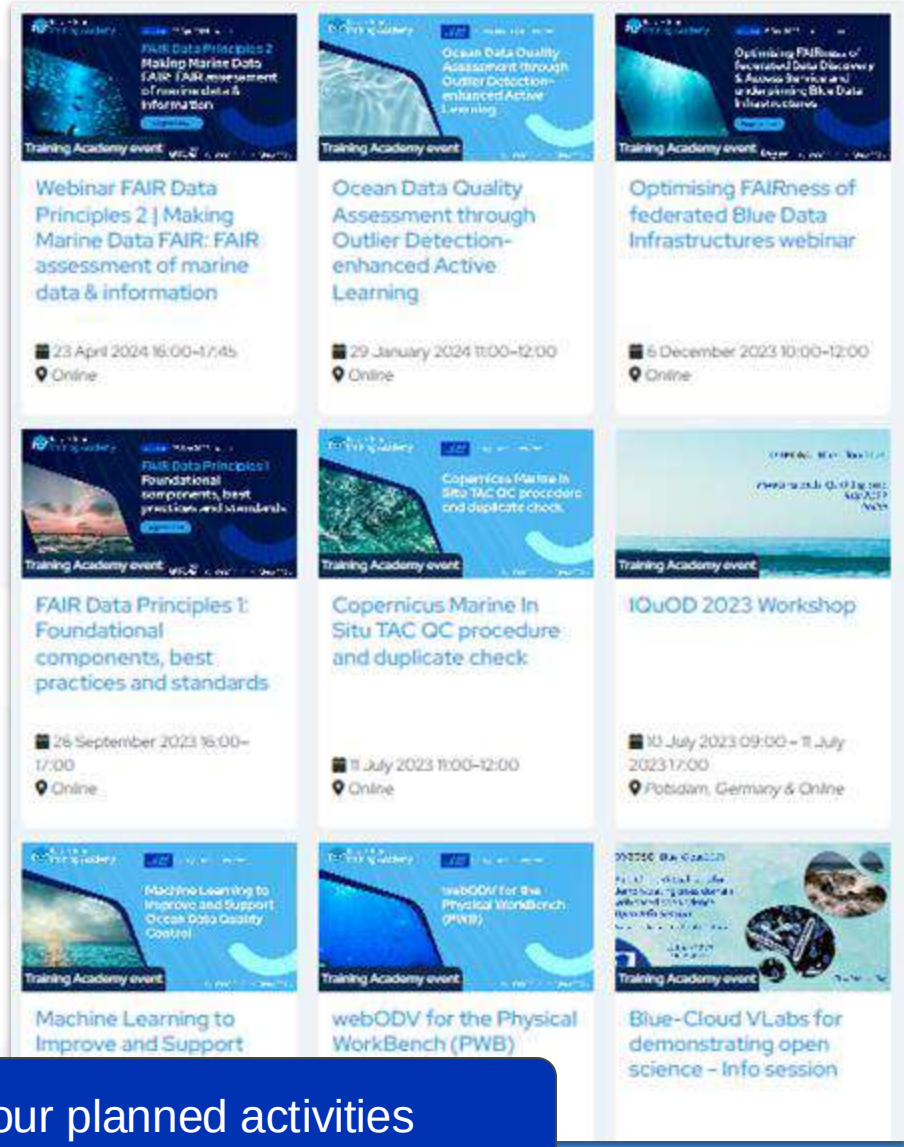
- 17 March - Blue-Cloud VRE
  - 127 registrants
  - 160 views on YT
- 8 June - Blue-Cloud VLabs
  - 99 registrants
  - 77 views on YT

blue-cloud.org/training-academy

Status today: webinars organised so far

KEY ACHIEVEMENTS

- **online webinars**:
  - 5 organised as open events focused on data FAIRness, Blue-Cloud services
  - 12 as closed meetings for the development of the WBs
- **140+ participants to the 2 latest webinars**
- **47 countries represented**



The training academy webinars organisation is on track with our planned activities

Blue Cloud 2026: WP6.2 Training Academy

Recent agreement by the Steering Board to structure future Blue-Cloud2026 webinars including VRE webinars as Training Courses.

The migration of **already presented** webinars to an online course structure and self-paced format is also being considered.

Ocean Teacher Global Academy (OTGA) with IEEE will facilitate the planning and structure using OTGA guidelines and standards, to deliver courses fit-for-purpose and with learning resources that can be easily reused.

OTGA is a global network of Regional and Specialised Centres delivering training on ocean sciences, services, and management using the a common e-learning platform.

Blue Cloud 2026: WP6.2 Training Academy

The OTGA e-Learning Platform will host and deliver the courses under the Blue-Cloud2026 Community and OTGA will use its communication and alumni network (+12.000 learners) to provide additional visibility and increase training impact.

The BC2026 courses will be accessible from the BC2026 Training Academy and UNESCO IOC OceanExpert webpages .

The UNESCO/IOC Project Office for IODE is an ISO certified Learning Service Provider.

Training materials: a general overview

A list of training materials has been recently prepared. It contains:

- Factsheets
- Guidelines
- Videos

The development of these materials helps achieve our **KPIs**:

- **Number of use-case scenarios** supported by the prototype implementation >5
- **VLabs Implementation guidelines, technical requirements, VLabs user Handbook downloaded** >200 times

Soon available from the Blue-Cloud Catalogue & website

Potential synergies

Ongoing activities

- The identified synergies help Blue-Cloud strengthen its position in the DTO, Mission Ocean, EOSC and Ocean Observation environments.
- Focus on establish synergies with players outside Europe (e.g. JAMSTEC).
- The Blue-Cloud team is in the process of developing MoUs with the most strategic initiatives (e.g. AquaINFRA, FAIR-EASE).

Useful materials for sharing & distribution

About Blue-Cloud 2026

- Poster
- Rollup
- Blue-Cloud Virtual Labs in support of Sustainable Development Goals
- Flyer

For dissemination & social media share

- Communication kit
- Twitter channel
- LinkedIn page
- Youtube account
- ZENODO account

Blue-Cloud Services

- In EOSC Marketplace
- Virtual Research Environment
- Data Discovery Access
- Data Catalogue
- Training Academy

Blue-Cloud Readings

- Strategic Roadmap
- Position Paper on EOSC
- Interfacing Blue Cloud Data Discovery and Access with EOSC
- Generic publications
- Newsletters

Blue-Cloud Virtual Labs

- Plankton Genomics
- Marine Environmental Indicators
- Zoo and Phytoplankton EOV products
- Fish, a matter of scales
- Aquaculture
- Carbon-Plankton Dynamics
- Global Fisheries Atlas
- Coastal currents from observations
- Integration of coastal ocean observations along Europe

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