

Use Cases for the EOSC Federation

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European Digital Twin Ocean

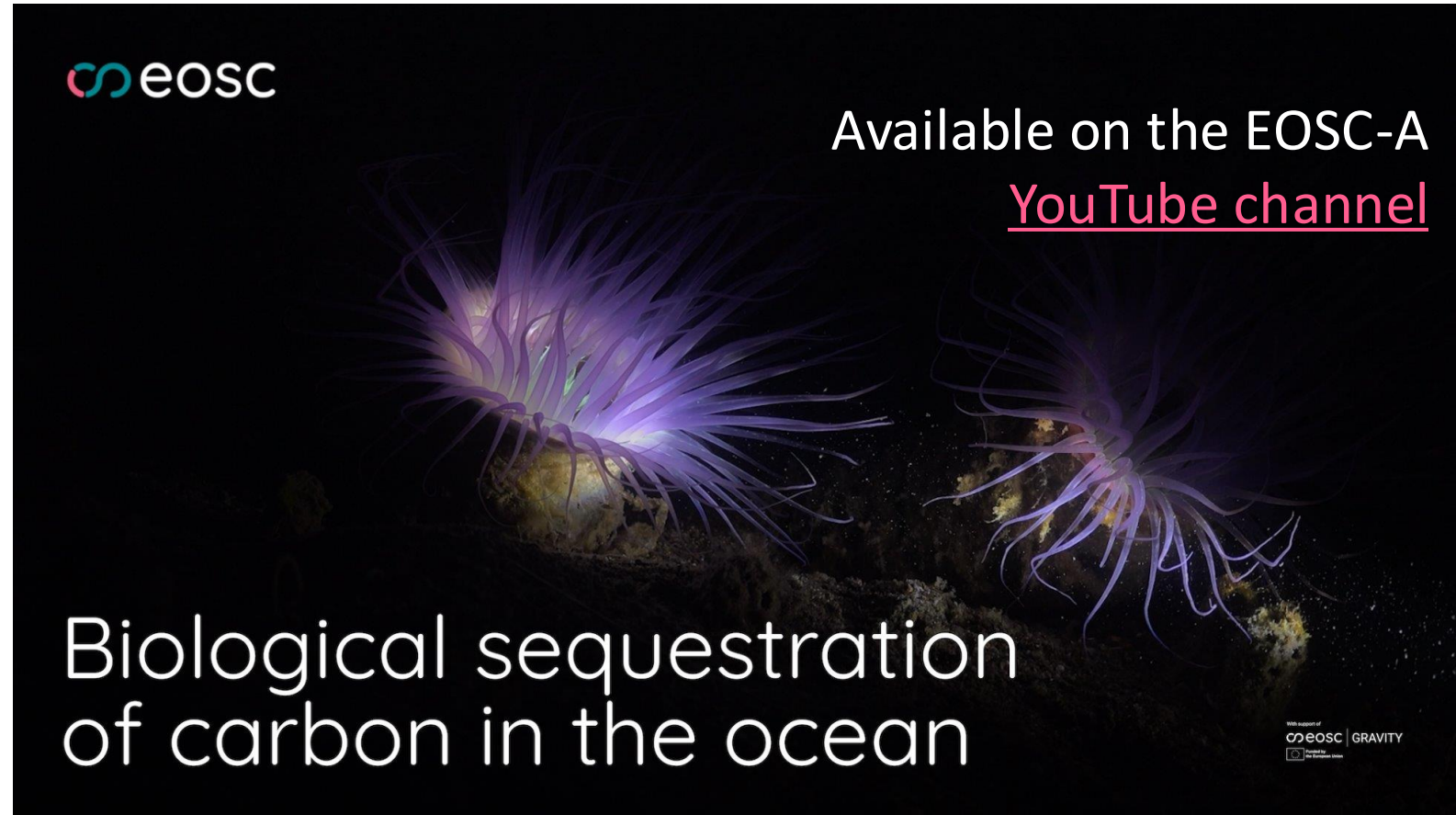
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The scientific challenge

The **Ocean Microbiome** is a diverse microscopic community, including viruses, bacteria, unicellular protists and small invertebrates, that **plays a pivotal role** in global biogeochemical cycles and processes, including the sequestration of atmospheric carbon in the ocean.

Modelling the ocean's biological carbon sequestration requires a comprehensive knowledge base of the ocean microbiome's biodiversity and biogeography, associated metabolic and biogeochemical functions, together with their physico-chemical drivers at global and decadal scales.

Molecular data are currently generated at an exponential rate and offer unprecedented information **about the Ocean Microbiome's** taxonomic and functional diversity. However, molecular data **are vastly underexploited** by global biogeochemical models.

Disciplines addressed

Biology

Biogeochemistry

Physical oceanography

The expected output

A cloud-based knowledge platform that will combine:

- **FAIR and harmonized molecular data** from the International Nucleotide Sequence Database Collaboration (INSDC)
- **State-of-the-art bioinformatics pipelines** that transform molecular data into discrete taxonomic and functional observations (biodiversity occurrences)
- **FAIR and harmonised environmental climatologies** from the Copernicus Marine Services and NOAA's Global Ocean Atlas
- **State-of-the-art global distribution models** that use biodiversity occurrences and environmental predictors to map the carbon sequestration potential under present and future climate scenarios

This thematic service aims to demonstrate how linking EOSC Node services enables robust ecological modelling and carbon cycle assessment.

This thematic service will serve as a blueprint for cross-domain data integration and advanced modelling in support of ocean health monitoring and climate-related decision-making

Project Information

EOSC-Marine
Grant agreement ID: 101292903

DOI 
[10.3030/101292903](https://doi.org/10.3030/101292903) 

EC signature date
7 May 2026

Start date End date
1 September 2026 31 August 2029

Funded under
Research infrastructures

Total cost 
€ 7 909 650,00

EU contribution 
€ 7 909 650,00



Investment in EU policy priorities 

| | | | |
|-------------------------|---|----------------|---|
| Digital agenda |  | Clean air |  |
| Artificial Intelligence |  | Climate action |  |
| Biodiversity |  | | |

Coordinated by
CONSIGLIO NAZIONALE DELLE RICERCHE
 Italy

It will be developed as a cross-node use case in cooperation of the **EOSC Node European DTO** with the **Life Sciences node** while synergy with 2 other EOSC nodes, namely the **Polish national node** and the **French Data Terra node**. The synergy will include data and knowledge sharing, providing a model and demonstrator for EOSC cross-node cooperation.

The cross-Node collaboration is organised under the remit of the EOSC-Marine HORIZON-INFRA-2025-01 project scheduled to start on September 1st, 2026, with secured funds till 2029 for

- the partners involved in the use case: EMBL-EBI, ETHZ, EMBRC-ERIC
- the Node coordinator: CNR-ISTI
- The additional contributing organisations: MARIS, Trust-IT, iFREMER, SSBE, MOI, VLIZ, CMCC, KNMI, CINECA, GRNET, NUBISWARE, SU, UvA, FORTH, IRD, OGS, HMRC, ETT, UWA, ULiège, EGI, INGV, SOCIB, EUROGOOS, SMHI, IH, SIOS, IOPAN, HUB OCEAN, IEEE, OceanScope, Pokapok

Implementation & Making Use of Federating Capabilities



Relevant node services & technologies

eosc Node | Digital Twin of the Ocean Environment



eosc Node | Life Sciences Connect Health & Food



Two service components will be established:

eOSC Node | Life Sciences Connect
Health & Food

1) Knowledge base service

Who: EMBL-EBI, together with EMBRC-ERIC

What: will provide global observations of marine microbiome diversity, taxonomy and functions, based on biomolecular (genetic) data collected over the last 25 years and made publicly available at the European Nucleotides Archive, including the EMO-BON time series since 2021¹.

- The taxonomic and functional analysis of those biomolecular data will be generated by the **MGnify and Ensembl services**, powered by EMBL-EBI and the Galaxy platform (ELIXIR).
- The **Beacon data lake technology** will be used to establish the Knowledge base service.

eOSC Node | European DTO
Environment

2) Modelling service

Who: ETHZ

What: will derive the spatiotemporal distribution and macroecological function of marine microbiomes based on macroecological relationships between biological data and their environmental context.

- It will upgrade their **workbench** as deployed on the Blue-Cloud VRE, which will use an ensemble of machine learning models (Schickele et al. 2025) to analyse the knowledge base provided by the EOSC Life Science Research Node.

The pipeline will enable a diverse range of stakeholders to assess the impacts of environmental change on both the marine biological carbon pump and broader marine ecosystem functioning

The EOSC Node | European DTO started configuring the integration for the production phase, discussing the configuration needed to implement for AAI . The integration testing phase has completed long time ago.

The EOSC Node | European DTO has successfully implemented interoperability with the EOSC EU Node across two core pillars:

- **Resource Catalogue:** All EOSC Node | European DTO thematic services and data discovery tools are now federated with the EOSC EU Node Catalogue. This ensures that marine-specific resources are findable through the central EOSC entry point, supporting a "Smart Federation" approach where local discovery capabilities are mirrored at the European level.
- **Federated AAI:** The Node has transitioned to a federated authentication model. However, this process has been categorised as High Effort due to the complexity of the EOSC Node | European DTO's multi-context operational environment. The implementation ensures users can seamlessly move between the EOSC Node | European DTO environment and EU Node services while maintaining secure, context aware identity management.

The EOSC Node European DTO is now officially registered in EOSC as a production node.

- **Advanced Authorisation for Cross-Node Workflows** : initial access remains interactive (web-based) to ensure users explicitly accept specific Terms of Use and Privacy Policies. A major challenge remains the transition to programmatic access using restricted tokens for cross-service execution
- **OAuth 2.0 Token Exchange**: requirement for a robust Token Exchange mechanism to support the "on-behalf-of" pattern
- **Account Linking**: As an operator of a Keycloak-based platform, the EOSC Node | European DTO requires support for "linking authentications" to allow users to merge multiple identities into a single EOSC Node | European DTO profile
- **OIDC Federation and Trust Bridging**: adopting the AARC-G100 guidelines and OIDC Federation to enable scalable trust across proxies, particularly as we move toward interoperability with sectoral European Data Spaces (e.g., Health, Environment) that may use Verifiable Credentials.

- Success will be monitored via the EOSC Marine project where the use case outputs are listed as Key Expected Results
- The Ocean biological carbon sequestration pipeline is embedded in the EOSC Node European DTO as one of the **EOSC Node thematic services**, which will operate at a TRL of 8 to 9
- The overarching ambition is to orchestrate **fully integrated, end-to-end workflows** that operate seamlessly across platforms and domains - demonstrating true interoperability within the EOSC ecosystem

Public deliverables

- Thematic services - User manual and documentation (beta) (Aug 2027)
- Operational Thematic services and documentation (Aug 2029)
- Mapping of existing EOSC assets of relevance for the marine thematic node and recommendations towards federation (Mar 2029)

A Node is first and foremost a community of users

- Between 2019 and 2026 the Blue-Cloud project de-facto piloted a marine thematic node within the European Open Science Cloud (EOSC) for quality marine science in support of the European Digital Twin of the Ocean (EU DTO) programme and its implementing facilities.
- In view of the new EU public infrastructure developed to support the EU DTO, the EDITO platform, stakeholders decided to combine efforts, services, and resources for establishing the EOSC Node European DTO as part of the EOSC Federation.

Stay in contact!



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