Blue-Cloud Virtual Labs & Workbenches in support of Sustainable Development Goals
The Blue-Cloud thematic Virtual Labs (VLabs) and Workbenches are the main test beds for users to get the hang of the Blue-Cloud framework, exploiting the 10+ million datasets available via the Data Discovery and Access Service (DD&AS), as well as the easy access to the collaborative VLabs via D4Science and the EOSC Federated login. These collaborative workspaces hosted in the Blue-Cloud Virtual Research Environment (VRE) are serving more than 1,600 users in total spread across more than 25 countries.

**Virtual Labs and applications at a glance**
A total of 9 VLabs were developed and deployed in both Blue-Cloud pilot and Blue-Cloud 2026 projects, making use of the analytical tools and generic services as provided through the VRE, and the data repositories, as made accessible via the DD&AS and through external data services. The Blue-Cloud VLabs are real-life demonstrators for web-based open science and are open and available for testing by different research communities. Each VLab comprises a series of applications for data processing, publishing of data results, and managing computation routines as well as services for collaboration, this way providing open science-friendly working environments for its users to analyse datasets and (re)generate research products.

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

Thematic marine services are included in the VLabs and make extensive use of the Blue-Cloud framework and its rich set of resources. These services illustrate the wide range of subjects that can be addressed using such 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.

**Workbenches in a nutshell**
A number of intensive workbenches for selected Essential Ocean Variables (EOVs), in physics, chemistry, and biology, are being developed and tested in Blue-Cloud 2026. Ocean and data scientists can implement efficient workflows that allow them to harmonise, validate and qualify large and various in situ data sources, exploiting the blue analytical services available in the Blue-Cloud. These workbenches are highly relevant for analysing the state of the environment and numerical simulations of the planned Digital Twin of the Ocean (DTO), forecasting its evolution and possible impacts of measures; testing and optimising these workflows, related provenance management, and storage facilities.

- Ecosystem-level EOVs
- Eutrophication: chlorophyll, nutrients, oxygen
- Physics: temperature & salinity

**Discover the many possibilities for Open Science in marine research with Blue-Cloud 2026**
Carbon Plankton Dynamics

This Virtual Lab provides a service to analyse the relative contribution of the drivers in phytoplankton dynamics in the Belgium part of the North Sea and the northern Adriatic Sea.

Partners Involved

VLIZ OGS

Data Sources


Main Target Users

Blue-Cloud Hackathon and Training Academy participants, Blue-Cloud Task Forces, Researchers, Policy makers/EU initiatives.

Blue-Cloud Added Value

The collaborative and open science tools used in the Blue-Cloud VRE platform allow their re-use by other researchers, so it can be applied to fit their own research and/or to respond to other research questions, such as “How do marine ecosystem respond to changing environmental conditions, such as ocean acidification and warming?” or “What is the role of biogenic reefs in carbon sequestration and its implications for climate change migration?”

Steven Pint

VLIZ

Disruptions in phytoplankton communities will have a cascading effect throughout the food web, impacting both ecological and commercially significant fish species. In our model, we incorporate carbon data because phytoplankton plays a pivotal role in the ocean’s carbon cycle, acting as carbon sinks through photosynthesis.
Global Fisheries Atlas

This Virtual Lab’s mission is to help making fisheries data FAIR and, by doing so, to provide a more comprehensive view of global fisheries to support informed decision-making and management of fisheries resources.

Partners Involved
IRD, FORTH, Food and Agriculture Organization of the United Nations

Data Sources
FIRMS (RFMOs), FishSource (Sustainable Fisheries Partnership), RAM, and FAO SDG14-4-1 Questionnaire.

Main Target Users
Fisheries management agencies, Marine Researchers, and the general public.

Services Introduction
The VLab offers a suite of tools and services to help users generate, browse and analyse (and interpret) data and knowledge. These tools include an integrated development environment (RStudio IDE), interactive maps and charts, as well as advanced data analysis and modeling capabilities. Some key datasets and code are made openly accessible (on Zenodo) to enable reproducible research.

SERVICES

Spatial Data Infrastructure
The Spatial Data Infrastructure is a catalog for data discovery and a spatial database and server to access standardized metadata and data.

Triplestore
The Triplestore enables access over the contents of semantic web knowledge bases (i.e. GRSF knowledge base) using W3C standards (i.e. through a SPARQL endpoint).

Runtime Environment
The Runtime Environment is a tool to reproduce or customize the execution of R code in a shared RStudio.

Atlas
The Atlas enables the viewers to display and explore information as map layers.

Julien Barde
IRD
Our objective is to make fisheries data and code open for people to understand the status of the fish stocks worldwide. As a result, we raise awareness to manage resources more sustainably.

Learn More Here!
Coastal Currents from Observations

This Virtual Lab provides a service to generate integrate ocean surface current maps from direct and indirect current measurements derived from different sources, High Frequency (HF) radar.

Partners Involved

Data Sources
CMEMS, GEBCO, EMODnet Bathymetry, NOAA, Open Street Map, ECMWF

Main Target Users

Scientists aiming to better understand the surface circulation, Model users (forecasting and validation purposes), and Oceanography students.

Blue-Cloud Added Value

The main output of this VLab is a service in the form of easily customizable Jupyter notebooks that allow users to generate surface currents maps for a user-chosen coastal region (when data is available and in particular the availability of HF radar data which extents depending on the configuration about 50 km – 200 km offshore). The user would also be able to make Lagrangian simulations based on these currents maps to visualize the movements of artificial drifters released at a user-chosen location (assuming suitable data coverage).

Abel Dechenne
ULiege

The code will be openly available as open-source. The DIVAnd method is coded in the Julia programming language, its package manager helps the user to create its environment in a reproducible way effortlessly. We are also aiming to make this service intuitive and easily understandable for the user by using a JavaScript library leaflet-velocity which creates an interactive output for the user.

Learn More Here!
Integration of Coastal observations along Europe

This Virtual Lab implements an environment that is specifically designed to widely expand user’s ability to access, integrate and exploit observations collected along the European coastal ocean areas, with particular focus to the observations provided by the partners of the Joint European Research Infrastructure for Coastal Observatories (JERICO-RI).

Partners Involved

Data Sources
CMEMS, EMODnet Physics, Geology, Biology, Bathymetry and Human Activities, SOCIB Data Repository, IH, PDE, PLOCAN.

Main Target Users
Blue-Cloud Hackathon Participants, Blue-Cloud Task Forces (EU DTO), Marine Researchers, Blue Economy Actors, Crisis Managers, Policy Makers/ EU Initiatives, Citizen Scientists.

Services Introduction
ICOOE implements advanced processing and post-processing facilities, analytical tools and interactive state-of-the-art visualizations to provide unprecedented insight and build new knowledge on key scientific and societal questions about the coastal ocean environment of Europe, focusing three Thematic Services.

UN SDGs addressed
13 CLIMATE ACTION
14 LIFE BELOW WATER

SERVICES

Transport and Connectivity
It focuses on “Transboundary Transport and Connectivity” along the European margins and explores the potential of integration of in situ and remote observations and of numerical model results, to advance in the understanding of the transboundary processes along the European coastal ocean and mapping their potential impacts such as biological connectivity or the spread of contaminants.

Extreme Events
It addresses the “Extreme Events” that affect the European coasts, providing a number of tools that enable to explore the available observations and to characterize the impacts of major storms on the coastal ocean environment and coastline.

Ocean Glider
The “Ocean Glider”, aims to demonstrate the added value chain of repeated glider sections from data acquisition to advanced products and visualisations.

João Vitorino
Instituto Hidrografico

We use the resources in Blue Cloud to fully exploit the integration of coastal ocean observations along Europe. The generated advanced exploration and visualization tools provided in the VLab will provide useful information to different stakeholders from the coastal environment.

Learn More Here!
Marine Environmental Indicators

The VLab aims to develop a web application that allows users to monitor and assess the environmental status of marine areas, by performing online spatio-temporal analysis with the implemented algorithms, for selected environmental variables.

Partners Involved

Data Sources
Copernicus Marine Service, Copernicus Climate
SeaDataNet, World Ocean Database, EMODnet

Main Target Users
Oceanographic and Environmental researchers, Governmental Environmental Agencies (like the Italian ARPA), Marine Protected Areas managers, Municipalities, Port Authorities

Services Introduction

Started in the pilot phase of Blue-Cloud (2020-2022), Marine Environmental Indicators (MEI) VLab (Virtual Lab) allows users to monitor and assess the environmental status of marine areas and support the decision-making process for the ocean management. Multiple data sources are exploited in a unique data analysis service, which will allow the online computation of indicators. Functionalities developed in the pilot Blue-Cloud are going to be improved, including new data sources (physics, biogeochemistry, biology, chemical data) and new algorithms. The tool will calculate online metocean information and indicators on the environmental quality of the Mediterranean Sea and Global Ocean, using input from BDIs, also improving uncertainty evaluation.

Francesco Palermo
CMCC Foundation

We want to improve the user experience so the generation of the current marine environmental indicators and the new ones will be easier.

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VLIZ  OGS

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Partners Involved

*hidrográfico*
*SOCIB*
*IEEE France Section*

Data Sources
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UN SDGs addressed

- **13 Climate Action**
- **14 Life Below Water**

SERVICES

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Learn More Here!
Workbenches
Workbenches for Essential Ocean Variables (EOVs)

A number of data-intensive Workbenches for selected Essential Ocean Variables (EOVs) are being developed and tested in Blue-Cloud 2026. Ocean and Data scientists will implement efficient workflows that allow them to harmonise, validate and qualify large and various in situ data sources, exploiting the blue analytical services available in the Blue-Cloud Virtual Research Environment.

The Workbenches

**Ecosystem-level EOVs**

The Ecosystem Workbench aims to improve the availability, quality, and interoperability of large collections of plankton observations and extrapolated biogeographies. This habitat modeling workflow will generate high-quality interpolated maps of these plankton entities, at the global scale and produce ecosystem-level EOVs.

**Eutrophication: chlorophyll, nutrients, oxygen**

This Workbench will define and implement an efficient production workflow to merge multi-source datasets managed by Copernicus Marine Service, EMODnet Chemistry and the World Ocean Database, together with key EU RIs and build highly qualified EOV datasets for eutrophication variables: chlorophyll, nutrients, oxygen.

**Physics: temperature & salinity**

This Workbench will implement a cloud-based workflow to generate harmonised, validated and customisable EOV data collections for temperature and salinity, integrating datasets released from different EU and non-EU data infrastructures for the test region of the Mediterranean Sea.

Partners involved

**Ecosystem-level EOVs**

ETH Zürich, Sorbonne Université, EMBL-EBI

**Eutrophication: chlorophyll, nutrients, oxygen**

Ifremer, POKaPOK

**Physics: temperature & salinity**

HCMR, Ifremer, POKaPOK, OCEANSCOPE

Learn More Here!
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