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A federated digital research environment in support of the European Digital Twin Ocean

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12 March 2026

Funded by the European Union

Our Journey: From Pathfinding Project to Official Node

Our Node is the **evolution of a proven ecosystem** built on six years of strategic investment and strong community engagement.

H2020 Blue-Cloud (Pilot)

- *2019-2023*
- **Developed the concept** and proved the value of federating key data services (**EMODnet, Copernicus Marine**) and Research Infrastructures (**EMSO, Euro-Argo, EMBRC**, etc.).

HE Blue-Cloud 2026

- *2023-2026*
- **Consolidated the infrastructure** and expanded the Virtual Research Environment (VRE). Grew the active user base to over **2,600 active users** and validated the core services.

Official EOSC Candidate Node

- *2024 onwards*
- The successful Blue-Cloud ecosystem is now the formally designated **EOSC Node | Digital Twin of the Ocean**. It is powered by the **D4Science e-infrastructure (CNR)** and is a marine research community's dedicated, operational entry point to the EOSC.

EOSC Node | Digital Twin of the Ocean Environment

Marine Research: A Sea of Silos

The Challenge for Marine Researchers

- **Scattered & Incompatible Data**: Critical data is spread across numerous, disconnected infrastructures, making integration a complex and time-consuming task.
- **Isolated Tools & Workflows**: Powerful analytical tools and workflows are often locked within specific communities, hindering collaboration and preventing cross-disciplinary research.
- **Difficult Access to Computing**: Researchers lack a unified way to access the large-scale computing and storage resources necessary to process vast ocean datasets.
- **Lack of Trust & Transparency**: It is difficult to track data provenance, making it challenging to verify results and build reproducible scientific workflows.

Research is slower, less collaborative, and limited in scope

The Strategic Landscape: No More Silos

«The Ocean doesn't work in silos — Why should we?» — *Nicolas Segebarth, DG RTD*

The European Mandate: Unifying Digital Ecosystems

- **EOSC Federation:** The horizontal, trusted **System of Systems** for all European Research.
- **EU Mission: "Restore our Ocean and Waters"** – The clear, policy-driven societal objective.
- **European DTO / EDITO:** The official, operational infrastructure for marine science.

The Challenge

- Ensuring these powerful strategic pillars are technically and operationally connected to prevent new, larger silos between the DTO Core and the long-tail scientific community.

Our Position

- The **EOSC Node Digital Twin of the Ocean** is the strategic and operational bridge. It promotes dedicated mechanisms to federate marine research capacity into the EOSC ecosystem.

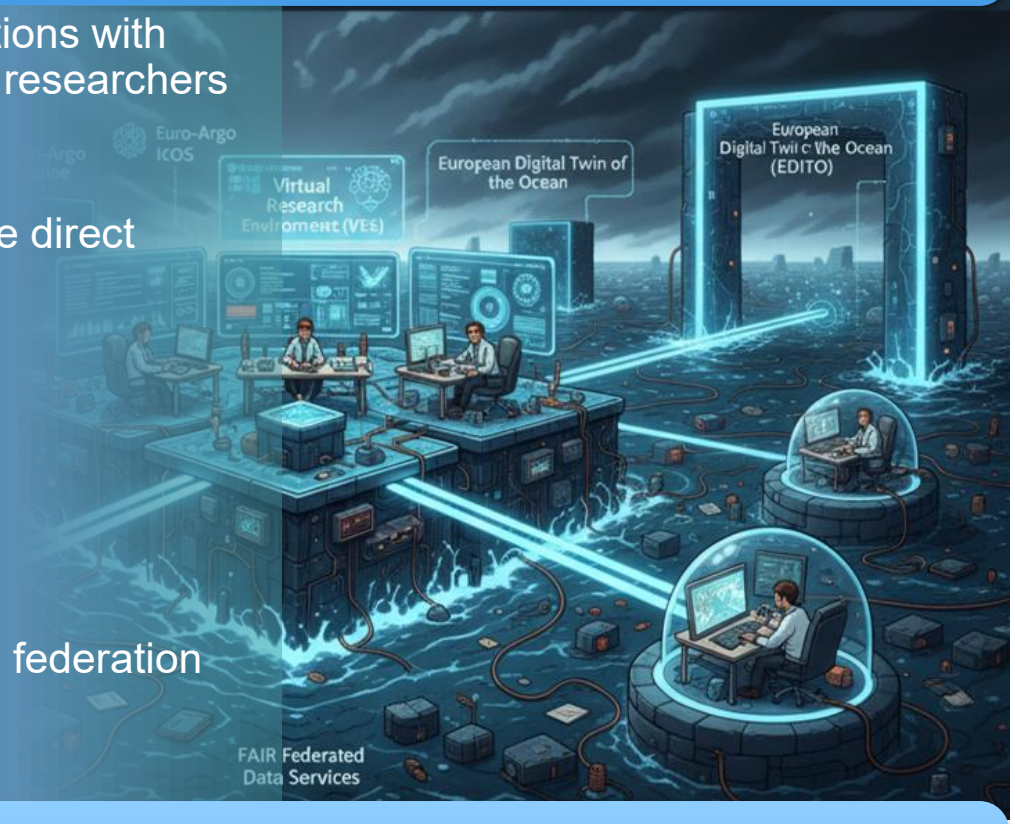
The Core Asset: VRE and Federating Capabilities

A Thematic Node for Empowered Researchers: Blue-Cloud transforms marine research by providing an integrated environment built on EOSC principles

- 🌊 **FAIR Federated Data Services**: We provide harmonised data collections with advanced subsetting, semantic enrichment, and provenance tracking, so researchers get exactly the data they need with full trust.

- 🔬 **Integrated Virtual Research Environment (VRE)**: Researchers have direct access to a suite of powerful tools within our Virtual Labs, including:
  - Interactive computing (Jupyter Notebooks, RStudio).
  - Reproducible workflows (CCP, Galaxy).
  - Containerization and application management pipelines.

- 🌐 **EOSC-Ready Capabilities**:
  - Federated AAI: Full integration and alignment with EOSC AAI.
  - Resource Catalogue: Our service catalogue is structured for immediate federation with the EOSC Exchange (EEN).
  - Operations: Professional, FitSM-aligned Helpdesk and Monitoring.



Researchers are empowered with trusted, interoperable tools and seamless access to data

Strategic Integration with DTO and EDITO

We are the **EOSC-facing research and collaboration component** that enables the wider Digital Twin of the Ocean ecosystem.

Strategic Integration via Interoperability

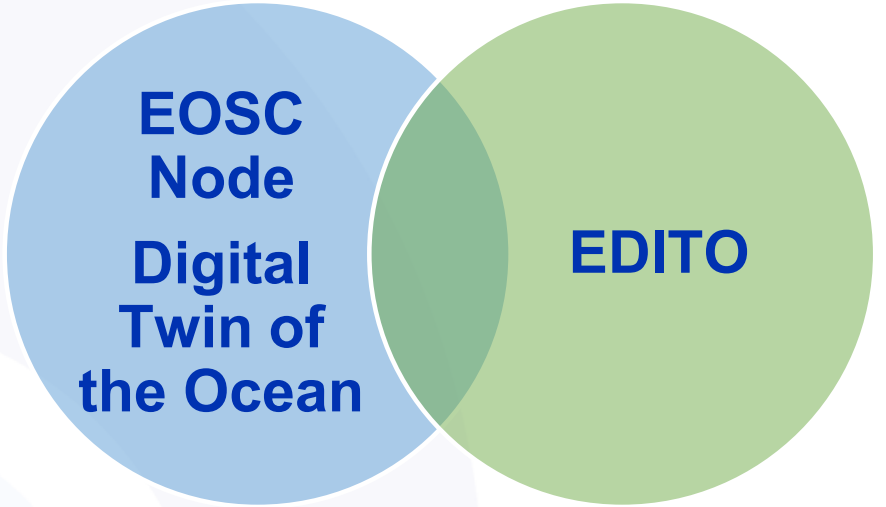
- **Smart Federation: bi-directional integration** between our **VRE** and the authoritative **EDITO** platform (the DTO Core), mutually exposing functionalities via common APIs.
- **Radical Transparency:** machine-actionable metadata and service descriptions, ensuring data from all sources (long-tail RIs) is genuinely **FAIR** and seamlessly exchangeable across the federated network.

Alignment with the DTO Roadmap

- **EDITO Exploitation:** utilise the advanced capabilities of the **Virtual Ocean Model Lab (VOML)** being developed by the **EDITO-Model Lab** project.
- **Sustainability:** integration into the long-term **EDITO Programme**, ensuring a stable future for the marine contribution to EOSC.

Strategic Objectives for the EU

- **Fosters True Interoperability:** Establishes a federated infrastructure and seamless access to the authoritative EDITO ecosystem.
- **Creates a Robust Infrastructure:** Ensures effective operation and scalability of a trusted and secure federated system.
- **Ensures Long-Term Sustainability:** Guarantees that the Node's assets contribute to the lasting DTO Programme.



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From Data to Societal Impact

Real-World Cross-Disciplinary Use Case

- A researcher can now seamlessly combine aggregated in-situ and satellite data from key European services like **EMODnet** and **Copernicus Marine** with specialised observation data from Research Infrastructures like **Euro-Argo**, carbon data from **ICOS**, and deep-sea data from **EMSO**.
- They can process this integrated dataset using interoperable workflows in a Blue-Cloud Virtual Lab, with the results directly contributing to the **European Digital Twin of the Ocean (EDITO)** and being shared openly via EOSC.

A Blueprint for Other Thematic Communities

- Our approach serves as a proven model for how other scientific domains can federate their specific services and data into the EOSC ecosystem, extending impact well beyond the marine community.

Makes complex, cross-domain science simple

The EOSC Federation accelerates scientific discovery and generates tangible societal impact

Blue-Cloud 2026 - The Technical Outputs

Core services: Virtual Research environment

An Open Science platform for collaborative marine research, using a wide variety of datasets and analytical tools, complemented by generic services such as sub-setting, pre-processing, harmonising, publishing and visualisation. The VRE hosts different Virtual Labs and is going to include thematic Workbenches, which users can access with existing credentials in EOSC, the European Open Science Cloud. The Blue-Cloud Marine Node implements several core capabilities, as defined by the EOSC Federation Handbook, to ensure effective operation and service deliver such as the Catalogue, AAI, the Gateway and more.

Generic services

- Workspace
- RStudio
- JupyterHub
- Galaxy
- CCP services

Data management facilities

- NoSQL Database
- Relational Database
- DD&AS
- Beacon

Marine Thematic Services

Virtual Labs offer data products and analytical tools within the Virtual Research Environment (VRE). These VLabs serve as real-life demonstrators for web-based open science and are available for testing by research communities within the EOSC federation. The VLabs offer applications for data processing, publishing data results, and managing computation routines. They also provide innovative services in the form of data products and analytical tools, showcasing the added value of web-based open science.

VLabs

- Coastal Ocean observations along Europe
- Coastal currents from observations
- Carbon-Plankton Dynamics
- Marine Environmental Indicators
- Global Fisheries Atlas

Workbenches

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

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Blue-Cloud Training Academy

Courses to empower ocean scientists by providing a comprehensive understanding and practical skills in using Vlabs running in the Blue-Cloud 2026 VRE.

Target Audience: Researchers, data scientists, academic professionals involved in ocean science and related fields who are interested in enhancing their research capabilities through advanced digital tools and collaborative platforms

unesco Intergovernmental Oceanographic Commission

OTGA OceanTeacher Global Academy

How to access: OceanTeacher Global Academy (OTGA),
Content: Video lessons and supporting material organised
Course time-frame: Self-paced course. Estimation of 4 hours each.
Costs: Free of charge until 31 July 2026.

Blue-Cloud Training Academy

Access the courses now

Coastal currents from observations Vlab

Learn how to use a multi-source approach framework to study and reconstruct surface currents through a variational inverse method.

Carbon-Plankton Dynamics Vlab

Utilise models to study carbon plankton and apply them to make decisions related to the carbon pump mechanism based on data products and modelling output

Global Fisheries Atlas Vlab

Increase knowledge and skills to effectively navigate, utilize and customize the Global Fisheries Atlas Virtual Lab for accessing, analyzing, and contributing to global fisheries data and research.

ABOUT TODAY'S WEBINAR VLAB

Integration of coastal ocean observations along Europe Vlab

Integrates and analyzes coastal ocean observation data across Europe to study coastal processes and support research, management, and open science.

And more courses coming soon…

Blue-Cloud Training Academy

Webinar 17 March 2026 | 14:30-16:00 CET

Ocean Literacy Series

BlueCloud 2026: How Industrial Data Can Bridge Critical Ocean Knowledge Gaps

Register now

EMODnet | OBIS Ocean Biodiversity Information System 25 | HUB Ocean | OGS | eosc | Blue-Cloud2026


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